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# THE EFFECT OF THERMOPHILIC HEAT TREATMENT ON THE ANAEROBIC DIGESTIBILITY OF PRIMARY SLUDGE

by

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## DECLARATION BY CANDIDATE

I, Hilton Barry Izzett, hereby declare
that this thesis is my own work, and that it has
not been submitted for a degree at any other university

Signed by candidate

September 1992

# SYNOPSIS

In a time when the world is becoming more environmentally conscious, and is looking for simple, efficient, economical, and environmentally friendly solutions to sewage and sludge treatment, the dual digestion system presents itself as an attractive alternative to other sludge treatment systems. The dual digestion system comprises an autoheated thermophilic (55-65$^{o}$C) aerobic first stage and a mesophilic (37$^{o}$C) anaerobic second stage. Past research into the dual digestion system has given rise, *inter alia*, to the following claims (de Villiers, *et al*, 1991):

a) sludge disinfection and stabilisation occur in one process - disinfection in the thermophilic aerobic first stage and stabilisation in the anaerobic second stage.

b) the stability of the anaerobic stage is considerably improved by the increase in $H_2CO_3^*$ alkalinity and pH in the aerobic stage.

c) in the aerobic stage the sludge is aerobically or thermally pretreated (conditioned) making it more readily digestible under anaerobic conditions, thereby allowing significantly reduced retention times from 25 to 30 days for normal digestion, to 8 to 10 days.

Messenger (1991), in a full scale investigation at the Potsdam Wastewater Treatment Plant in Milnerton, Cape Town, verified claims (a) and (b), but was unable to verify claim (c) above. It was the intention in this investigation to verify this claim at full scale using the existing dual digestion plant at Milnerton. However, after 9 months of starting up the plant, the fiberglass aerobic tank failed structurally along one of its seams. This failure was so extensive that the plant could not be started up again and the research project was terminated.

The failure of the aerobic reactor necessitated continuing this thesis investigation in the laboratory. With regard to claim (c) above, no conclusion could be reached by past research as to whether the conditioning of the sludge was caused simply by the heating of the sludge or by the biological action of the thermophilic bacteria on the sludge. Therefore, it was the initial intention of the laboratory investigation to operate 3 anaerobic units using 3 different feed sludges **viz:** 1) autotheral thermophilic aerobic sludge, 2) sludge heat treated to thermophilic temperatures, and 3) primary sludge as a control. By comparing the anaerobic performance of feed sludge types (1), (2) and (3) above, with progressively reduced retention times, it was

hoped to establish which feed type displayed superior anaerobic digestibility ie. which feed type could be treated at the lowest anaerobic retention time. The difference in digestibility between feed types (1) and (2) would indicate whether the heating only, or the aerobic biological heating, conditioned the sludge. However, difficulties were experienced in starting up and operating an autothermal thermophilic aerobic reactor at laboratory scale and this part of the investigation had to be abandoned.

Consequently, experimentation continued using only feed sludge types (2) and (3) above. The objectives of the investigation were modified since it would no longer be possible to establish the difference in anaerobic digestibility between the heat treated sludge and the thermophilic aerobic sludge. The objectives of this investigation , therefore, became to:

(1) determine whether or not the exposure of the sludge to thermophilic temperatures caused the conditioning of the sludge

(2) determine how the performance of the anaerobic digester fed heat treated primary sludge compared with a digester fed untreated primary sludge

In order to fulfill the objectives above, four 14 litre anaerobic digesters were operated using the two different feed types (feed types (2) and (3) above). The heat treatment of the primary sludge took place in stainless steel reactors that were operated at a retention time of 1.5 days and a temperature of 65$^{o}$C. These parameters were selected to simulate the heating conditions in the aerobic reactor that was operated as part of the dual digestion system at Milnerton. The anaerobic digesters were all operated at a temperature of 37$^{o}$C while the retention times were progressively reduced until they failed. The purpose of this was to establish the minimum retention for the anaerobic digestion of the two feed types mentioned above and, therefore, to determine if there was any difference in digestibility between the two sludge types. From these results it would be possible to determine if the heat treatment process had any conditioning effects on the primary sludge that enhanced anaerobic digestion.

The results from the experiments described above gave rise to the following conclusions:

(1) **As indicated by measurements and calculations of the following parameters:**

**a) percent volatile solids (VS) removed**

b) **percent COD removed**

c) **gas produced per VS and COD removed**

d) **digester gas composition (% $CO_2$ and $CH_4$)**

e) **pH**

f) **$H_2CO_3^*$ alkalinity**

g) **Short chain fatty acid (SCFA) concentration**

h) **SCFA:alk ratios**

**the digestibilities of the primary sludge and the heat treated sludge showed no significant difference.**

(2) **There was no noticeable conditioning of the primary sludge by the heat treatment process insofar as digestibility is concerned.**

(3) **The digesters fed primary and heat treated sludge were both operated under stable conditions at a retention times of 20, 15, 12, 10 and 7 days, but failed at a retention time of 4 days.**

Past research at a bench scale (Drnevich and Matsch, 1978) has shown that the anaerobic stage of a dual digestion system can be operated at a retention time as low as 3 days. This thesis investigation has shown that a normal digester fed primary sludge can be operated a retention time as low as 7 days. Therefore, it is possible that claim (c) above, regarding digester retention times, takes into account a safety factor so that the given retention times are relevant to full scale digestion under conditions that are not ideal.

From this thesis investigation it is clear that thermophilic heat treatment of primary sludge does not improve the digestibility of the sludge under anaerobic conditions. In other words, the heating process does not condition the sludge. This result indicates that in a dual digestion system, the heat generated in the aerobic stage is not responsible for the conditioning effect that the aerobic stage has on the sludge. It is most probable that that the bacteriological action on the sludge is responsible for any conditioning. However, the effects of the aerobic conditioning on the anaerobic digestion process are still uncertain and more research on this system is required to conclusively verify some of the claims about it.

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| | | |
|---|---|---|
| COD | = | chemical oxygen demand (mg/l or $kg/m^3$). |
| % $CO_2$ | = | percent carbon dioxide in digester gas. |
| $H_2CO_3$* alkalinity | = | alkalinity of carbonate species with reference to $H_2CO_3$* species (mg/l as $CaCO_3$). Sometimes referred to by others as carbonate alkalinity or Alkalinity. |
| IA:PA | = | ratio of intermediate alkalinity, as measured by titration to a pH of 4.3, to partial alkalinity, as measured by titration to a pH of 5.75. Alkalinity here refers to the total alkalinity. |
| % $CH_4$ | = | percent methane in the digester gas, calculated as 100 - %$CO_2$. |
| pH | = | measure of the hydrogen ion concentration as given by, $-\log_{10}$(hydrogen ion concentration). |
| SCFA | = | short chain fatty acid concentration (mg/l as HAc). |
| SCFA:alk | = | ratio of SCFA to $H_2CO_3$* alkalinity. |
| TKN | = | total Kjeldahl nitrogen (mg N/l). |
| VS | = | volatile solids concentration (mg/l). This is a variation on the VSS test. Centrifuged samples of heat treated sludge left behind in the supernatant a significant portion of the suspended solids. As a result the procedure for the VSS test could not be used. A variation of this test was used which excluded the centrifuging step. |

# CHAPTER 1

## INTRODUCTION

In municipal wastewater treatment plants the incoming sewage is usually separated into the liquid (settled sewage) and solid phases (primary sludge) by primary sedimentation. The settled sewage is treated biologically, commonly by activated sludge or trickling filters. In these processes particulate and soluble pollutants at a low concentration are transformed and removed from the wastewater as a concentrated low volume sludge (secondary sludge), leaving a clear effluent stream. The secondary sludge is added to the primary sludge for further treatment.

Having treated the settled sewage, it remains to treat the combined primary and secondary sludges. This sludge is a putrefactive concentrated aqueous suspension of organic material containing mainly biodegradable, but also some inert substances. The putrefactive organic nature of the sludge makes it a potential public nuisance and health hazard. It is very active biologically and is prone to intense biodegradation which produces unpleasant odours and provides a site for insect and fly breeding. Uncontrolled disposal of this sludge without treatment can seriously pollute surface and ground waters and contaminate land with human pathogens and heavy metals.

Generally, the treatment of sludge involves the controlled degradation of the putrefactive organic fraction of the sludge. This process is called stabilisation. After stabilisation the sludge is dewatered, which concentrates the sludge further into as small a volume as possible. This eases sludge handling problems such as transportation. The concentrated sludge can be disposed of in a number of ways such as incineration and land fill, or in more beneficial ways such as a soil conditioner.

In many countries, especially European countries, the most common way of sludge disposal is as a soil conditioner. Apart from the beneficial aspects of this method, it can also be a very economical method. However, there are some associated health risks. The stabilising and dewatering processes do not disinfect the sludge sufficiently for the levels of pathogens, such as *Salmonella* and *Ascaris Lumbricoides,* to be within safe limits. To reduce the health risk the sludge would need to be disinfected. Processes that reduce pathogen levels to acceptable limits include wet air oxidation

(Zimpro), composting under certain conditions, beta and gamma ray radiation and pasteurisation (70$^{o}$C for 30 minutes).

Another health problem associated with using sludge as a soil conditioner is the one of contamination by heavy metals such as Cadmium, Mercury and Lead. Municipal wastewater treatment plants with large industrial effluent contributions will most probably experience high heavy metal concentrations in their sludges. Heavy metals pose a health risk since high concentrations in plants and animals, including man, become toxic causing growth inhibition, deformities and expiration. The extraction of heavy metals from sludge is costly and difficult, so it is best to deal with the problem at the source and prevent the discharge of effluents containing heavy metals. Nevertheless, all sludges will invariably contain some traces of heavy metals, and depending on the level, the sludge may, if used as a soil conditioner, be a potential health risk.

In South Africa the most favoured sludge stabilisation process is mesophilic (35$^{o}$C - 38$^{o}$C temperature range) anaerobic digestion. In this process the degradation of the biodegradable fraction of the sludge produces carbon dioxide and methane gases. Methane is a high energy gas that is combustible, and so it is a useful form of energy. At many wastewater treatment plants using anaerobic digestion the methane is collected and used to provide heating of the anaerobic sludge to mesophilic temperatures; or it may be used to power a gas combustion engine which drives other mechanical equipment like turbines and pumps. However, while anaerobic digestion effectively stabilises the sludge, it does not disinfect the sludge sufficiently to reduce the pathogen level to an acceptable limit.

In European countries aerobic digestion is the a common sludge stabilisation process and when operated at thermophilic temperatures ( > 60$^{o}$C ), also satisfactorily disinfects the sludge. In this process temperatures in excess of 60$^{o}$C can be maintained autothermally at retention times of 6 - 8 days. The biological reactions that lead to stabilisation also generate heat and eliminate the need for costly external heating of the sludge. However, this process consumes energy for aeration and so maintenance and running costs are relatively high.

With growing concern about the health risks associated with using stabilised sludge for agricultural purposes, disinfection to specified limits by recognised methods like pasteurisation is often recommended or required. In South Africa where mesophilic anaerobic digestion is popular, the conversion to thermophilic aerobic digestion for

the purpose of attaining simultaneous pasteurisation and stabilisation would be impractical as well as costly: it would convert the anaerobic digesters from net producers of energy to consumers of energy.

The dual digestion system, which comprises a thermophilic aerobic first stage and a mesophilic anaerobic second stage, seeks to overcome this problem. It combines the advantage of pasteurisation by the autothermal thermophilic aerobic digestion with the advantage of energy efficient stabilisation of the mesophilic anaerobic digestion. Due to the high rate of metabolism in the aerobic stage, sufficient heat is generated to sustain high sludge loading rates, with the result that short retention times of 1 - 2 days are possible. At these short retention times the sludge is heated for a sufficient time for it to become pasteurised, but only very limited stabilisation takes place. Stabilisation is completed in the anaerobic stage. The heat generated in the aerobic stage is sufficient to maintain mesophilic temperatures in the anaerobic stage without any other heating. As a result, all the methane produced by the anaerobic stage is available for uses other than on the dual digestion system.

Research into the dual digestion system has given rise, *inter alia,* to the following claims (de Villiers, *et al,* 1991):

a) **sludge disinfection and stabilisation occur in one process - disinfection in the thermophilic aerobic first stage and stabilisation in the anaerobic second stage.**

b) **no external heating of the anaerobic digester is required since all the heat required is supplied by the hot sludge from the first stage.**

c) **the process is a net producer of energy since all the biogas produced is available for uses other than on the dual digestion system.**

d) **the stability of the anaerobic stage is considerably improved by the increase in $H_2CO_3^*$ alkalinity and pH in the aerobic stage.**

e) **in the aerobic stage the sludge is aerobically or thermally pretreated (conditioned) making it more readily digestible under anaerobic conditions,**

**thereby allowing significantly reduced retention times from 25 to 30 days for normal digestion, to 8 to 10 days.**

A full scale dual digestion plant was set up at the Potsdam Wastewater Treatment Plant in Milnerton to investigate the systems and the claims made for it. In this investigation most of the claims stated above were supported (Messenger, 1991). The one claim that was not conclusively verified was the one regarding the shorter retention times of the anaerobic stage ie. (e) above. Also, no conclusion could be reached as to whether the conditioning of the sludge was produced simply through the heating of the sludge or the autothermal biological heat generation of the sludge. It was the intention of this thesis to verify this claim at full scale using the plant at Milnerton. However, 9 months after starting up the plant, the fiberglass aerobic tank failed structurally along one of its seams. This failure was so extensive that the plant could not be started up again and the research project was terminated.

The failure of the aerobic reactor necessitated continuing this thesis investigation in the laboratory. Initially the intention of the laboratory investigation was to operate 3 anaerobic units using 3 different feed sludges **viz:** 1) autotheral thermophilic aerobic sludge, 2) sludge heat treated to thermophilic temperatures, and 3) primary sludge as a control. By comparing the anaerobic performance of feed sludge types (1), (2) and (3) above, with progressively reduced retention times, it was hoped to establish which feed type displayed superior anaerobic digestibility. The difference in digestibility between feed types (1) and (2) would indicate whether the heating only, or the aerobic biological heating, conditioned the sludge.

However, difficulties were experienced in starting up and operating an autothermal thermophilic aerobic reactor at laboratory scale and this part of the investigation had to be abandoned. Consequently, experimentation continued using only feed sludge types (2) and (3) above. The objectives of the investigation were modified since it would no longer be possible to establish the difference in anaerobic digestibility between the heat treated sludge and the thermophilic aerobic sludge. The objectives of this investigation , therefore, became to:

(1) determine whether or not the exposure of the sludge to thermophilic temperatures caused the conditioning of the sludge.

(2) determine how the performance of the anaerobic digester fed heat treated primary sludge compared with a digester fed untreated primary sludge.

The layout of this thesis is as follows: in Chapter 2 the experimental investigation is discussed in detail. In Chapter 3 the results from the experiments are presented, evaluated, discussed and compared with results on anaerobic digestion of sewage sludge from other research. In Chapter 4 the conclusions from the investigation are presented.

# CHAPTER 2

## OVERVIEW OF EXPERIMENTAL INVESTIGATION

### 2.1 INTRODUCTION

This chapter gives an overview of the experimental procedures that led to the completion of this investigation. The day to day operation of the digesters and reactors is discussed first, followed by a listing of the tests conducted on the influent and effluent sludges. A discussion is presented on the monitoring of digester stability and the manner in which it was done in this thesis. Finally, a description is given of the operational changes made to each digester operated in this investigation.

### 2.2 OPERATION OF THE MESOPHILIC ANAEROBIC DIGESTERS AND THE THERMOPHILIC HEAT TREATED SLUDGE REACTORS

In this investigation four mesophilic anaerobic digesters (hereafter called 'digesters') and two thermophilic heat treatment reactors (hereafter called 'reactors') were operated. The digesters were fed either primary sludge or heat treated sludge, while the reactors were fed only primary sludge. The primary sludge was collected from the Milnerton Wastewater Treatment Plant's primary sludge storage tank and stored in the laboratory in 30 litre containers at a temperature of $4^{o}C$. Prior to storage the sludge was seived by hand through a 3mm wire mesh so that large particles and pieces of cloth would not block or clog the reactors or the digesters. The batches of sludge collected were stored for no more than 10 days at a time.

In order to comply with the heating conditions of the aerobic reactor of the Milnerton dual digestion system (Messenger, 1991) the reactors were operated at a retention time of 1.5 days and a temperature of $65^{o}C$. To attain this temperature the reactors, which were made of stainless steel, were placed in a heated water bath with a thermostatic temperature controller. The two reactors were operated each with a capacity of 2.25 litres and fitted with an overhead motorised stirrer for mixing the sludge. Theoretically, only one 4.5 litre reactor was necessary but at the time of the experimentation the only suitable equipment available were two 2.25 litre reactors. The reactors were batch fed once a day with primary sludge . The quantity of sludge fed to the reactors was calculated so that the amount of sludge wasted from the reactors daily equalled the amount of heat treated sludge required for feeding the

anaerobic digesters and for sampling, while maintaining a reactor retention time of 1.5 days. A photograph of the reactors in the water bath can be seen in Figure 2.1. For more details on the design and operation of the reactors see Appendices A and B.

While only two digesters were necessary because only two different feed types were investigated, four anaerobic digesters were operated in the experimental investigation; two additional digesters were operated to obtain as much data as possible in a short period of time. The digesters, named D1 to D4, were all started up with anaerobic sludge collected from the anaerobic digesters at the Mitchell's Plain Wastewater Treatment Plant. The digesters each had a capacity of 14 litres and were equipped with overhead motorised stirrers for sludge mixing. The digesters were operated at a temperature of 37$^{o}$C. The temperature was controlled by means of individual flexible heating coils wound around the digester walls and connected to thermostats (see Figure 2.2). Each digester was completely sealed except for a gas outlet pipe that was connected to a gas meter, and a sludge feed inlet pipe that was sealed except during sludge feeding. Sludge was withdrawn by gravity from the base of the digesters through an outlet pipe that was sealed with a clamp. The entries of the stirrer shafts into the digesters were sealed by water seals. For more detailed information on the design of the experimental apparatus and the operating procedures see Appendices A and B.

The main aim of this thesis investigation was to run the digesters at progressively shorter retention times until the digesters failed; this was to establish the minimum retention time for the primary and heat treated sludge feeds. A comparison between the results from the digesters fed with the two feed types would indicate which feed type had superior digestibility and, therefore, whether or not the heat treatment process conditioned the sludge. In order to do this the digesters were run for a period of at least 3 retention times for each of the different retention times tested. The first retention time period at each retention time served as a stabilising period. The next 2 retention times were for the collection of relevant data that would be indicative of the performance of the digester at that particular retention time. The digesters that were operated at retention times of less than 10 days would be run for 4 retention time periods in order to obtain more information over a longer period of time for a more accurate statistical analysis. The retention time in the digesters was reduced by increasing the feed volume per day while maintaining a constant digester volume.

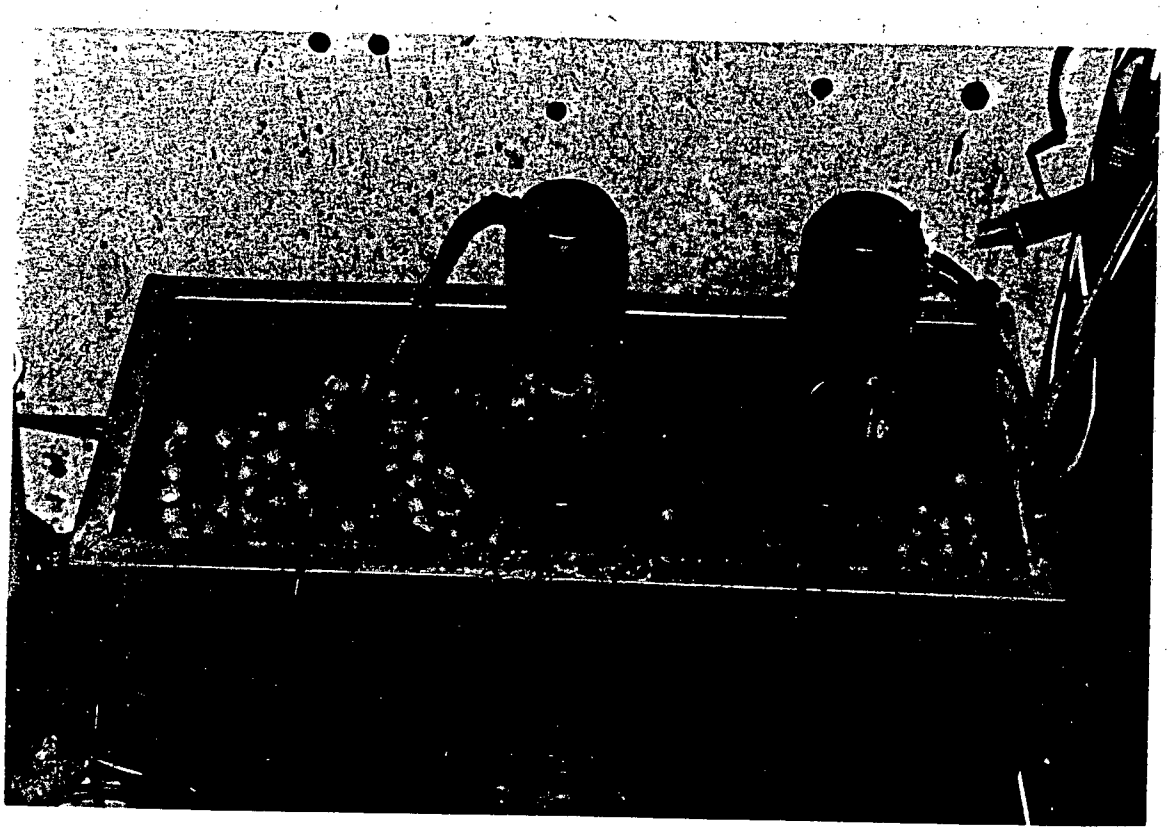

Figure 2.1: *Photograph showing the two 2.25 litre stainless steel reactors in the water bath.*

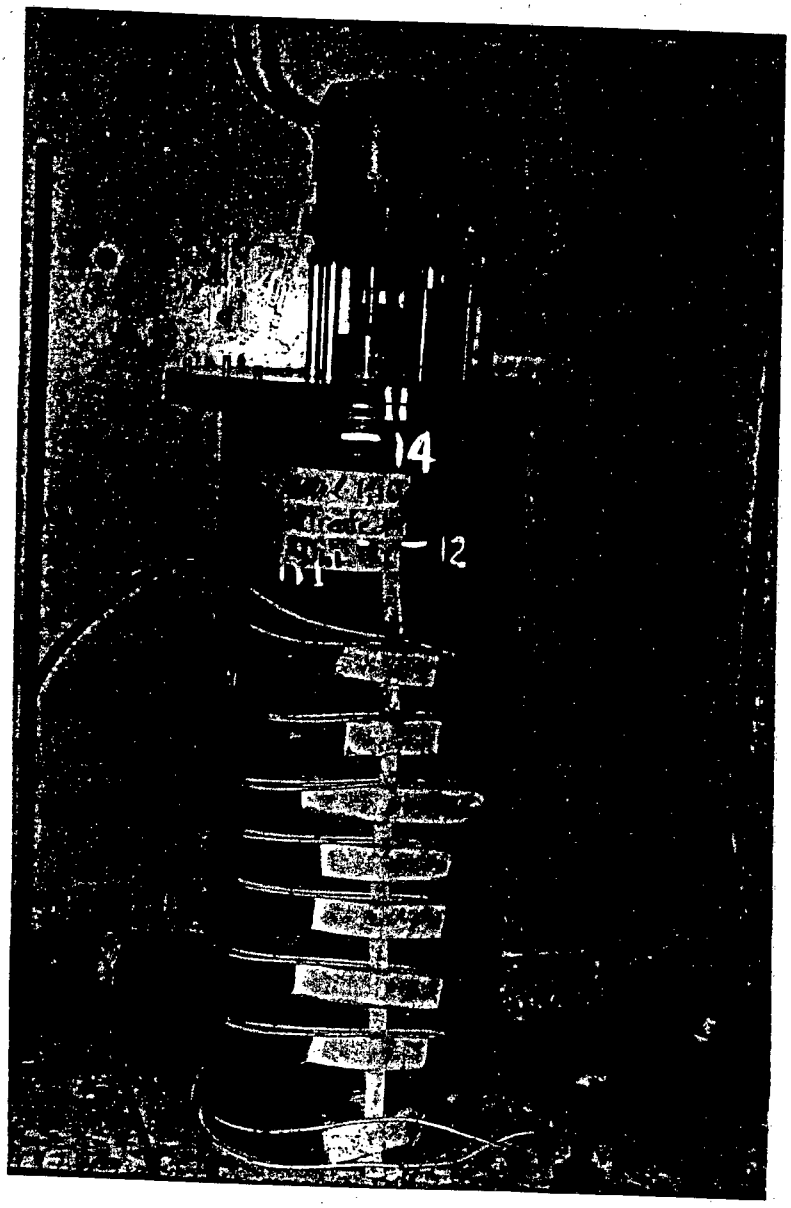


Figure 2.2: *Photograph showing one of the 14 litre anaerobic digesters operated in this thesis investigation.*

Should a digester show failure, the strategy for the subsequent operation of the digester was planned to be as follows (see section 2.4 below for the definition of failure):

1) The feeding rate of digester would be reduced drastically to between 0 and 0.5 l/day. This in effect would increase the retention time to greater than 25 days which would enable the population of anaerobic bacteria in the digester to recover to a stable level again.
2) Once the digester had stabilised the feeding rate would be increased to about one third of the feeding rate (or 3 times the retention time) that caused failure until the digester showed stability at that feeding rate.
3) The feeding rate would then be increased to the same rate that it was at for the shortest retention time at which the digester was operated successfully. The period of operation at this retention time would be for about 1.5 times the retention time. This would show that, after recovery, the performance of the digester does not change.

## 2.3 TESTS CONDUCTED ON THE INFLUENT AND EFFLUENT SLUDGES

The digester influent and effluent sludges were tested daily. This included testing (1) the primary sludge that was used to feed the digesters and the reactors, (2) the heat treated sludge that was used to feed the digesters, and (3) the sludge wasted from the digesters. The following tests were conducted on the reactor and digester influent and effluent sludges:

1) TKN
2) Free and saline ammonia
3) COD
4) Total solids
5) Volatile solids
6) $H_2CO_3^*$ alkalinity
7) Short chain fatty acids

On the anaerobic digester the gas production and the carbon dioxide content of the gas were measured. More details on the sampling and testing procedures of the reactors and digesters appear in Appendix B.

## 2.4 MONITORING DIGESTER STABILITY

In section 2.2 above a description was given of the steps to be taken when a digester failed. This section explains how the stability of the digesters was monitored and which of the measured parameters were used to indicate digester failure.

To gauge the stability of the digesters various parameters were monitored. These were pH, $H_2CO_3^*$ alkalinity, short chain fatty acids (SCFA) and gas production. All of these parameters are linked in that a change one will effect changes, of varying degrees, in the others (Moosbrugger *et al*, 1992a). For instance, in the case of a digester on the path to failure due to overloading, the resulting increase in the SCFA concentration of the supernatant in the system would effect a decrease in the $H_2CO_3^*$ alkalinity. Since $H_2CO_3^*$ alkalinity is a buffering agent the change in pH would be less noticeable than the change in SCFA concentration. An increase in the SCFA concentration would indicate that acid forming bacteria in the system were producing more products than the methane forming bacteria could consume. As a result, the rate of gas production by the methane forming bacteria would decrease.

The optimum pH for methane fermentation is between 7 and 8 (McCarty, 1974). Therefore, as long as a digester's pH falls into this range it can be considered to be 'healthy'. Reports of the lower pH limits for methane fermentation vary from 6 (McCarty, 1974) to 6.8 (Pretorius, 1983). In this thesis the pH value of 6.8 was taken to imply that the methanogenic population in the digester were under stress. The $H_2CO_3^*$ alkalinity in a 'healthy' digester may vary depending on the conditions. It depends on the partial pressure of the carbon dioxide in the digester gas and the pH of the digester liquid. The relationship between these three parameters is given in Figure 2.3 with an indication of the limits of normal anaerobic digester operation (McCarty, 1974). However, this diagram assumes equilibrium and does not take into account the situation where an upset in the equilibrium, like a shock load, may cause a rapid deterioration in the digester stability. The $H_2CO_3^*$ alkalinity, carbon dioxide partial pressure and pH may fall within the limits of normal digestion, but the system may be under irreversible stress unless the cause of the upset is rectified. In this thesis a rapid drop in the $H_2CO_3^*$ alkalinity after a period of stability was taken to indicate irreversible stress in the digester and therefore failure.

The SCFA concentration in a digester may vary from as low as 24 mg/l as HAc in a digester with batch feeding (McGhee, 1971) to over 3000 mg/l as HAc,

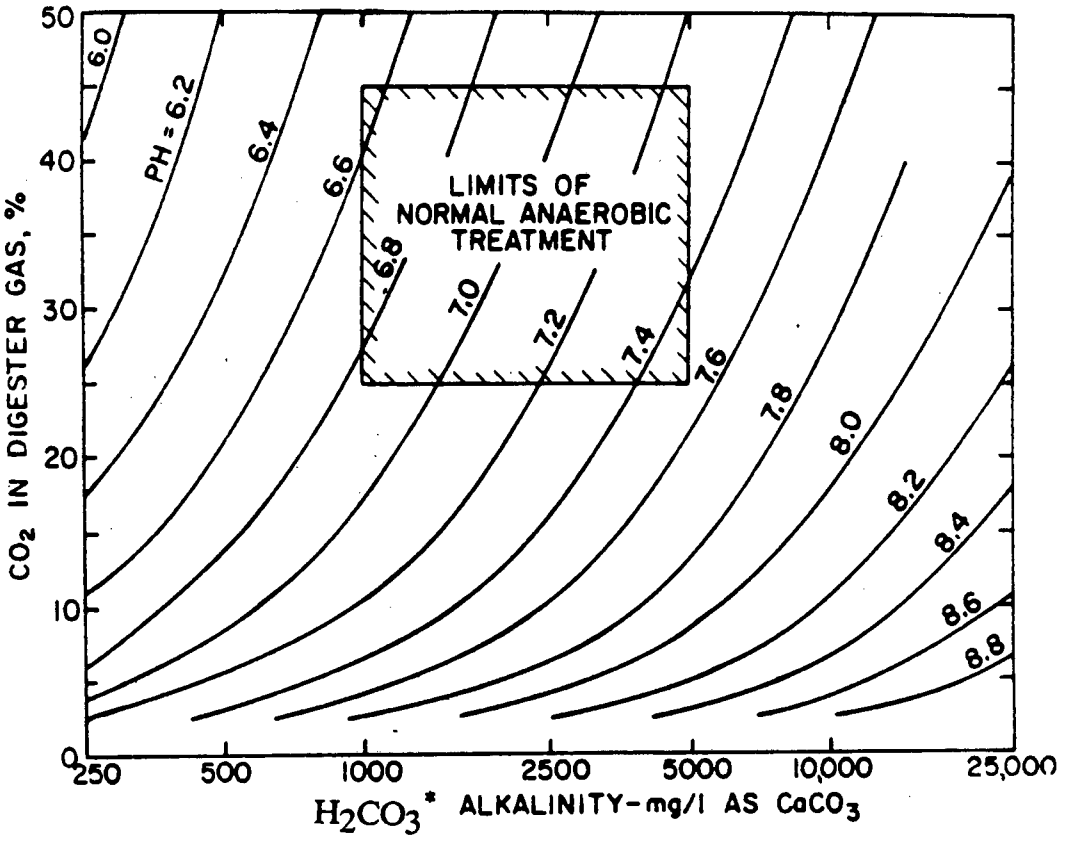


Figure 2.3: *Relationship between $H_2CO_3^*$ alkalinity, pH and carbon dioxide percentage in anaerobic treatment.*

as in a completely mixed digester with high solids concentration (Shindala *et al*, 1970) while the digester maintains a pH of over 7. Therefore, there are no set limits on the SCFA concentration alone to indicate failure.

During digester overloading an increase in the SCFA concentration is accompanied by a decrease in $H_2CO_3^*$ alkalinity. As a result, the SCFA:alkalinity ratio presents itself as a more sensitive monitoring parameter than SCFA or $H_2CO_3^*$ alkalinity alone. The SCFA:alk ratio is often monitored in full scale digesters and values of 0.1 to 0.35 have been considered typical of well operated digesters (Ripley, *et al*, 1986). However, caution needs to be exercised when interpreting these SCFA:alk ratios because, strictly speaking, they imply a steady state in the digester. Most digesters at wastewater treatment works are continuously fed rather than batch fed and therefore can achieve a form of steady state. In contrast, with batch fed digesters McGhee (1971) showed that a batch fed digester, maintained at 10 days retention time, exhibited a SCFA fluctuation from about 300 mg/l as HAc 3 hours after feeding, to 24 mg/l just prior to feeding. As a result, the SCFA:alk values given above that are indicative of stable operation cannot be applied to this investigation where batch fed digesters were operated. The results obtained from these digesters were from samples taken at the end of the feeding cycle with the digester being in a dynamic steady state. The samples were taken at the same time every day. Therefore, the daily SCFA:alk ratios of the digesters operated were consistently low (below 50 mg/l as HAc) and a sudden and continuous increase in this value was taken to indicate that failure had occurred.

In this investigation the SCFA and $H_2CO_3^*$ alkalinity values were measured directly. For digesters where these tests cannot be performed Ripley, *et al*, (1986) suggested a test that gives the IA:PA (intermediate alkalinity:partial alkalinity) ratio, which is analogous to the SCFA:alk ratio. He also showed that a rapid increase in the IA:PA ratio is indicative of imminent failure.

## 2.5 DESCRIPTION OF OPERATIONAL CHANGES MADE TO THE DIGESTERS D1, D2, D3 AND D4

This section describes the operational changes that were made to each individual digester and gives reasons for these changes.

### 2.5.1 DESCRIPTION OF OPERATIONAL CHANGES MADE TO DIGESTER D1

Digester D1 was started on day 1 with anaerobic sludge from Mitchell's Plain Wastewater Treatment Plant. This sludge was tested and the results showed that it was a 'healthy' anaerobic sludge and had originated in a digester that was operating under optimum anaerobic conditions. The D1 digester was run at a retention time of 20 days for 62 days. During this time the digester volume was maintained at 14 litres with a daily feed of 0.7 litres of heat treated sludge. Throughout the experimentation the temperature of the digester was maintained at 37$^{o}$C. The test results, specifically the $H_2CO_3^*$ alkalinity, pH, SCFA, and gas production, were relatively constant throughout the 62 days of this phase of experimentation (for day-to-day tables and graphs of this data see Appendix C). The results were therefore considered to be representative of the characteristics of the sludge under the conditions in the digester at 20 days retention time. A summary of the operational changes to digester D1 is given in Table 2.1, and the averages of the measured parameters for this period are given in Table 3.1.

From day 64 to day 112 the sludge from the digester was stored in the laboratory at 4$^{o}$C without any feeding due to a break in the experimentation. On day 113 the sludge was transferred back to digester D1 and heated to 37$^{o}$C over one day. Feeding started at a rate of 1.16 litres per day for 2 days, but the digester showed signs of instability and so the feeding was stopped for one day. For the following 5 days the feed rate was increased to 0.6 l/day. By this time the digester was showing signs of stability: the $H_2CO_3^*$ alkalinity was constant, as was the pH, and the gas production had increased and remained stable. The feed rate was therefore increased to 1.16 l/day and maintained at this level for 36 days. During this time the digester volume remained constant at 14 l, which gives a retention time of 12 days. The test results were relatively constant throughout the 36 days of this phase of experimentation (for day-to-day tables and graphs of this data see Appendix C). The results were therefore considered to be representative of the characteristics of the sludge under the conditions in the digester at 12 days retention time. A summary of the operational changes to digester D1 is given in Table 2.1, and the averages of the measured parameters for this period are given in Table 3.1.

On day 157 the feed rate was increased to 2.0 l/day. With the digester volume still at 14 l, this meant that the retention time was 7 days. These conditions were maintained

**Table 2.1 : Operational changes made to digester D1 (Day 1 to 211)**

| Day | Feed sludge type | Retention time | Digester volume | Volume feed | Operating period |
|---|---|---|---|---|---|
| 1 | Heat treated | 20 days | 14 l | 0.7 l | 62 days |
| 63 | (sludge stored at 4$^{o}$C due to break in experimentation) | | | | |
| 113 | Heat treated (stabilisation period | variable after storage) | 14 l | 0-1.16 l | 8 days |
| 121 | Heat treated | 12 days | 14 l | 1.16 l | 36 days |
| 157 | Heat treated | 7 days | 14 l | 2.0 l | 28 days |
| 185 | Heat treated (digester classified as failed after 5 | 4 days | 12 l days) | 3.0 l | 5 days |
| 190 | Heat treated | variable (revival period for digester) | 12 l | 0-0.5 l | 7 days |
| 197 | Heat treated | 12 days | 12 l | 1.0 l | 4 days |
| 201 | Heat treated | 7 days | 12 l | 1.71 l | 10 days |
| 211 | (Shut down digester.) | | | | |

for 28 days. On day 167 the digester started foaming. The problem was remedied by withdrawing sludge until the foam layer was level with the top paddle at 14l volume. After about 10 minutes the foam had disappeared and the withdrawn sludge was fed back into the reactor. By day 170 the digester was foaming again. On day 171 the stirrer shaft was taken out of the digester and the paddles were adjusted so that the top paddle lay level with the surface of the sludge in the digester. No more foaming occurred during this phase of the experimentation. Apart from the short periods of foaming the test results during this phase were relatively constant and showed the signs of stability described earlier (for day-to-day tables and graphs of this data see Appendix C). The results were therefore considered to be representative of the characteristics of the sludge under the conditions in the digester. A summary of the operational changes to digester D1 is given in Table 2.1, and the averages of the measured parameters for this period are given in Table 3.1.

On day 185 the feed rate was increased to 3.0 l/day. The desired retention time here was 4 days, which, with a digester volume of 14 l, would have required a feed rate of 3.5 l/day. The reactors, which were operated at a retention time of 1.5 days, would have required a combined volume of 5.25 l to heat treat the sludge. The available volume was 4.5 l, which gives a feed rate of 3.0 l/day. To attain a retention time in the digester of 4 days it was necessary, therefore, to reduce the operating volume of the digester to 12 l. After 1 day the digester began foaming. To remedy this the stirrer shaft was taken out and another paddle added to it. No more foaming was experienced after this. After the first feed of 3.0l the digester showed immediate signs of instability with the $H_2CO_3^*$ alkalinity dropping and the SCFA rising. This trend continued with other parameters also showing instability and on day 190 , 5 days after the change to 4 days retention time, the digester was classified, according to the guidelines laid out in section 2.4, as failed.

Days 190 to 196 served as a revival period for the digester. The volume of the digester was maintained at 12l and the feed rate varied from 0 to 0.5 l/day. During this time the $H_2CO_3^*$ alkalinity and the SCFA concentrations attained their original stable operating levels (see Figures 3.11 to 3.14). On day 197 the feed rate was increased to 1.0 l/day, while the digester volume was maintained at 12l. This meant that the retention time was 12 days. These conditions were maintained for 4 days during which time the digester test results continued to be stable (see Figures 3.11 to 3.14). The feed rate was therefore increased to 1.71 l/day while the digester volume was maintained at 12l. This meant that the retention time was 7 days. The digester

was operated at this retention time for 10 days, during which period the test results were relatively constant and similar to the results obtained earlier when the digester was first run at 7 days retention time. The digester was therefore considered to be stable and was shut down. A summary of the operational changes to digester D1 is given in Table 2.1.

### 2.5.2 DESCRIPTION OF OPERATIONAL CHANGES MADE TO DIGESTER D2

Digester D2 was started on day 1 with the same anaerobic sludge that was used for digester D1. The digester was operated at a retention time of 15 days for 62 days. During this time the digester volume was maintained at 14 litres with a daily feed of 0.93 litres of heat treated sludge. Throughout the experimentation the temperature of the digester was maintained at $37^{o}C$. The test results, specifically the $H_2CO_3^*$ alkalinity, pH, SCFA, and gas production, were relatively constant throughout the 62 days of this phase of experimentation (for day-to-day tables and graphs of this data see Appendix C). The results were therefore considered to be representative of the characteristics of the sludge under the conditions in the digester at 15 days retention time. A summary of the operational changes to digester D2 is given in Table 2.2, and the averages of the measured parameters for this period are given in Table 3.1.

From day 64 to day 112 the sludge from the digester was stored in the laboratory at $4^{o}C$ without any feeding due to a break in the experimentation. On day 113 the sludge was transferred back to digester D2. Feeding with heat treated sludge started at a rate of 1.40 litres per day for 2 days, but the digester showed signs of instability and so the feeding was reduced to 0 for 1 day. For the following 5 days the feed rate was increased to 0.7 l/day. By day 120 the digester was showing signs of stability: the $H_2CO_3^*$ alkalinity was constant, as was the pH, and the gas production had increased and remained stable. The feed rate was therefore increased to 1.40 l/day and maintained at this level for 30 days (day 121 to 150). The digester volume remained constant at 14l, which means that the retention time was 10 days. The test results were relatively constant throughout the 30 days of this phase of experimentation (for day-to-day tables and graphs of this data see Appendix C). The results were therefore

**Table 2.2 : Operational changes made to digester D2 (Day 1 to 181)**

| Day | Feed sludge type | Retention time | Digester volume | Volume feed | Operating period |
|---|---|---|---|---|---|
| 1 | Heat treated | 15 days | 14 l | 0.93 l | 62 days |
| 63 | (sludge stored at 4$^{o}$C due to break in experimentation) | | | | |
| 113 | Heat treated (stabilisation period | variable after storage) | 14 l | 0-1.4 l | 8 days |
| 121 | Heat treated | 10 days | 14 l | 1.4 l | 30 days |
| 151 | Primary | 10 days | 14 l | 1.4 l | 30 days |
| 181 | (Shut down digester.) | | | | |

considered to be representative of the characteristics of the sludge under the conditions in the digester at 10 days retention time. A summary of the operational changes to digester D2 is given in Table 2.2, and the averages of the measured parameters for this period are given in Table 3.1.

On day 151 the sludge feed type was changed to primary sludge. The feed rate remained at 1.4 l/day, and the digester volume at 14l. The retention time therefore also remained the same at 10 days. These conditions remained the same for 30 days until day 180. During this period the test results were relatively constant (for day-to-day tables and graphs of this data see Appendix C) and were, therefore, considered to be representative of the characteristics of the sludge under the conditions in the digester. This brought to an end the experimentation on digester D2. A summary of the operational changes to digester D2 is given in Table 2.2, and the averages of the measured parameters for the period from day 151 to 180 are given in Table 3.2.

### 2.5.3 DESCRIPTION OF OPERATIONAL CHANGES MADE TO DIGESTER D3

Digester D3 was operated in exactly the same manner as digester D1. The feed rates were the same for the same time periods, the digester volume was the same for the same periods and therefore the retention times were the same for the same periods. The changes in operating characteristics were effected on the same days for the same reasons. Only the feed type was different in that primary sludge was fed to the digester instead of heat treated sludge. Foaming did not occur to the same extent as in digester D1 and, therefore, did not present any operational problems.

The digester was shut down on day 211 after completing all the necessary experimentation (for day-to-day tables and graphs of the data see Appendix C). A summary of the operational changes to digester D3 is given in Table 2.3, and the averages of the measured parameters for this period are given in Table 3.2.

### 2.5.4 DESCRIPTION OF OPERATIONAL CHANGES MADE TO DIGESTER D4

Digester D4 was started up with anaerobic sludge from the Mitchell's Plain Wastewater Treatment Plant. This anaerobic seed sludge was collected about 11

weeks prior to the startup of digester D4. The sludge was stored at 20°C for 4 weeks and at 4°C for a further 7 weeks. Because digester D4 was started later than the others, what is day 113 for digesters D1, D2 and D3 is actually day 1 for digester D4. The reason for this is that digester D4 was still under construction while the other digesters were being operated. Due to the long storage period of the seed sludge it was unstable when it was added to digester D4. As a result the initial stabilising period was longer than that experienced by the other digesters after storage of their sludges.

The operating volume for digester D4 until the end of experimentation was 14l, while the operating temperature was 37°C. For the first 2 days after startup the digester was fed 0.93 l/day of primary sludge. Test results showed that the concentration of SCFA's was very high and the $H_2CO_3^*$ alkalinity was very low compared with the other digesters. Therefore, after 1 day of no feeding, the feeding rate was set at 0.5 l/day of primary sludge for the next 15 days. During this period the SCFA's dropped to a level much closer to that of the other digesters with a concomitant increase in the $H_2CO_3^*$ alkalinity.

On day 19 the feed rate was increased to 0.93 l/day. This meant that the retention time was 15 days. These conditions were maintained for 45 days until day 64. During this time the test results were relatively constant (for day-to-day tables and graphs of this data see Appendix C) and were therefore considered to be representative of the characteristics of the sludge under the conditions in the digester. Since there was no need for any further experimentation with digester D4, it was shut down. A summary of the operational changes to digester D4 is given in Table 2.4, and the averages of the measured parameters for this period are given in Table 3.2.

In Chapter 3 the results of the investigation described in this chapter are presented, evaluated and discussed. The important parameters are statistically evaluated to establish if there is a difference in digestiblity between the two different feed types used.

**Table 2.3 : Operational changes made to digester D3 (Day 1 to 211)**

| Day | Feed sludge type | Retention time | Digester volume | Volume feed | Operating period |
|---|---|---|---|---|---|
| 1 | Primary | 20 days | 14 l | 0.7 l | 62 days |
| 63 | (sludge stored at 4$^{o}$C due to break in experimentation) | | | | |
| 113 | Primary (stabilisation period | variable after storage) | 14 l | 0-1.16 l | 8 days |
| 121 | Primary | 12 days | 14 l | 1.16 l | 36 days |
| 157 | Primary | 7 days | 14 l | 2.0 l | 28 days |
| 185 | Primary (digester classified as failed after 5 days) | 4 days | 12 l | 3.0 l | 5 days |
| 190 | Primary (revival period for digester) | variable | 12 l | 0-0.5 l | 7 days |
| 197 | Primary | 12 days | 12 l | 1.0 l | 4 days |
| 201 | Primary | 7 days | 12 l | 1.71 l | 10 days |
| 211 | (Shut down digester.) | | | | |

**Table 2.4 : Operational changes made to digester D4 (Day 1 to 64)**

| Day | Feed sludge type | Retention time | Digester volume | Volume feed | Operating period |
|---|---|---|---|---|---|
| 1 | Primary | variable (stabilising period) | 14 l | 0-0.93 l | 19 days |
| 19 | Primary | 15 days | 14 l | 0.93 l | 45 days |
| 64 | (Shut down digester.) | | | | |

# CHAPTER 3

## PRESENTATION, EVALUATION AND DISCUSSION OF THE RESULTS FROM THE INVESTIGATION

### 3.1 INTRODUCTION

In this chapter the results from this investigation are presented, evaluated and discussed. A summary of the results from the two different feed sludge types (*viz.* primary and heat treated sludge) is given first. Thereafter, the more important parameters are compared statistically to establish if there is a difference in the anaerobic digestibilities of the two feed types. The implications of the statistical comparison of the results from the two feed types are discussed, and finally, the results are compared with results from other research on anaerobic digestion of sewage sludge.

### 3.2 SUMMARY OF EXPERIMENTAL DATA COLLECTED FROM DIGESTERS D1, D2, D3 AND D4

The experimental data collected from digesters D1 to D4 was analysed and averages of the appropriate parameters were calculated. The data collected during the first retention time period of each retention time that the digesters were operated was not included in the calculation of the averages. The first retention time period was a stabilising period and the data collected during these periods was not considered to be representative. The averages of the data collected from the digesters fed heat treated sludge, and the averages of the calculated parameters, are given in Table 3.1. The averages of the data collected from the digesters fed primary sludge, and the averages of the calculated parameters, are given in Table 3.2. Detailed tables showing the day-to-day data and calculated parameters are given in Appendix C.

Of the averages given in Tables 3.1 and 3.2, the parameters that give an indication of digester performance are:

1) percent VS removed
2) percent COD removed
3) gas production per day
4) gas produced per VS and COD removed

Table 3.1: Averages of data calculated from digesters fed with heat treated sludge

| Retention | Total Solids | | Volatile Solids | | | | |
|---|---|---|---|---|---|---|---|
| time | influent | effluent | influent | added | effluent | removed | removed |
| (days) | (g/l) | (g/l) | (g/l) | (g/day) | (g/l) | (g/day) | (%) |
| 7 | 31.416 | 20.118 | 26.060 | 52120 | 15.105 | 21911 | 41.8 |
| 10 | 29.046 | 17.132 | 23.936 | 33510 | 12.736 | 15680 | 46.8 |
| 12 | 29.862 | 17.207 | 24.714 | 28668 | 12.638 | 14007 | 48.6 |
| 15 | 30.744 | 18.079 | 25.294 | 23524 | 13.182 | 11264 | 47.6 |
| 20 | 30.463 | 16.987 | 25.037 | 17526 | 12.209 | 8979 | 51.2 |

| Retention | Non-volatile Solids | | | TKN | | Free & Saline Ammonia | |
|---|---|---|---|---|---|---|---|
| time | influent | effluent | removed | influent | effluent | influent | effluent |
| (days) | (g/l) | (g/l) | (%) | (mg/l) | (mg/l) | (mg/l) | (mg/l) |
| 7 | 5.356 | 5.013 | 5.2 | 1079 | 1039 | 238 | 377 |
| 10 | 5.110 | 4.397 | 13.6 | 1035 | 1052 | 242 | 448 |
| 12 | 5.148 | 4.568 | 10.9 | 1046 | 1038 | 255 | 449 |
| 15 | 5.450 | 4.897 | 9.3 | 1146 | 1130 | 273 | 484 |
| 20 | 5.426 | 4.778 | 11.3 | 1161 | 1177 | 273 | 504 |

| Retention | COD | | | | | Conductivity | |
|---|---|---|---|---|---|---|---|
| time | influent | added | effluent | removed | removed | influent | effluent |
| (days) | (g/l) | (g/day) | (g/l) | (g/day) | (%) | (mS/m) | (mS/m) |
| 7 | 42.386 | 84.772 | 25.675 | 33.323 | 39.2 | 226 | 291 |
| 10 | 39.027 | 54.637 | 19.523 | 27.279 | 49.6 | 267 | 351 |
| 12 | 39.984 | 46.381 | 20.113 | 23.032 | 49.2 | 263 | 351 |
| 15 | 42.774 | 39.780 | 20.023 | 21.158 | 52.7 | 255 | 384 |
| 20 | 42.549 | 29.784 | 19.637 | 16.038 | 53.4 | 254 | 387 |

Table 3.1: Averages of data calculated from digesters fed with heat
(cont.) treated sludge

| Retention time | pH | | Alkalinity (as CaCO3) | | SCFA (as HAc) | | SCFA/Alk | |
|---|---|---|---|---|---|---|---|---|
| | influent | effluent | influent | effluent | influent | effluent | influent | effluent |
| (days) | | | (mg/l) | (mg/l) | (mg/l) | (mg/l) | | |
| 7 | 5.45 | 7.08 | 90 | 1858 | 1958 | 43 | 21.7 | 0.023 |
| 10 | 5.24 | 7.17 | 89 | 1977 | 2483 | 33 | 28.9 | 0.017 |
| 12 | 5.36 | 7.16 | 96 | 1993 | 2340 | 31 | 25.6 | 0.016 |
| 15 | 5.19 | 7.14 | 49 | 1950 | 2155 | 36 | 44.4 | 0.018 |
| 20 | 5.21 | 7.19 | 48 | 1999 | 2115 | 26 | 45.1 | 0.013 |

| Retention time | Gas production | Carbon dioxide | Methane | Gas produced per.... | | | |
|---|---|---|---|---|---|---|---|
| | | | | COD remove | CODadded | VS remove | VS added |
| (days) | (l/day) | (%) | (%) | l/g | l/g | l/g | l/g |
| 7 | 27.93 | 35.4 | 64.6 | 0.92 | 0.33 | 1.34 | 0.53 |
| 10 | 18.13 | 36.5 | 63.5 | 0.64 | 0.32 | 1.15 | 0.54 |
| 12 | 15.85 | 35.9 | 64.1 | 0.69 | 0.34 | 1.15 | 0.55 |
| 15 | 13.71 | 35.6 | 64.4 | 0.69 | 0.35 | 1.27 | 0.59 |
| 20 | 10.18 | 35.6 | 64.4 | 0.66 | 0.34 | 1.19 | 0.59 |

| Retention time | Methane produced per..... | | | | Carbon dioxide produced per... | | | |
|---|---|---|---|---|---|---|---|---|
| | VS remove | VS added | COD remov | CODadded | VS remove | VS added | COD remove | CODadde |
| (days) | l/g | l/g | l/g | l/g | l/g | l/g | l/g | l/g |
| 7 | 0.87 | 0.34 | 0.59 | 0.21 | 0.47 | 0.19 | 0.32 | 0.12 |
| 10 | 0.73 | 0.34 | 0.41 | 0.21 | 0.42 | 0.20 | 0.23 | 0.12 |
| 12 | 0.73 | 0.35 | 0.44 | 0.22 | 0.42 | 0.20 | 0.25 | 0.12 |
| 15 | 0.82 | 0.38 | 0.44 | 0.23 | 0.45 | 0.21 | 0.25 | 0.13 |
| 20 | 0.76 | 0.38 | 0.42 | 0.22 | 0.42 | 0.21 | 0.23 | 0.12 |

Note: Alkalinity = $H_2CO_3^*$ alkalinity

All gas volumes measured at 1 atmosphere pressure and 20°C.

Table 3.2: Averages of data calculated from digesters fed with primary sludge

| Retention | Total Solids | | Volatile Solids | | | | |
|---|---|---|---|---|---|---|---|
| time | influent | effluent | influent | added | effluent | removed | removed |
| (days) | (g/l) | (g/l) | (g/l) | (g/day) | (g/l) | (g/day) | (%) |
| 7 | 31.308 | 19.405 | 25.971 | 51.942 | 14.601 | 22741 | 43.4 |
| 10 | 31.161 | 17.936 | 25.768 | 36.076 | 13.386 | 17335 | 47.7 |
| 12 | 29.977 | 17.453 | 24.727 | 28.684 | 12.264 | 14457 | 50.1 |
| 15 | 31.301 | 17.081 | 25.863 | 24.053 | 12.619 | 12317 | 50.9 |
| 20 | 31.554 | 16.922 | 25.690 | 17.983 | 12.131 | 9491 | 52.8 |

| Retention | Non-volatile Solids | | | TKN | | Free & Saline Ammonia | |
|---|---|---|---|---|---|---|---|
| time | influent | effluent | removed | influent | effluent | influent | effluent |
| (days) | (g/l) | (g/l) | (%) | (mg/l) | (mg/l) | (mg/l) | (mg/l) |
| 7 | 5.337 | 4.805 | 9.0 | 1105 | 1041 | 196 | 371 |
| 10 | 5.392 | 4.550 | 14.5 | 1100 | 1039 | 203 | 409 |
| 12 | 5.250 | 5.188 | 1.4 | 1028 | 992 | 235 | 430 |
| 15 | 5.437 | 4.461 | 17.1 | 1075 | 976 | 221 | 404 |
| 20 | 5.865 | 4.791 | 17.6 | 1171 | 1157 | 244 | 511 |

| Retention | COD | | | | | Conductivity | |
|---|---|---|---|---|---|---|---|
| time | influent | added | effluent | removed | removed | influent | effluent |
| (days) | (g/l) | (g/day) | (g/l) | (g/day) | (%) | (mS/m) | (mS/m) |
| 7 | 42.906 | 85.811 | 23.530 | 38.818 | 44.9 | 208 | 284 |
| 10 | 42.354 | 59.295 | 20.852 | 30.453 | 50.6 | 216 | 299 |
| 12 | 39.714 | 46.068 | 19.148 | 23.994 | 51.6 | 252 | 354 |
| 15 | 42.367 | 39.401 | 19.969 | 20.663 | 52.3 | 224 | 323 |
| 20 | 42.570 | 29.799 | 18.741 | 16.680 | 55.4 | 271 | 407 |

Table 3.2: Averages of data calculated from digesters fed with primary sludge (cont.)

| Retention time | pH | | Alkalinity (as CaCO3) | | SCFA (as HAc) | | SCFA/Alk | |
|---|---|---|---|---|---|---|---|---|
| | influent | effluent | influent | effluent | influent | effluent | influent | effluent |
| (days) | | | (mg/l) | (mg/l) | (mg/l) | (mg/l) | | |
| 7 | 5.38 | 7.11 | 79 | 1853 | 1770 | 51 | 22.5 | 0.028 |
| 10 | 5.38 | 7.12 | 82 | 1903 | 1831 | 30 | 22.4 | 0.016 |
| 12 | 5.36 | 7.16 | 85 | 2068 | 2197 | 33 | 25.3 | 0.016 |
| 15 | 5.42 | 7.14 | 82 | 1994 | 1824 | 27 | 22.2 | 0.014 |
| 20 | 5.29 | 7.17 | 59 | 2110 | 2244 | 25 | 39.0 | 0.012 |

| Retention time | Gas production | Carbon dioxide | Methane | Gas produced per.... | | | |
|---|---|---|---|---|---|---|---|
| | | | | COD remove | CODadded | VS remove | VS added |
| (days) | (l/day) | (%) | (%) | l/g | l/g | l/g | l/g |
| 7 | 27.741 | 36.8 | 63.2 | 0.72 | 0.32 | 1.20 | 0.52 |
| 10 | 20.670 | 37.9 | 62.1 | 0.68 | 0.35 | 1.21 | 0.57 |
| 12 | 17.215 | 36.7 | 63.3 | 0.77 | 0.38 | 1.24 | 0.61 |
| 15 | 13.958 | 36.4 | 63.6 | 0.71 | 0.36 | 1.17 | 0.58 |
| 20 | 11.173 | 36.7 | 63.3 | 0.72 | 0.38 | 1.20 | 0.62 |

| Retention time | Methane produced per..... | | | | Carbon dioxide produced per... | | | |
|---|---|---|---|---|---|---|---|---|
| | VS remove | VS added | COD remov | CODadded | VS remove | VS added | COD remove | CODadde |
| (days) | l/g | l/g | l/g | l/g | l/g | l/g | l/g | l/g |
| 7 | 0.76 | 0.33 | 0.46 | 0.20 | 0.44 | 0.19 | 0.26 | 0.12 |
| 10 | 0.75 | 0.36 | 0.42 | 0.22 | 0.45 | 0.22 | 0.26 | 0.13 |
| 12 | 0.78 | 0.39 | 0.49 | 0.24 | 0.45 | 0.22 | 0.28 | 0.14 |
| 15 | 0.74 | 0.37 | 0.45 | 0.23 | 0.43 | 0.21 | 0.26 | 0.13 |
| 20 | 0.76 | 0.39 | 0.46 | 0.24 | 0.44 | 0.23 | 0.27 | 0.14 |

Note: Alkalinity = $H_2CO_3^*$ alkalinity

All gas volumes measured at 1 atmosphere pressure and 20$^{o}$C.

5) digester gas composition (% $CO_2$ and $CH_4$)
6) influent and effluent pH
7) influent and effluent $H_2CO_3^*$ alkalinity
8) influent and effluent SCFA
9) digester SCFA:alk ratios

Graphs of these parameters are given below in Figures 3.1 to 3.9 respectively. Accompanying each of these graphs is an evaluation of the data contained in each graph and a discussion of the implications of this data. Following these discussions three more graphs are given for interest in Figs. 3.10 to 3.12 showing influent and effluent TKN, influent and effluent ammonia, and gas produced per VS and COD added. For the day-to-day graphs of the above parameters from which the averages in Tables 3.1 and 3.2 were calculated see Appendix C.

The graphs of the parameter averages depict the characteristics of the digesters when they were operating under stable conditions. Figures 3.13 to 3.16 show the paths to failure of the digesters D1 and D3, as indicated by the parameters SCFA, $H_2CO_3^*$ alkalinity, SCFA:alk ratio and gas production, respectively.

## 3.3 EVALUATION AND DISCUSSION OF THE VOLATILE SOLIDS REMOVAL DATA

Figure 3.1 shows the variation of the percentage VS removal with retention time in the digesters for the two different feed types. It can be clearly seen from this figure that there is a definite decrease in the efficiency of the anaerobic process with a decrease in retention time. The % VS removal for the heat treated sludge feed decreased from 51.2% at 20 days retention time to 41.8% at 7 days retention time. This represents a decrease in efficiency of 18%. The % VS removal for the primary sludge feed decreased from 52.8% at 20 days retention time to 43.4% at 7 days retention time. This also represents a decrease in efficiency of 18%.

It should be recalled at this point that problems were experienced with foaming in the digester D1 when operated at a retention time of 7 days. On day 171 the foaming problem was eliminated, as described in sub-section 2.5.1. The day-to-day graph of % VS removal (see Appendix C) shows that after day 171 the digester effluent VS concentration increased by about 3.5 g/l, from about 12.5 g/l to about 16.0 g/l. The VS concentration showed only a very slight decline from day 172 until the end of the 7

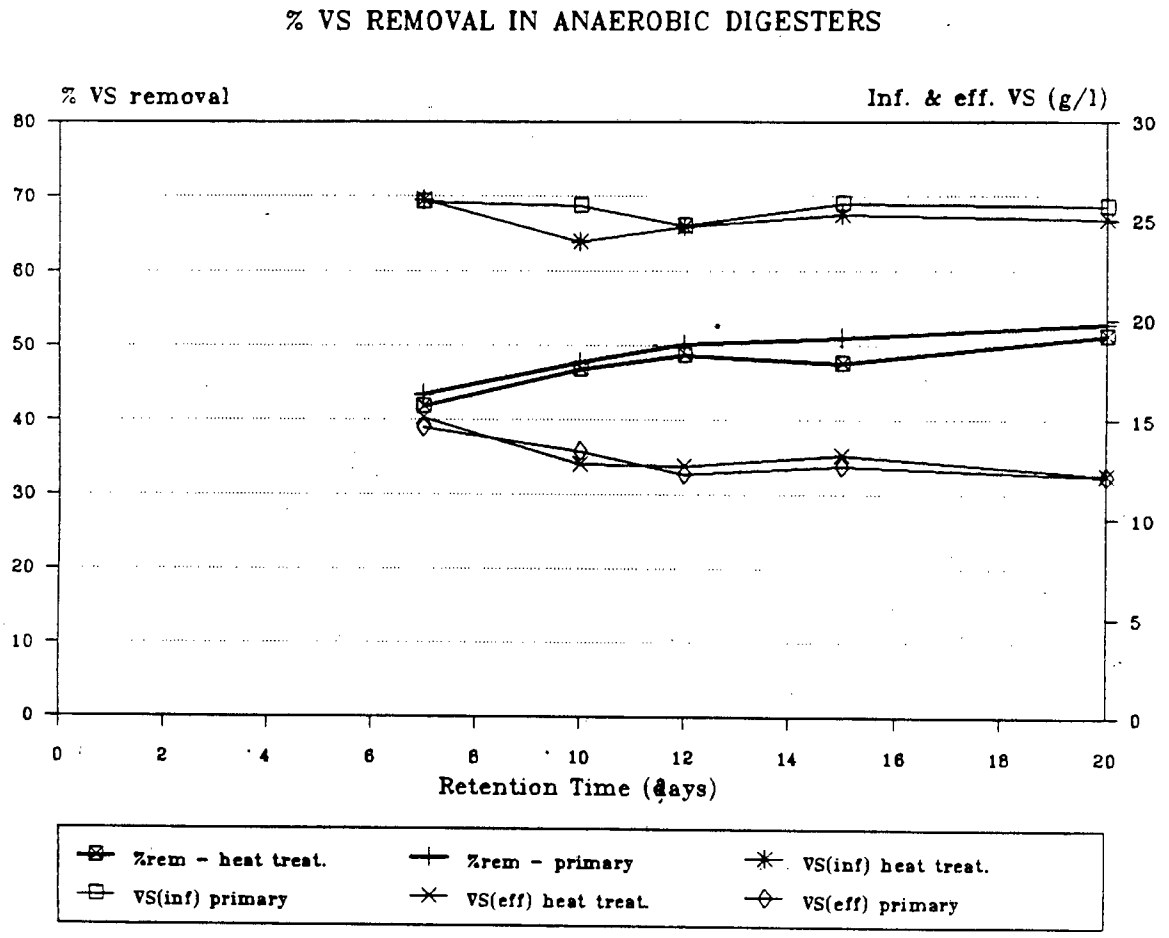


*Figure 3.1*: *Graph showing the variation with retention time of the % VS removed for the digesters fed primary and heat treated sludge. The graph also includes data on the influent and effluent VS concentrations from which the % VS removed data was calculated. It was concluded that there was no significant difference between the % VS removals of the digesters fed primary and heat treated sludge.*

day retention time period on day 185. It appears, therefore, that there was a high concentration of unbiodegradable solids in the layer of foam that had developed in the free space above the surface of the liquid in the digester. Once this foam layer was broken up the unbiodegradable solids that were stored in it were released into the digester liquid. As a result, the total VS concentration increased, and only showed a gradual decline as the excess unbiodegradable VS was withdrawn from the digester along with the sludge that was wasted daily. As a consequence of this the digester D1 showed a lower % VS removal than it should have.

Statistical comparisons (Guttman, Wilks and Hunter, 1982) between the two % VS removed data points for each of the different retention times show that, at a 95% confidence interval, there is no difference between these pairs of data points, except for those at 15 days retention time. However, the difference between the % VS removed data points at 15 days retention time is only 6.6%. Operationally speaking, this is a negligible difference. It can, therefore, be concluded that, as indicated by the parameter % VS removal, there was no difference in digestibility between the heat treated sludge and the primary sludge. A corollary of this conclusion is that there was no conditioning of the primary sludge by the heat treatment insofar as % VS removal is concerned.

## 3.4 EVALUATION AND DISCUSSION OF THE COD REMOVAL DATA

Figure 3.2 shows the variation of the percentage COD removal with retention time in the digesters for the two different feed types. It can be clearly seen from this figure that there is a definite decrease in the efficiency of the anaerobic process with a decrease in retention time. The % COD removal for the heat treated sludge feed decreased from 53.4% at 20 days retention time to 39.2% at 7 days retention time. This represents a decrease in efficiency of 36%. The value for % COD removal for the heat treated sludge at 7 days retention time was lower than expected. The reasons for this are explained in the next paragraph. The % COD removal for the primary sludge feed decreased from 55.4% at 20 days retention time to 44.9% at 7 days retention time. This represents a decrease in efficiency of 23%.

The lower than expected % COD removal for the heat treated sludge at 7 days retention time may be attributed to the foaming problem that was mentioned in

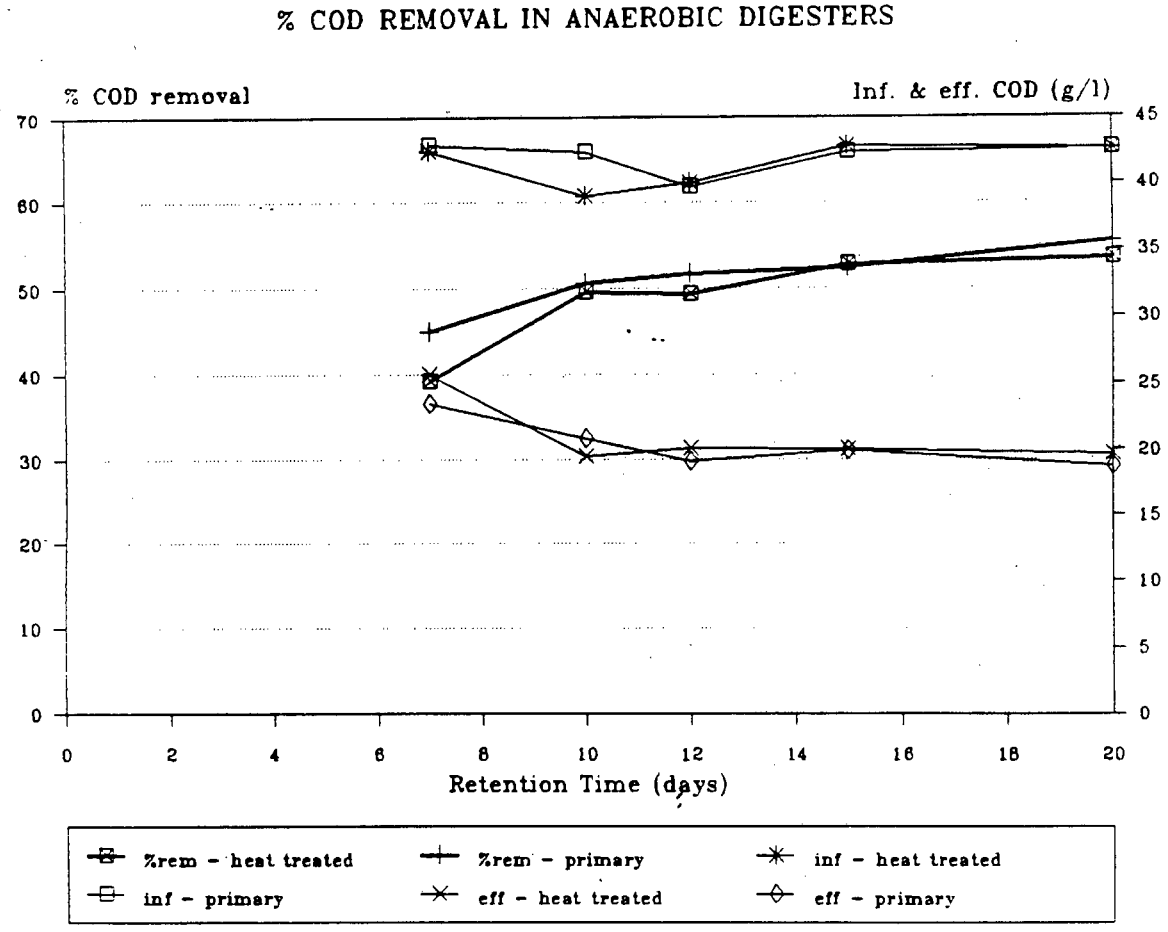


*Figure 3.2*: *Graph showing the variation with retention time of the % COD removed for the digesters fed primary and heat treated sludge. The graph also includes data on the influent and effluent COD concentrations from which the % COD removed data was calculated. It was concluded that there was no significant difference between the % COD removals of the digesters fed primary and heat treated sludge.*

subsection 2.5.1 and section 3.3 above. The reasons for the lower than expected % COD removal are the same as those specified in section 3.3 above for the lower than expected % VS removal value for the heat treated sludge at 7 days retention time. Therefore, the decrease in efficiency of the anaerobic process with respect to % COD removal of 36% is unrealistic. A value similar to the 23% decrease in efficiency for primary sludge is probably a more realistic value.

Statistical comparisons (Guttman, Wilks and Hunter, 1982) between the two % COD removed data points for each of the different retention times show that, at a 95% confidence interval, there is no difference between these pairs of data points , except for those at 7 days retention time. The reason for this exception was explained above. It can, therefore, be concluded that, as indicated by the parameter % COD removal, there is no difference in digestibility between the heat treated sludge and the primary sludge. A corollary of this conclusion is that there was no conditioning of the primary sludge by the heat treatment insofar as % COD removal is concerned.

## 3.5 EVALUATION AND DISCUSSION OF THE GAS PRODUCTION DATA

Figure 3.3 shows the variation of gas production per day with retention time. From this figure it can be seen that with a decrease in retention time there is a marked increase in gas production. This is a predictable trend since, as long as the digester volume is constant, the shorter the retention time, the larger the volume of sludge that is fed to the digester. The more sludge fed to the digester, the more gas that will be produced.

The gas production averages have not been compared statistically because they are dependant on a number of variable parameters, the main one being the feed sludge concentration. The gas production is best presented in more specific terms like: litres gas produced per gram VS removed (see section 3.6).

## 3.6 EVALUATION AND DISCUSSION OF THE GAS PRODUCTION PER VS AND COD REMOVED DATA

Figure 3.4 shows the variation with retention time of gas production per VS and COD removed. This figure shows that, with the exception of the values for the heat treated sludge at 7 days retention time, the data remains virtually constant with decreasing retention time. As mentioned and explained in sections 3.3 and 3.4, the VS and COD

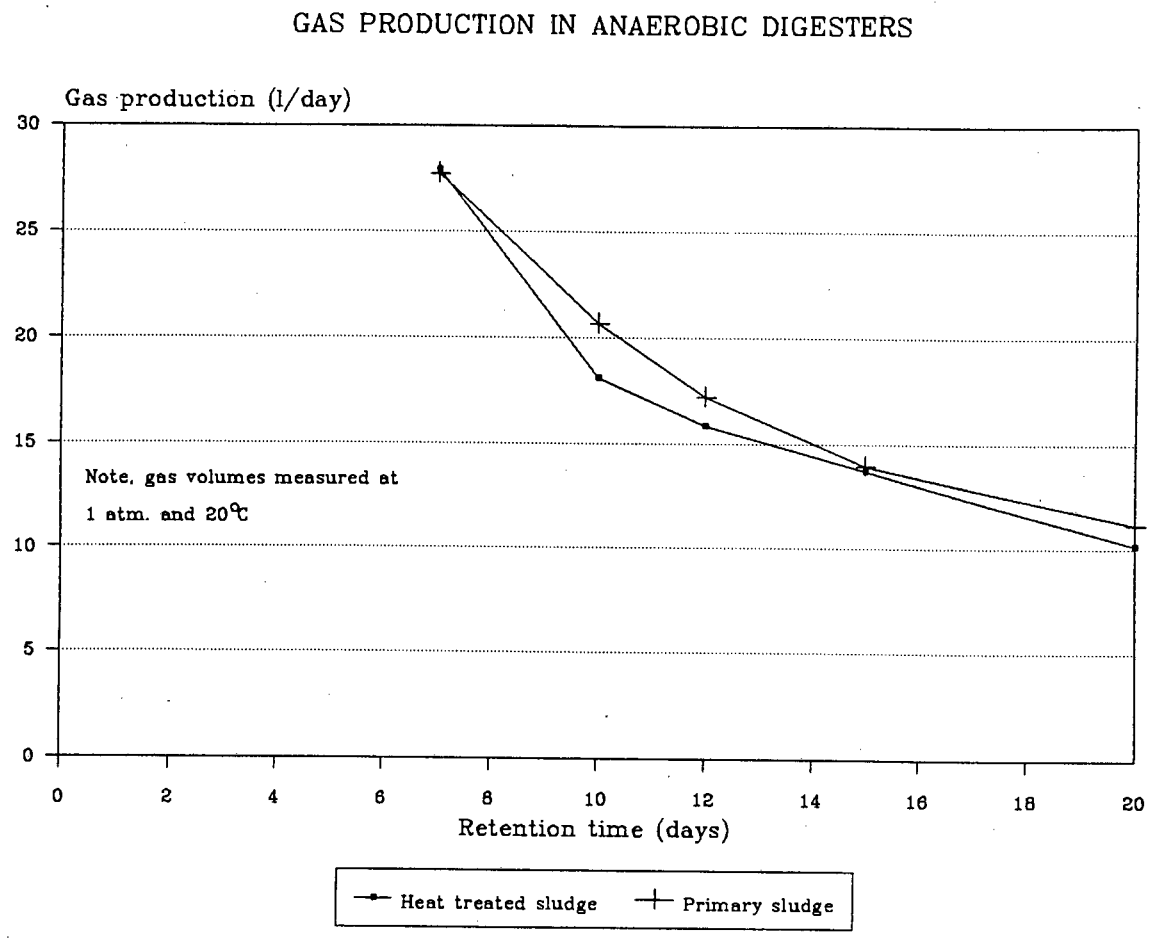


*Figure 3.3:* *Graph showing the variation with retention time of the rate of gas production for the digesters fed primary and heat treated sludge. There is a marked increase in gas production with a decrease in retention time because of the increase in feeding rate with the decrease in retention time.*

removals were lower than expected for the heat treated sludge at 7 days retention time. However, the gas production did not seem to be affected by the foaming problem experienced in digester D1 (see Figure 3.3). It seems, therefore, that though foaming was a problem, the anaerobic processes continued inside the foam layer and the gas production was not affected. With the gas production unaffected and the VS and COD removals lower than expected, it makes sense that the calculations of gas produced per VS and COD removed for the digester fed heat treated sludge at 7 days retention time are higher than expected.

Statistical comparisons (Guttman, Wilks and Hunter, 1982) between the two gas-production-per-VS-removed data points at each of the different retention times show that, at a 95% confidence interval, there is no difference between these pairs of data, except for those at 7 days retention time. The reasons for this exception were given in the paragraph above.

In order to confirm the observation above that there is virtually no variation in gas production per VS removed, a statistical comparison between the data points for primary sludge at 20 days retention time and the data points for primary sludge at 15, 12, 10 and 7 days retention time was performed. This comparison showed that, at a 95% confidence interval, there was no significant difference between these data points. The same statistical comparison between the data points for heat treated sludge gave the same result. This statistical information, therefore, confirms the observation at the beginning of this section that the averages of the gas-production-per-VS-removed data remained virtually constant with decreasing retention time for both the feed types.

The same statistical comparisons performed on the gas-production-per-VS-removed were also performed on the gas-production-per-COD-removed data. These comparisons gave the same results ie. (1) there was no significant difference between the pairs of data at each retention time for gas production per COD removed, and (2) the gas-production-per-COD-removed data remained virtually constant with decreasing retention time for both the feed types.

From the above information it can be concluded that, as indicated by the parameters gas produced per VS and COD removed, there is no significant difference between the anaerobic digestibilities of the primary and the heat treated sludge. A corollary of this conclusion is that there was no conditioning of the primary sludge by the heat

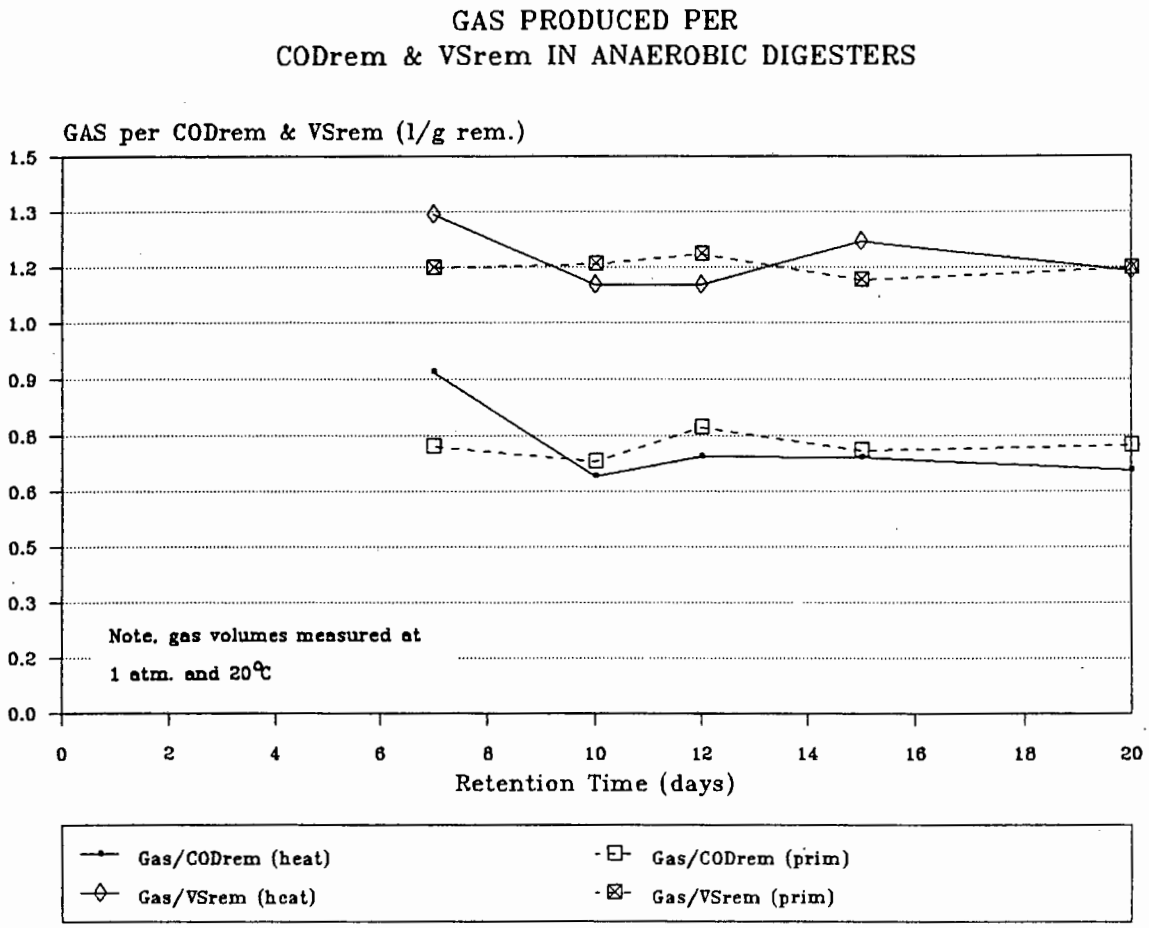


*Figure 3.4*: *Graph showing the variation with retention time of the gas production per VS and COD removed for the digesters fed primary and heat treated sludge. It was concluded that there was no significant difference in gas production per VS and COD removed between the digesters fed primary and heat treated sludge.*

treatment insofar as gas production per VS and COD removed is concerned. Furthermore, it can also be concluded that the gas production per VS and COD removed does not vary significantly with a change in retention time, as long as the digester is in a stable condition.

## 3.7 EVALUATION AND DISCUSSION OF THE GAS COMPOSITION DATA

Figure 3.5 shows the variation of the gas composition with retention time of the digesters. Since only the % carbon dioxide was measured, and the % methane calculated as the balance of the gas (see Appendix B for experimental procedures), what is true for the % carbon dioxide data, therefore, also holds true for the % methane data.

Figure 3.5 shows that the gas composition does not change with decreasing retention time. Though the figure also shows that the % carbon dioxide in the digester gas for the two different feed types are virtually identical, a statistical comparison shows that, at a 95% confidence interval, there is a significant difference in the pairs of data at each retention time except for those at a 15 day retention time. However, the largest difference between any pair of data points is only 1.4 $\%CO_2$. Operationally speaking, this is a negligible difference. Therefore, there is very little difference between the gas composition from the digesters fed primary and heat treated sludge.

From the above discussion it can be concluded that, as indicated by the gas composition, there is very little difference between anaerobic digestibilities of the primary and heat treated sludges. It can, therefore, also be concluded that there was no conditioning of the primary sludge by the heat treatment insofar as gas composition is concerned.

## 3.8 EVALUATION AND DISCUSSION OF THE pH DATA

Figure 3.6 shows the variation of pH with retention time of the sludge wasted from the digesters. A statistical comparison between the pairs of data for the two different feed types at each retention time shows that, at a 95% confidence interval, there is no significant difference between these pairs of data, except at 10 and 7 days retention time. However, the largest difference in pH between any pair of data points, which occurred at 10 days retention time, was only 0.7%.

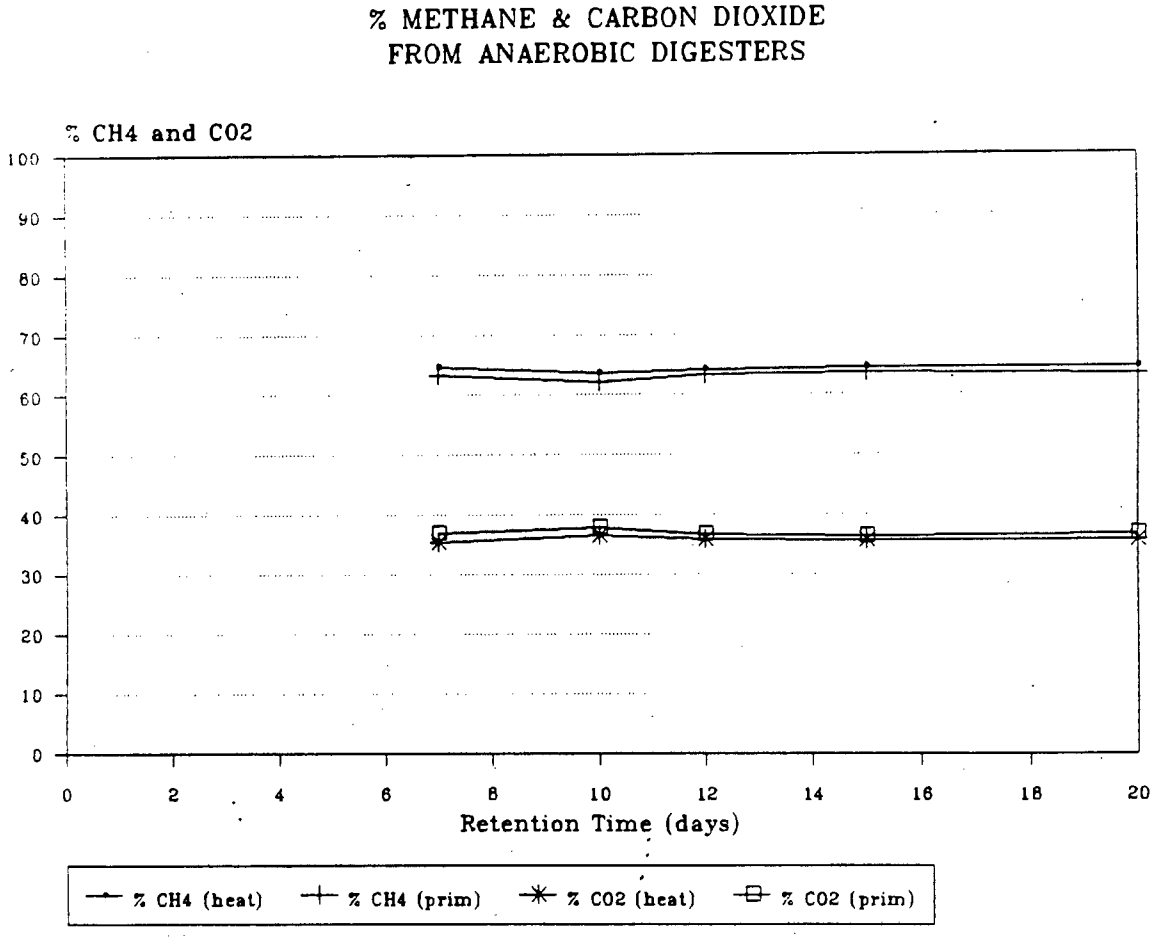


*Figure 3.5*: *Graph showing the variation with retention time of the gas composition (% carbon dioxide and % methane by volume) for the digesters fed primary and heat treated sludge. It was concluded that there was only a negligible difference in the gas composition between the gasses from the digesters fed primary and heat treated sludge.*

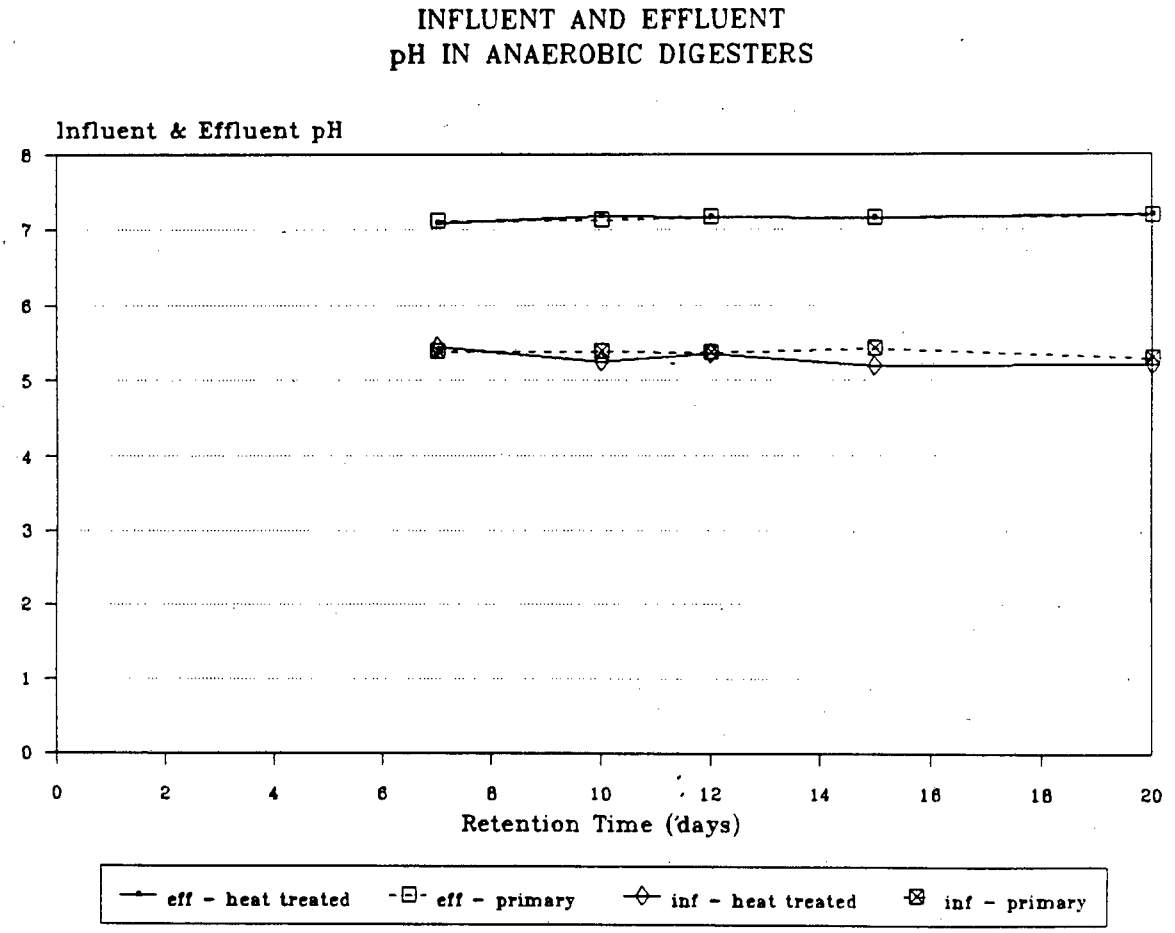


*Figure 3.6*: *Graph showing the variation with retention time of the pH in the digester supernatant for the digesters fed primary and heat treated sludge. The graph also shows the pH of the influent sludge, illustrating the increase in pH through the anaerobic digesters. It was concluded that there was very little difference between the pH values in the digesters fed primary and heat treated sludge.*

A statistical comparison between the pH data points for the primary sludge feed at 20 days and 7 days retention time, shows that, at a 95% confidence interval, there is a significant difference between these pH values. This means that there is a slight decrease in pH of 1.0% with a decrease in retention time. The same statistical test on the pH data for heat treated sludge gives the same result with a pH decrease of 1.5% between the pH values at 20 days and 7 days retention time. It should be noted that because of the effect of pH buffering by the $H_2CO_3^*$ alkalinity in the digester, the pH is unlikely to display large fluctuations when operated under stable conditions. Other parameters, like $H_2CO_3^*$ alkalinity and SCFA, that are linked to the pH are more likely to show larger fluctuations (see sections 3.9 and 3.10).

From the above discussion it can be concluded that, as indicated by the pH measurement, there is very little difference between the anaerobic digestibilities of the primary and heat treated sludges. It can, therefore, also be concluded that there was no conditioning of the primary sludge by the heat treatment insofar as pH is concerned.

## 3.9 EVALUATION AND DISCUSSION OF THE $H_2CO3^*$ ALKALINITY DATA

Figure 3.7 shows the variation of the averages of the $H_2CO_3^*$ alkalinity with retention time in the digesters fed primary and heat treated sludge. Statistical comparisons between the pairs of data points at each retention time show that, at a 95% confidence interval, there is a significant difference between these data points, except at a retention time of 7 days. The largest difference between the data points of each pair is 5.3%, which occurs between the pair of data points at 20 days retention time. Operationally speaking, this is a negligible difference.

Figure 3.7 also shows that there is a trend which indicates a decrease in $H_2CO_3^*$ alkalinity with a decrease in retention time. This trend is especially noticeable in the data for the digesters fed primary sludge, and in both sets of data between 10 and 7 days retention time.

Therefore, it can be concluded that, as indicated by the digester $H_2CO_3^*$ alkalinity, there is very little difference between the anaerobic digestibilities of the primary and heat treated sludges. It can, therefore, also be concluded that there was no conditioning of the primary sludge by the heat treatment insofar as $H_2CO3^*$ alkalinity is concerned.

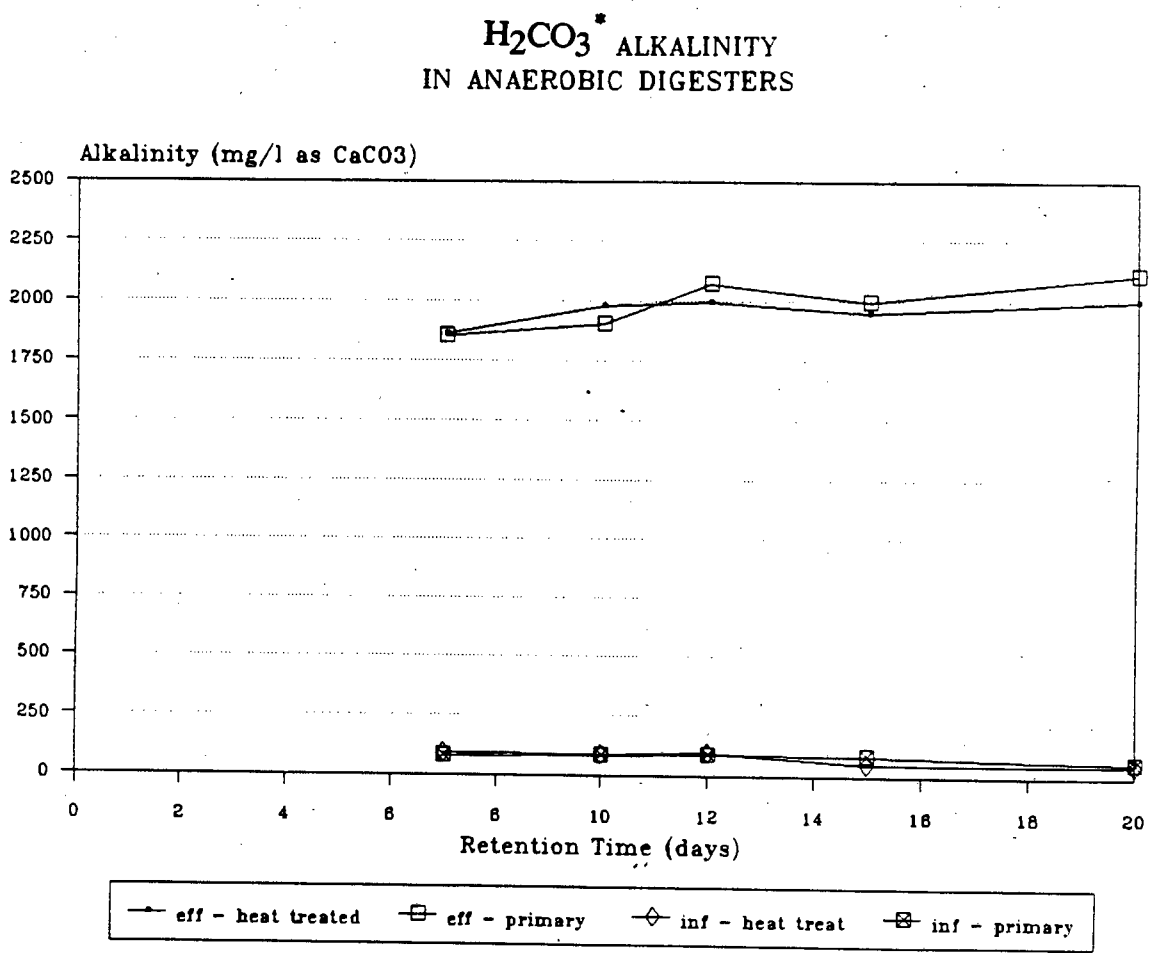


*Figure 3.7*: *Graph showing the variation with retention time of the $H_2CO_3^*$ alkalinity in the digester supernatant for the digesters fed primary and heat treated sludge. The graph also shows the $H_2CO_3^*$ alkalinity of the influent sludge, illustrating the increase in $H_2CO_3^*$ alkalinity through the anaerobic digesters. It was concluded that there was very little difference between the $H_2CO_3^*$ alkalinities in the digesters fed primary and heat treated sludge.*

## 3.10 EVALUATION AND DISCUSSION OF THE SCFA DATA

Figure 3.8 shows the variation of the averages of the SCFA concentration in the supernatant of the sludge wasted from the digesters fed primary and heat treated sludge. A statistical comparison between the pairs of data points at each retention time shows that, at a 95% confidence interval, there is no significant difference between the two sets of data at retention times of 20, 12 and 10 days, while there is a significant difference at 15 and 7 days. The largest difference between the two sets of data is 33% at 15 days retention time. Operationally speaking, when dealing with such low SCFA concentration (< 50 mg/l as HAc) this apparently large difference is insignificant. Figure 3.8 shows that there is a definite increase in SCFA with a corresponding decrease in retention time. The SCFA increase is from about 25 mg/l (as HAc) at 20 days retention time, to between 43 and 51 mg/l (as HAc) at 7 days retention time.

Therefore, it can be concluded that, as indicated by the digester SCFA concentration, there is very little difference between the anaerobic digestibilities of the primary and heat treated sludges. It can, therefore, also be concluded that there was no conditioning of the primary sludge by the heat treatment insofar as SCFA concentration is concerned.

## 3.11 EVALUATION AND DISCUSSION OF SCFA:alk RATIO DATA

Figure 3.9 shows the variation with retention time of the SCFA:alk ratios of the digesters fed primary and heat treated sludge. A statistical comparison between the pairs of data points at each retention time shows that, at a 95% confidence interval, there is no significant difference between the two sets of data at retention times of 20, 12 and 10 days, while there is a significant difference at 15 and 7 days. The pair of data points at 15 days retention time show the largest difference between any pair of data points in Fig 3.9 of 35%. This difference appears to be large, but when dealing with such low values it is, operationally speaking, nominal. It can, therefore be said that there is very little difference between the SCFA:alk ratios for the digesters fed primary and heat treated sludge.

Fig 3.9 also shows that there is an increase in SCFA:alk ratio with a decrease in retention time. The SCFA:alk ratio increases from between 0.012 and 0.013 (for the primary and heat treated sludges respectively) at 20 days retention time, to between 0.023 and 0.028 at 7 days retention time.

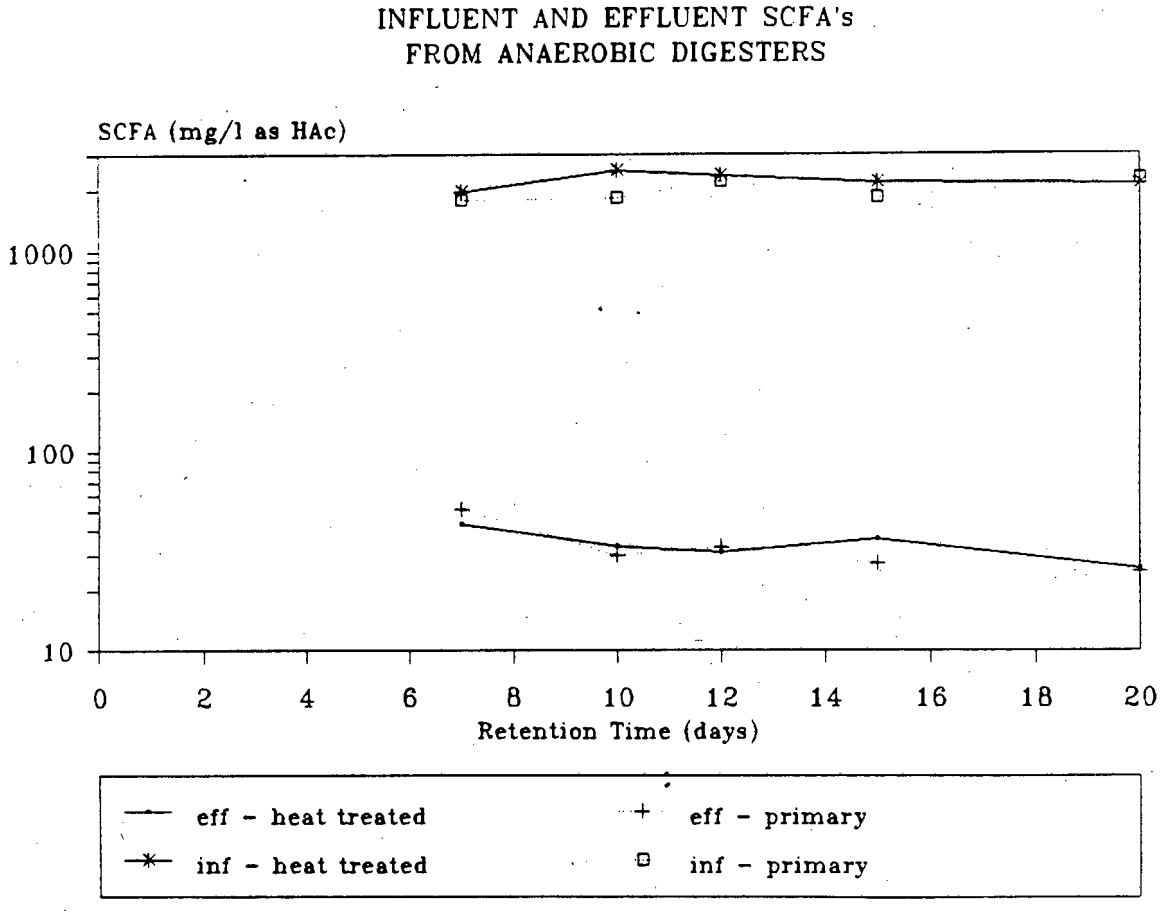


*Figure 3.8*: *Graph showing the variation with retention time of the SCFA concentration in the digesters fed primary and heat treated sludge. The graph also shows the SCFA concentration of the influent sludges, illustrating the increase in SCFA conc. through the anaerobic digesters. It was concluded that there was very little difference between the SCFA concentrations in the digesters fed primary and heat treated sludge.*

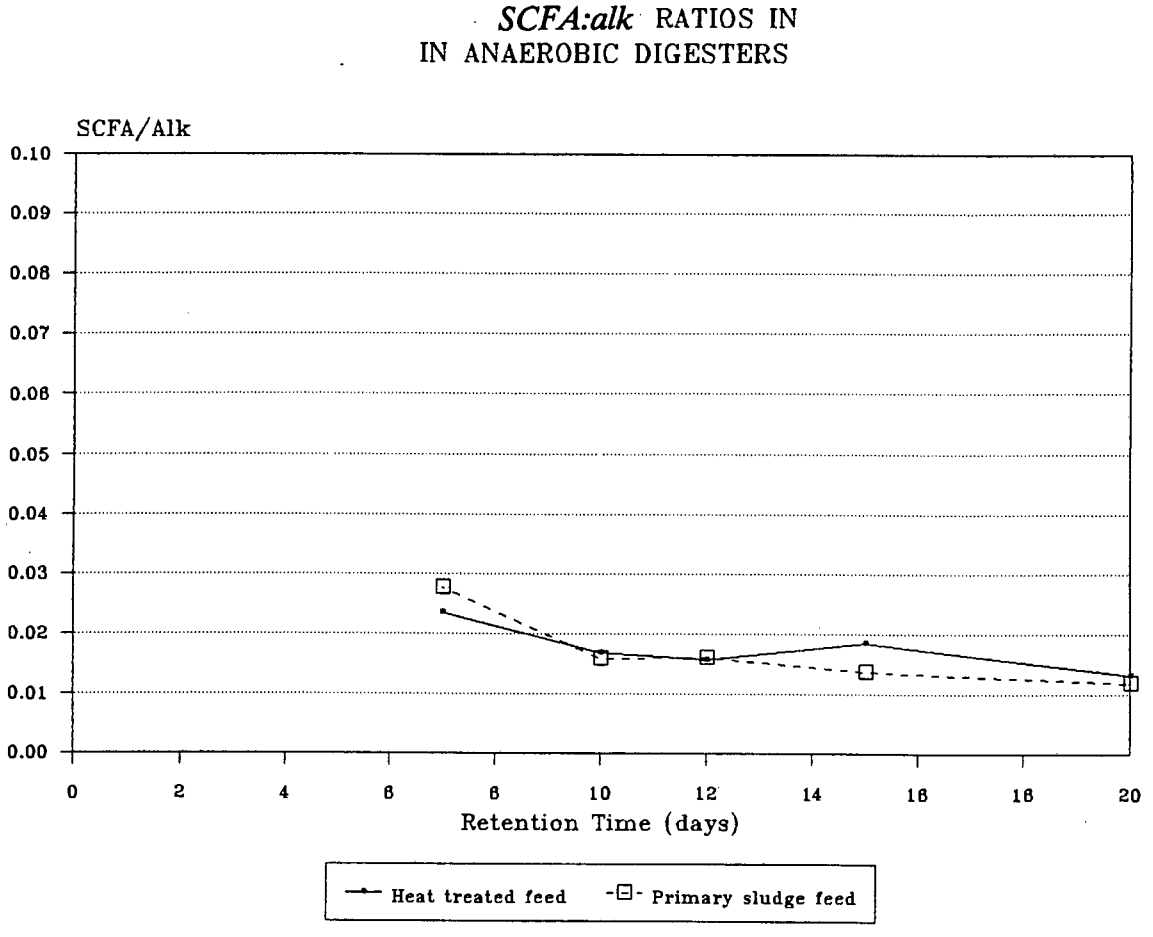


*Figure 3.9*: *Graph showing the variation with retention time of the SCFA:alk ratios in the digesters fed primary and heat treated sludge. It was concluded that there was very little difference between the SCFA:alk ratios in the digesters fed primary and heat treated sludge.*

Alkalinity = $H_2CO_3^*$ alkalinity

From the above discussion it can be concluded that, as indicated by the digester SCFA:alk ratios, there is very little difference between the anaerobic digestibilities of the primary and heat treated sludges. It can, therefore, also be concluded that there was no conditioning of the primary sludge by the heat treatment insofar as the SCFA:alk ratio is concerned.

The figures shown and discussed in sections 3.3 to 3.11 are of the more important parameters related to the anaerobic digestibility of sludge. For interest a number of additional graphs of results given in Tables 3.1 and 3.2 are given below in Figs. 3.10 to 3.12. These graphs show, respectively, the variation of the following parameters with retention time:

1) gas produced per VS and COD added
2) influent and effluent TKN
3) influent and effluent free and saline ammonia

## 3.12 DISCUSSION ON FAILURE OF DIGESTERS D1 AND D3

The paths to failure of digesters D1 and D3, as indicated by the parameters $H_2CO_3^*$ alkalinity, SCFA concentration, SCFA:alk ratio and gas production, are given in Figs. 3.13 to 3.16 respectively. All of these graphs begin on day 157 of operation (for both the digesters) and end on day 211 when the digesters were shut down. From the period day 157 to 184 the retention time in both the digesters was 7 days and both digesters operated stably at this retention time. On day 185 the retention time in both digesters was reduced to 4 days. Fig. 3.13 shows how the $H_2CO_3^*$ alkalinity of both digesters dropped from above 1750 mg/l (as $CaCO_3$) on day 185 to below 1250 mg/l on day 190. As described in section 2.3 above, this rapid decrease in $H_2CO_3^*$ alkalinity showed that the digester was undergoing failure. Therefore, as indicated by the parameter $H_2CO_3^*$ alkalinity, both digesters failed at a retention time of 4 days. Between days 190 and 197 the retention time was increased to a minimum of 24 days and thereafter both digesters D1 and D3 showed an immediate recovery pattern. For the last 10 days of operation of both digesters the retention time was 7 days. During this period the $H_2CO_3^*$ alkalinities recovered to the same levels as those during the earlier 7 day retention time period before the failure at 4 days retention time.

Fig. 3.14 shows how the SCFA concentration in the liquor in digester D1 (fed heat treated sludge) rose from below 50 mg/l (as HAc) on day 185, when the retention was

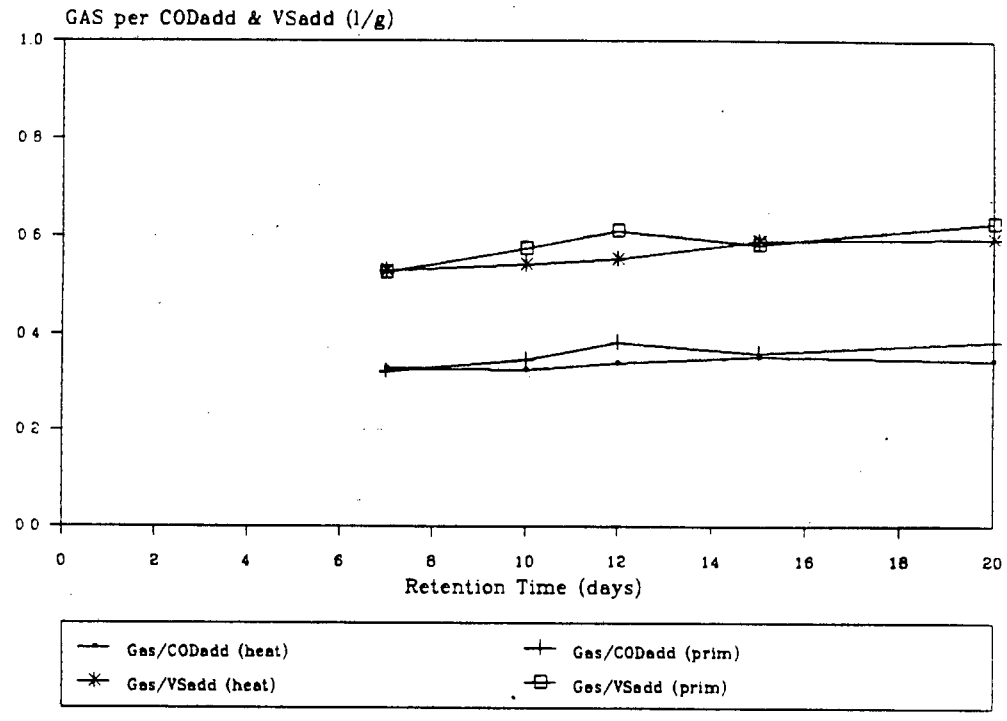


*Figure 3.10*: *Graph showing the variation with retention time of the gas production per VS and COD added for the digesters fed primary and heat treated sludge.*

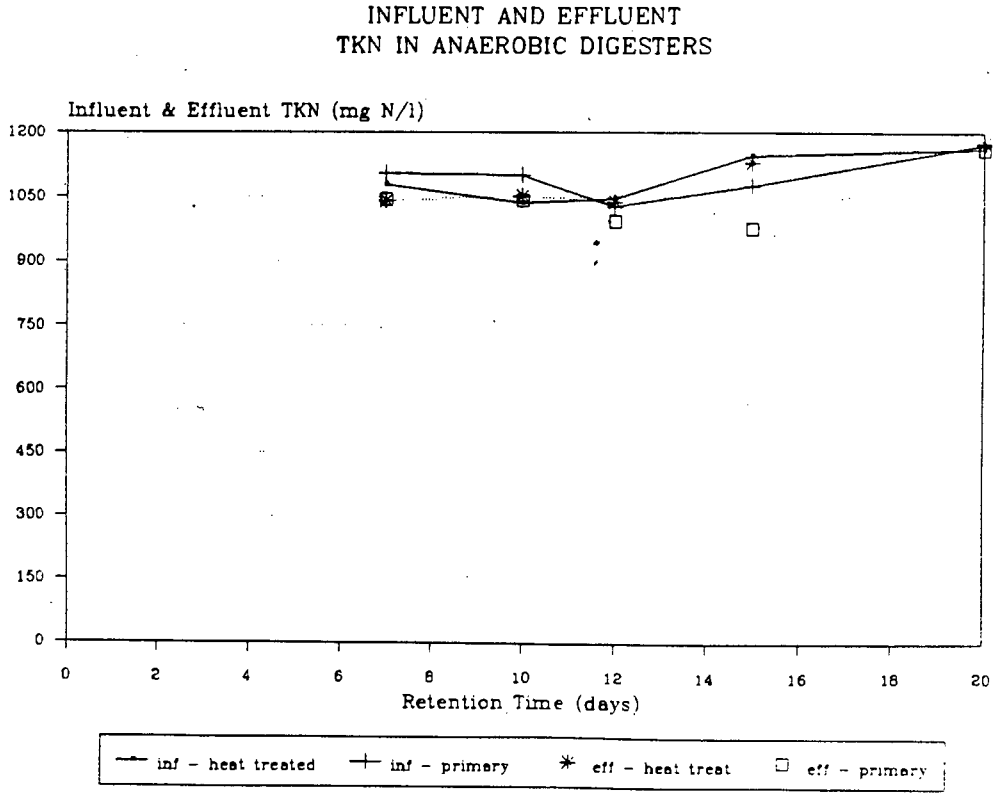


*Figure 3.11*: *Graph showing the influent and effluent TKN at the different retention times for the digesters fed primary and heat treated sludge.*

Note: All gas volumes measured at 1 atmosphere pressure and 20°C.

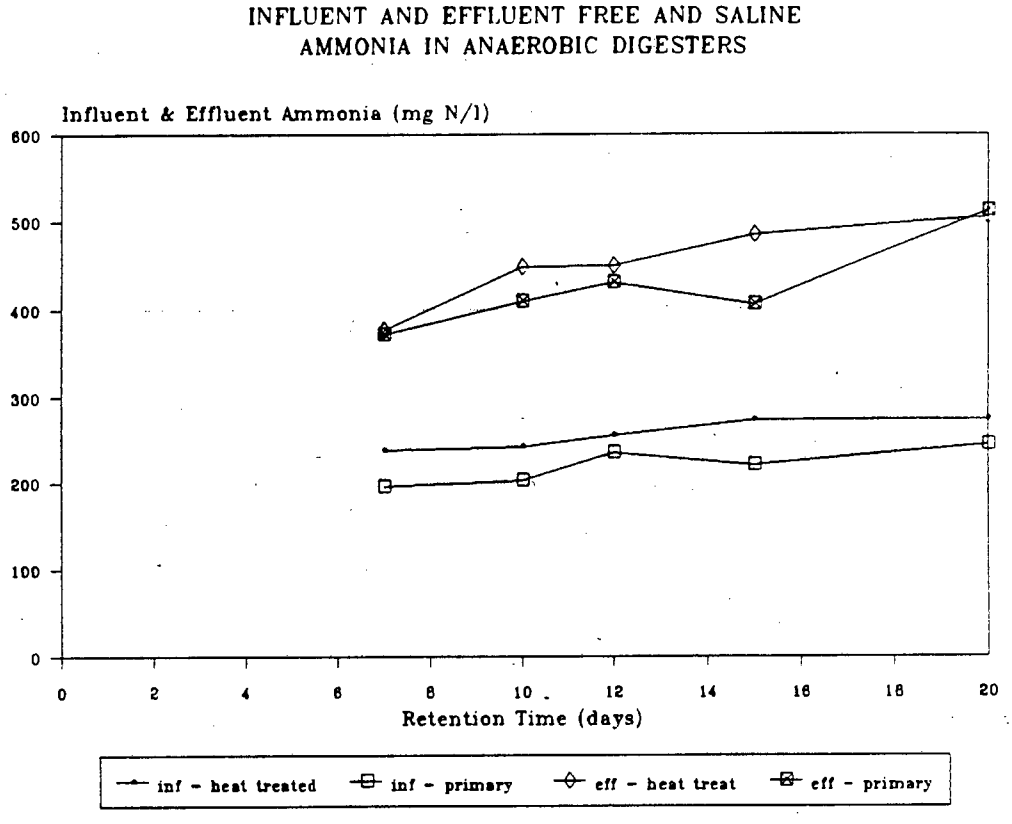


*Figure 3.12*: *Graph showing the influent and effluent free and saline ammonia concentrations at the different retention times for the digesters fed primary and heat treated sludge.*

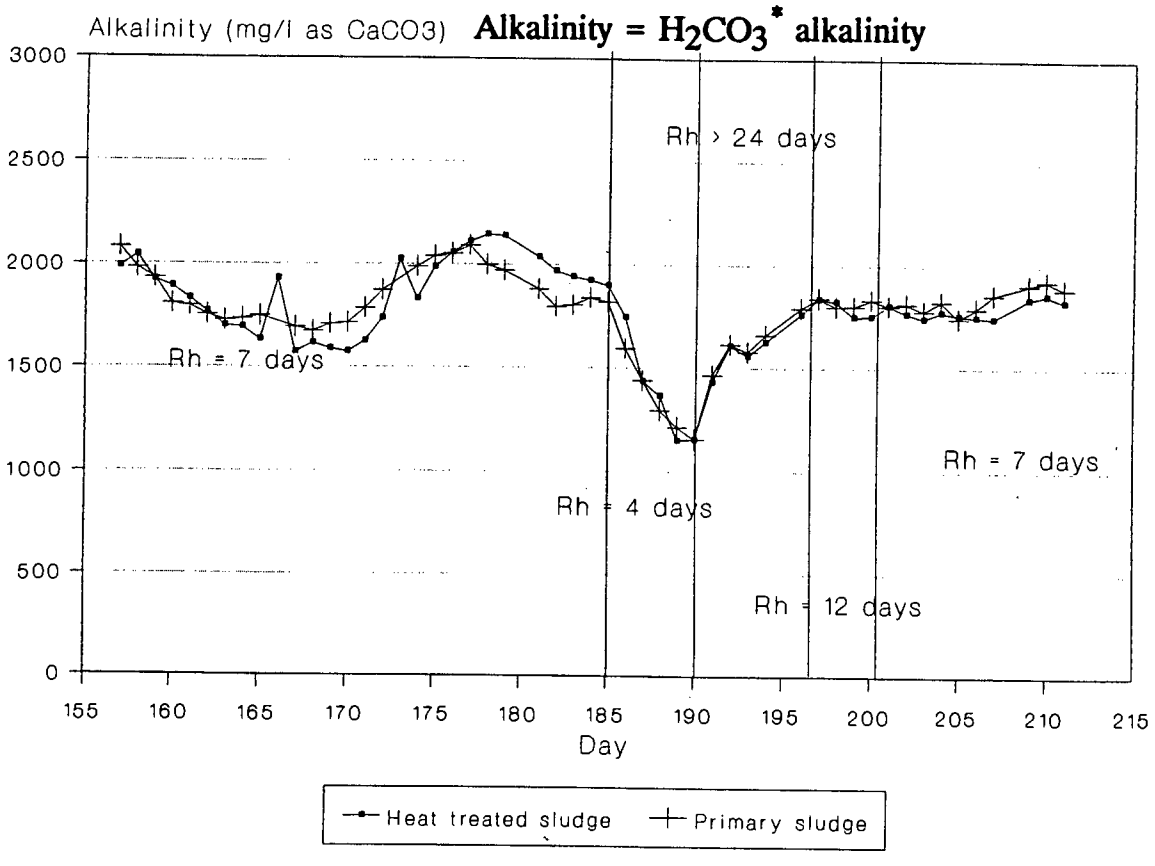


*Figure 3.13*: *Graph showing the paths to failure of digesters D1 (fed heat treated sludge) and D3 (fed primary sludge) with $H_2CO_3^*$ alkalinity as the stability indicator.*

reduced from 7 to 4 days, to above 450 mg/l on day 190. During the same period the SCFA concentration in the liquor in digester D3 (fed primary sludge) rose from about 50 mg/l (as HAc) to about 400 mg/l. As described in section 2.3, these rapid increases in SCFA concentration showed that the digester was undergoing failure. During the last 10 days of operation when the digesters were at 7 days retention time, the SCFA concentrations in both digesters recovered to about the same levels as those during the earlier 7 day retention time period before the failure at 4 days retention time.

Fig. 3.15 shows how the SCFA:alk ratio displays almost exactly the same failure pattern as that of Fig. 3.14 (SCFA conc.) described above. The comments made above, therefore, also hold true for the SCFA:alk ratio ie. that the digesters showed failure, as indicated by the SCFA:alk ratio, at 4 days retention time, and recovered to the same levels at 7 days retention time.

Fig. 3.16 shows the variation in gas production over the critical period (measured at 1 atmosphere pressure and 20$^{o}$C). It should be noted here that gas production per VS and COD removed values are not calculated or plotted for this failure period. These values have no meaning because the digesters were not at a steady state at 4 days retention time. It is for this reason that only gas production per day is reported here.

During the period when the digesters were first operated at a retention time of 7 days (days 157-184), the gas production for both digesters was averaging about 28 l/day (measured at a pressure of 1 atmosphere and a temperature of 20$^{o}$C). When the retention time was changed from 7 to 4 days the feed was increased from 2 l/day to 3 l/day. One would therefore have expected a gas production increase in proportion to the feed increase. Instead, there was a decrease in gas production in both digesters down to about 21 l/day by day 190. This indicated that the digester was undergoing failure. At this point the feed was reduced in both digesters to between 0 and 0.5 l/day. As a result the gas production continued to drop until after day 197 when the feed was increased to 1 l/day. The gas production increased steadily and on day 201 the feed was again increased in both digesters to 1.71 l/day, giving a retention time of 7 days. The gas production continued to rise for 5 days (day 201 to 205), after which it leveled off at about 25 l/day for the last 5 days (day 206 to 211) of operation of both digesters.

Between days 157 and 185 both digesters were operated at a retention time of 7 days, with the feeding rate at 2 l/day and the digester volume at 14l. When the digesters

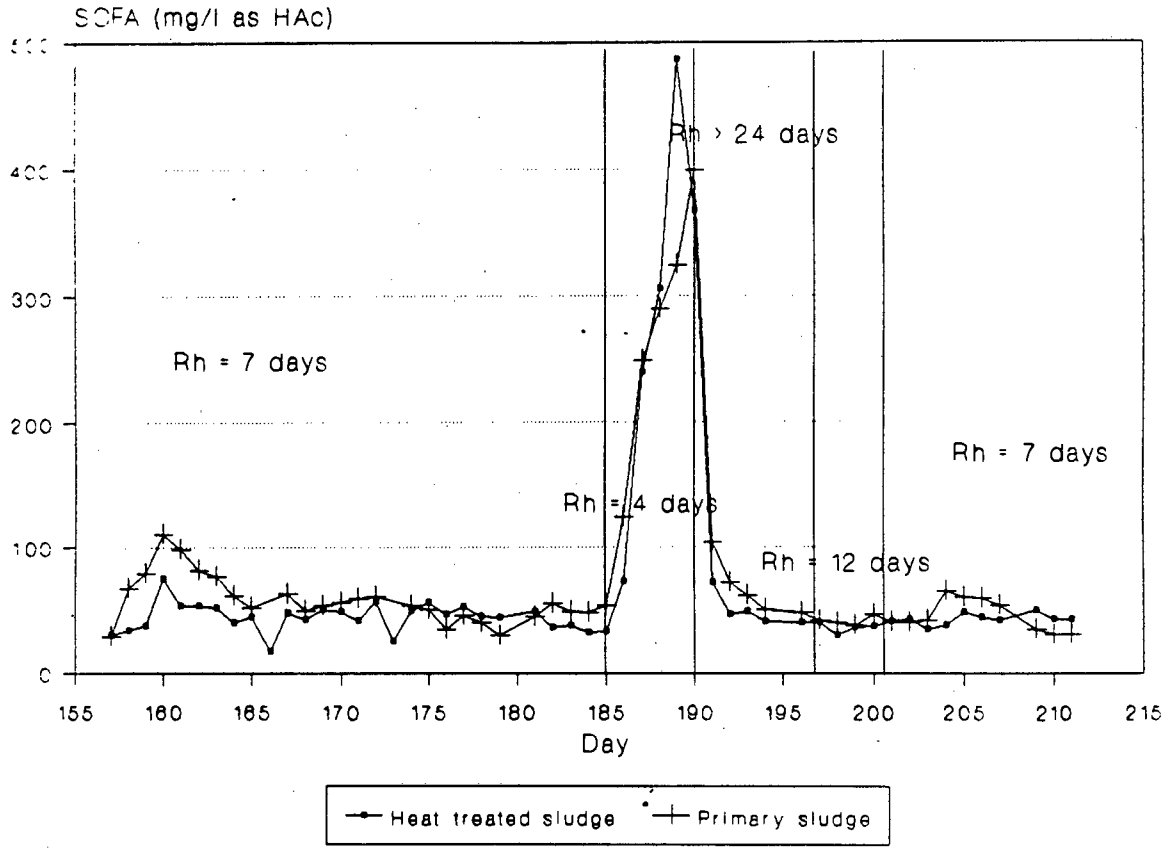


*Figure 3.14*: *Graph showing the paths to failure of digesters D1 (fed heat treated sludge) and D3 (fed primary sludge) with SCFA concentration as the stability indicator.*

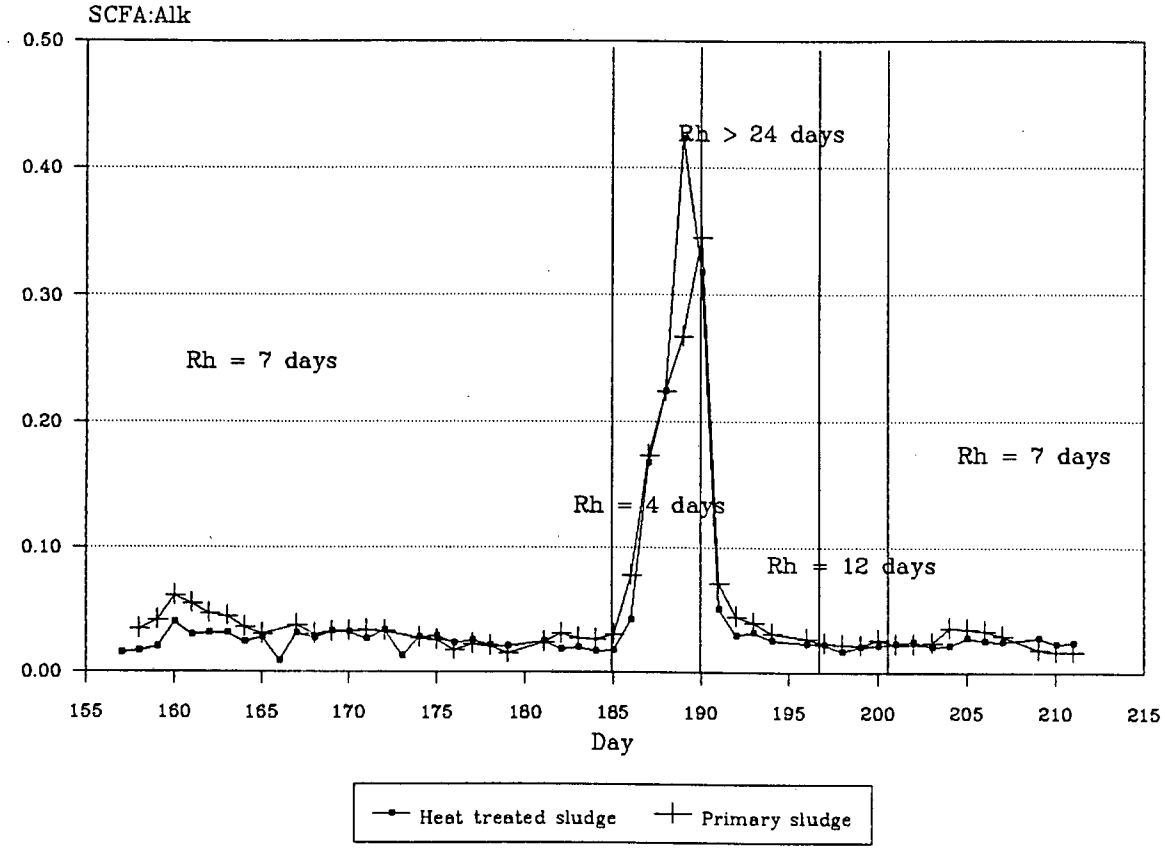


*Figure 3.15*: *Graph showing the paths to failure of digesters D1 (fed heat treated sludge) and D3 (fed primary sludge) with SCFA:alk ratio as the stability indicator.*

Alkalinity = $H_2CO_3^*$ alkalinity


*Figure 3.16*: *Graph showing the paths to failure of digesters D1 (fed heat treated sludge) and D3 (fed primary sludge) with gas production as the stability indicator.*

**All gas volumes measured at 1 atmosphere pressure and 20°C.**

were again operated at a retention time of 7 days, the feeding rate was 1.71 l/day and the digester volumes were 12l each (see section 2.5.1 for an explanation). One would expect the gas productions for each digester under these different operating conditions to be directly proportional to the feeding rates. A ratio of the two feeding rates gives: 2/1.71 = 1.17. Taking a ratio of the average gas production rates (which is about the same for both digesters) gives: 29/25 = 1.16. The values are almost the same which indicates that both the digesters made a full recovery.

To sum up the above information, it can be concluded that, as indicated by the parameters, (1) $H_2CO_3^*$ alkalinity, (2) SCFA concentration, (3) SCFA:alk ratio, and (4) gas production, the digesters D1 (fed heat treated sludge) and D3 (fed primary sludge) both failed at a retention time of 4 days. The digesters were then able to be operated at a retention time of 7 days again, after a recovery period of 11 days.

## 3.13 COMPARISON OF RESULTS FROM THIS INVESTIGATION WITH RESULTS FROM OTHER INVESTIGATIONS ON ANAEROBIC DIGESTION OF SEWAGE SLUDGE

Most reports on anaerobic digestion measure the performance of the digesters in terms of, (1) % VS removed, (2) % COD removed, (3) volume of gas produced per mass VS removed, and (4) volume of gas produced per mass COD removed. These parameters, where available, will form the basis of the comparison between the data collected during this investigation and the data from other investigations into anaerobic digestion.

Table 3.3 below shows a list given by Ross (1988) of typical normal operating parameters for well-functioning high-rate (completely mixed at 37$^{o}$C) anaerobic digesters. As a comparison the same parameter averages from this investigation are also given. From this data it can be clearly seen that the average performance of the digesters in this investigation is better than that of the digesters used to compile the list given by Ross (1988). This is to be expected because Ross (1988) obtained his data from full scale digesters which are not operated under well controlled conditions like those in this investigation.

Brade and Noone (1981) give % VS removal values of between 35% and 52% for digester retention time ranging from 12 to 19 days. These values are in the same range as those given in this thesis of between 43% and 53%. Brade and Noone (1981) also gives gas-produced-per-VS-removed values of between 0.77 and 0.93 $m^3$/kg VS

Table 3.3: Comparison between anaerobic performance data given by Ross (1988) and data obtained from this investigation.

| | | Research | |
|---|---|---|---|
| Parameter | Units | Ross, 1988 | This investigation* |
| % VS removed | % | 40 to 65 | 43 to 53 |
| Retention time | days | 15 to 25 | 7 to 20 |
| Biogas production | m^3/kg VSrem | 0.4 to 0,7 | 1.15 to 1.27 |
| % CO2 in gas | % | 25 to 33 | 36 |
| Digester temp. | deg C | 32 to 38 | 37 |
| pH of digester | | 6.8 to 7.2 | 7.08 to 7.19 |
| SCFA conc. | mg/l | < 400 | < 50 |
| SCFA:Alk ratio | | 0.1 to 0.25 | 0.013 to 0.023 |

* gas volumes measured at 1 atmosphere pressure and 20°C.

removed (temperature and pressure not given for these values). These are lower than the values given in this thesis of between 1.15 and 1.27 $m^3$/kg VS removed (measured at 1 atmosphere and 20$^oC$). However, Brade and Noone (1981) conducted his research on a full scale digester of 950 $m^3$ capacity. It is likely that the mixing conditions in the digester were not as efficient as the conditions that can be attained on a laboratory scale system.

Table 3.4 shows a comparison between data given by Haug, *et al*, (1978), Messenger (1991) and data given in this investigation. Haug, *et al*, (1978), in an effort to establish the effect of thermal pretreatment on anaerobic digestion, operated a number of 1.125l digesters at 15 days retention time and a temperature of 35$^oC$. In his investigation a number of different sludge types were treated. The sludges of interest to this investigation were primary sludge and an activated-primary sludge mixture in a ratio of 1:1. For each sludge type a control digester was operated in which the feed sludge had no pretreatment. Another digester was operated using the same sludge type which had been thermally pretreated at 180$^oC$ for 30 minutes. Messenger (1991) operated a full scale dual digestion plant. The digester in his investigation had a capacity of 1000 $m^3$ and was fed autoheated thermophilic aerobic sludge. It was operated and tested over a period of 30 weeks with an average retention time of 20 days.

The data given in Table 3.4 shows that there is very little difference between all the parameters. In fact, Haug, *et al*, (1978) concluded in his investigation that thermal pretreatment had no noticeable effect on the digestibility of primary sludge, and only a minor effect on the digestibility of the activated-primary sludge mixture. The data given by Messenger (1991) indicates a digester performance that is less efficient than the ones it is compared with. However, this may also be attributed to the fact that the digester was a full scale one, while the others were laboratory scale.

With regard to the minimum retention time for anaerobic digestion, Drnevich and Matsch (1978) found that, in a bench scale dual digestion system, the anaerobic digesters were able to be operated at a retention time of 3 days (pH = 7.0; Temp. = 35$^oC$). The % VS removal in the digester at this retention time was 16% which is a very low value. However, the overall system % VS removal was 28%. In the same investigation an anaerobic digester was operated at 7 days retention time giving a VS removal in the digester of 31%, and an overall VS removal of 41%. In this thesis investigation the average VS removal for the two different feed types at 7 days retention time was 42.6%.

Table 3.4: Comparison between anaerobic performance data given by Haug, *et al*, (1978), Messenger (1991) and data obtained from this investigation.

| | Research | Haug, 1978 | | | | Messenger, 1991 | This investigation★ | |
|---|---|---|---|---|---|---|---|---|
| | Feed Sludge Type | Primary Sludge | | Activated:Primary sludge 1:1 | | Primary Sludge | Primary Sludge | |
| Parameter | Pretreatment | None | Thermal (180 degC) | None | Thermal (180 degC) | Aerobic (65 degC) | None | Thermal (65 degC) |
| G a s e r | VS add (l/g) | 0.62 | 0.63 | 0.50 | 0.57 | 0.46 | 0.58 | 0.59 |
| | VS rem (l/g) | 1.03 | 1.00 | 1.09 | 1.05 | 0.92 | 1.17 | 1.27 |
| | CODadd (l/g) | 0.36 | 0.36 | 0.28 | 0.32 | 0.29 | 0.36 | 0.35 |
| | CODrem (l/g) | 0.59 | 0.59 | 0.52 | 0.55 | 0.66 | 0.71 | 0.66 |
| % VS removed | | 61.3 | 63.8 | 46.2 | 54.5 | 49.8 | 50.9 | 47.6 |
| %COD removed | | 61.8 | 61.6 | 53.4 | 57.4 | 44.9 | 52.3 | 52.7 |

★ gas volumes measured at 1 atmosphere pressure and 20$^{o}$C.

The information above shows that the overall VS removal performance of the two systems discussed here is very similar at 7 days retention time. Although more evidence is required, the above information also suggests that the thermophilic aerobic sludge is not more easily digested than the primary sludge. Therefore, it is possible that the aerobic stage of the dual digestion system does not improve the anaerobic digestibility of the sludge. This means that the claim (see Chapter 1) that in the aerobic stage the sludge is conditioned making it more readily digestible under anaerobic conditions, may not be justified.

However, the claim (see Chapter 1) that the stability of the anaerobic stage is considerably improved by the increases in $H_2CO_3^*$ alkalinity and pH in the aerobic stage, seems to be more relevant to the disscussion. (This claim was conclusively verified by Messenger, 1991). It is probable that this improved stability of the anaerobic stage may acccount for the fact that an anaerobic digester fed thermophilic aerobic sludge can be operated at a shorter retention time than a digester fed primary sludge.

de Villiers, *et al*, (1991) in their report on the dual digestion research carried out at Milnerton, indicates that problems were experienced when trying to operate the anaerobic digester at a retention time of 12 days. However, from the writers personal experience at the same plant, it was observed that mixing conditions in the digester were far from ideal. There was also an unusually rapid build up of grit in the digester over the period of research done by Messenger (1991) at the plant in Milnerton. This grit had to be taken out of the digester at the beginning of 1990. The quantities of grit involved are unknown, but it undoubtedly affected the retention time in the digester. Therefore, from a research point of view, the fact that the anaerobic digester was unable to be operated at a retention time of 12 days cannot be considered accurate information as it is likely that the actual retention time was shorter.

The outcome of Drnevich and Matsch's (1978) research indicates that one of the claims about dual digestion listed by de Villers, *et al*, (1991) regarding the retention time of the anaerobic digester (see Chapter 1) may be based on some unspecified criteria. The claim says that retention times in the anaerobic stage of a dual digestion system can be reduced from 25 to 30 days, as in normal digesters, down to 8 to 10 days. It is clear from this investigation that normal digesters have been operated at retention times as low as 7 days. It is also clear from the above discussion that digesters in a dual digestion system can be operated at retention times as low as 3 days. Therefore, it is possible that the specified claim takes into account a safety

factor so that the given retention times are relevant to full scale digestion under conditions that are not ideal.

From the above information it can be concluded that the digesters operated in this investigation yeilded results that conform closely with the results from other research. The data given in this thesis can, therefore, be accepted with confidence as being representative of the experiments carried out during the investigation.

# CHAPTER 4

## CONCLUSIONS

### 4.1 OBJECTIVES OF INVESTIGATION

In a time when the world is becoming more environmentally conscious, and is looking for simple, efficient, economical and environmentally friendly solutions to sewage treatment, the dual digestion system appears as an attractive alternative to other sludge treatment systems. The dual digestion system comprises an autoheated thermophilic (55-65$^{o}$C) aerobic first stage and a mesophilic (37$^{o}$C) anaerobic second stage. Past research into the dual digestion system has given rise, *inter alia*, to the following claims (de Villiers, *et al*, (1991):

a) sludge disinfection and stabilisation occur in one process - disinfection in the thermophilic aerobic first stage and stabilisation in the anaerobic second stage

b) the stability of the anaerobic stage is considerably improved by the increase in $H_2CO_3^*$ alkalinity and pH in the aerobic stage

c) in the aerobic stage the sludge is aerobically or thermally pretreated (conditioned) making it more readily digestible under anaerobic conditions, thereby allowing significantly reduced retention times from 25 to 30 days for normal digestion, to 8 to 10 days

Messenger (1991) verified claims (a) and (b), but was unable to verify claim (c) above. With regard to claim (c), no conclusion could be reached as to whether the conditioning of the sludge was caused simply by the heating of the sludge or by the biological action of the thermophilic bacteria in the sludge. The objectives of this investigation were, therefore, to:

(1) determine whether or not the exposure of the sludge to thermophilic temperatures caused the conditioning of the sludge

(2) determine how the performance of the anaerobic digester fed heat treated primary sludge compared with a digester fed untreated primary sludge

### 4.2 EXPERIMENTAL PROCEDURE

In order to fulfill the objectives above, four 14 litre anaerobic digesters were operated using two different feed types *viz.*: (1) primary sludge, and (2) heat treated primary

sludge. The heat treatment process took place in stainless steel reactors that were operated at a retention time of 1.5 days and a temperature of 65°C. These parameters were selected to simulate the heating conditions in the aerobic reactor that was operated as part of the dual digestion system at the Potsdam Wastewater Treatment Plant in Milnerton, Cape Town. The digesters were all operated at a temperature of 37°C while the retention times were progressively reduced until they failed. The purpose of this was to establish the minimum retention for the anaerobic digestion of the two feed types mentioned above and, therefore, to determine if there was any difference in digestibility between the two sludge types. From these results it would be possible to determine if the heat treatment process had any conditioning effects on the primary sludge that enhanced anaerobic digestion.

## 4.3 CONCLUSIONS

The results obtained from the experiments described above gave rise to the following conclusions:

(1) **As indicated by measurements and calculations of the following parameters:**

- a) **percent VS removed**
- b) **percent COD removed**
- c) **gas produced per VS and COD removed**
- d) **digester gas composition (% $CO_2$ and $CH_4$)**
- e) **pH**
- f) **$H_2CO_3^*$ alkalinity**
- g) **SCFA concentration**
- h) **SCFA:alk ratios**

**the digestibilities of the primary sludge and the heat treated sludge showed no significant difference.**

(2) **There was no noticeable conditioning of the primary sludge by the heat treatment process insofar as digestibility is concerned.**

(3) **The digesters fed primary and heat treated sludge were both operated under stable conditions at a retention times of 20, 15, 12, 10 and 7 days, but failed at a retention time of 4 days.**

## 4.4 DISCUSSION

Past research on a bench scale (Drnevich and Matsch, 1978) has shown that the anaerobic stage of a dual digestion system can be operated at a retention time as low as 3 days. This investigation has shown that a normal digester fed primary sludge can be operated a retention time as low as 7 days. Therefore, it is possible that claim (c) above, regarding digester retention times, takes into account a safety factor so that the given retention times are relevant to full scale digestion under conditions that are not ideal.

From this thesis investigation it is clear that thermophilic heat treatment of primary sludge does not improve the digestibility of the sludge under anaerobic conditions. In other words, the heating process does not condition the sludge. This result indicates that in a dual digestion system, the heat generated in the aerobic stage is not responsible for the conditioning effect that the aerobic stage has on the sludge. It is most probable that the bacteriological action on the sludge is responsible for any conditioning. However, the effects of the aerobic conditioning on the anaerobic digestion process are still uncertain and more research on this system is required to conclusively verify some of the claims about it.

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# APPENDIX A

## EXPERIMENTAL APPARATUS MAKING UP THE DIGESTION SYSTEM

### A.1 Introduction

A description of the apparatus used in this thesis is given in this appendix. Items covered are:

1) the typical design of the reactor used for thermophilic heat treatment of the primary sludge
2) the typical design of an anaerobic digester

### A.2 Typical reactor design

A schematic drawing of one of the two thermophilic heat treatment reactors used in this thesis is given in Figure A.1. Each 2.25 litre container was made of low grade stainless steel to prevent corrosion and subsequent contamination of the sludge processed in it. Also, the reactor had to be able to withstand the relatively high operating temperature ($65^{o}C$). To attain this temperature the reactors were placed in a water bath with a temperature regulator. On top of the reactor was a perspex lid on which was mounted a stirrer motor. Attached to the motor was a stainless steel shaft which extended through the lid to the bottom of the reactor. Attached to the shaft was a perspex paddle with 4 blades. Standing vertically against the inside wall of the reactor were 2 baffles, secured with screws $180^{o}$ apart. The baffles were used to create turbulence and thus ensure thorough mixing.

### A.3 Typical digester design

A schematic drawing of one of the four anaerobic digesters used in this thesis is given in Figure A.2. Each 14 litre container was made of a perspex tube with a diameter of 200mm. A flat perspex disc formed the base of the digester. An outlet port was formed by drilling a 10mm diameter hole in the base of the digester, and gluing into it a 50mm length of perspex tube.

# HEAT TREATMENT REACTOR

Volume = 2.25 l

operating temperature = 65°C

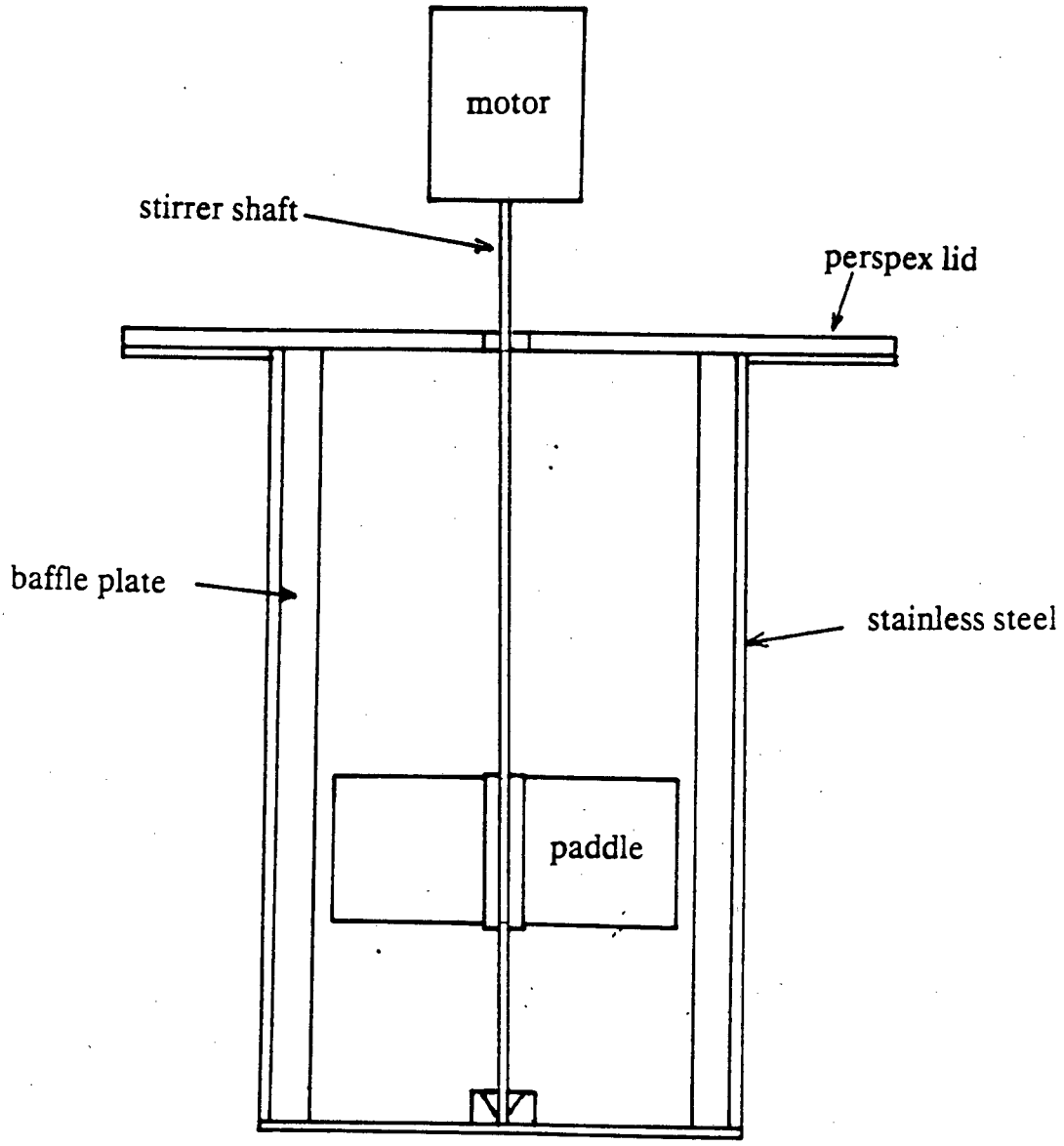


*Figure A.1*: *Diagram of the 2.25 litre stainless steel heat treatment reactor that was operated at a retention time of 1.5 days to heat treat primary sludge.*

Volume = 14 l

operating temperature = 37°C

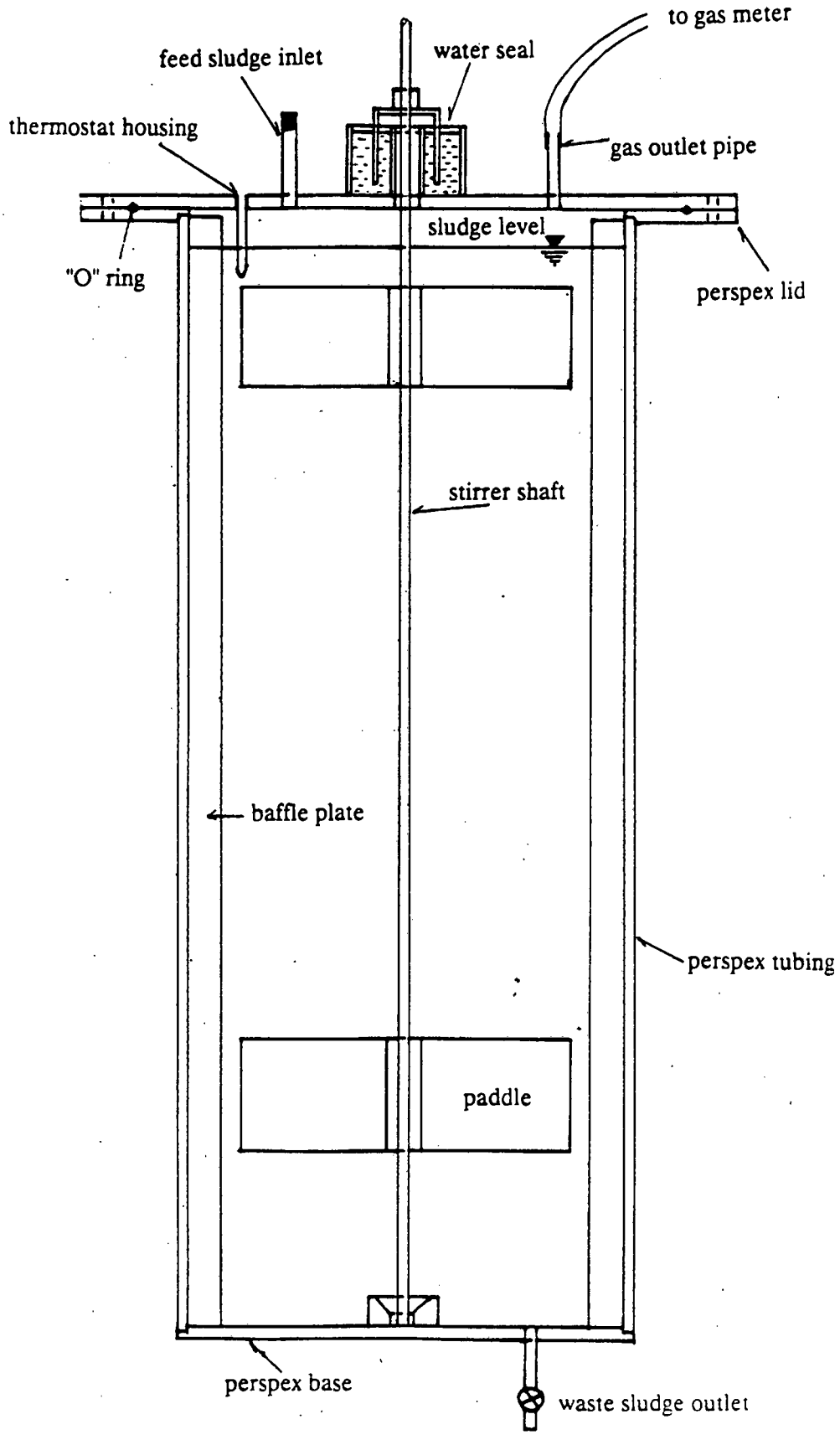


*Figure A.2*: *Diagram of the 14 litre perspex anaerobic digester that was operated during this investigation.*

The lid of the digester was also made of perspex and was fixed to the top of the digester by means of 6 wing nuts. To ensure that the digester was sealed at the union between the tube and the lid, an 'O' ring was inserted between the two. Into the lid were fixed an inlet port and a gas port in the same manner used for the outlet port. Another hole was drilled in the lid and was used as an entry for the thermostat and its flex. Once the thermostat was fixed in place the hole was plugged with silicone sealant.

Mounted on the lid of the digester was a stirrer motor. Attached to the motor was a stainless steel shaft which extended through the lid to the bottom of the digester. Attached to the shaft were 2 perspex paddles with 4 blades each. Standing vertically against the inside wall of the digester were 2 baffle plates, secured with glue $180^{o}$ apart. The baffles were used to create turbulence and thus ensure thorough mixing. The hole through which the stirrer shaft passed was sealed with a water seal. A sketch of the water seal is given in Figure A.3.

# WATER SEAL

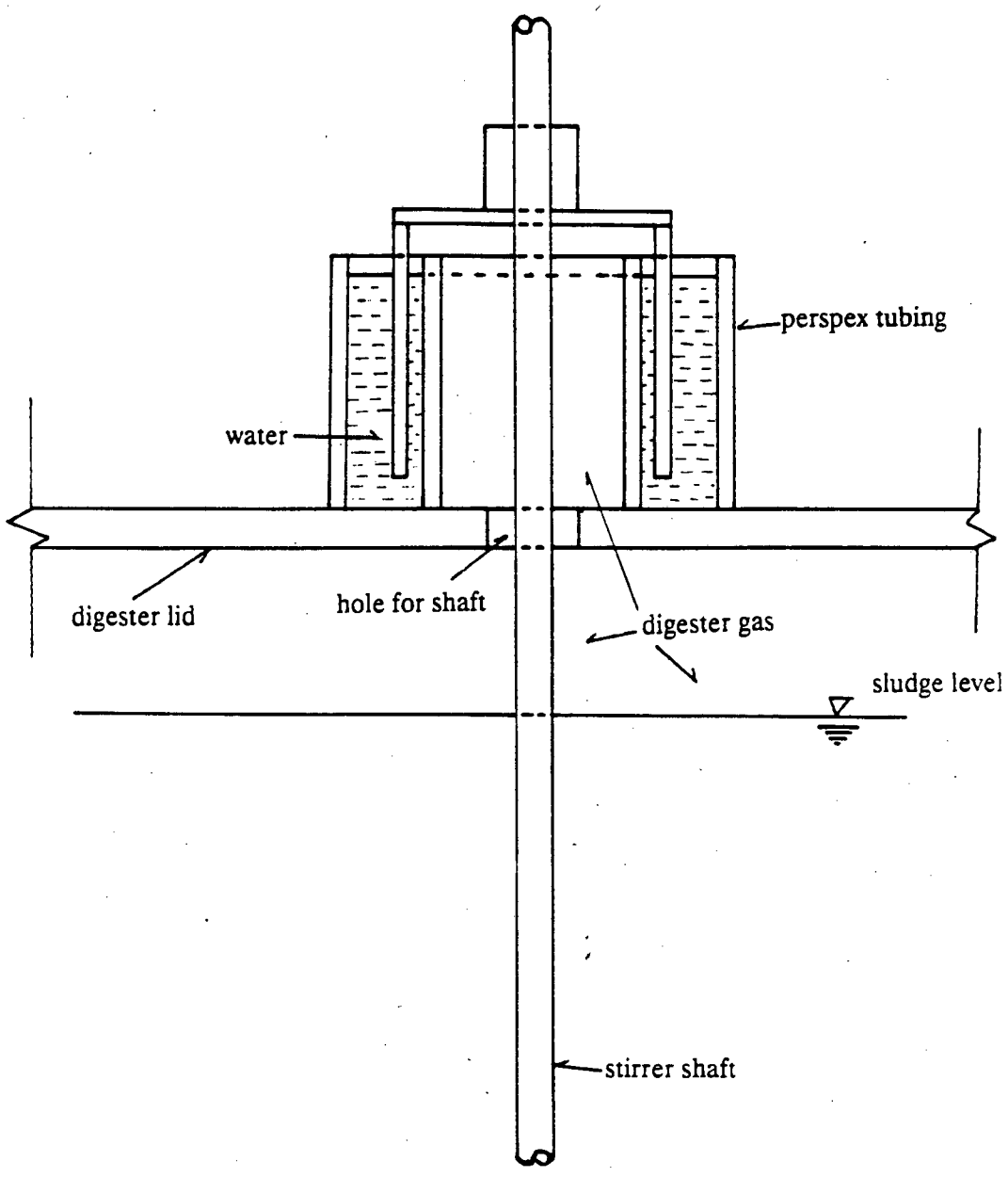


*Figure A.3*: *Detailed diagram of the water seal that was mounted on the lid of the digester to prevent any gas leakage.*

# APPENDIX B

## PROCEDURES FOR THE OPERATION, SAMPLING AND TESTING OF THE DIGESTION SYSTEMS

### B.1 Introduction

This appendix describes the methods employed for the operation, sampling and testing of the digestion system used in this thesis. The procedures covered are:

1) sludge collection, preparation and storage
2) sampling and feeding of the system
3) general system operation and maintenance
4) testing performed on the primary, heat treated and anaerobic sludges

### B.1 Sludge collection, preparation and storage

Since the initial research into dual digestion took place at the Potsdam Wastewater Treatment Plant in Milnerton, all the primary sludge used in this thesis was collected there. The primary sludge at the Potsdam Wastewater Treatment Plant is derived from two sources, 1) primary sedimentation and, 2) secondary sedimentation. The sludge from secondary sedimentation is produced in the trickling filters which precede the secondary settling tanks. Both the primary and secondary sludges are pumped into the primary storage tank and consequently into a fibreglass thickening tank. It was from the thickening tank that all the sludge used in this thesis was collected.

The primary sludge was transported to the laboratory in 30 litre plastic containers and stored in the cold room at a temperature of $4^{o}C$. The amount of sludge collected on each trip was calculated to last 10 - 14 days. Before a container of sludge was used it was first sieved by hand through a 3mm wire mesh. This was to avoid blockages and clogging up of the system.

### B.3 Sampling and feeding of the system

Every day within 1 hour of the same time sludge from the anaerobic digesters was wasted. The quantity of sludge wasted from each digester depended on the retention time of the digester and was calculated as follows:

$$\text{Waste sludge (l)} = \frac{\text{Volume of digester (l)}}{\text{Retention time (days)}}$$

A 200ml sample from the wasted sludge was retained for testing and the rest of the sludge was thrown away.

Sludge from the heat treatment reactors, which were operated continuously at a retention time of 1.5 days, was wasted immediately after wasting sludge from the digesters. The volume of sludge processed in the reactors was calculated so that the quantity of sludge wasted would equal the quantity of sludge required for feeding the digesters and for sampling. The volume of sludge processed per day was calculated as follows:

Vol. sludge processed (l) = (Vol. required for feeding + 200ml for sample) * (1.5 day retention time)

Seeing that 2 reactors were used the sludge from both reactors was mixed in a plastic container before wasting . A 200ml sample was taken from this for testing. The quantity of sludge required for feeding the digesters was measured out, and to the sludge remaining in the plastic container was added the primary feed sludge. This mixture of heat treated sludge and primary sludge was shared between the reactors.

The heat treated sludge that was measured out from the reactors was used to feed the digesters that required heat treated sludge. The sludge was poured into the digesters via a funnel connected to the inlet port. After this the primary sludge was measured out and fed to the digesters that required the primary sludge. A 200ml sample was taken from the primary sludge for testing.

### B.3 General operation and maintenance

Before wasting from the digesters the gas outlet pipes had to be disconnected from the gas meters otherwise the suction caused by draining the sludge would suck the water from the water seals into the digester. One of the gas meters was filled with acidic water and the suction from wasting sludge could have caused this liquid to be sucked into the digester. The result would have been an immediate drop in pH and $H_2CO_3^*$ alkalinity.

Two of the stirrer motors operated at quite a high temperature. This heat was conducted down the stirrer shaft and heated the water in the water seals causing them to evaporate at a relatively high rate. The water seals therefore had to be topped up daily so that no gas escaped from the digesters and affected the gas meter readings. The water in the water bath also evaporated quickly and had to be topped up at least every 2 days to prevent it from drying up.

## B.5 Tests performed on the primary, heat treated and anaerobic sludges

The digester influent and effluent sludges were tested daily. This included testing (1) the primary sludge that was used to feed the digesters and the reactors, (2) the heat treated sludge that was used to feed the digesters, and (3) the sludge wasted from the digesters. The following tests were conducted on the reactor and digester influent and effluent sludges:

1) TKN
2) Free and saline ammonia
3) COD
4) Total solids
5) Volatile solids
6) $H_2CO_3^*$ alkalinity
7) Short chain fatty acids

On the anaerobic digesters the gas production and the carbon dioxide content of the gases were measured.

Due to the fact that there were only two gas meters available it was impossible to obtain gas production readings for every digester every day. When there were 4 digesters operating gas production readings were taken once every 2 days. When there were 3 digesters operating gas production readings were taken twice every 3 days. In the last stages of experimentation there were only two digesters operating and gas production readings were taken every day.

The methods for analysis of COD, TKN, free and saline ammonia, total solids (TS) and volatile solids (VS) were obtained from 'Standard Methods for the Examination of Water and Wastewater', 16th edition (1985).

It should be noted that the solids tests performed in this investigation yeilded 'total solids (TS)' and 'volatile solids (VS)' as opposed to the more usual 'total suspended solids (TSS)' and 'volatile suspended solids (VSS)'. The reason for this was that when centrifuging a heat treated sample, the separated supernatant was very turbid and still contained a large portion of the suspended solids. Therefore, for universal comparison, all the samples were tested in the same manner which meant excluding the centrifuging step of the procedure. This same phenomenon was also experienced with the aerobic thermophilic sludge during the research on dual digestion at the Potsdam Wastewater Treatment Plant (Messenger, 1991). During this research all the sludge samples were also tested for TS and VS.

The test for $H_2CO_3^*$ alkalinity and SCFA employed in this investigation is described in detail by Moosbrugger (1991). The test involves the titration of a sample of digester supernatant to 5 pH point with diluted hydrochloric acid. A computer program developed especially for the test calculates the $H_2CO_3^*$ alkalinity and SCFA concentration of the supernatant.

The test for $\%CO_2$ in the digester gas was performed with an apparatus that was developed in the laboratory by Moosebrugger. A photograph and a diagram of this apparatus are given in Figs. B1 and B2. The apparatus operates on the simple principle that concentrated sodium hydroxide absorbs $CO_2$. Gas saturated with water vapour is sucked into the gas chamber (see Fig. B1) by means of a syringe-type screw. This gas is then pushed through the sodium hydroxide chamber with the screw syringe. The $CO_2$ in the gas is absorbed by the NaOH thus reducing the volume of gas in the apparatus. This gas volume reduction induces a pressure reduction creating a suction in the apparatus. This suction is relieved as a volume of water from the reservoir is 'sucked up' the measuring column. The measurement of the height to which the volume of water rises is multiplied by a factor to give the $\%CO_2$. This factor is obtained by calibrating the apparatus from time to time with a dry gas of known $CO_2$ and $CH_4$ percentages. The % methane in the gas was calculated as the balance of the $\%CO_2$ measurement ie. $\%CH_4 = 100 - \%CO_2$. This calculation introduces a minor error since wet gas at 1 atmosphere pressure and $20^oC$ occupies 2.4% of the gas volume. However, this error was considered to be negligible for the purpose of the investigation.

The gas samples that were tested with the $\%CO_2$ apparatus were collected in a water sealed container (see Figs. B2 and B3). This gas sample container was designed so that the pressure build up in the digester while the gas sample was being collected did

not break the water seal on the digester. To do this the sampler was designed so that the head of water in it was less than the head of water in the water seal on the digester. The water in the sampler was acidic so that it would not absorb any of the $CO_2$ in the gas.

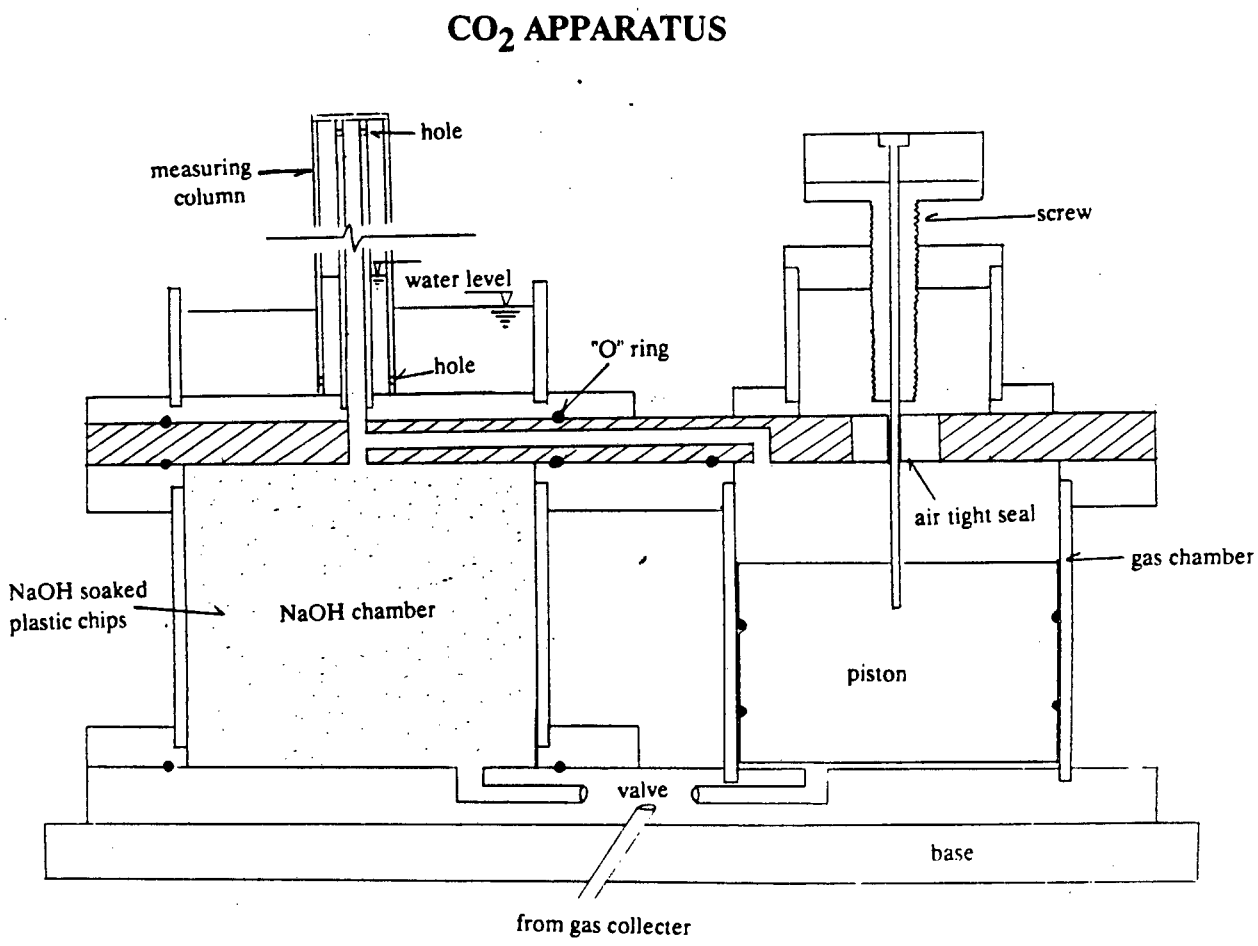


*Figure B.1*: *Diagram of the $CO_2$ apparatus that was used to measure the % $CO_2$ in the digester gas. The % $CH_4$ was taken as the balance of the volume of gas.*

*Figure B.2: Photograph of the $CO_2$ apparatus and the gas collecter.*

## GAS COLLECTER

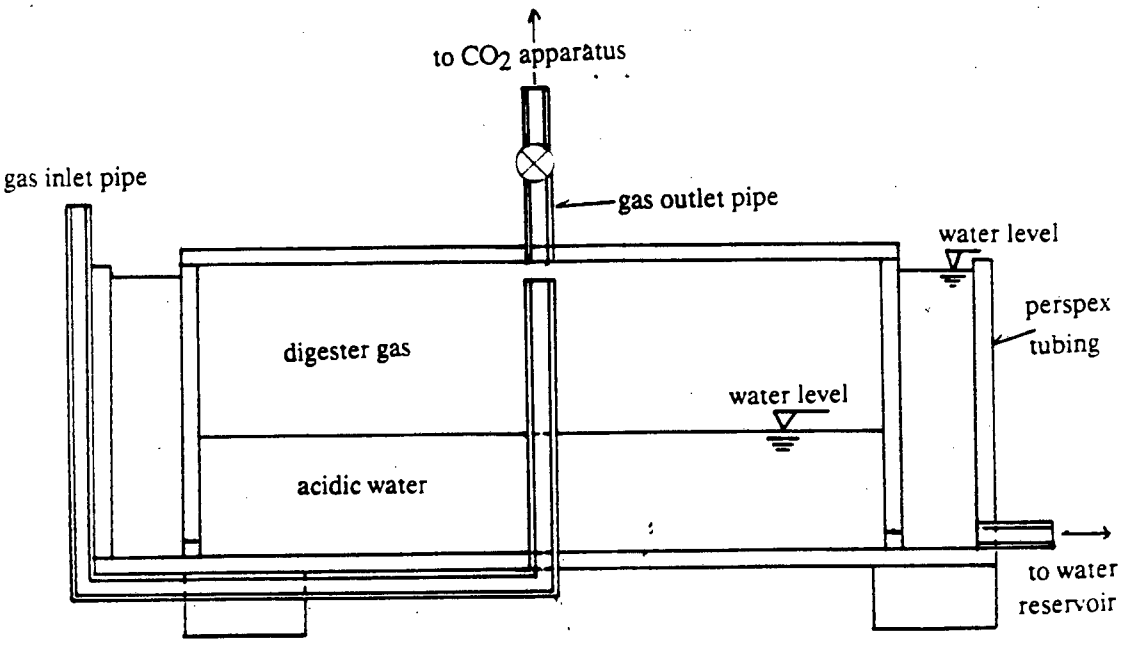


*Figure B.3*: *Diagram of the gas collecter in which the digester gas was collected prior to it being tested with the $CO_2$ apparatus.*

# APPENDIX C

## TABLES AND GRAPHS OF THE DAY-TO-DAY MEASURED AND CALCULATED PARAMETERS FOR DIGESTERS D1, D2, D3 AND D4

This appendix gives tables and graphs of the day-to-day measured and calculated parameters for the digesters D1 to D4. It was from this data that the average values, as shown in Tables 3.1 and 3.2 in Chapter 3, were calculated.

Table C1 gives all the day-to-day data for digester D1. This table is followed by Figs. C1 to C12 which show graphically the daily variations of the most important data.

Table C2 gives all the day-to-day data for digester D2. This table is followed by Figs. C13 to C24 which show graphically the daily variations of the most important data.

Table C3 gives all the day-to-day data for digester D3. This table is followed by Figs. C25 to C36 which show graphically the daily variations of the most important data.

Table C4 gives all the day-to-day data for digester D4. This table is followed by Figs. C37 to C48 which show graphically the daily variations of the most important data.

The only parameter calculation that warrants explanation is the one used to calculate the % removal data for VS and COD. For this calculation it was assumed that a dynamic steady state existed in the digesters, in which case the following equation applied:

$$\% \text{ Removed} = \frac{\text{concentration in effluent}}{\text{concentration in influent}} \times 100$$

Table C1: List of parameters measured daily and parameters calculated from these measured parameters for digester D1

| Day No. | Volume Feed | Total Solids | | Volatile Solids | | | | |
|---|---|---|---|---|---|---|---|---|
| | | influent | effluent | influent | added | effluent | removed | removed |
| | (l/day) | (g/l) | (g/l) | (g/l) | (g/day) | (g/l) | (g/l) | (%) |
| 1 | 0.7 | | 15.736 | | | 11.672 | | |
| 2 | 0.7 | 26.566 | 15.388 | 21.196 | 14.837 | 11.190 | 7.004 | 47.2 |
| 3 | 0.7 | 28.722 | 14.716 | 23.272 | 16.290 | 10.806 | 8.726 | 53.6 |
| 4 | 0.7 | 28.716 | 14.890 | 23.356 | 16.349 | 10.972 | 8.669 | 53.0 |
| 5 | 0.7 | 27.488 | 15.602 | 22.182 | 15.527 | 11.584 | 7.419 | 47.8 |
| 6 | 0.7 | 31.062 | 15.448 | 25.354 | 17.748 | 11.390 | 9.775 | 55.1 |
| 7 | 0.7 | 32.230 | 15.712 | 26.354 | 18.448 | 11.398 | 10.469 | 56.8 |
| 8 | 0.7 | 24.384 | 15.488 | 19.612 | 13.728 | 11.126 | 5.940 | 43.3 |
| 9 | 0.7 | 26.412 | | 21.320 | 14.924 | | | |
| 10 | 0.7 | | | | | | | |
| 11 | 0.7 | | 15.820 | | | 11.354 | | |
| 12 | 0.7 | 25.886 | 15.266 | 20.982 | 14.687 | 10.934 | 7.034 | 47.9 |
| 13 | 0.7 | 28.860 | 15.330 | 23.482 | 16.437 | 11.004 | 8.735 | 53.1 |
| 14 | 0.7 | 29.412 | 15.292 | 24.084 | 16.859 | 10.866 | 9.253 | 54.9 |
| 15 | 0.7 | 32.436 | 15.730 | 26.526 | 18.568 | 11.252 | 10.692 | 57.6 |
| 16 | 0.7 | 30.198 | 15.530 | 24.642 | 17.249 | 11.154 | 9.442 | 54.7 |
| 17 | 0.7 | 27.330 | 15.932 | 22.278 | 15.595 | 11.320 | 7.671 | 49.2 |
| 18 | 0.7 | 26.252 | 15.962 | 21.346 | 14.942 | 11.246 | 7.070 | 47.3 |
| 19 | 0.7 | 26.068 | 15.890 | 21.206 | 14.844 | 11.196 | 7.007 | 47.2 |
| 20 | 0.7 | 26.166 | 15.558 | 21.162 | 14.813 | 10.930 | 7.162 | 48.4 |
| 21 | 0.7 | 25.940 | 15.842 | 21.040 | 14.728 | 11.170 | 6.909 | 46.9 |
| 22 | 0.7 | 27.154 | 15.736 | 22.246 | 15.572 | 11.106 | 7.798 | 50.1 |
| 23 | 0.7 | 27.292 | 15.874 | 22.214 | 15.550 | 11.188 | 7.718 | 49.6 |
| 24 | 0.7 | 29.422 | 15.900 | 23.656 | 16.559 | 11.206 | 8.715 | 52.6 |
| 25 | 0.7 | 30.900 | 15.828 | 25.510 | 17.857 | 11.056 | 10.118 | 56.7 |
| 26 | 0.7 | 31.012 | 15.954 | 25.118 | 17.583 | 11.330 | 9.652 | 54.9 |
| 27 | 0.7 | 31.736 | 15.808 | 26.188 | 18.332 | 11.262 | 10.448 | 57.0 |
| 28 | 0.7 | 30.046 | 16.242 | 24.896 | 17.427 | 11.736 | 9.212 | 52.9 |
| 29 | 0.7 | 31.520 | 16.432 | 26.098 | 18.269 | 11.682 | 10.091 | 55.2 |
| 30 | 0.7 | 30.636 | 17.048 | 25.210 | 17.647 | 12.364 | 8.992 | 51.0 |
| 31 | 0.7 | 30.708 | 17.046 | 25.236 | 17.665 | 12.318 | 9.043 | 51.2 |
| 32 | 0.7 | 31.312 | 17.942 | 25.706 | 17.994 | 12.966 | 8.918 | 49.6 |
| 33 | 0.7 | 32.012 | 16.884 | 26.448 | 18.514 | 11.896 | 10.186 | 55.0 |
| 34 | 0.7 | 32.942 | 16.972 | 26.886 | 18.820 | 12.160 | 10.308 | 54.8 |
| 35 | 0.7 | 33.232 | 16.596 | 27.274 | 19.092 | 12.014 | 10.682 | 56.0 |
| 36 | 0.7 | 30.276 | 16.410 | 24.156 | 16.909 | 11.840 | 8.621 | 51.0 |
| 37 | 0.7 | 29.880 | 17.010 | 24.248 | 16.974 | 12.320 | 8.350 | 49.2 |
| 38 | 0.7 | 29.856 | 17.268 | 24.500 | 17.150 | 12.510 | 8.393 | 48.9 |
| 39 | 0.7 | 30.154 | 17.532 | 24.610 | 17.227 | 12.642 | 8.378 | 48.6 |
| 40 | 0.7 | 29.236 | 17.768 | 24.220 | 16.954 | 12.758 | 8.023 | 47.3 |

Table C1: List of parameters measured daily and parameters calculated from (cont) these measured parameters for digester D1

| Day No. | Volume Feed | Total Solids | | Volatile Solids | | | | |
|---|---|---|---|---|---|---|---|---|
| | | influent | effluent | influent | added | effluent | removed | removed |
| | (l/day) | (g/l) | (g/l) | (g/l) | (g/day) | (g/l) | (g/l) | (%) |
| 41 | 0.7 | 31.360 | 18.008 | 25.972 | 18.180 | 12.906 | 9.146 | 50.3 |
| 42 | 0.7 | 29.732 | 17.758 | 24.164 | 16.915 | 12.842 | 7.925 | 46.9 |
| 43 | 0.7 | 29.554 | 17.828 | 24.456 | 17.119 | 12.814 | 8.149 | 47.6 |
| 44 | 0.7 | 28.758 | 17.536 | 23.582 | 16.507 | 12.810 | 7.540 | 45.7 |
| 45 | 0.7 | 29.516 | 17.384 | 24.458 | 17.121 | 12.402 | 8.439 | 49.3 |
| 46 | 0.7 | 29.448 | 18.354 | 24.438 | 17.107 | 13.248 | 7.833 | 45.8 |
| 47 | 0.7 | 30.600 | 16.928 | 25.442 | 17.809 | 12.332 | 9.177 | 51.5 |
| 48 | 0.7 | 23.712 | 17.270 | 19.190 | 13.433 | 12.480 | 4.697 | 35.0 |
| 49 | 0.7 | 32.646 | 17.268 | 27.254 | 19.078 | 12.464 | 10.353 | 54.3 |
| 50 | 0.7 | 37.052 | 17.406 | 30.870 | 21.609 | 12.696 | 12.722 | 58.9 |
| 51 | 0.7 | 32.672 | 17.100 | 27.206 | 19.044 | 12.298 | 10.436 | 54.8 |
| 52 | 0.7 | 32.628 | 17.490 | 26.932 | 18.852 | 12.618 | 10.020 | 53.1 |
| 53 | 0.7 | 33.158 | 17.954 | 27.484 | 19.239 | 13.124 | 10.052 | 52.2 |
| 54 | 0.7 | 30.380 | 17.750 | 25.154 | 17.608 | 12.806 | 8.644 | 49.1 |
| 55 | 0.7 | 29.498 | 15.964 | 24.352 | 17.046 | 11.126 | 9.258 | 54.3 |
| 56 | 0.7 | 29.590 | 17.550 | 24.552 | 17.186 | 12.790 | 8.233 | 47.9 |
| 57 | 0.7 | 30.394 | 17.444 | 23.026 | 16.118 | 12.754 | 7.190 | 44.6 |
| 58 | 0.7 | 29.862 | 17.040 | 24.940 | 17.458 | 12.428 | 8.758 | 50.2 |
| 59 | 0.7 | 30.268 | 16.968 | 25.346 | 17.742 | 12.368 | 9.085 | 51.2 |
| 60 | 0.7 | 30.336 | 17.092 | 25.354 | 17.748 | 12.442 | 9.038 | 50.9 |
| 61 | 0.7 | 30.628 | 17.092 | 25.476 | 17.833 | 12.140 | 9.335 | 52.3 |
| 62 | 0.7 | 32.370 | 16.184 | 26.426 | 18.498 | 11.384 | 10.529 | 56.9 |
| | | | | | | | | |
| 113 | 1.16 | | 18.532 | | | 13.568 | | |
| 114 | 1.16 | 22.726 | 15.606 | 18.852 | 21.868 | 11.554 | 8.466 | 38.7 |
| 115 | 0 | | | | | | | |
| 116 | 0.6 | | | | | | | |
| 117 | 0.6 | | 15.584 | | | 11.268 | | |
| 118 | 0.6 | 23.286 | 14.000 | 19.184 | 11.510 | 9.492 | 5.815 | 50.5 |
| 119 | 0.6 | 22.466 | 16.406 | 18.530 | 11.118 | 11.784 | 4.048 | 36.4 |
| 120 | 0.6 | 22.512 | 16.114 | 18.666 | 11.200 | 11.856 | 4.086 | 36.5 |
| 121 | 1.16 | 22.512 | 15.650 | 18.666 | 21.653 | 11.428 | 8.396 | 38.8 |
| 122 | 1.16 | 23.024 | 16.224 | 19.094 | 22.149 | 11.918 | 8.324 | 37.6 |
| 123 | 1.16 | 22.950 | 15.266 | 18.802 | 21.810 | 11.076 | 8.962 | 41.1 |
| 124 | 1.16 | 24.020 | 14.852 | 19.690 | 22.840 | 10.818 | 10.292 | 45.1 |
| 125 | 1.16 | 21.931 | 14.760 | 17.721 | 20.556 | 10.576 | 8.288 | 40.3 |
| 126 | 1.16 | 28.640 | 14.574 | 22.638 | 26.260 | 10.612 | 13.950 | 53.1 |
| 127 | 1.16 | 27.696 | 14.094 | 22.330 | 25.903 | 10.130 | 14.152 | 54.6 |
| 128 | 1.16 | 27.978 | 14.532 | 21.326 | 24.738 | 10.648 | 12.386 | 50.1 |
| 129 | 1.16 | 28.448 | 14.976 | 22.738 | 26.376 | 11.098 | 13.502 | 51.2 |
| 130 | 1.16 | 28.756 | 15.454 | 23.108 | 26.805 | 11.460 | 13.512 | 50.4 |

Table C1: List of parameters measured daily and parameters calculated from (cont) these measured parameters for digester D1

| Day No. | Volume Feed | Total Solids | | Volatile Solids | | | | |
|---|---|---|---|---|---|---|---|---|
| | | influent | effluent | influent | added | effluent | removed | removed |
| | (l/day) | (g/l) | (g/l) | (g/l) | (g/day) | (g/l) | (g/l) | (%) |
| 131 | 1.16 | 28.518 | 15.908 | 23.328 | 27.060 | 11.626 | 13.574 | 50.2 |
| 132 | 1.16 | 29.030 | 16.394 | 23.850 | 27.666 | 12.222 | 13.488 | 48.8 |
| 133 | 1.16 | 30.392 | 16.904 | 24.084 | 27.937 | 12.358 | 13.602 | 48.7 |
| 134 | 1.16 | 28.472 | 17.622 | 23.484 | 27.241 | 13.074 | 12.076 | 44.3 |
| 135 | 1.16 | 28.238 | 17.630 | 23.204 | 26.917 | 12.958 | 11.885 | 44.2 |
| 136 | 1.16 | 28.870 | 17.796 | 23.870 | 27.689 | 13.046 | 12.556 | 45.3 |
| 137 | 1.16 | 28.140 | 17.686 | 23.092 | 26.787 | 13.084 | 11.609 | 43.3 |
| 138 | 1.16 | 28.496 | 17.950 | 23.490 | 27.248 | 13.362 | 11.748 | 43.1 |
| 139 | 1.16 | 28.934 | 17.872 | 23.742 | 27.541 | 13.072 | 12.377 | 44.9 |
| 140 | 1.16 | 29.998 | 17.874 | 24.422 | 28.330 | 13.186 | 13.034 | 46.0 |
| 141 | 1.16 | 29.040 | 17.292 | 23.946 | 27.777 | 12.612 | 13.147 | 47.3 |
| 142 | 1.16 | 29.534 | 17.800 | 24.238 | 28.116 | 13.142 | 12.871 | 45.8 |
| 143 | 1.16 | 29.598 | 16.814 | 24.248 | 28.128 | 12.332 | 13.823 | 49.1 |
| 144 | 1.16 | 28.788 | 16.172 | 23.864 | 27.682 | 11.980 | 13.785 | 49.8 |
| 145 | 1.16 | 29.390 | 17.266 | 24.440 | 28.350 | 12.638 | 13.690 | 48.3 |
| 146 | 1.16 | 29.554 | 17.714 | 24.662 | 28.608 | 13.024 | 13.500 | 47.2 |
| 147 | 1.16 | 30.324 | 17.706 | 25.246 | 29.285 | 12.966 | 14.245 | 48.6 |
| 148 | 1.16 | 29.508 | 17.174 | 24.598 | 28.534 | 13.000 | 13.454 | 47.2 |
| 149 | 1.16 | 29.366 | 17.570 | 24.580 | 28.513 | 11.900 | 14.709 | 51.6 |
| 150 | 1.16 | 26.730 | 16.822 | 22.324 | 25.896 | 12.488 | 11.410 | 44.1 |
| 151 | 1.16 | 29.916 | 16.928 | 24.702 | 28.654 | 12.388 | 14.284 | 49.9 |
| 152 | 1.16 | 30.904 | 16.068 | 25.784 | 29.909 | 11.822 | 16.196 | 54.1 |
| 153 | 1.16 | 32.210 | 16.702 | 26.776 | 31.060 | 12.236 | 16.866 | 54.3 |
| 154 | 1.16 | 33.638 | 17.298 | 28.120 | 32.619 | 12.820 | 17.748 | 54.4 |
| 155 | 1.16 | 32.730 | 16.792 | 27.600 | 32.016 | 12.354 | 17.685 | 55.2 |
| 156 | 1.16 | 33.912 | 15.508 | 28.612 | 33.190 | 11.480 | 19.873 | 59.9 |
| 157 | 2.0 | 33.360 | 15.386 | 27.942 | 55.884 | 11.324 | 33.236 | 59.5 |
| 158 | 2.0 | 34.614 | 16.696 | 28.608 | 57.216 | 12.426 | 32.364 | 56.6 |
| 159 | 2.0 | 34.908 | 16.636 | 28.842 | 57.684 | 12.256 | 33.172 | 57.5 |
| 160 | 2.0 | 35.806 | 16.302 | 29.572 | 59.144 | 12.090 | 34.964 | 59.1 |
| 161 | 2.0 | 34.738 | 16.376 | 28.406 | 56.812 | 12.168 | 32.476 | 57.2 |
| 162 | 2.0 | 34.108 | 16.652 | 28.082 | 56.164 | 12.458 | 31.248 | 55.6 |
| 163 | 2.0 | 33.562 | 16.360 | 27.682 | 55.364 | 12.178 | 31.008 | 56.0 |
| 164 | 2.0 | 33.740 | 17.324 | 28.100 | 56.200 | 13.094 | 30.012 | 53.4 |
| 165 | 2.0 | 32.350 | 16.944 | 26.610 | 53.220 | 12.646 | 27.928 | 52.5 |
| 166 | 2.0 | 30.528 | 16.736 | 24.890 | 49.780 | 12.846 | 24.088 | 48.4 |
| 167 | 2.0 | 28.832 | 17.602 | 24.154 | 48.308 | 13.224 | 21.860 | 45.3 |
| 168 | 2.0 | 27.740 | 16.422 | 22.932 | 45.864 | 12.082 | 21.700 | 47.3 |
| 169 | 2.0 | 30.128 | 16.490 | 24.894 | 49.788 | 12.216 | 25.356 | 50.9 |
| 170 | 2.0 | 31.018 | 17.604 | 25.988 | 51.976 | 13.422 | 25.132 | 48.4 |



Table C1: List of parameters measured daily and parameters calculated from (cont) these measured parameters for digester D1

| Day No. | Volume Feed | Total Solids | | Volatile Solids | | | | |
|---|---|---|---|---|---|---|---|---|
| | | influent | effluent | influent | added | effluent | removed | removed |
| | (l/day) | (g/l) | (g/l) | (g/l) | (g/day) | (g/l) | (g/l) | (%) |
| 171 | 2.0 | 31.222 | 23.472 | 26.176 | 52.352 | 17.508 | 17.336 | 33.1 |
| 172 | 2.0 | 32.216 | 24.108 | 26.974 | 53.948 | 18.122 | 17.704 | 32.8 |
| 173 | 2.0 | 32.716 | 22.724 | 27.180 | 54.360 | 16.952 | 20.456 | 37.6 |
| 174 | 2.0 | 32.296 | 22.664 | 27.114 | 54.228 | 17.126 | 19.976 | 36.8 |
| 175 | 2.0 | 28.528 | 22.162 | 23.768 | 47.536 | 16.580 | 14.376 | 30.2 |
| 176 | 2.0 | 27.710 | 22.236 | 22.986 | 45.972 | 16.672 | 12.628 | 27.5 |
| 177 | 2.0 | 26.534 | 20.672 | 22.244 | 44.488 | 15.240 | 14.008 | 31.5 |
| 178 | 2.0 | 31.616 | 21.986 | 26.410 | 52.820 | 16.716 | 19.388 | 36.7 |
| 179 | 2.0 | 31.492 | 21.730 | 26.358 | 52.716 | 16.446 | 19.824 | 37.6 |
| 180 | 2.0 | 31.858 | 21.392 | 26.678 | 53.356 | 15.870 | 21.616 | 40.5 |
| 181 | 2.0 | 33.808 | 21.174 | 27.436 | 54.872 | 15.864 | 23.144 | 42.2 |
| 182 | 2.0 | 33.404 | 21.118 | 27.272 | 54.544 | 15.954 | 22.636 | 41.5 |
| 183 | 2.0 | 35.118 | 20.756 | 28.750 | 57.500 | 15.706 | 26.088 | 45.4 |
| 184 | 2.0 | 34.742 | 20.920 | 28.728 | 57.456 | 15.838 | 25.780 | 44.9 |
| 185 | 3.0 | 34.448 | 19.432 | 28.524 | 85.572 | 14.880 | 40.932 | 47.8 |
| 186 | 3 | 33.806 | 20.960 | 28.200 | 84.600 | 16.002 | 36.594 | 43.3 |
| 187 | 3 | 35.108 | 24.750 | 28.934 | 86.802 | 19.218 | 29.148 | 33.6 |
| 188 | 3 | 30.738 | 24.556 | 25.668 | 77.004 | 19.268 | 19.200 | 24.9 |
| 189 | 3 | 31.442 | 23.736 | 26.190 | 78.570 | 18.802 | 22.164 | 28.2 |
| 190 | 0.5 | 34.324 | 23.340 | 29.024 | 14.512 | 18.234 | 5.395 | 37.2 |
| 191 | 0.5 | 34.832 | 22.714 | 29.274 | 14.637 | 17.378 | 5.948 | 40.6 |
| 192 | 0.5 | 34.500 | 22.394 | 28.980 | 14.490 | 17.172 | 5.904 | 40.7 |
| 193 | 0.5 | 34.646 | 22.474 | 29.282 | 14.641 | 16.926 | 6.178 | 42.2 |
| 194 | 0.5 | 33.870 | 22.654 | 29.058 | 14.529 | 17.152 | 5.953 | 41.0 |
| 195 | 0 | | 23.032 | 0.000 | | 17.348 | | |
| 196 | 0 | | 21.578 | 0.000 | | 15.976 | | |
| 197 | 1 | 33.294 | 22.036 | 28.202 | 28.202 | 16.676 | 11.526 | 40.9 |
| 198 | 1 | 34.616 | 22.286 | 28.972 | 28.972 | 16.808 | 12.164 | 42.0 |
| 199 | 1 | 33.794 | 22.092 | 28.216 | 28.216 | 16.822 | 11.394 | 40.4 |
| 200 | 1 | 34.340 | 21.666 | 28.500 | 28.500 | 16.360 | 12.140 | 42.6 |
| 201 | 1.71 | 34.566 | 22.256 | 28.622 | 48.944 | 16.834 | 20.157 | 41.2 |
| 202 | 1.71 | 34.010 | 22.052 | 28.714 | 49.101 | 16.714 | 20.520 | 41.8 |
| 203 | 1.71 | 33.580 | 22.190 | 28.246 | 48.301 | 16.764 | 19.634 | 40.7 |
| 204 | 1.71 | 33.316 | 21.918 | 28.084 | 48.024 | 16.530 | 19.757 | 41.1 |
| 205 | 1.71 | 34.140 | 21.808 | 28.666 | 49.019 | 16.566 | 20.691 | 42.2 |
| 206 | 1.71 | 33.808 | 21.508 | 28.606 | 48.916 | 16.270 | 21.095 | 43.1 |
| 207 | 1.71 | 34.522 | 22.076 | 29.152 | 49.850 | 16.674 | 21.337 | 42.8 |
| 208 | 1.71 | 32.300 | 21.168 | 27.318 | 46.714 | 15.968 | 19.409 | 41.5 |
| 209 | 1.71 | 31.208 | 20.550 | 26.344 | 45.048 | 15.520 | 18.509 | 41.1 |
| 210 | 1.71 | 30.920 | 20.190 | 26.124 | 44.672 | 15.070 | 18.902 | 42.3 |

Table C1: List of parameters measured daily and parameters calculated from (cont) these measured parameters for digester D1

| Day No. | Non-volatile Solids | | | TKN | | Ammonia | |
|---|---|---|---|---|---|---|---|
| | influent | effluent | removed | influent | effluent | influent | effluent |
| | (g/l) | (g/l) | (%) | (mg/l) | (mg/l) | (mg/l) | (mg/l) |
| 1 | | 4.064 | | | 1439 | | |
| 2 | 5.370 | 4.198 | 21.8 | 252 | | | |
| 3 | 5.450 | 3.910 | 28.3 | | 1316 | | 728 |
| 4 | 5.360 | 3.918 | 26.9 | 1221 | | 266 | |
| 5 | 5.306 | 4.018 | 24.3 | | | | |
| 6 | 5.708 | 4.058 | 28.9 | | 1232 | | 739 |
| 7 | 5.876 | 4.314 | 26.6 | 1260 | 1299 | 325 | 694 |
| 8 | 4.772 | 4.362 | 8.6 | 963 | 1450 | 325 | 706 |
| 9 | 5.092 | | | 1725 | | 493 | |
| 10 | | | | | | | |
| 11 | | 4.466 | | | 1053 | | 773 |
| 12 | 4.904 | 4.332 | 11.7 | 1232 | 1725 | 347 | 616 |
| 13 | 5.378 | 4.326 | 19.6 | 1378 | 1389 | 325 | 717 |
| 14 | 5.328 | 4.426 | 16.9 | 1512 | 1310 | 426 | 666 |
| 15 | 5.910 | 4.478 | 24.2 | 1501 | | 347 | |
| 16 | 5.556 | 4.376 | 21.2 | | 1333 | | 694 |
| 17 | 5.052 | 4.612 | 8.7 | 1249 | 1266 | 392 | |
| 18 | 4.906 | 4.716 | 3.9 | 1142 | 1266 | 241 | 605 |
| 19 | 4.862 | 4.694 | 3.5 | 1165 | 1254 | 269 | |
| 20 | 5.004 | 4.628 | 7.5 | 1904 | 1182 | 364 | 594 |
| 21 | 4.900 | 4.672 | 4.7 | 1070 | 1204 | 258 | 566 |
| 22 | 4.908 | 4.630 | 5.7 | 1187 | 1159 | 302 | 526 |
| 23 | 5.078 | 4.686 | 7.7 | 1120 | 1736 | 314 | 571 |
| 24 | 5.766 | 4.691 | 18.6 | 1176 | 1226 | 286 | 543 |
| 25 | 5.390 | 4.772 | 11.5 | 1322 | 1243 | 280 | 627 |
| 26 | 5.894 | 4.624 | 21.5 | 1260 | 1204 | 263 | 470 |
| 27 | 5.548 | 4.546 | 18.1 | 1204 | 1154 | 291 | 454 |
| 28 | 5.150 | 4.506 | 12.5 | 1243 | 1210 | 263 | 515 |
| 29 | 5.422 | 4.750 | 12.4 | 1294 | 1204 | 241 | 521 |
| 30 | 5.426 | 4.684 | 13.7 | 1182 | 1215 | 224 | 543 |
| 31 | 5.472 | 4.728 | 13.6 | 1187 | 1215 | 286 | 487 |
| 32 | 5.606 | 4.976 | 11.2 | 1232 | 1249 | 235 | 515 |
| 33 | 5.561 | 4.988 | 10.4 | 1266 | 1137 | 280 | 398 |
| 34 | 6.056 | 4.812 | 20.5 | 1176 | 1142 | 224 | 392 |
| 35 | 5.958 | 4.582 | 23.1 | 1187 | 1137 | 263 | 420 |
| 36 | 6.120 | 4.570 | 25.3 | 1165 | 1198 | 235 | 437 |
| 37 | 5.632 | 4.690 | 16.7 | 1109 | 1232 | 241 | 498 |
| 38 | 5.356 | 4.758 | 11.2 | 1058 | 941 | 280 | 454 |
| 39 | 5.544 | 4.890 | 11.8 | 1137 | 1064 | 252 | 482 |
| 40 | 5.016 | 5.010 | 0.1 | 1092 | 1198 | 302 | 493 |



Table C1: List of parameters measured daily and parameters calculated from (cont) these measured parameters for digester D1

| Day No. | Non-volatile Solids | | | TKN | | Ammonia | |
|---|---|---|---|---|---|---|---|
| | influent | effluent | removed | influent | effluent | influent | effluent |
| | (g/l) | (g/l) | (%) | (mg/l) | (mg/l) | (mg/l) | (mg/l) |
| 41 | 5.388 | 5.102 | 5.3 | 1165 | 1187 | 375 | 538 |
| 42 | 5.568 | 4.916 | 11.7 | 1092 | 1238 | 241 | 582 |
| 43 | 5.098 | 5.014 | 1.6 | 1092 | 1204 | 291 | 549 |
| 44 | 5.176 | 4.726 | 8.7 | 1098 | 1260 | 274 | 510 |
| 45 | 5.058 | 4.982 | 1.5 | 1081 | 1187 | 224 | 538 |
| 46 | 5.010 | 5.106 | -1.9 | 1176 | 1210 | 286 | 515 |
| 47 | 5.158 | 4.596 | 10.9 | 1086 | 1154 | 286 | 470 |
| 48 | 4.522 | 4.790 | -5.9 | 1008 | 1109 | 252 | 521 |
| 49 | 5.392 | 4.804 | 10.9 | 1221 | 1226 | 280 | 498 |
| 50 | 6.182 | 4.710 | 23.8 | 1389 | 1109 | 246 | 526 |
| 51 | 5.466 | 4.802 | 12.1 | 1260 | 1198 | 308 | 470 |
| 52 | 5.696 | 4.872 | 14.5 | 1137 | 1092 | 286 | 532 |
| 53 | 5.674 | 4.830 | 14.9 | 1176 | 1142 | 286 | 549 |
| 54 | 5.226 | 4.944 | 5.4 | 1154 | 1103 | 297 | 526 |
| 55 | 5.146 | 4.838 | 6.0 | 1064 | 1092 | 297 | 470 |
| 56 | 5.038 | 4.760 | 5.5 | 1086 | 1131 | 297 | 577 |
| 57 | 7.368 | 4.690 | 36.3 | 1092 | 1086 | 274 | 521 |
| 58 | 4.922 | 4.612 | 6.3 | 1109 | 1154 | 263 | 448 |
| 59 | 4.922 | 4.600 | 6.5 | 1182 | 1131 | 246 | 459 |
| 60 | 4.982 | 4.650 | 6.7 | 1182 | 1114 | 297 | 487 |
| 61 | 5.152 | 4.952 | 3.9 | 1109 | 1103 | 297 | 470 |
| 62 | 5.944 | 4.800 | 19.2 | 1159 | 1126 | 263 | 498 |
| | | | | | | | |
| 113 | | 4.964 | | | 1064 | | 493 |
| 114 | 3.874 | 4.052 | -4.6 | | 1047 | 291.2 | 498 |
| 115 | | | | | | | |
| 116 | | | | | | | |
| 117 | | 4.316 | | | 1042 | | 454 |
| 118 | 4.102 | 4.508 | -9.9 | 1036 | 1036 | 263.2 | 493 |
| 119 | 3.936 | 4.622 | -17.4 | 974.4 | 1053 | 252 | 538 |
| 120 | 3.846 | 4.258 | -10.7 | 985.6 | 1081 | 268.8 | 504 |
| 121 | 3.846 | 4.222 | -9.8 | 986 | 1081 | 269 | 476 |
| 122 | 3.930 | 4.306 | -9.6 | 1002 | 1008 | 235 | 448 |
| 123 | 4.148 | 4.190 | -1.0 | 952 | | 258 | |
| 124 | 4.330 | 4.034 | 6.8 | 980 | 1002 | | 465 |
| 125 | 4.210 | 4.184 | 0.6 | | 963 | 241 | 448 |
| 126 | 6.002 | 3.962 | 34.0 | 974 | 930 | 263 | 392 |
| 127 | 5.366 | 3.964 | 26.1 | 952 | 980 | 185 | 470 |
| 128 | 6.652 | 3.884 | 41.6 | 1036 | 913 | 314 | 454 |
| 129 | 5.710 | 3.878 | 32.1 | 980 | 950 | 235 | 459 |
| 130 | 5.648 | 3.994 | 29.3 | 1002 | | 263 | |

Table C1: List of parameters measured daily and parameters calculated from (cont) these measured parameters for digester D1

| Day No. | Non-volatile Solids | | | TKN | | Ammonia | |
|---|---|---|---|---|---|---|---|
| | influent | effluent | removed | influent | effluent | influent | effluent |
| | (g/l) | (g/l) | (%) | (mg/l) | (mg/l) | (mg/l) | (mg/l) |
| 131 | 5.190 | 4.282 | 17.5 | | 980 | | 448 |
| 132 | 5.180 | 4.172 | 19.5 | 1047 | 913 | 269 | 437 |
| 133 | 6.308 | 4.546 | 27.9 | 1030 | 1014 | 241 | 448 |
| 134 | 4.988 | 4.548 | 8.8 | 1081 | 1064 | 241 | 459 |
| 135 | 5.034 | 4.672 | 7.2 | 1103 | 1103 | 213 | 420 |
| 136 | 5.000 | 4.750 | 5.0 | 1081 | 1086 | 246 | 454 |
| 137 | 5.048 | 4.602 | 8.8 | 1008 | | 241 | |
| 138 | 5.006 | 4.588 | 8.3 | | 1040 | | 476 |
| 139 | 5.192 | 4.800 | 7.6 | 1086 | 1058 | 263 | 437 |
| 140 | 5.576 | 4.688 | 15.9 | 1109 | 1092 | 241 | 454 |
| 141 | 5.094 | 4.680 | 8.1 | 1086 | 1047 | 263 | 448 |
| 142 | 5.296 | 4.658 | 12.0 | 1109 | 1075 | 230 | 448 |
| 143 | 5.350 | 4.482 | 16.2 | 969 | 1120 | 207 | 431 |
| 144 | 4.924 | 4.192 | 14.9 | 941 | | 258 | |
| 145 | 4.950 | 4.628 | 6.5 | | 1098 | | 448 |
| 146 | 4.892 | 4.690 | 4.1 | 1036 | 913 | 246 | 482 |
| 147 | 5.078 | 4.740 | 6.7 | 1019 | 1058 | 235 | 448 |
| 148 | 4.910 | 4.174 | 15.0 | 980 | 997 | 230 | 431 |
| 149 | 4.786 | 5.670 | -18.5 | 1002 | 1025 | 258 | 454 |
| 150 | 4.406 | 4.334 | 1.6 | 902 | 1002 | 235 | 392 |
| 151 | 5.214 | 4.540 | 12.9 | 1047 | | 280 | |
| 152 | 5.120 | 4.246 | 17.1 | | 935 | | 470 |
| 153 | 5.434 | 4.466 | 17.8 | 1064 | 1014 | 297 | 426 |
| 154 | 5.518 | 4.478 | 18.8 | 997 | 1053 | 325 | 465 |
| 155 | 5.130 | 4.438 | 13.5 | 1165 | 1042 | 330 | 493 |
| 156 | 5.300 | 4.028 | 24.0 | 1154 | 963 | 286 | 442 |
| 157 | 5.418 | 4.062 | 25.0 | 1176 | 991 | 274 | 403 |
| 158 | 6.006 | 4.270 | 28.9 | 1070 | | 218 | |
| 159 | 6.066 | 4.380 | 27.8 | | 1014 | | 398 |
| 160 | 6.234 | 4.212 | 32.4 | 6658 | 974 | 213 | 370 |
| 161 | 6.332 | 4.208 | 33.5 | 1008 | 1008 | 224 | 364 |
| 162 | 6.026 | 4.194 | 30.4 | 986 | 1014 | 246 | 386 |
| 163 | 5.880 | 4.182 | 28.9 | 1008 | 885 | 280 | 336 |
| 164 | 5.640 | 4.230 | 25.0 | 1030 | 960 | 235 | 392 |
| 165 | 5.740 | 4.298 | 25.1 | 1002 | | 224 | |
| 166 | 5.638 | 3.890 | 31.0 | | 907 | | 319 |
| 167 | 4.678 | 4.378 | 6.4 | 930 | 986 | 269 | 319 |
| 168 | 4.808 | 4.340 | 9.7 | 935 | 935 | 235 | 314 |
| 169 | 5.234 | 4.274 | 18.3 | 1120 | 879 | 207 | 370 |
| 170 | 5.030 | 4.182 | 16.9 | 1114 | 952 | 235 | 342 |



Table C1: List of parameters measured daily and parameters calculated from (cont) these measured parameters for digester D1

| Day No. | Non-volatile Solids | | | TKN | | Ammonia | |
|---|---|---|---|---|---|---|---|
| | influent | effluent | removed | influent | effluent | influent | effluent |
| | (g/l) | (g/l) | (%) | (mg/l) | (mg/l) | (mg/l) | (mg/l) |
| 171 | 5.046 | 5.964 | -18.2 | 1120 | 1019 | 241 | 392 |
| 172 | 5.242 | 5.986 | -14.2 | 1232 | | 252 | |
| 173 | 5.536 | 5.772 | -4.3 | | 1103 | | 375 |
| 174 | 5.182 | 5.538 | -6.9 | 1193 | 1131 | 252 | 386 |
| 175 | 4.760 | 5.582 | -17.3 | 1025 | 1176 | 230 | 386 |
| 176 | 4.724 | 5.564 | -17.8 | 1109 | 1120 | 252 | 403 |
| 177 | 4.290 | 5.432 | -26.6 | 1092 | 1103 | 241 | 386 |
| 178 | 5.206 | 5.270 | -1.2 | 1131 | 1081 | 241 | 381 |
| 179 | 5.134 | 5.284 | -2.9 | 1053 | | 202 | |
| 180 | 5.180 | 5.522 | -6.6 | | 1081 | | 409 |
| 181 | 6.372 | 5.310 | 16.7 | 1098 | 1114 | 196 | 448 |
| 182 | 6.132 | 5.164 | 15.8 | 1053 | 1092 | 224 | 420 |
| 183 | 6.368 | 5.050 | 20.7 | 1103 | 1154 | 269 | 375 |
| 184 | 6.014 | 5.082 | 15.5 | 1148 | 1058 | 235 | 403 |
| 185 | 5.924 | 4.552 | 23.2 | 1097.6 | 1036 | 252 | 341.6 |
| 186 | 5.606 | 4.958 | 11.6 | 1086.4 | 1052.8 | 156.8 | 308 |
| 187 | 6.174 | 5.532 | 10.4 | 1069.6 | 1120 | 212.8 | 274.4 |
| 188 | 5.070 | 5.288 | -4.3 | 963.2 | 1120 | 151.2 | 257.6 |
| 189 | 5.252 | 4.934 | 6.1 | 1002.4 | | 145.6 | 280 |
| 190 | 5.300 | 5.106 | 3.7 | | 1092 | 145.6 | 364 |
| 191 | 5.558 | 5.336 | 4.0 | 1176 | 1176 | 280 | 313.6 |
| 192 | 5.520 | 5.222 | 5.4 | 1176 | | 184.8 | 386.4 |
| 193 | 5.364 | 5.548 | -3.4 | | | 224 | |
| 194 | 4.812 | 5.502 | -14.3 | | | | |
| 195 | | 5.684 | | | 1170.4 | | 358.4 |
| 196 | | 5.602 | | | 1170.4 | | 386.4 |
| 197 | 5.092 | 5.360 | -5.3 | 1103.2 | 1069.6 | 184.8 | 408.8 |
| 198 | 5.644 | 5.478 | 2.9 | 1136.8 | 1164.8 | 252 | 453.6 |
| 199 | 5.578 | 5.270 | 5.5 | 1215.2 | 1114.4 | 263.2 | 397.6 |
| 200 | 5.840 | 5.306 | 9.1 | 1204 | 1120 | 285.6 | 420 |
| 201 | 5.944 | 5.422 | 8.8 | 1232 | 1153.6 | 313.6 | 436.8 |
| 202 | 5.296 | 5.338 | -0.8 | 1125.6 | 1159.2 | 268.8 | 425.6 |
| 203 | 5.334 | 5.426 | -1.7 | 1226.4 | 1164.8 | 240.8 | 375.2 |
| 204 | 5.232 | 5.388 | -3.0 | 1276.8 | 1148 | 246.4 | 431.2 |
| 205 | 5.474 | 5.242 | 4.2 | 1282.4 | 1181.6 | 285.6 | 414.4 |
| 206 | 5.202 | 5.238 | -0.7 | 1220.8 | | 274.4 | |
| 207 | 5.370 | 5.402 | -0.6 | | | | |
| 208 | 4.982 | 5.200 | -4.4 | | 1232 | | 464.8 |
| 209 | 4.864 | 5.030 | -3.4 | 1198.4 | 1142.4 | 263.2 | 425.6 |
| 210 | 4.796 | 5.120 | -6.8 | 1153.6 | 1226.4 | 280 | 425.6 |

Table C1: List of parameters measured daily and parameters calculated from these measured parameters for digester D1 (cont)

| Day No. | COD | | | | | Conductivity | |
|---|---|---|---|---|---|---|---|
| | influent (g/l) | added (g/day) | effluent (g/l) | removed (g/l) | removed (%) | influent (mS/m) | effluent (mS/m) |
| 1 | | | 18369 | | | | 540 |
| 2 | 43891 | 30724 | 17556 | 18434 | 60.0 | 320 | 540 |
| 3 | 46492 | 32545 | 18044 | 19914 | 61.2 | 280 | 525 |
| 4 | 49093 | 34365 | 19345 | 20824 | 60.6 | 310 | 510 |
| 5 | 43241 | 30269 | 20320 | 16045 | 53.0 | 290 | 490 |
| 6 | 45842 | 32089 | 18422 | 19194 | 59.8 | 320 | 470 |
| 7 | 45396 | 31778 | 19080 | 18422 | 58.0 | 310 | 485 |
| 8 | 39475 | 27633 | 19738 | 13816 | 50.0 | 300 | 490 |
| 9 | 44410 | 31087 | | | | 270 | |
| 10 | | | | | | | |
| 11 | | | 20067 | | | | 465 |
| 12 | 38817 | 27172 | 19902 | 13241 | 48.7 | 280 | 450 |
| 13 | 47699 | 33389 | 17265 | 21304 | 63.8 | 275 | 415 |
| 14 | 47887 | 33521 | 18405 | 20637 | 61.6 | 290 | 420 |
| 15 | 50167 | 35117 | 18405 | 22233 | 63.3 | 270 | 340 |
| 16 | 40720 | 28504 | 18080 | 15848 | 55.6 | 250 | 430 |
| 17 | 38765 | 27136 | 18243 | 14366 | 52.9 | 260 | 420 |
| 18 | 38900 | 27230 | 18894 | 14004 | 51.4 | 255 | 390 |
| 19 | 39091 | 27364 | 18044 | 14733 | 53.8 | 250 | 410 |
| 20 | 34138 | 23896 | 16906 | 12062 | 50.5 | 270 | 420 |
| 21 | 38689 | 27082 | 20645 | 12631 | 46.6 | 260 | 420 |
| 22 | 39014 | 27310 | 17394 | 15134 | 55.4 | 260 | 410 |
| 23 | 34788 | 24351 | 12517 | 15590 | 64.0 | 270 | 410 |
| 24 | 34788 | 24351 | 13005 | 15248 | 62.6 | 240 | 410 |
| 25 | 44541 | 31179 | 17556 | 18889 | 60.6 | 250 | 390 |
| 26 | 52995 | 37096 | 17882 | 24579 | 66.3 | 245 | 390 |
| 27 | 46492 | 32545 | 16744 | 20824 | 64.0 | 250 | 385 |
| 28 | 38364 | 26855 | 15565 | 15960 | 59.4 | 240 | 380 |
| 29 | 35389 | 24773 | 17695 | 12386 | 50.0 | 240 | 390 |
| 30 | 46203 | 32342 | 19825 | 18465 | 57.1 | 230 | 400 |
| 31 | 40807 | 28565 | 17859 | 22361 | 64.1 | 250 | 370 |
| 32 | 32598 | 20819 | 19661 | 16056 | 53.8 | 235 | 370 |
| 33 | 48197 | 33918 | 20972 | 19268 | 56.8 | 240 | 370 |
| 34 | 32598 | 20819 | 19661 | 16056 | 53.8 | 240 | 350 |
| 35 | 48197 | 33948 | 19169 | 20529 | 60.5 | 240 | 350 |
| 36 | 41288 | 28901 | 19392 | 15327 | 53.0 | 230 | 370 |
| 37 | 52035 | 36425 | 18099 | 23755 | 65.2 | 220 | 365 |
| 38 | 40100 | 28280 | 19230 | 14819 | 52.4 | 220 | 370 |
| 39 | 38161 | 26923 | 19230 | 13461 | 50.0 | 230 | 380 |
| 40 | 38138 | 26696 | 23109 | 10520 | 39.4 | 250 | 390 |

Table C1: List of parameters measured daily and parameters calculated from these measured parameters for digester D1 (cont)

| Day No. | COD | | | | | Conductivity | |
|---|---|---|---|---|---|---|---|
| | influent (g/l) | added (g/day) | effluent (g/l) | removed (g/l) | removed (%) | influent (mS/m) | effluent (mS/m) |
| 41 | 39107 | 27375 | 23658 | 10814 | 39.5 | 270 | 390 |
| 42 | 44669 | 31268 | 20515 | 16908 | 54.1 | 240 | 355 |
| 43 | 43345 | 30342 | 22334 | 14708 | 48.5 | 220 | 360 |
| 44 | 37720 | 26404 | 22831 | 10423 | 39.5 | 230 | 355 |
| 45 | 43345 | 30342 | 18695 | 17255 | 56.9 | 240 | 400 |
| 46 | 40367 | 28257 | 21176 | 13434 | 47.5 | 260 | 385 |
| 47 | 40036 | 28026 | 20184 | 13897 | 49.6 | 240 | 360 |
| 48 | 35404 | 24783 | 20018 | 10770 | 43.5 | 250 | 360 |
| 49 | 56250 | 39375 | 21507 | 24320 | 61.8 | 280 | 380 |
| 50 | 50294 | 35206 | 23327 | 18877 | 53.6 | 280 | 380 |
| 51 | 44007 | 30805 | 26140 | 12507 | 40.6 | 280 | 410 |
| 52 | 47647 | 33353 | 20349 | 19108 | 57.3 | 275 | 405 |
| 53 | 46985 | 32889 | 19191 | 19456 | 59.2 | 270 | 410 |
| 54 | 40036 | 28026 | 19026 | 14708 | 52.5 | 270 | 400 |
| 55 | 42022 | 29415 | 19522 | 15750 | 53.5 | 265 | 410 |
| 56 | 38382 | 26867 | 19191 | 13434 | 50.0 | 255 | 405 |
| 57 | 40036 | 28026 | 19853 | 14129 | 50.4 | 260 | 395 |
| 58 | 37059 | 25941 | 18860 | 12739 | 49.1 | 280 | 405 |
| 59 | 41360 | 28952 | 19026 | 15634 | 54.0 | 280 | 410 |
| 60 | 41691 | 29184 | 20685 | 14704 | 50.4 | 290 | 415 |
| 61 | 42662 | 29864 | 21816 | 14592 | 48.9 | 285 | 395 |
| 62 | 41046 | 28732 | 21654 | 13574 | 47.2 | 290 | 395 |
| 113 | | | 21627 | | | | 420 |
| 114 | 31785 | 36871 | 18678 | 15204 | 41.2 | 280 | 390 |
| 115 | | | | | | | 525 |
| 116 | | | | | | | 510 |
| 117 | | | 19005 | | | | 390 |
| 118 | 31457 | 18874 | 17859 | 8159 | 43.2 | 280 | 380 |
| 119 | 34734 | 20840 | 19169 | 9339 | 44.8 | 300 | 390 |
| 120 | 28836 | 17302 | 18514 | 6193 | 35.8 | 280 | 390 |
| 121 | 28836 | 33450 | 17469 | 13186 | 39.4 | 280 | 390 |
| 122 | 41530 | 48174 | 18458 | 26764 | 55.6 | 290 | 390 |
| 123 | 31312 | 36322 | 16480 | 17205 | 47.4 | 285 | 385 |
| 124 | 31642 | 36704 | 17139 | 16823 | 45.8 | 290 | 400 |
| 125 | 34608 | 40145 | 16645 | 20837 | 51.9 | 300 | 390 |
| 126 | 35267 | 40910 | 16974 | 21220 | 51.9 | 240 | 380 |
| 127 | 37245 | 43204 | 16974 | 23514 | 54.4 | 240 | 365 |
| 128 | 39552 | 45880 | 17469 | 25617 | 55.8 | 225 | 360 |
| 129 | 36256 | 42057 | 16974 | 22367 | 53.2 | 210 | 355 |
| 130 | 39552 | 45880 | 17139 | 25999 | 56.7 | 210 | 390 |

Table C1: List of parameters measured daily and parameters calculated from these measured parameters for digester D1 (cont)

| Day No. | COD | | | | | Conductivity | |
|---|---|---|---|---|---|---|---|
| | influent | added | effluent | removed | removed | influent | effluent |
| | (g/l) | (g/day) | (g/l) | (g/l) | (%) | (mS/m) | (mS/m) |
| 131 | | | 17304 | | | | 340 |
| 132 | 38893 | 45116 | 19282 | 22749 | 50.4 | 280 | 345 |
| 133 | 45155 | 52380 | 19282 | 30013 | 57.3 | 280 | 340 |
| 134 | 36586 | 42439 | 21589 | 17396 | 41.0 | 280 | 350 |
| 135 | 38893 | 45116 | 21299 | 20409 | 45.2 | 290 | 340 |
| 136 | 41237 | 47835 | 20972 | 23508 | 49.1 | 285 | 335 |
| 137 | 43581 | 50554 | | | | 280 | 390 |
| 138 | 40724 | 47240 | 19988 | 24053 | 50.9 | | 340 |
| 139 | 38994 | 45233 | 21135 | 20716 | 45.8 | 280 | 340 |
| 140 | 38994 | 45233 | 19988 | 22046 | 48.7 | 280 | 340 |
| 141 | 34406 | 39911 | 19005 | 17865 | 44.8 | 285 | 360 |
| 142 | 36045 | 41812 | 20808 | 17675 | 42.3 | 290 | 360 |
| 143 | 37028 | 42952 | 19057 | 20846 | 48.5 | 240 | 370 |
| 144 | 32902 | 38166 | 20116 | 14832 | 38.9 | 240 | 370 |
| 145 | | | 21174 | | | | 345 |
| 146 | 42023 | 48747 | 19383 | 26263 | 53.9 | 230 | 350 |
| 147 | 37462 | 43456 | 19871 | 20406 | 47.0 | 270 | 350 |
| 148 | 41697 | 48369 | 20034 | 25129 | 52.0 | 240 | 360 |
| 149 | 42349 | 49125 | 19871 | 26074 | 53.1 | 250 | 360 |
| 150 | 35508 | 41189 | 20523 | 17383 | 42.2 | 240 | 355 |
| 151 | 37788 | 43834 | | | | 250 | 380 |
| 152 | 38440 | 44590 | 17917 | 23807 | 53.4 | | 345 |
| 153 | 39091 | 45346 | 19871 | 22295 | 49.2 | 250 | 345 |
| 154 | 46909 | 54415 | 20034 | 31175 | 57.3 | 260 | 345 |
| 155 | 44629 | 51770 | 21663 | 26641 | 51.5 | 260 | 330 |
| 156 | 49190 | 57060 | 18894 | 35143 | 61.6 | 250 | 330 |
| 157 | 45932 | 91864 | 17265 | 57334 | 62.4 | 260 | 340 |
| 158 | 46258 | 92516 | 18243 | 56031 | 60.6 | 230 | 330 |
| 159 | | | 19220 | | | | 320 |
| 160 | 47887 | 95773 | 19871 | 56031 | 58.5 | 230 | 300 |
| 161 | 45606 | 91213 | 23292 | 44629 | 48.9 | 225 | 290 |
| 162 | 46258 | 92516 | 22445 | 47626 | 51.5 | 215 | 285 |
| 163 | 44248 | 88497 | 22926 | 42645 | 48.2 | 220 | 285 |
| 164 | 45852 | 91703 | 21002 | 49699 | 54.2 | 230 | 280 |
| 165 | 46813 | 93627 | | | | 225 | |
| 166 | 43767 | 87535 | 20681 | 46172 | 52.7 | | 270 |
| 167 | 40721 | 81443 | 23407 | 34629 | 42.5 | 220 | 270 |
| 168 | 37515 | 75030 | 21643 | 31743 | 42.3 | 220 | 280 |
| 169 | 42645 | 85290 | 20521 | 44248 | 51.9 | 230 | 270 |
| 170 | 40401 | 80801 | 21483 | 37836 | 46.8 | 250 | 270 |



Table C1: List of parameters measured daily and parameters calculated from these measured parameters for digester D1 (cont)

| Day No. | COD | | | | | Conductivity | |
|---|---|---|---|---|---|---|---|
| | influent | added | effluent | removed | removed | influent | effluent |
| | (g/l) | (g/day) | (g/l) | (g/l) | (%) | (mS/m) | (mS/m) |
| 171 | 41042 | 82084 | 30300 | 21483 | 26.2 | 245 | 285 |
| 172 | 41683 | 83366 | 29098 | 25170 | 30.2 | 260 | 415 |
| 173 | | | 27896 | | | | 290 |
| 174 | 42645 | 85290 | 29339 | 26613 | 31.2 | 255 | 300 |
| 175 | 39118 | 78236 | 27256 | 23724 | 30.3 | 240 | 305 |
| 176 | 36449 | 72899 | 28385 | 16128 | 22.1 | 245 | 310 |
| 177 | 38707 | 77414 | 26289 | 24837 | 32.1 | 250 | 310 |
| 178 | 43546 | 87091 | 29353 | 28385 | 32.6 | 215 | 310 |
| 179 | 41610 | 83220 | 28143 | 26934 | 32.4 | 215 | |
| 180 | | | 26934 | | | | 300 |
| 181 | 43868 | 87736 | 28224 | 31288 | 35.7 | 200 | 260 |
| 182 | 44836 | 89672 | 25160 | 39352 | 43.9 | 190 | 265 |
| 183 | 44836 | 89672 | 24998 | 39675 | 44.2 | 190 | 280 |
| 184 | 47416 | 94833 | 26127 | 42578 | 44.9 | 200 | 260 |
| 185 | 41933 | 125798 | 24515 | 52255 | 41.5 | 190 | 280 |
| 186 | 42900 | 128701 | 26611 | 48868 | 38.0 | 200 | 265 |
| 187 | 48384 | 145152 | 35320 | 39191 | 27.0 | 205 | 260 |
| 188 | 40320 | 120960 | 31611 | 26127 | 21.6 | 195 | 250 |
| 189 | 43546 | 130637 | 33385 | 30482 | 23.3 | 190 | 240 |
| 190 | 46126 | 23063 | 30593 | 7766 | 33.7 | 200 | 240 |
| 191 | 48357 | 24179 | 30429 | 8964 | 37.1 | 200 | 250 |
| 192 | 47041 | 23521 | 27962 | 9540 | 40.6 | 200 | 255 |
| 193 | 50989 | 25494 | 28126 | 11431 | 44.8 | 200 | 255 |
| 194 | | | 27962 | | | | |
| 195 | 0 | 0 | 27633 | | | | 255 |
| 196 | 0 | 0 | 26646 | | | | 260 |
| 197 | 46712 | 46712 | 28948 | 17764 | 38.0 | 215 | 260 |
| 198 | 46383 | 46383 | 25494 | 20889 | 45.0 | 215 | 260 |
| 199 | 46712 | 46712 | 28291 | 18422 | 39.4 | 220 | 255 |
| 200 | 47699 | 47699 | 25988 | 21711 | 45.5 | 220 | 250 |
| 201 | 48686 | 83253 | 29606 | 32626 | 39.2 | 225 | 250 |
| 202 | 48357 | 82691 | 26975 | 36564 | 44.2 | 220 | 245 |
| 203 | 44739 | 76503 | 30593 | 24188 | 31.6 | 210 | 240 |
| 204 | 42765 | 73128 | 28126 | 25032 | 34.2 | 210 | 240 |
| 205 | 41449 | 70878 | 28126 | 22782 | 32.1 | 220 | 250 |
| 206 | 51318 | 87753 | 29261 | 37717 | 43.0 | 220 | 260 |
| 207 | 48118 | 82281 | | | | 225 | |
| 208 | | | 25522 | | | | 250 |
| 209 | 46492 | 79502 | 26335 | 34469 | 43.4 | 220 | 250 |
| 210 | 46817 | 80058 | 24221 | 38639 | 48.3 | 220 | 250 |

Table C1: List of parameters measured daily and parameters calculated from these measured parameters for digester D1 (cont)

| Day No. | pH | | Alkalinity(as CaCO3) | | SCFA (as HAc) | | SCFA/Alk | |
|---|---|---|---|---|---|---|---|---|
| | influent | effluent | influent | effluent | influent | effluent | influent | effluent |
| | | | (mg/l) | (mg/l) | (mg/l) | (mg/l) | | |
| 1 | | 7.45 | | 2360 | | 246 | | |
| 2 | 5.33 | 7.44 | 78 | 2629 | 2158 | 176 | 27.7 | 0.067 |
| 3 | 5.31 | 7.27 | 61 | 2551 | 1787 | 131 | 29.3 | 0.051 |
| 4 | 5.36 | 7.29 | 67 | 2455 | 2025 | 82 | 30.2 | 0.033 |
| 5 | 5.31 | 7.34 | 57 | 2565 | 1951 | 32 | 34.2 | 0.012 |
| 6 | 5.34 | 7.41 | 67 | 2461 | 2317 | 18 | 34.6 | 0.007 |
| 7 | 5.30 | 7.25 | 67 | 2454 | 2183 | 41 | 32.6 | 0.017 |
| 8 | 5.33 | 7.24 | 48 | 2475 | 2126 | 30 | 44.3 | 0.012 |
| 9 | 5.33 | | 46 | | 1896 | | 41.2 | |
| 10 | | | | | | | | |
| 11 | | 7.26 | | 2389 | | 15 | | 0.006 |
| 12 | 5.41 | 7.27 | 50 | 2340 | 1972 | 39 | 39.4 | 0.017 |
| 13 | 5.37 | 7.28 | 47 | 2274 | 1997 | 20 | 42.5 | 0.009 |
| 14 | 5.44 | 7.25 | 60 | 2283 | 1897 | 18 | 31.6 | 0.008 |
| 15 | 5.42 | | 57 | 2057 | 1875 | 22 | 32.9 | 0.011 |
| 16 | | 7.37 | 50 | 2245 | 1922 | 0 | 38.4 | 0.000 |
| 17 | 5.42 | 7.33 | 42 | 2262 | 1866 | 11 | 44.4 | 0.005 |
| 18 | 5.41 | 7.23 | 40 | 2085 | 1838 | 0 | 46.0 | 0.000 |
| 19 | 5.40 | 7.26 | 37 | 2114 | 1840 | 14 | 49.7 | 0.007 |
| 20 | 5.42 | 7.24 | 46 | 2180 | 1977 | 4 | 43.0 | 0.002 |
| 21 | 5.41 | 7.30 | 42 | 2241 | 1889 | 12 | 45.0 | 0.005 |
| 22 | 5.43 | 7.26 | 43 | 2134 | 1878 | 0 | 43.7 | 0.000 |
| 23 | 5.38 | 7.30 | 46 | 2076 | 1951 | 19 | 42.4 | 0.009 |
| 24 | 5.28 | 7.28 | 39 | 2086 | 1849 | 9 | 47.4 | 0.004 |
| 25 | 5.23 | 7.28 | 46 | 2038 | 2011 | 13 | 43.7 | 0.006 |
| 26 | 5.17 | 7.15 | 39 | 2071 | 2085 | 39 | 53.5 | 0.019 |
| 27 | 5.16 | 7.20 | 43 | 2037 | 2116 | 24 | 49.2 | 0.012 |
| 28 | 5.18 | 7.27 | 42 | 2024 | 2068 | 16 | 49.2 | 0.008 |
| 29 | 5.17 | 7.25 | 41 | 1956 | 2018 | 16 | 49.2 | 0.008 |
| 30 | 5.15 | 7.20 | 40 | 2139 | 1966 | 14 | 49.2 | 0.007 |
| 31 | 5.19 | 7.22 | 47 | 1942 | 2192 | 14 | 46.6 | 0.007 |
| 32 | 5.21 | 7.13 | 45 | 2112 | 2014 | 15 | 44.8 | 0.007 |
| 33 | 5.17 | 7.24 | 45 | 1974 | 2160 | 23 | 48.0 | 0.012 |
| 34 | 5.21 | 7.20 | 49 | 1945 | 2082 | 25 | 42.5 | 0.013 |
| 35 | 5.17 | 7.19 | 45 | 1969 | 2194 | 21 | 48.8 | 0.011 |
| 36 | 5.20 | 7.15 | 45 | 1948 | 1999 | 39 | 44.4 | 0.020 |
| 37 | 5.14 | 7.12 | 40 | 1965 | 1873 | 105 | 46.8 | 0.053 |
| 38 | 5.17 | 7.08 | 40 | 2076 | 2061 | 52 | 51.5 | 0.025 |
| 39 | 5.18 | 7.09 | 49 | 1875 | 2134 | 51 | 43.6 | 0.027 |
| 40 | 5.16 | 7.10 | 45 | 1962 | 2099 | 50 | 46.6 | 0.025 |

Note: Alkalinity = $H_2CO_3^*$ alkalinity



Table C1: List of parameters measured daily and parameters calculated from these measured parameters for digester D1 (cont)

| Day No. | pH | | Alkalinity(as CaCO3) | | SCFA (as HAc) | | SCFA/Alk | |
|---|---|---|---|---|---|---|---|---|
| | influent | effluent | influent | effluent | influent | effluent | influent | effluent |
| | | | (mg/l) | (mg/l) | (mg/l) | (mg/l) | | |
| 41 | 5.15 | 7.21 | 52 | 2130 | 2286 | 17 | 44.0 | 0.008 |
| 42 | 5.20 | 7.16 | 46 | 1952 | 1994 | 20 | 43.3 | 0.010 |
| 43 | 5.16 | 7.16 | 39 | 2039 | 1879 | 15 | 48.2 | 0.007 |
| 44 | 5.19 | 7.17 | 46 | 1984 | 2059 | 18 | 44.8 | 0.009 |
| 45 | 5.18 | 7.11 | 41 | 1933 | 1950 | 61 | 47.6 | 0.032 |
| 46 | 5.17 | 7.16 | 46 | 1972 | 2097 | 28 | 45.6 | 0.014 |
| 47 | 5.15 | 7.18 | 42 | 1869 | 2108 | 26 | 50.2 | 0.014 |
| 48 | 5.17 | 7.17 | 71 | 1923 | 3425 | 44 | 48.2 | 0.023 |
| 49 | 5.13 | 7.17 | 55 | 2045 | 2636 | 10 | 47.9 | 0.005 |
| 50 | 5.11 | 7.17 | 53 | 1939 | 2626 | 22 | 49.5 | 0.011 |
| 51 | 5.16 | 7.20 | 48 | 1971 | 2356 | 17 | 49.1 | 0.009 |
| 52 | 5.20 | 7.21 | 88 | 1991 | 2002 | 18 | 22.8 | 0.009 |
| 53 | 5.22 | 7.20 | 48 | 1929 | 2159 | 17 | 45.0 | 0.009 |
| 54 | 5.20 | 7.18 | 45 | 1886 | 2065 | 19 | 45.9 | 0.010 |
| 55 | 5.20 | 7.17 | 46 | 1994 | 2026 | 24 | 44.0 | 0.012 |
| 56 | 5.20 | 7.18 | 45 | 1963 | 1912 | 24 | 42.5 | 0.012 |
| 57 | 5.28 | 7.21 | 50 | 1942 | 1923 | 25 | 38.5 | 0.013 |
| 58 | 5.24 | 7.20 | 48 | 1954 | 2139 | 35 | 44.6 | 0.018 |
| 59 | 5.23 | 7.22 | 50 | 1984 | 2110 | 23 | 42.2 | 0.012 |
| 60 | 5.25 | 7.21 | 54 | 2022 | 2153 | 25 | 39.9 | 0.012 |
| 61 | 5.28 | 7.18 | 54 | 1928 | 2104 | 13 | 39.0 | 0.007 |
| 62 | 5.29 | 7.18 | 61 | 2017 | 2183 | 28 | 35.8 | 0.014 |
| | | | | | | | | |
| 113 | | 7.28 | | 2125 | | 19 | | |
| 114 | 5.19 | 7.23 | 70 | 1949 | 2251 | 32 | 32.2 | |
| 115 | | 7.27 | | 2551 | | 131 | | |
| 116 | | 7.29 | | 2455 | | 82 | | |
| 117 | | 7.23 | | 1932 | | 2 | | |
| 118 | 5.21 | 7.23 | 70 | 1919 | 2244 | 21 | 32.1 | |
| 119 | 5.21 | 7.25 | 72 | 1934 | 2381 | 26 | 33.1 | |
| 120 | 5.22 | 7.26 | 65 | 1934 | 2308 | 23 | 35.5 | |
| 121 | 5.22 | 7.29 | 65 | 1944 | 2308 | 23 | 35.5 | 0.012 |
| 122 | 5.24 | 7.24 | 68 | 1880 | 2316 | 32 | 34.1 | 0.017 |
| 123 | 5.23 | 7.22 | 74 | 1894 | 2323 | 26 | 31.4 | 0.014 |
| 124 | 5.23 | 7.25 | | 1913 | | 25 | | 0.013 |
| 125 | 5.23 | 7.19 | 73 | 1892 | 2329 | 16 | 31.9 | 0.008 |
| 126 | 5.19 | 7.22 | 59 | 1851 | 1770 | 30 | 30.0 | 0.016 |
| 127 | 5.15 | 7.20 | 57 | 1881 | 1705 | 39 | 29.9 | 0.021 |
| 128 | 5.17 | 7.18 | 54 | 1838 | 1636 | 28 | 30.3 | 0.015 |
| 129 | 5.15 | 7.16 | 53 | 1810 | 1572 | 38 | 29.7 | 0.021 |
| 130 | 5.14 | 7.15 | 49 | | 1558 | | 31.8 | |

Table C1: List of parameters measured daily and parameters calculated from (cont) these measured parameters for digester D1

| Day No. | pH | | Alkalinity(as CaCO3) | | SCFA (as HAc) | | SCFA/Alk | |
|---|---|---|---|---|---|---|---|---|
| | influent | effluent | influent | effluent | influent | effluent | influent | effluent |
| | | | (mg/l) | (mg/l) | (mg/l) | (mg/l) | | |
| 131 | 5.24 | 7.17 | | 1819 | | 28 | | 0.015 |
| 132 | 5.08 | 7.17 | 71 | 1860 | 2730 | 26 | 38.5 | 0.014 |
| 133 | 5.1 | 7.20 | 85 | 1846 | 2822 | 27 | 33.2 | 0.015 |
| 134 | 5.11 | 7.24 | 86 | 1846 | 2891 | 36 | 33.6 | 0.020 |
| 135 | 5.12 | 7.23 | 86 | 1898 | 2814 | 35 | 32.7 | 0.018 |
| 136 | 5.1 | 7.20 | 85 | 1910 | 2912 | 49 | 34.3 | 0.026 |
| 137 | 5.09 | 7.18 | 82 | | 2971 | | 36.2 | |
| 138 | 5.21 | 7.23 | | 2034 | | 45 | | 0.022 |
| 139 | 5.09 | 7.22 | 92 | 2042 | 3084 | 41 | 33.5 | 0.020 |
| 140 | 5.11 | 7.23 | 91 | 2056 | 2993 | 26 | 32.9 | 0.013 |
| 141 | 5.1 | 7.19 | 88 | 2091 | 3069 | 27 | 34.9 | 0.013 |
| 142 | 5.1 | 7.24 | 87 | 2065 | 2998 | 28 | 34.5 | 0.014 |
| 143 | 5.26 | 7.06 | 76 | 2052 | 2049 | 36 | 27.0 | 0.018 |
| 144 | 5.38 | 6.95 | 79 | | 1841 | | 23.3 | |
| 145 | 5.4 | 7.18 | | 1904 | | 53 | | 0.028 |
| 146 | 5.43 | 7.18 | 62 | 2024 | 1754 | 42 | 28.3 | 0.021 |
| 147 | 5.42 | 7.15 | 165 | 1981 | 1807 | 33 | 11.0 | 0.017 |
| 148 | 5.45 | 7.14 | 87 | 2027 | 1826 | 24 | 21.0 | 0.012 |
| 149 | 5.49 | 7.16 | 103 | 2044 | 1878 | 15 | 18.2 | 0.007 |
| 150 | 5.56 | 7.14 | 93 | 2008 | 1766 | 19 | 19.0 | 0.009 |
| 151 | 5.91 | 7.14 | 105 | | 1760 | | 16.8 | |
| 152 | 5.72 | 7.11 | | 2068 | | 23 | | 0.011 |
| 153 | 5.65 | 7.14 | 106 | 1997 | 1869 | 17 | 17.6 | 0.009 |
| 154 | 5.69 | 7.15 | 111 | 1992 | 1907 | 22 | 17.2 | 0.011 |
| 155 | 5.56 | 7.13 | 111 | 1992 | 1997 | 22 | 18.0 | 0.011 |
| 156 | 5.48 | 7.12 | 138 | 1985 | 2126 | 30 | 15.4 | 0.015 |
| 157 | 5.48 | 7.10 | 119 | 2043 | 2087 | 34 | 17.5 | 0.017 |
| 158 | 5.44 | 7.11 | 87 | 1922 | 1768 | 38 | 20.3 | 0.020 |
| 159 | 5.49 | 7.11 | | 1890 | | 75 | | 0.040 |
| 160 | 5.42 | 7.08 | 82 | 1832 | 1846 | 54 | 22.5 | 0.029 |
| 161 | 5.41 | 7.06 | 78 | 1769 | 1819 | 54 | 23.3 | 0.031 |
| 162 | 5.46 | 7.07 | 81 | 1701 | 1785 | 52 | 22.0 | 0.031 |
| 163 | 5.49 | 7.07 | 82 | 1694 | 1776 | 40 | 21.7 | 0.024 |
| 164 | 5.47 | 7.06 | 78 | 1632 | 1822 | 45 | 23.4 | 0.028 |
| 165 | 5.50 | 7.02 | 79 | 1929 | 1847 | 17 | 23.4 | 0.009 |
| 166 | 5.55 | 7.08 | | 1570 | | 48 | | 0.031 |
| 167 | 5.47 | 7.03 | 73 | 1615 | 1649 | 43 | 22.6 | 0.027 |
| 168 | 5.48 | 7.06 | 76 | 1589 | 1724 | 51 | 22.7 | 0.032 |
| 169 | 5.45 | 7.04 | 91 | 1574 | 1907 | 49 | 21.2 | 0.031 |
| 170 | 5.41 | 7.09 | 101 | 1624 | 2137 | 42 | 21.2 | 0.026 |

Note: Alkalinity = $H_2CO_3^*$ alkalinity



Table C1: List of parameters measured daily and parameters calculated from (cont) these measured parameters for digester D1

| Day No. | pH | | Alkalinity(as CaCO3) | | SCFA (as HAc) | | SCFA/Alk | |
|---|---|---|---|---|---|---|---|---|
| | influent | effluent | influent | effluent | influent | effluent | influent | effluent |
| | | | (mg/l) | (mg/l) | (mg/l) | (mg/l) | | |
| 171 | 5.40 | 7.06 | 112 | 1736 | 2216 | 57 | 19.8 | 0.033 |
| 172 | 5.39 | 7.06 | 109 | 2022 | 2412 | 25 | 22.1 | 0.012 |
| 173 | 5.45 | 7.12 | | 1832 | | 50 | | 0.027 |
| 174 | 5.40 | 7.11 | 108 | 1986 | 2493 | 56 | 23.1 | 0.028 |
| 175 | 5.38 | 7.11 | 104 | 2058 | 2342 | 47 | 22.5 | 0.023 |
| 176 | 5.39 | 7.14 | 104 | 2110 | 2340 | 53 | 22.5 | 0.025 |
| 177 | 5.38 | 7.15 | 105 | 2144 | 2372 | 45 | 22.6 | 0.021 |
| 178 | 5.42 | 7.08 | 81 | 2140 | 1742 | 44 | 21.5 | 0.021 |
| 179 | 5.39 | 7.08 | 84 | | 1792 | | 21.3 | |
| 180 | 5.59 | 7.14 | | 2038 | | 49 | | 0.024 |
| 181 | 5.43 | 7.08 | 84 | 1970 | 1638 | 36 | 19.5 | 0.018 |
| 182 | 5.43 | 7.08 | 74 | 1941 | 1558 | 38 | 21.1 | 0.020 |
| 183 | 5.46 | 7.03 | 84 | 1924 | 1658 | 32 | 19.7 | 0.017 |
| 184 | 5.45 | 7.08 | 85 | 1900 | 1679 | 33 | 19.8 | 0.017 |
| 185 | 5.42 | 6.95 | 84 | 1747 | 1712 | 73 | 20.4 | 0.042 |
| 186 | 5.42 | 6.97 | 87 | 1436 | 1690 | 240 | 19.4 | 0.167 |
| 187 | 5.41 | 6.86 | 85 | 1366 | 1743 | 306 | 20.5 | 0.224 |
| 188 | 5.42 | 6.82 | 78 | 1150 | 1592 | 486 | 20.4 | 0.423 |
| 189 | 5.45 | 6.81 | 78 | 1156 | 1601 | 367 | 20.5 | 0.317 |
| 190 | 5.42 | 6.96 | 85 | 1432 | 1760 | 72 | 20.7 | 0.050 |
| 191 | 5.48 | 7.05 | 89 | 1609 | 1741 | 47 | 19.6 | 0.029 |
| 192 | 5.54 | 7.09 | 92 | 1559 | 1702 | 49 | 18.5 | 0.031 |
| 193 | 5.61 | 7.09 | 84 | 1626 | 1583 | 41 | 18.8 | 0.025 |
| 194 | | | | | | | | |
| 195 | | 7.19 | | 1763 | | 40 | | 0.023 |
| 196 | | 7.18 | | 1839 | | 40 | | 0.022 |
| 197 | 5.98 | 7.18 | 90 | 1825 | 1770 | 30 | 19.7 | 0.016 |
| 198 | 5.83 | 7.07 | 99 | 1752 | 1706 | 36 | 17.2 | 0.021 |
| 199 | 5.84 | 7.04 | 89 | 1755 | 1755 | 37 | 19.7 | 0.021 |
| 200 | 5.79 | 7.06 | 102 | 1807 | 1821 | 41 | 17.9 | 0.023 |
| 201 | 5.82 | 7.06 | 89 | 1768 | 1976 | 43 | 22.2 | 0.024 |
| 202 | 5.69 | 7.06 | 85 | 1745 | 2102 | 35 | 24.7 | 0.020 |
| 203 | 5.58 | 7.08 | 78 | 1775 | 2076 | 38 | 26.6 | 0.021 |
| 204 | 5.55 | 7.09 | 86 | 1758 | 2116 | 48 | 24.6 | 0.027 |
| 205 | 5.55 | 7.07 | 86 | 1751 | 2178 | 44 | 25.3 | 0.025 |
| 206 | 5.55 | 7.09 | 85 | 1744 | 2262 | 42 | 26.6 | 0.024 |
| 207 | 5.54 | 7.09 | 87 | | 2278 | | 26.2 | |
| 208 | 5.7 | 7.07 | | 1840 | | 50 | | 0.027 |
| 209 | 5.57 | 7.1 | 87 | 1860 | 2213 | 43 | 25.4 | 0.023 |
| 210 | 5.59 | 7.1 | 90 | 1828 | 2143 | 43 | 23.8 | 0.024 |

Table C1: List of parameters measured daily and parameters calculated from these measured parameters for digester D1 (cont)

| Day No. | Gas production | Carbon dioxide | Methane | Gas produced per.... | | | |
|---|---|---|---|---|---|---|---|
| | | | | COD remov | CODadded | VS remove | VS added |
| | (l/day) | (%) | (%) | (l/g) | (l/g) | (l/g) | (l/g) |
| 1 | | | | | | | |
| 2 | 7.70 | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | | | | | | | |
| 7 | 13.99 | | | 1.34 | 0.76 | 0.76 | 0.44 |
| 8 | | | | | | | |
| 9 | | | | | | | |
| 10 | | | | | | | |
| 11 | | | | | | | |
| 12 | 7.63 | | | | | | |
| 13 | 9.27 | | | 1.06 | 0.56 | 0.44 | 0.28 |
| 14 | | | | | | | |
| 15 | 9.99 | | | 0.93 | 0.54 | 0.45 | 0.28 |
| 16 | 10.04 | | | 1.06 | 0.58 | 0.63 | 0.35 |
| 17 | | | | | | | |
| 18 | 9.60 | | | 1.36 | 0.64 | 0.69 | 0.35 |
| 19 | 9.57 | | | 1.37 | 0.64 | 0.65 | 0.35 |
| 20 | | | | | | | |
| 21 | 8.60 | | | 1.24 | 0.58 | 0.68 | 0.32 |
| 22 | 8.69 | | | 1.11 | 0.56 | 0.57 | 0.32 |
| 23 | | | | | | | |
| 24 | 8.50 | | | 0.98 | 0.51 | 0.56 | 0.35 |
| 25 | 9.77 | | | 0.97 | 0.55 | 0.52 | 0.31 |
| 26 | | | | | | | |
| 27 | 9.70 | | | 0.93 | 0.53 | 0.47 | 0.30 |
| 28 | 9.54 | | | 1.04 | 0.55 | 0.60 | 0.36 |
| 29 | | | | | | | |
| 30 | 10.02 | | | 1.11 | 0.57 | 0.54 | 0.31 |
| 31 | 9.77 | | | 1.08 | 0.55 | 0.44 | 0.28 |
| 32 | | | | | | | |
| 33 | 10.51 | | | 1.03 | 0.57 | 0.55 | 0.31 |
| 34 | 9.77 | | | 0.95 | 0.52 | 0.61 | 0.33 |
| 35 | | | | | | | |
| 36 | 10.46 | | | 1.21 | 0.62 | 0.68 | 0.36 |
| 37 | 9.98 | | | 1.20 | 0.59 | 0.42 | 0.27 |
| 38 | | | | | | | |
| 39 | 10.98 | | | 1.31 | 0.64 | 0.82 | 0.41 |
| 40 | 10.56 | | | 1.32 | 0.62 | 1.00 | 0.40 |

Note: All gas volumes measured at 1 atmosphere pressure and 20$^{o}$C.



Table C1: List of parameters measured daily and parameters calculated from these measured parameters for digester D1 (cont)

| Day No. | Gas production | Carbon dioxide | Methane | Gas produced per.... | | | |
|---|---|---|---|---|---|---|---|
| | | | | COD remov | CODadded | VS remove | VS added |
| | (l/day) | (%) | (%) | (l/g) | (l/g) | (l/g) | (l/g) |
| 41 | | | | | | | |
| 42 | 10.44 | | | 1.32 | 0.62 | 0.62 | 0.33 |
| 43 | 10.71 | | | 1.31 | 0.63 | 0.73 | 0.35 |
| 44 | | | | | | | |
| 45 | 11.59 | | | 1.37 | 0.68 | 0.67 | 0.38 |
| 46 | 11.25 | | | 1.44 | 0.66 | 0.84 | 0.40 |
| 47 | | | | | | | |
| 48 | 9.42 | | | 2.01 | 0.70 | 0.87 | 0.38 |
| 49 | 11.09 | | | 1.07 | 0.58 | 0.46 | 0.28 |
| 50 | | | | | | | |
| 51 | 10.85 | | | 1.04 | 0.57 | 0.87 | 0.35 |
| 52 | 10.72 | | | 1.07 | 0.57 | 0.56 | 0.32 |
| 53 | | 35.2 | 64.8 | | | | |
| 54 | 10.11 | 35.9 | 64.1 | 1.17 | 0.57 | 0.69 | 0.36 |
| 55 | 10.59 | 35.7 | 64.3 | 1.14 | 0.62 | 0.67 | 0.36 |
| 56 | | 35.7 | 64.3 | | | | |
| 57 | 10.00 | 35.5 | 64.5 | 1.39 | 0.62 | 0.71 | 0.36 |
| 58 | 10.21 | 35.7 | 64.3 | 1.17 | 0.58 | 0.80 | 0.39 |
| 59 | | 34.7 | 65.3 | | | | |
| 60 | 10.86 | 35.9 | 64.1 | 1.20 | 0.61 | 0.74 | 0.37 |
| 61 | 10.42 | 35.7 | 64.3 | 1.12 | 0.58 | 0.71 | 0.35 |
| 62 | | 36.4 | 63.6 | | | | |
| 113 | 6.51 | | | | | | |
| 114 | 10.50 | | | 1.24 | 0.48 | 0.69 | 0.28 |
| 115 | 6.33 | | | | | | |
| 116 | | | | | | | |
| 117 | 2.68 | | | | | | |
| 118 | | | | | | | |
| 119 | 7.07 | | | 1.75 | 0.64 | 0.76 | 0.34 |
| 120 | | | | | | | |
| 121 | | | | | | | |
| 122 | 10.23 | | | 1.23 | 0.46 | 0.38 | 0.21 |
| 123 | | | | | | | |
| 124 | 11.66 | | | 1.13 | 0.51 | 0.69 | 0.32 |
| 125 | | | | | | | |
| 126 | 11.58 | | | 0.83 | 0.44 | 0.55 | 0.28 |
| 127 | | | | | | | |
| 128 | 12.97 | | | 1.05 | 0.52 | 0.51 | 0.28 |
| 129 | | | | | | | |
| 130 | 13.38 | | | 0.99 | 0.50 | 0.51 | 0.29 |

Table C1: List of parameters measured daily and parameters calculated from (cont) these measured parameters for digester D1

| Day No. | Gas production | Carbon dioxide | Methane | Gas produced per.... | | | |
|---|---|---|---|---|---|---|---|
| | | | | COD remov | CODadded | VS remove | VS added |
| | (l/day) | (%) | (%) | (l/g) | (l/g) | (l/g) | (l/g) |
| 131 | | | | | | | |
| 132 | 16.54 | 34.9 | 65.1 | 1.23 | 0.60 | 0.73 | 0.37 |
| 133 | | 34.9 | 64.6 | | | | |
| 134 | 16.11 | 35.4 | 65.1 | 1.33 | 0.59 | 0.93 | 0.38 |
| 135 | | 34.9 | 64.6 | | | | |
| 136 | 15.60 | 35.4 | 61.5 | 1.24 | 0.56 | 0.66 | 0.33 |
| 137 | | 38.5 | 64.1 | | | | |
| 138 | 17.20 | 35.9 | 64.1 | 1.46 | 0.63 | 0.72 | 0.36 |
| 139 | | 35.9 | 64.1 | | | | |
| 140 | 16.46 | 35.9 | 64.1 | 1.26 | 0.58 | 0.75 | 0.36 |
| 141 | | 35.9 | 63.4 | | | | |
| 142 | | 36.6 | 64.8 | | | | |
| 143 | | 35.2 | 69.5 | | | | |
| 144 | 10.70 | 30.5 | 64.1 | 0.78 | 0.39 | 0.72 | 0.28 |
| 145 | | 35.9 | 63.4 | | | | |
| 146 | 17.61 | 36.6 | 63.1 | 1.30 | 0.62 | 0.67 | 0.36 |
| 147 | | 36.9 | 63.8 | | | | |
| 148 | 16.39 | 36.2 | 63.1 | 1.22 | 0.57 | 0.65 | 0.34 |
| 149 | | 36.9 | 63.6 | | | | |
| 150 | 14.97 | 36.4 | 64.8 | 1.31 | 0.58 | 0.86 | 0.36 |
| 151 | | 35.2 | 64.1 | | | | |
| 152 | 15.66 | 35.9 | 64.8 | 0.97 | 0.52 | 0.66 | 0.35 |
| 153 | | 35.2 | 65.0 | | | | |
| 154 | 15.90 | 35.0 | 63.8 | 0.90 | 0.49 | 0.51 | 0.29 |
| 155 | | 36.2 | 64.8 | | | | |
| 156 | 17.78 | 35.2 | 59.2 | 0.89 | 0.54 | 0.51 | 0.31 |
| 157 | | 40.8 | 59.2 | | | | |
| 158 | 23.71 | 36.2 | 63.8 | 0.73 | 0.41 | 0.42 | 0.26 |
| 159 | | 36.7 | 63.3 | | | | |
| 160 | 26.66 | 34.5 | 65.5 | 0.76 | 0.45 | 0.48 | 0.28 |
| 161 | | 35.7 | 64.3 | | | | |
| 162 | 26.35 | 38.7 | 61.3 | 0.84 | 0.47 | 0.55 | 0.28 |
| 163 | | 37.6 | 62.4 | | | | |
| 164 | 25.30 | 36.4 | 63.6 | 0.84 | 0.45 | 0.51 | 0.28 |
| 165 | | 37.3 | 62.7 | | | | |
| 166 | 26.10 | 36.7 | 63.3 | 1.08 | 0.52 | 0.57 | 0.30 |
| 167 | | 36.7 | 63.3 | | | | |
| 168 | 23.26 | 32.2 | 67.8 | 1.07 | 0.51 | 0.73 | 0.31 |
| 169 | | 35.7 | 64.3 | | | | |
| 170 | | 36.7 | 63.3 | | | | |

Note: All gas volumes measured at 1 atmosphere pressure and 20°C.

Table C1: List of parameters measured daily and parameters calculated from (cont) these measured parameters for digester D1

| Day No. | Gas production | Carbon dioxide | Methane | Gas produced per.... | | | |
|---|---|---|---|---|---|---|---|
| | | | | COD remov | CODadded | VS remove | VS added |
| | (l/day) | (%) | (%) | (l/g) | (l/g) | (l/g) | (l/g) |
| 171 | | 31.9 | 68.1 | | | | |
| 172 | 30.74 | 34.3 | 65.7 | 1.74 | 0.57 | 1.22 | 0.37 |
| 173 | | 36.7 | 63.3 | | | | |
| 174 | 30.95 | 35.7 | 64.3 | 1.55 | 0.57 | 1.16 | 0.36 |
| 175 | | 33.1 | 66.9 | | | | |
| 176 | 28.72 | 36.4 | 63.6 | 2.27 | 0.62 | 1.78 | 0.39 |
| 177 | | 32.6 | 67.4 | | | | |
| 178 | 28.97 | 35.9 | 64.1 | 1.49 | 0.55 | 1.02 | 0.33 |
| 179 | 26.47 | 35.7 | 64.3 | 1.34 | 0.50 | 0.98 | 0.32 |
| 180 | | 36.7 | 63.3 | | | | |
| 181 | 28.58 | 35.2 | 64.8 | 1.23 | 0.52 | 0.91 | 0.33 |
| 182 | 27.30 | 34.7 | 65.3 | 1.21 | 0.50 | 0.69 | 0.30 |
| 183 | 29.77 | 35.4 | 64.6 | 1.14 | 0.52 | 0.75 | 0.33 |
| 184 | 28.95 | 35.7 | 64.3 | 1.12 | 0.50 | 0.68 | 0.31 |
| 185 | 26.89 | 32.2 | 67.8 | 0.66 | 0.31 | 0.51 | 0.21 |
| 186 | 28.89 | 36.6 | 63.4 | 0.79 | 0.34 | 0.59 | 0.22 |
| 187 | 26.15 | 36.9 | 63.1 | 0.90 | 0.30 | 0.67 | 0.18 |
| 188 | 25.04 | 37.3 | 62.7 | 1.30 | 0.33 | 0.96 | 0.21 |
| 189 | 21.45 | 33.1 | 66.9 | 0.97 | 0.27 | 0.70 | 0.16 |
| 190 | 21.02 | 31.9 | 68.1 | 3.90 | 1.45 | 2.71 | 0.91 |
| 191 | 15.55 | 30.0 | 70.0 | 2.61 | 1.06 | 1.73 | 0.64 |
| 192 | 14.48 | 26.3 | 73.7 | 2.45 | 1.00 | 1.52 | 0.62 |
| 193 | 14.88 | 24.9 | 75.1 | 2.41 | 1.02 | 1.30 | 0.58 |
| 194 | 13.98 | 28.4 | 71.6 | | | | |
| 195 | 12.14 | 29.5 | 70.5 | | | | |
| 196 | 8.12 | 31.4 | 68.6 | | | | |
| 197 | 10.80 | 32.9 | 67.1 | 0.94 | 0.38 | 0.61 | 0.23 |
| 198 | 14.28 | 32.4 | 67.6 | 1.17 | 0.49 | 0.68 | 0.31 |
| 199 | 17.08 | 31.9 | 68.1 | 1.50 | 0.61 | 0.93 | 0.37 |
| 200 | 16.19 | 34.0 | 66.0 | 1.33 | 0.57 | 0.75 | 0.34 |
| 201 | 21.93 | 33.8 | 66.2 | 1.09 | 0.45 | 0.67 | 0.26 |
| 202 | 23.68 | 33.1 | 66.9 | 1.15 | 0.48 | 0.65 | 0.29 |
| 203 | 24.20 | 33.6 | 66.4 | 1.23 | 0.50 | 1.00 | 0.32 |
| 204 | 24.51 | 30.5 | 69.5 | 1.24 | 0.51 | 0.98 | 0.34 |
| 205 | 25.37 | 33.6 | 66.4 | 1.23 | 0.52 | 1.11 | 0.36 |
| 206 | 23.77 | 34.0 | 66.0 | 1.13 | 0.49 | 0.63 | 0.27 |
| 207 | | 33.3 | 66.7 | 0.45 | 0.19 | 0.00 | 0.12 |
| 208 | 26.15 | 32.9 | 67.1 | 1.35 | 0.56 | 0.00 | 0.00 |
| 209 | 24.72 | 34.5 | 65.5 | 1.34 | 0.55 | 0.72 | 0.31 |
| 210 | | | | | | | |

Table C1: List of parameters measured daily and parameters calculated from these measured parameters for digester D1 (cont)

| Day No. | Methane produced per..... | | | | Carbon dioxide produced per... | | | |
|---|---|---|---|---|---|---|---|---|
| | VS remo | VS added | COD re | CODadd | VS remo | VS added | COD re | CODadd |
| | l/g | l/g | l/g | l/g | l/g | l/g | l/g | l/g |
| 1 | | | | | | | | |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | 0.86 | 0.49 | 0.49 | 0.28 | 0.48 | 0.27 | 0.27 | 0.16 |
| 8 | | | | | | | | |
| 9 | | | | | | | | |
| 10 | | | | | | | | |
| 11 | | | | | | | | |
| 12 | | | | | | | | |
| 13 | 0.68 | 0.36 | 0.28 | 0.18 | 0.38 | 0.20 | 0.15 | 0.10 |
| 14 | | | | | | | | |
| 15 | 0.60 | 0.35 | 0.29 | 0.18 | 0.33 | 0.19 | 0.16 | 0.10 |
| 16 | 0.68 | 0.37 | 0.41 | 0.23 | 0.38 | 0.21 | 0.23 | 0.13 |
| 17 | | | | | | | | |
| 18 | 0.87 | 0.41 | 0.44 | 0.23 | 0.48 | 0.23 | 0.24 | 0.13 |
| 19 | 0.88 | 0.42 | 0.42 | 0.23 | 0.49 | 0.23 | 0.23 | 0.12 |
| 20 | | | | | | | | |
| 21 | 0.80 | 0.38 | 0.44 | 0.20 | 0.44 | 0.21 | 0.24 | 0.11 |
| 22 | 0.72 | 0.36 | 0.37 | 0.20 | 0.40 | 0.20 | 0.20 | 0.11 |
| 23 | | | | | | | | |
| 24 | 0.63 | 0.33 | 0.36 | 0.22 | 0.35 | 0.18 | 0.20 | 0.12 |
| 25 | 0.62 | 0.35 | 0.33 | 0.20 | 0.34 | 0.19 | 0.18 | 0.11 |
| 26 | | | | | | | | |
| 27 | 0.60 | 0.34 | 0.30 | 0.19 | 0.33 | 0.19 | 0.17 | 0.11 |
| 28 | 0.67 | 0.35 | 0.38 | 0.23 | 0.37 | 0.19 | 0.21 | 0.13 |
| 29 | | | | | | | | |
| 30 | 0.72 | 0.37 | 0.35 | 0.20 | 0.40 | 0.20 | 0.19 | 0.11 |
| 31 | 0.70 | 0.36 | 0.28 | 0.18 | 0.38 | 0.20 | 0.16 | 0.10 |
| 32 | | | | | | | | |
| 33 | 0.66 | 0.37 | 0.35 | 0.20 | 0.37 | 0.20 | 0.19 | 0.11 |
| 34 | 0.61 | 0.33 | 0.39 | 0.21 | 0.34 | 0.18 | 0.22 | 0.12 |
| 35 | | | | | | | | |
| 36 | 0.78 | 0.40 | 0.44 | 0.23 | 0.43 | 0.22 | 0.24 | 0.13 |
| 37 | 0.77 | 0.38 | 0.27 | 0.18 | 0.43 | 0.21 | 0.15 | 0.10 |
| 38 | | | | | | | | |
| 39 | 0.84 | 0.41 | 0.53 | 0.26 | 0.47 | 0.23 | 0.29 | 0.15 |
| 40 | 0.85 | 0.40 | 0.65 | 0.25 | 0.47 | 0.22 | 0.36 | 0.14 |

Note: All gas volumes measured at 1 atmosphere pressure and 20$^{0}$C.

Table C1: List of parameters measured daily and parameters calculated from these measured parameters for digester D1 (cont)

| Day No | Methane produced per ... | | | | Carbon dioxide produced per.... | | | |
|---|---|---|---|---|---|---|---|---|
| | VS remo | VS added | COD re | CODadd | VS remo | VS added | COD re | CODadd |
| | l/g | l/g | l/g | l/g | l/g | l/g | l/g | l/g |
| 41 | | | | | | | | |
| 42 | 0.85 | 0.40 | 0.40 | 0.21 | 0.47 | 0.22 | 0.22 | 0.12 |
| 43 | 0.85 | 0.40 | 0.47 | 0.23 | 0.47 | 0.22 | 0.26 | 0.13 |
| 44 | | | | | | | | |
| 45 | 0.88 | 0.44 | 0.43 | 0.25 | 0.49 | 0.24 | 0.24 | 0.14 |
| 46 | 0.92 | 0.42 | 0.54 | 0.26 | 0.51 | 0.23 | 0.30 | 0.14 |
| 47 | | | | | | | | |
| 48 | 1.29 | 0.45 | 0.56 | 0.24 | 0.71 | 0.25 | 0.31 | 0.14 |
| 49 | 0.69 | 0.37 | 0.29 | 0.18 | 0.38 | 0.21 | 0.16 | 0.10 |
| 50 | | | | | | | | |
| 51 | 0.67 | 0.37 | 0.56 | 0.23 | 0.37 | 0.20 | 0.31 | 0.13 |
| 52 | 0.69 | 0.37 | 0.36 | 0.21 | 0.38 | 0.20 | 0.20 | 0.11 |
| 53 | | | | | | | | |
| 54 | 0.75 | 0.37 | 0.44 | 0.23 | 0.42 | 0.21 | 0.25 | 0.13 |
| 55 | 0.74 | 0.40 | 0.43 | 0.23 | 0.41 | 0.22 | 0.24 | 0.13 |
| 56 | | | | | | | | |
| 57 | 0.90 | 0.40 | 0.46 | 0.23 | 0.49 | 0.22 | 0.25 | 0.13 |
| 58 | 0.75 | 0.38 | 0.52 | 0.25 | 0.42 | 0.21 | 0.29 | 0.14 |
| 59 | | | | | | | | |
| 60 | 0.77 | 0.39 | 0.47 | 0.24 | 0.43 | 0.22 | 0.27 | 0.13 |
| 61 | 0.72 | 0.38 | 0.46 | 0.22 | 0.40 | 0.21 | 0.25 | 0.12 |
| 62 | | | | | | | | |
| 113 | | | | | | | | |
| 114 | 0.80 | 0.31 | 0.44 | 0.18 | 0.45 | 0.17 | 0.25 | 0.10 |
| 115 | | | | | | | | |
| 116 | | | | | | | | |
| 117 | | | | | | | | |
| 118 | | | | | | | | |
| 119 | 1.12 | 0.41 | 0.49 | 0.22 | 0.63 | 0.23 | 0.27 | 0.12 |
| 120 | | | | | | | | |
| 121 | | | | | | | | |
| 122 | 0.79 | 0.30 | 0.25 | 0.14 | 0.44 | 0.17 | 0.14 | 0.08 |
| 123 | | | | | | | | |
| 124 | 0.73 | 0.33 | 0.44 | 0.20 | 0.41 | 0.18 | 0.25 | 0.11 |
| 125 | | | | | | | | |
| 126 | 0.53 | 0.28 | 0.35 | 0.18 | 0.30 | 0.16 | 0.20 | 0.10 |
| 127 | | | | | | | | |
| 128 | 0.67 | 0.34 | 0.32 | 0.18 | 0.38 | 0.19 | 0.18 | 0.10 |
| 129 | | | | | | | | |
| 130 | 0.63 | 0.32 | 0.33 | 0.19 | 0.36 | 0.18 | 0.18 | 0.10 |

Table C1: List of parameters measured daily and parameters calculated from (cont) these measured parameters for digester D1

| Day No. | Methane produced per..... | | | | Carbon dioxide produced per... | | | |
|---|---|---|---|---|---|---|---|---|
| | VS remo | VS added | COD re | CODadd | VS remo | VS added | COD re | CODadd |
| | l/g | l/g | l/g | l/g | l/g | l/g | l/g | l/g |
| 131 | | | | | | | | |
| 132 | 0.80 | 0.39 | 0.47 | 0.24 | 0.43 | 0.21 | 0.25 | 0.13 |
| 133 | | | | | | | | |
| 134 | 0.87 | 0.39 | 0.60 | 0.25 | 0.47 | 0.21 | 0.32 | 0.13 |
| 135 | | | | | | | | |
| 136 | 0.76 | 0.35 | 0.41 | 0.20 | 0.48 | 0.22 | 0.26 | 0.13 |
| 137 | | | | | | | | |
| 138 | 0.94 | 0.40 | 0.46 | 0.23 | 0.53 | 0.23 | 0.26 | 0.13 |
| 139 | | | | | | | | |
| 140 | 0.81 | 0.37 | 0.48 | 0.23 | 0.45 | 0.21 | 0.27 | 0.13 |
| 141 | | | | | | | | |
| 142 | | | | | | | | |
| 143 | | | | | | | | |
| 144 | 0.50 | 0.25 | 0.46 | 0.18 | 0.28 | 0.14 | 0.26 | 0.10 |
| 145 | | | | | | | | |
| 146 | 0.82 | 0.39 | 0.42 | 0.23 | 0.48 | 0.23 | 0.25 | 0.13 |
| 147 | | | | | | | | |
| 148 | 0.77 | 0.36 | 0.41 | 0.21 | 0.45 | 0.21 | 0.24 | 0.12 |
| 149 | | | | | | | | |
| 150 | 0.85 | 0.37 | 0.56 | 0.24 | 0.46 | 0.20 | 0.30 | 0.13 |
| 151 | | | | | | | | |
| 152 | 0.63 | 0.34 | 0.43 | 0.23 | 0.34 | 0.18 | 0.23 | 0.12 |
| 153 | | | | | | | | |
| 154 | 0.57 | 0.31 | 0.33 | 0.19 | 0.32 | 0.18 | 0.18 | 0.11 |
| 155 | | | | | | | | |
| 156 | 0.53 | 0.32 | 0.30 | 0.18 | 0.37 | 0.22 | 0.21 | 0.13 |
| 157 | | | | | | | | |
| 158 | 0.47 | 0.26 | 0.27 | 0.16 | 0.27 | 0.15 | 0.15 | 0.09 |
| 159 | | | | | | | | |
| 160 | 0.50 | 0.30 | 0.31 | 0.18 | 0.26 | 0.16 | 0.16 | 0.10 |
| 161 | | | | | | | | |
| 162 | 0.52 | 0.29 | 0.34 | 0.17 | 0.33 | 0.18 | 0.21 | 0.11 |
| 163 | | | | | | | | |
| 164 | 0.51 | 0.29 | 0.32 | 0.18 | 0.31 | 0.16 | 0.19 | 0.10 |
| 165 | | | | | | | | |
| 166 | 0.69 | 0.33 | 0.36 | 0.19 | 0.40 | 0.19 | 0.21 | 0.11 |
| 167 | | | | | | | | |
| 168 | 0.73 | 0.34 | 0.50 | 0.21 | 0.31 | 0.16 | 0.24 | 0.10 |
| 169 | | | | | | | | |
| 170 | | | | | | | | |

Note: All gas volumes measured at 1 atmosphere pressure and 20$^{o}$C.



Table C1: List of parameters measured daily and parameters calculated from (cont) these measured parameters for digester D1

| Day No. | Methane produced per..... | | | | Carbon dioxide produced per... | | | |
|---|---|---|---|---|---|---|---|---|
| | VS remo | VS added | COD re | CODadd | VS remo | VS added | COD re | CODadd |
| | l/g | l/g | l/g | l/g | l/g | l/g | l/g | l/g |
| 171 | | | | | | | | |
| 172 | 1.14 | 0.37 | 0.80 | 0.24 | 0.60 | 0.20 | 0.42 | 0.13 |
| 173 | | | | | | | | |
| 174 | 1.00 | 0.37 | 0.75 | 0.23 | 0.55 | 0.20 | 0.41 | 0.13 |
| 175 | | | | | | | | |
| 176 | 1.45 | 0.40 | 1.13 | 0.25 | 0.83 | 0.23 | 0.65 | 0.14 |
| 177 | | | | | | | | |
| 178 | 0.96 | 0.35 | 0.65 | 0.21 | 0.54 | 0.20 | 0.37 | 0.12 |
| 179 | 0.86 | 0.32 | 0.63 | 0.20 | 0.48 | 0.18 | 0.35 | 0.11 |
| 180 | | | | | | | | |
| 181 | 0.80 | 0.34 | 0.59 | 0.21 | 0.43 | 0.18 | 0.32 | 0.11 |
| 182 | 0.79 | 0.33 | 0.45 | 0.20 | 0.42 | 0.17 | 0.24 | 0.11 |
| 183 | 0.74 | 0.33 | 0.48 | 0.21 | 0.40 | 0.18 | 0.27 | 0.12 |
| 184 | 0.72 | 0.32 | 0.44 | 0.20 | 0.40 | 0.18 | 0.24 | 0.11 |
| 185 | 0.45 | 0.21 | 0.35 | 0.15 | 0.21 | 0.10 | 0.17 | 0.07 |
| 186 | 0.50 | 0.22 | 0.37 | 0.14 | 0.29 | 0.13 | 0.22 | 0.08 |
| 187 | 0.57 | 0.19 | 0.42 | 0.11 | 0.33 | 0.11 | 0.25 | 0.07 |
| 188 | 0.82 | 0.20 | 0.60 | 0.13 | 0.49 | 0.12 | 0.36 | 0.08 |
| 189 | 0.65 | 0.18 | 0.47 | 0.11 | 0.32 | 0.09 | 0.23 | 0.05 |
| 190 | 2.65 | 0.99 | 1.84 | 0.62 | 1.24 | 0.46 | 0.86 | 0.29 |
| 191 | 1.83 | 0.74 | 1.21 | 0.45 | 0.79 | 0.32 | 0.52 | 0.19 |
| 192 | 1.81 | 0.74 | 1.12 | 0.45 | 0.64 | 0.26 | 0.40 | 0.16 |
| 193 | 1.81 | 0.76 | 0.98 | 0.44 | 0.60 | 0.25 | 0.32 | 0.15 |
| 194 | | | | | | | | |
| 195 | | | | | | | | |
| 196 | | | | | | | | |
| 197 | 0.63 | 0.26 | 0.41 | 0.16 | 0.31 | 0.13 | 0.20 | 0.08 |
| 198 | 0.79 | 0.33 | 0.46 | 0.21 | 0.38 | 0.16 | 0.22 | 0.10 |
| 199 | 1.02 | 0.41 | 0.63 | 0.25 | 0.48 | 0.19 | 0.30 | 0.12 |
| 200 | 0.88 | 0.37 | 0.49 | 0.22 | 0.45 | 0.19 | 0.25 | 0.12 |
| 201 | 0.72 | 0.30 | 0.44 | 0.17 | 0.37 | 0.15 | 0.23 | 0.09 |
| 202 | 0.77 | 0.32 | 0.43 | 0.19 | 0.38 | 0.16 | 0.21 | 0.09 |
| 203 | 0.82 | 0.33 | 0.66 | 0.21 | 0.41 | 0.17 | 0.34 | 0.11 |
| 204 | 0.86 | 0.35 | 0.68 | 0.23 | 0.38 | 0.16 | 0.30 | 0.10 |
| 205 | 0.81 | 0.34 | 0.74 | 0.24 | 0.41 | 0.17 | 0.37 | 0.12 |
| 206 | 0.74 | 0.32 | 0.42 | 0.18 | 0.38 | 0.17 | 0.21 | 0.09 |
| 207 | 0.30 | 0.13 | | 0.08 | 0.15 | 0.06 | | 0.04 |
| 208 | 0.90 | 0.38 | | | 0.44 | 0.18 | | |
| 209 | 0.87 | 0.36 | 0.47 | 0.20 | 0.46 | 0.19 | 0.25 | 0.11 |
| 210 | | | | | | | | |

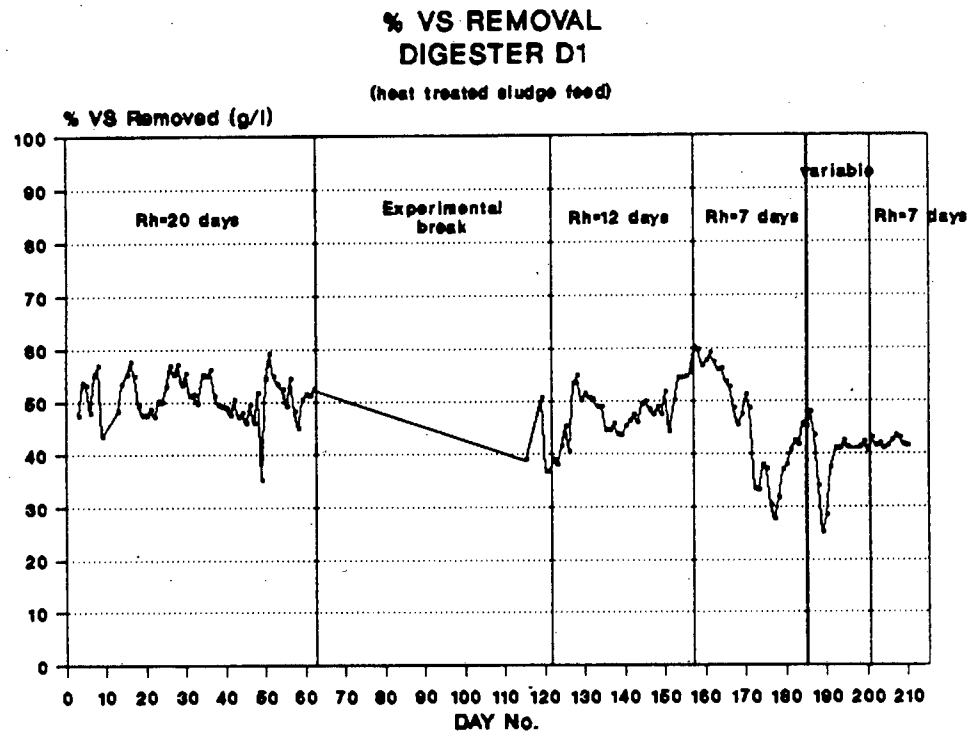


*Figure C1*: *Graph showing the day-to-day % VS removed in digester D1 for the period day 1 to day 211.*

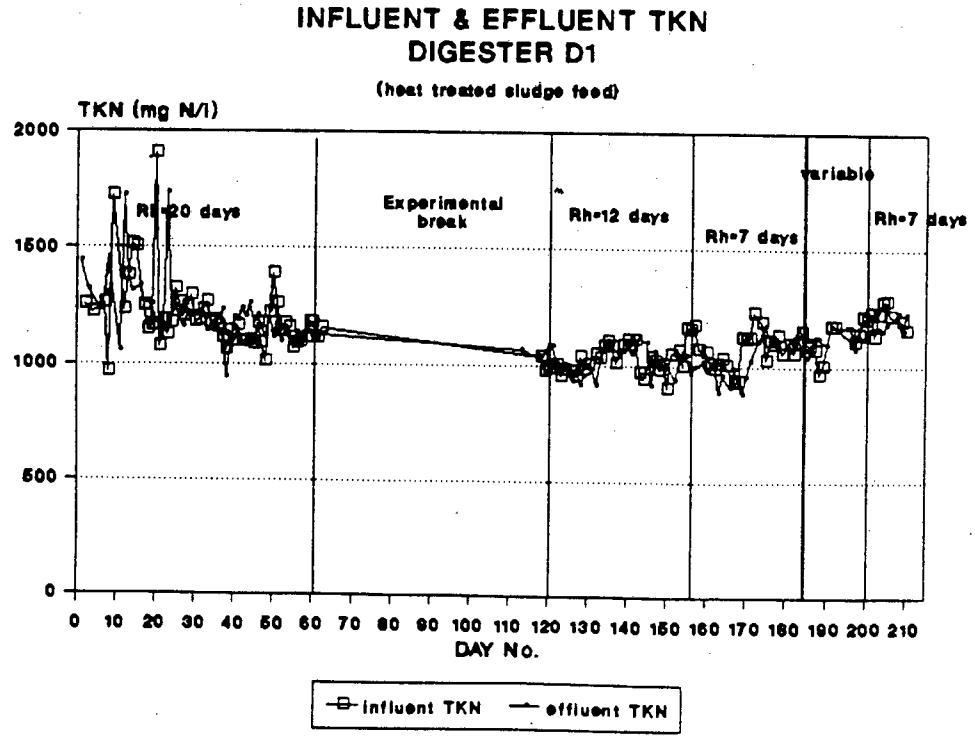


*Figure C2*: *Graph showing the day-to-day influent and effluent TKN in digester D1 for the period day 1 to day 211.*

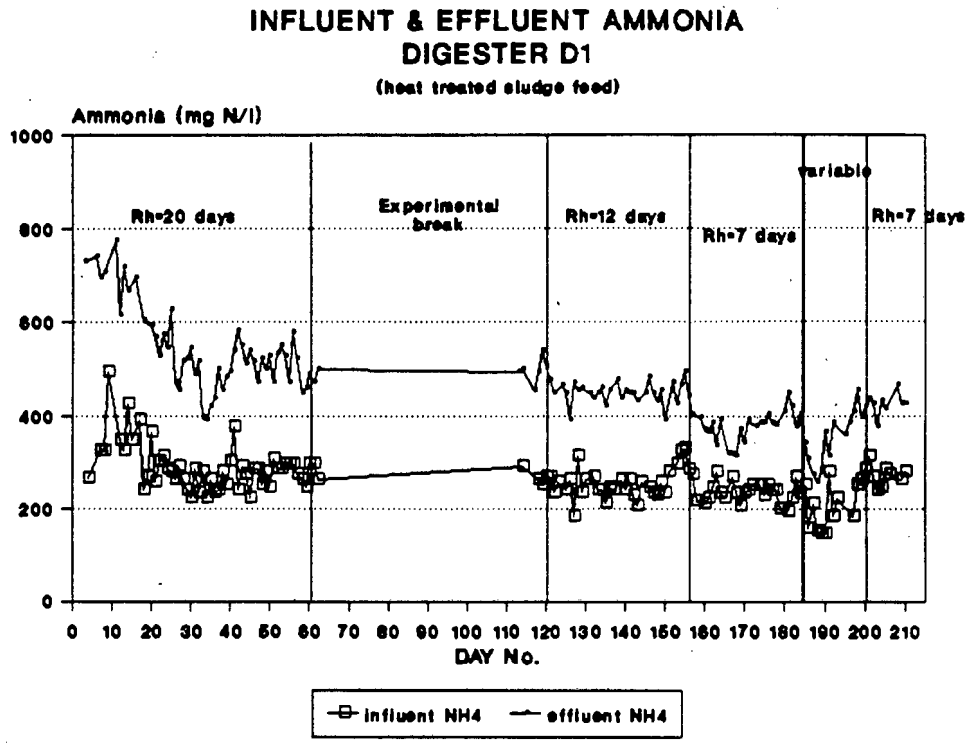


*Figure C3*: *Graph showing the day-to-day influent and effluent free and saline ammonia concentration in digester D1 for the period day 1 to day 211.*

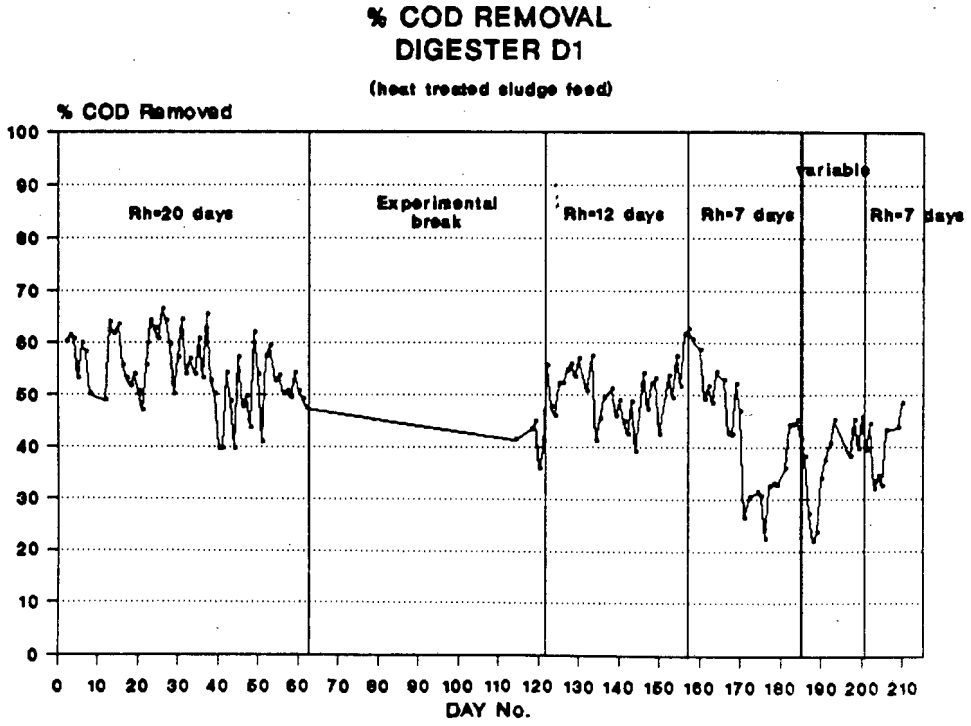


*Figure C4*: *Graph showing the day-to-day % COD removed in digester D1 for the period day 1 to day 211.*

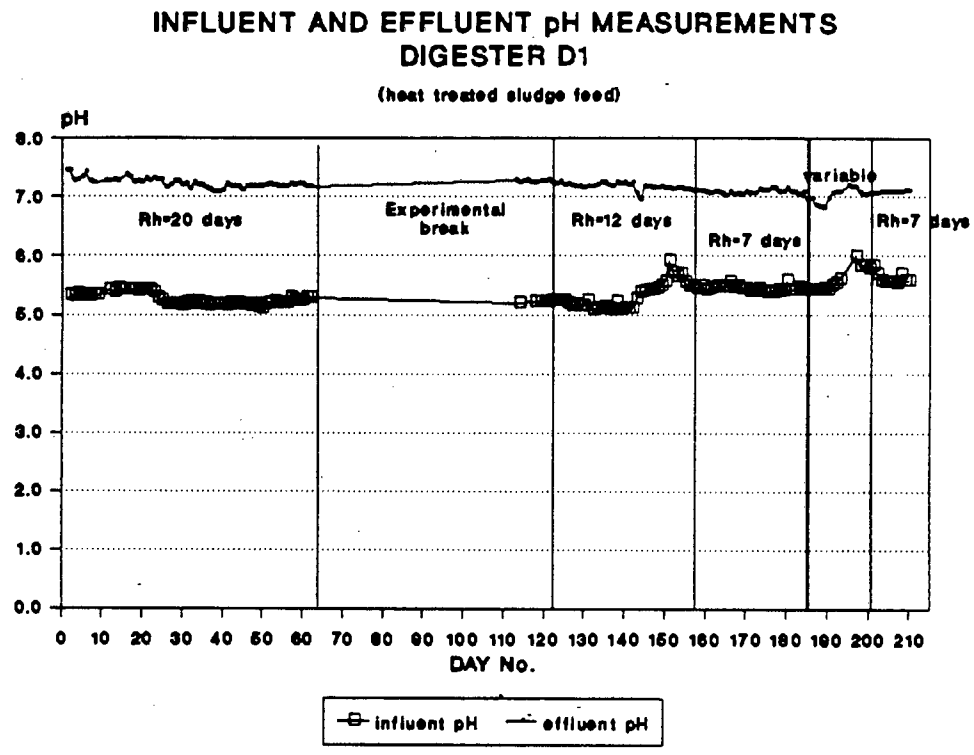


*Figure C5*: *Graph showing the day-to-day influent and effluent pH for digester D1 during the period day 1 to day 211.*

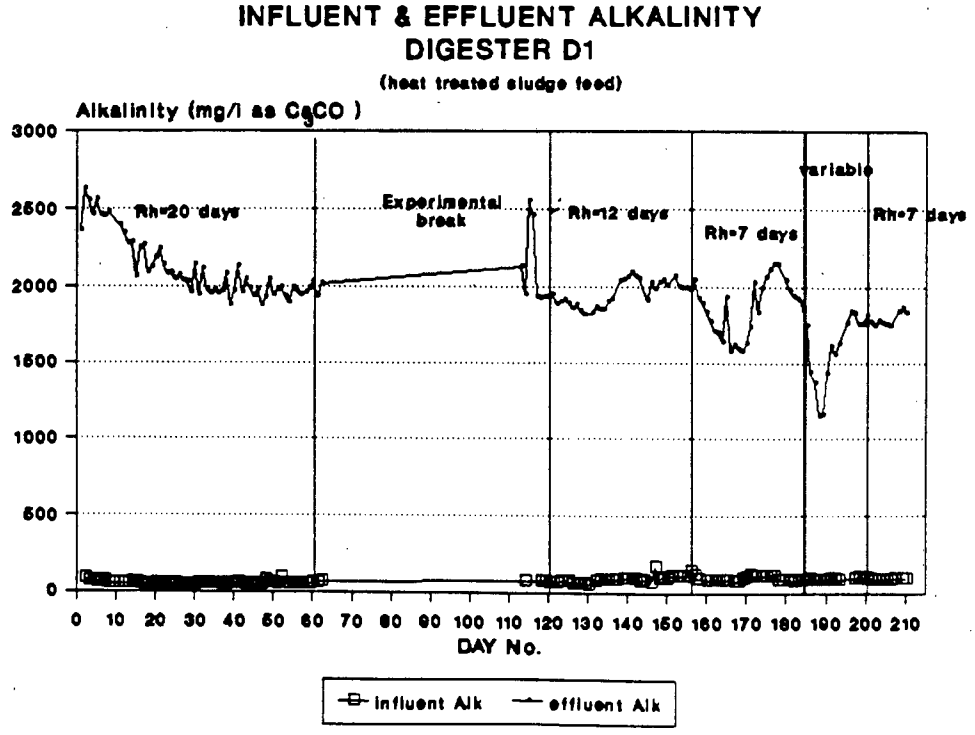


*Figure C6*: *Graph showing the day-to-day influent and effluent $H_2CO_3^*$ alkalinities for digester D1 during the period day 1 to day 211.*

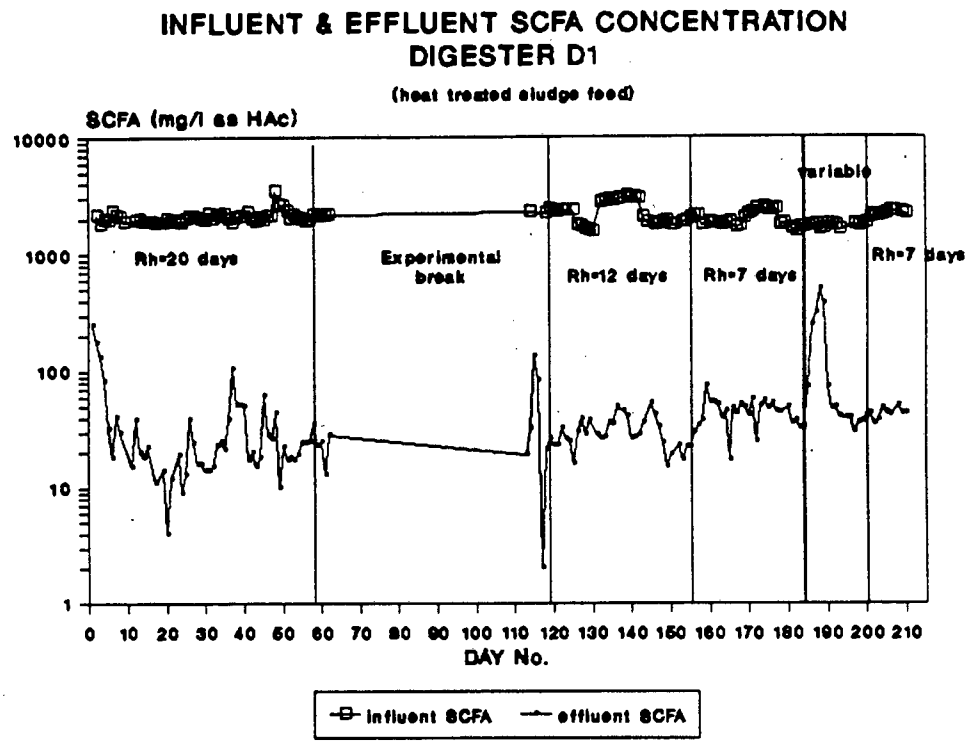


*Figure C7*: *Graph showing the day-to-day influent and effluent SCFA concentrations for digester D1 during the period day 1 to day 211.*

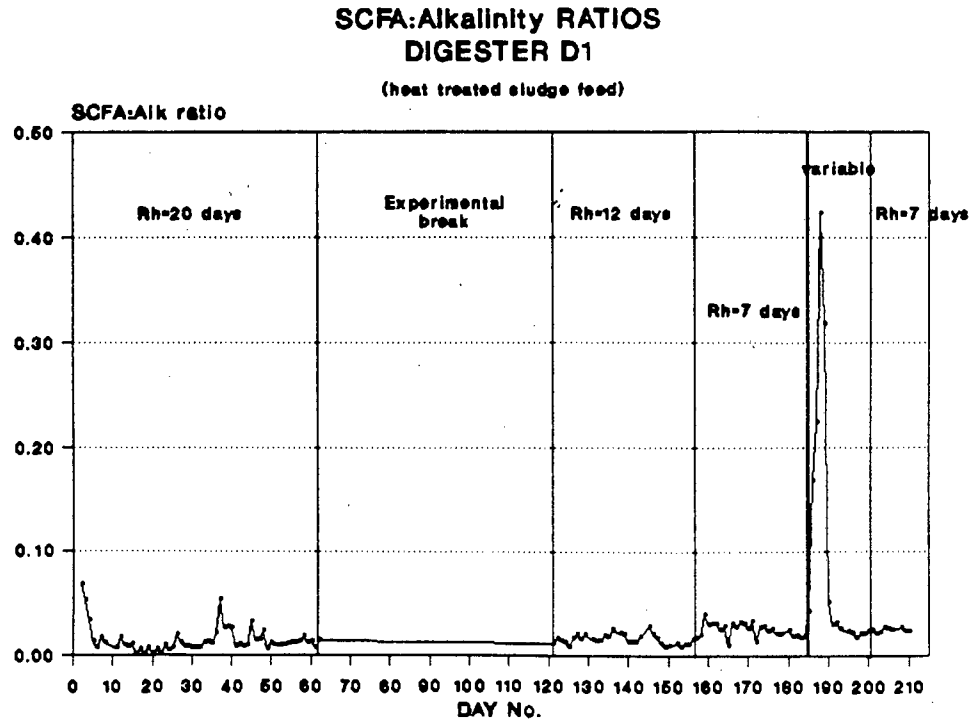


*Figure C8*: *Graph showing the day-to-day SCFA:alk ratios in digester D1 for the period day 1 to day 211.*

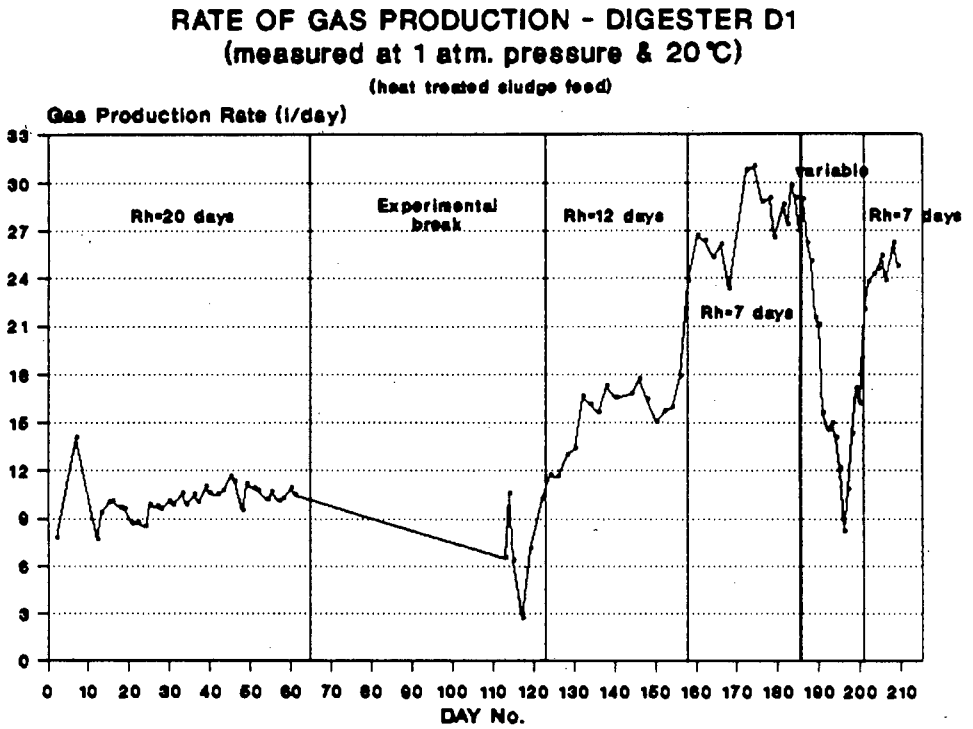


*Figure C9*: *Graph showing the day-to-day gas production rates in digester D1 for the period day 1 to day 211.*

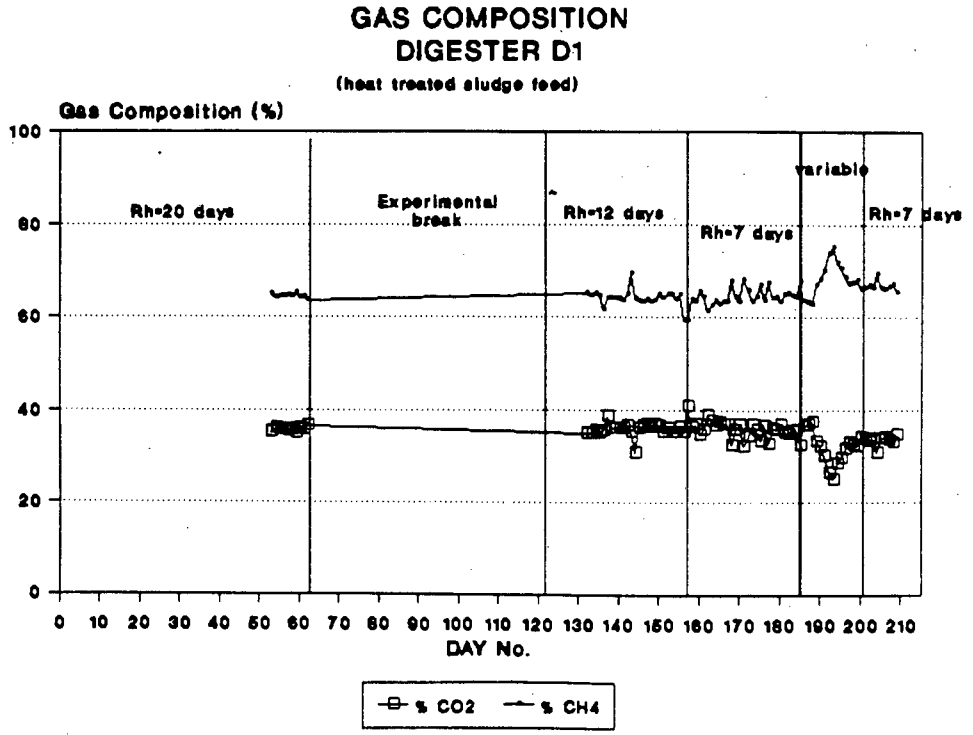


*Figure C10*: *Graph showing the day-to-day gas composition (% carbon dioxide and % methane) for digester D1 during the period day 1 to day 211.*

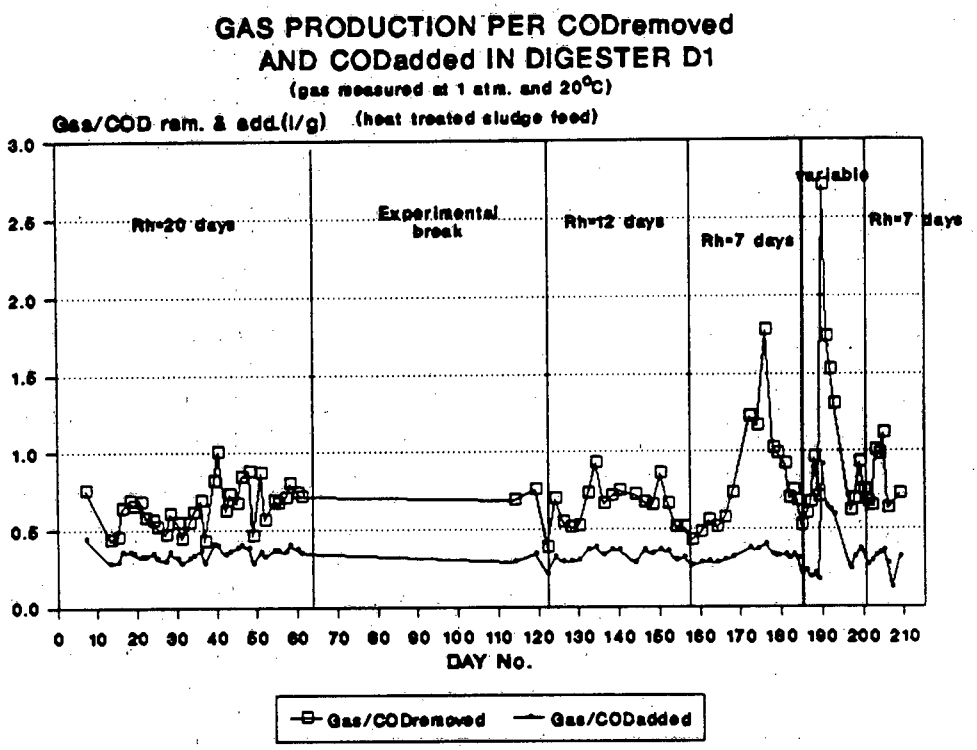


*Figure C11*: *Graph showing the day-to-day gas production per mass of COD removed and COD added for digester D1 during the period day 1 to day 211.*

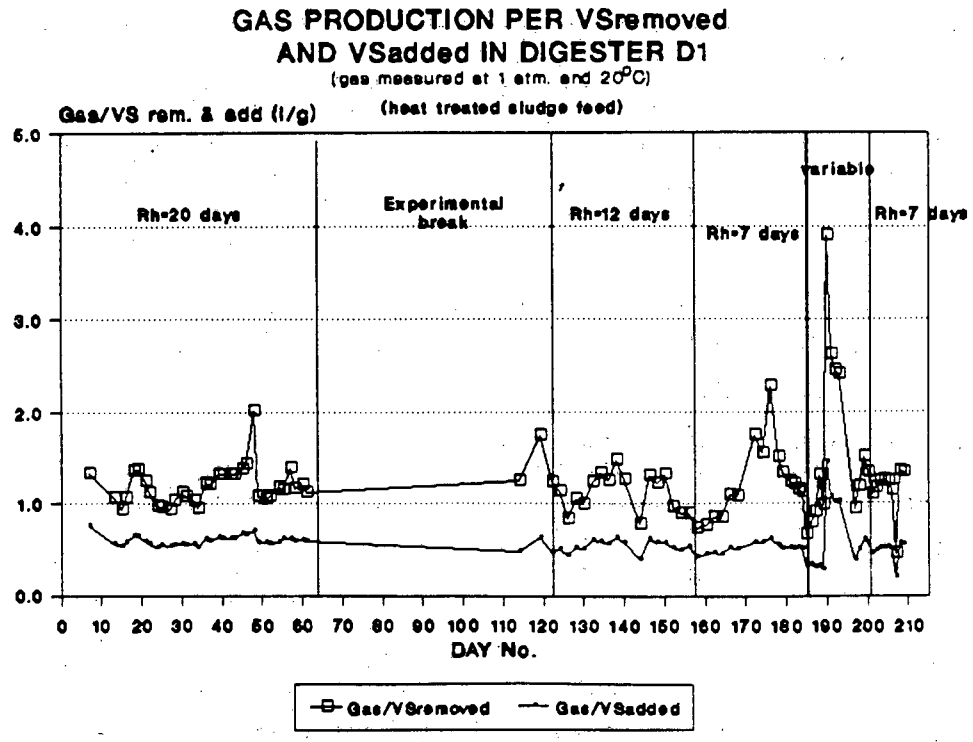


*Figure C12*: *Graph showing the day-to-day gas production per mass of VS removed and VS added for digester D1 during the period day 1 to day 211.*

Table C2: List of parameters measured daily and parameters calculated from these measured parameters for digester D2

| Day No. | Volume Feed | Total Solids | | Volatile Solids | | | | |
|---|---|---|---|---|---|---|---|---|
| | | influent | effluent | influent | added | effluent | removed | removed |
| | (l/day) | (g/l) | (g/l) | (g/l) | (g/day) | (g/l) | (g/l) | (%) |
| 1 | 0.96 | | | | | | | |
| 2 | 0.96 | 26.566 | 14.920 | 21.196 | 20348 | 10.862 | 9921 | 48.8 |
| 3 | 0.96 | 28.722 | 14.716 | 23.272 | 22341 | 10.864 | 11912 | 53.3 |
| 4 | 0.96 | 28.716 | 14.798 | 23.356 | 22422 | 10.764 | 12088 | 53.9 |
| 5 | 0.96 | 27.488 | 15.546 | 22.182 | 21295 | 11.422 | 10330 | 48.5 |
| 6 | 0.96 | 31.062 | 15.530 | 25.354 | 24340 | 11.408 | 13388 | 55.0 |
| 7 | 0.96 | 32.230 | 15.708 | 26.354 | 25300 | 11.338 | 14415 | 57.0 |
| 8 | 0.96 | 24.384 | 16.226 | 19.612 | 18828 | 11.664 | 7630 | 40.5 |
| 9 | 0.96 | 26.412 | | 21.320 | 20467 | | 20467 | |
| 10 | 0.96 | | | | | | | |
| 11 | 0.96 | | 15.992 | | | 11.448 | | |
| 12 | 0.96 | 25.886 | 15.516 | 20.982 | 20143 | 11.012 | 9571 | 47.5 |
| 13 | 0.96 | 28.860 | 16.038 | 23.482 | 22543 | 11.448 | 11553 | 51.2 |
| 14 | 0.96 | 29.412 | 15.794 | 24.084 | 23121 | 11.258 | 12313 | 53.3 |
| 15 | 0.96 | 32.436 | 16.142 | 26.526 | 25465 | 11.522 | 14404 | 56.6 |
| 16 | 0.96 | 30.198 | 16.028 | 24.642 | 23656 | 11.588 | 12532 | 53.0 |
| 17 | 0.96 | 27.330 | 16.564 | 22.278 | 21387 | 11.872 | 9990 | 46.7 |
| 18 | 0.96 | 26.252 | 16.392 | 21.346 | 20492 | 11.662 | 9297 | 45.4 |
| 19 | 0.96 | 26.068 | 16.302 | 21.206 | 20358 | 11.544 | 9276 | 45.6 |
| 20 | 0.96 | 26.166 | 15.860 | 21.162 | 20316 | 11.202 | 9562 | 47.1 |
| 21 | 0.96 | 25.910 | 16.360 | 21.040 | 20198 | 11.560 | 9101 | 45.1 |
| 22 | 0.96 | 27.154 | 16.334 | 22.246 | 21356 | 11.608 | 10212 | 47.8 |
| 23 | 0.96 | 27.292 | 16.342 | 22.214 | 21325 | 11.536 | 10251 | 48.1 |
| 24 | 0.96 | 29.422 | 16.640 | 23.656 | 22710 | 11.824 | 11359 | 50.0 |
| 25 | 0.96 | 30.900 | 16.460 | 25.510 | 24490 | 11.610 | 13344 | 54.5 |
| 26 | 0.96 | 31.012 | 16.510 | 25.118 | 24113 | 11.770 | 12814 | 53.1 |
| 27 | 0.96 | 31.736 | 16.398 | 26.188 | 25140 | 11.750 | 13860 | 55.1 |
| 28 | 0.96 | 30.036 | 17.206 | 24.896 | 23900 | 12.498 | 11902 | 49.8 |
| 29 | 0.96 | 31.520 | 16.982 | 26.098 | 25054 | 12.154 | 13386 | 53.4 |
| 30 | 0.96 | 30.636 | 18.274 | 25.210 | 24202 | 13.432 | 11307 | 46.7 |
| 31 | 0.96 | 30.708 | 17.812 | 25.236 | 24227 | 12.980 | 11766 | 48.6 |
| 32 | 0.96 | 31.312 | 17.914 | 25.706 | 24678 | 13.052 | 12148 | 49.2 |
| 33 | 0.96 | 32.012 | 17.374 | 26.448 | 25390 | 12.338 | 13546 | 53.3 |
| 34 | 0.96 | 32.912 | 17.196 | 26.886 | 25811 | 12.414 | 13893 | 53.8 |
| 35 | 0.96 | 33.232 | 17.198 | 27.274 | 26183 | 12.786 | 13908 | 53.1 |
| 36 | 0.96 | 30.276 | 17.344 | 24.156 | 23190 | 12.636 | 11059 | 47.7 |
| 37 | 0.96 | 29.880 | 17.918 | 24.248 | 23278 | 13.088 | 10714 | 46.0 |
| 38 | 0.96 | 29.856 | 18.894 | 24.500 | 23520 | 13.802 | 10270 | 43.7 |
| 39 | 0.96 | 30.154 | 16.636 | 24.610 | 23626 | 12.082 | 12027 | 50.9 |
| 40 | 0.96 | 29.236 | 18.822 | 24.220 | 23251 | 13.612 | 10181 | 43.8 |



Table C2: (cont.) List of parameters measured daily and parameters calculated from these measured parameters for digester D2

| Day No. | Volume Feed | Total Solids | | Volatile Solids | | | | |
|---|---|---|---|---|---|---|---|---|
| | | influent | effluent | influent | added | effluent | removed | removed |
| | (l/day) | (g/l) | (g/l) | (g/l) | (g/day) | (g/l) | (g/l) | (%) |
| 41 | 0.96 | 31.360 | 18.548 | 25.972 | 24933 | 13.414 | 12056 | 48.4 |
| 42 | 0.96 | 29.732 | 18.846 | 24.164 | 23197 | 13.598 | 10143 | 43.7 |
| 43 | 0.96 | 29.554 | 18.290 | 24.456 | 23478 | 13.270 | 10739 | 45.7 |
| 44 | 0.96 | 28.758 | 18.382 | 23.582 | 22639 | 13.548 | 9633 | 42.5 |
| 45 | 0.96 | 29.516 | 18.332 | 24.458 | 23480 | 13.238 | 10771 | 45.9 |
| 46 | 0.96 | 29.448 | 18.690 | 24.438 | 23460 | 13.622 | 10383 | 44.3 |
| 47 | 0.96 | 30.600 | 17.492 | 25.442 | 24424 | 12.816 | 12121 | 49.6 |
| 48 | 0.96 | 23.712 | 17.892 | 19.190 | 18422 | 13.048 | 5896 | 32.0 |
| 49 | 0.96 | 32.646 | 17.940 | 27.254 | 26164 | 13.086 | 13601 | 52.0 |
| 50 | 0.96 | 37.052 | 17.560 | 30.870 | 29635 | 12.836 | 17313 | 58.4 |
| 51 | 0.96 | 32.672 | 18.260 | 27.206 | 26118 | 13.328 | 13323 | 51.0 |
| 52 | 0.96 | 32.628 | 18.500 | 26.932 | 25855 | 13.608 | 12791 | 49.5 |
| 53 | 0.96 | 33.158 | 18.900 | 27.484 | 26385 | 13.900 | 13041 | 49.4 |
| 54 | 0.96 | 30.380 | 18.764 | 25.154 | 24148 | 13.812 | 10888 | 45.1 |
| 55 | 0.96 | 29.498 | 18.408 | 24.352 | 23378 | 13.452 | 10464 | 44.8 |
| 56 | 0.96 | 29.590 | 18.296 | 24.552 | 23570 | 13.486 | 10623 | 45.1 |
| 57 | 0.96 | 30.394 | 18.532 | 23.026 | 22105 | 13.636 | 9014 | 40.8 |
| 58 | 0.96 | 29.862 | 18.114 | 24.940 | 23942 | 13.408 | 11071 | 46.2 |
| 59 | 0.96 | 30.268 | 17.830 | 25.346 | 24332 | 13.100 | 11756 | 48.3 |
| 60 | 0.96 | 30.336 | 17.768 | 25.354 | 24340 | 13.122 | 11743 | 48.2 |
| 61 | 0.96 | 30.628 | 18.226 | 25.476 | 24457 | 13.138 | 11844 | 48.4 |
| 62 | 0.96 | 32.370 | 17.266 | 26.426 | 25369 | 12.374 | 13490 | 53.2 |
| | | | | | | | | |
| 113 | 1.4 | | 15.022 | | | 12.034 | | |
| 114 | 1.4 | | 16.518 | | | 12.186 | | |
| 115 | 0 | 22.726 | | 18.852 | | | | |
| 116 | 0.7 | | | | | | | |
| 117 | 0.7 | | 16.506 | | | 12.084 | | |
| 118 | 0.7 | | 16.752 | | | 12.008 | | |
| 119 | 0.7 | 23.286 | 16.666 | 19.184 | 26132 | 12.122 | 4943 | 36.8 |
| 120 | 0.7 | 22.466 | 16.318 | 18.530 | 26132 | 11.998 | 4572 | 35.3 |
| 121 | 1.4 | 22.512 | 15.868 | 18.666 | 26132 | 11.676 | 9786 | 37.4 |
| 122 | 1.4 | 23.024 | 16.054 | 19.094 | 26732 | 11.784 | 10234 | 38.3 |
| 123 | 1.4 | 22.950 | 15.458 | 18.802 | 26323 | 11.340 | 10447 | 39.7 |
| 124 | 1.4 | 24.020 | 15.168 | 19.690 | 27566 | 11.086 | 12046 | 43.7 |
| 125 | 1.4 | 21.931 | 14.960 | 17.721 | 24809 | 10.902 | 9547 | 38.5 |
| 126 | 1.4 | 28.640 | 14.984 | 22.638 | 31693 | 10.948 | 16366 | 51.6 |
| 127 | 1.4 | 27.696 | 14.328 | 22.330 | 31262 | 10.470 | 16604 | 53.1 |
| 128 | 1.4 | 27.978 | 14.834 | 21.326 | 29856 | 10.876 | 14630 | 49.0 |
| 129 | 1.4 | 28.448 | 15.216 | 22.738 | 31833 | 11.420 | 15845 | 49.8 |
| 130 | 1.4 | 28.756 | 15.626 | 23.108 | 32351 | 11.604 | 16106 | 49.8 |

Table C2: List of parameters measured daily and parameters calculated from (cont.) these measured parameters for digester D2

| Day No. | Volume Feed | Total Solids | | Volatile Solids | | | | |
|---|---|---|---|---|---|---|---|---|
| | | influent | effluent | influent | added | effluent | removed | removed |
| | (l/day) | (g/l) | (g/l) | (g/l) | (g/day) | (g/l) | (g/l) | (%) |
| 131 | 1.4 | 28.518 | 15.982 | 23.328 | 32659 | 11.816 | 16117 | 49.3 |
| 132 | 1.4 | 29.030 | 16.374 | 23.850 | 33390 | 12.106 | 16442 | 49.2 |
| 133 | 1.4 | 30.392 | 16.784 | 24.084 | 33718 | 12.378 | 16388 | 48.6 |
| 134 | 1.4 | 28.472 | 17.156 | 23.484 | 32878 | 12.708 | 15086 | 45.9 |
| 135 | 1.4 | 28.238 | 17.786 | 23.204 | 32486 | 13.276 | 13899 | 42.8 |
| 136 | 1.4 | 28.870 | 17.606 | 23.870 | 33418 | 12.942 | 15299 | 45.8 |
| 137 | 1.4 | 28.140 | 17.554 | 23.092 | 32329 | 13.228 | 13810 | 42.7 |
| 138 | 1.4 | 28.496 | 17.892 | 23.490 | 32886 | 13.376 | 14160 | 43.1 |
| 139 | 1.4 | 28.934 | 17.694 | 23.742 | 33239 | 13.176 | 14792 | 44.5 |
| 140 | 1.4 | 29.998 | 17.532 | 24.422 | 34191 | 13.094 | 15859 | 46.4 |
| 141 | 1.4 | 29.040 | 17.350 | 23.946 | 33524 | 12.946 | 15400 | 45.9 |
| 142 | 1.4 | 29.534 | 17.458 | 24.238 | 33933 | 12.922 | 15842 | 46.7 |
| 143 | 1.4 | 29.598 | 17.436 | 24.248 | 33947 | 12.966 | 15795 | 46.5 |
| 144 | 1.4 | 28.788 | 17.360 | 23.864 | 33410 | 12.838 | 15436 | 46.2 |
| 145 | 1.4 | 29.390 | 17.238 | 24.440 | 34216 | 12.814 | 16276 | 47.6 |
| 146 | 1.4 | 29.554 | 17.098 | 24.662 | 34527 | 12.610 | 16873 | 48.9 |
| 147 | 1.4 | 30.324 | 16.866 | 25.246 | 35344 | 12.498 | 17847 | 50.5 |
| 148 | 1.4 | 29.508 | 16.738 | 24.598 | 34437 | 12.658 | 16716 | 48.5 |
| 149 | 1.4 | 29.366 | 16.476 | 24.580 | 34412 | 12.274 | 17228 | 50.1 |
| 150 | 1.4 | 26.730 | 16.268 | 22.324 | 31254 | 12.090 | 14328 | 45.8 |
| 151 | 1.4 | 30.856 | 16.512 | 25.578 | 35809 | 12.256 | 18651 | 52.1 |
| 152 | 1.4 | 32.974 | 15.618 | 27.408 | 38371 | 11.502 | 22268 | 58.0 |
| 153 | 1.4 | 33.374 | 16.214 | 27.734 | 38828 | 12.022 | 21997 | 56.7 |
| 154 | 1.4 | 33.806 | 17.094 | 28.110 | 39354 | 12.684 | 21596 | 54.9 |
| 155 | 1.4 | 33.668 | 17.000 | 28.090 | 39326 | 12.644 | 21624 | 55.0 |
| 156 | 1.4 | 33.206 | 17.342 | 27.752 | 38853 | 12.870 | 20835 | 53.6 |
| 157 | 1.4 | 34.220 | 17.718 | 28.278 | 39589 | 13.120 | 21221 | 53.6 |
| 158 | 1.4 | 34.010 | 17.848 | 28.028 | 39239 | 13.200 | 20759 | 52.9 |
| 159 | 1.4 | 35.132 | 18.318 | 28.932 | 40505 | 13.614 | 21445 | 52.9 |
| 160 | 1.4 | 34.152 | 18.358 | 28.040 | 39256 | 13.574 | 20252 | 51.6 |
| 161 | 1.4 | 34.026 | 18.916 | 27.934 | 39108 | 14.110 | 19354 | 49.5 |
| 162 | 1.4 | 33.736 | 18.302 | 27.726 | 38816 | 13.518 | 19891 | 51.2 |
| 163 | 1.4 | 34.102 | 18.552 | 28.002 | 39203 | 13.804 | 19877 | 50.7 |
| 164 | 1.4 | 30.934 | 18.830 | 25.508 | 35711 | 13.902 | 16248 | 45.5 |
| 165 | 1.4 | 28.132 | 18.600 | 23.042 | 32259 | 13.762 | 12992 | 40.3 |
| 166 | 1.4 | 28.390 | 18.428 | 23.296 | 32614 | 13.890 | 13168 | 40.4 |
| 167 | 1.4 | 28.090 | 17.732 | 23.334 | 32668 | 13.192 | 14199 | 43.5 |
| 168 | 1.4 | 31.040 | 18.074 | 26.120 | 36568 | 13.190 | 18102 | 49.5 |
| 169 | 1.4 | 31.426 | 18.292 | 26.088 | 36523 | 13.544 | 17562 | 48.1 |
| 170 | 1.4 | 31.300 | 17.472 | 25.882 | 36235 | 13.102 | 17892 | 49.4 |

Table C2: List of parameters measured daily and parameters calculated from (cont.) these measured parameters for digester D2

| Day No. | Volume Feed | Total Solids | | Volatile Solids | | | | |
|---|---|---|---|---|---|---|---|---|
| | | influent | effluent | influent | added | effluent | removed | removed |
| | (l/day) | (g/l) | (g/l) | (g/l) | (g/day) | (g/l) | (g/l) | (%) |
| 171 | 1.4 | 33.756 | 17.866 | 27.464 | 38450 | 13.262 | 19883 | 51.7 |
| 172 | 1.4 | 33.758 | 17.972 | 27.046 | 37864 | 13.420 | 19076 | 50.4 |
| 173 | 1.4 | 33.050 | 17.516 | 26.710 | 37394 | 13.144 | 18992 | 50.8 |
| 174 | 1.4 | 26.434 | 16.964 | 22.070 | 30898 | 12.734 | 13070 | 42.3 |
| 175 | 1.4 | 26.546 | 16.886 | 22.168 | 31035 | 12.674 | 13292 | 42.8 |
| 176 | 1.4 | 26.774 | 17.234 | 22.414 | 31380 | 12.908 | 13308 | 42.4 |
| 177 | 1.4 | 34.746 | 17.554 | 29.204 | 40886 | 13.182 | 22431 | 54.9 |
| 178 | 1.4 | 31.682 | 17.868 | 26.464 | 37050 | 13.556 | 18071 | 48.8 |
| 179 | 1.4 | 32.028 | 17.852 | 26.874 | 37624 | 13.576 | 18617 | 49.5 |
| 180 | 1.4 | 33.264 | 17.812 | 28.020 | 39228 | 13.258 | 20667 | 52.7 |

Table C2: List of parameters measured daily and parameters calculated from (cont) these measured parameters for digester D2

| Day No. | Non-volatile Solids | | | TKN | | Ammonia | |
|---|---|---|---|---|---|---|---|
| | influent | effluent | removed | influent | effluent | influent | effluent |
| | (g/l) | (g/l) | (%) | (mg/l) | (mg/l) | (mg/l) | (mg/l) |
| 1 | | | | | | | |
| 2 | 5.370 | 4.058 | 24.4 | 252 | | | |
| 3 | 5.450 | 3.852 | 29.3 | | 1579 | | 767 |
| 4 | 5.360 | 4.034 | 24.7 | 1220.8 | | 266 | |
| 5 | 5.306 | 4.124 | 22.3 | | | | |
| 6 | 5.708 | 4.122 | 27.8 | | 1299 | | 784 |
| 7 | 5.876 | 4.370 | 25.6 | 1260 | 1624 | 324.8 | 739 |
| 8 | 4.772 | 4.562 | 4.4 | 963.2 | 1344 | 324.8 | 638 |
| 9 | 5.092 | | | 1724.8 | | 492.8 | |
| 10 | | | | | | | |
| 11 | | 4.544 | | | | | 683 |
| 12 | 4.904 | 4.504 | 8.2 | 1232 | 930 | 347.2 | 599 |
| 13 | 5.378 | 4.590 | 14.7 | 1377.6 | 1366 | 324.8 | 678 |
| 14 | 5.328 | 4.536 | 14.9 | 1512 | 1277 | 425.6 | 605 |
| 15 | 5.910 | 4.620 | 21.8 | 1500.8 | | 347.2 | |
| 16 | 5.556 | 4.440 | 20.1 | | 1288 | | 588 |
| 17 | 5.052 | 4.692 | 7.1 | 1249 | 2100 | 392 | 521 |
| 18 | 4.906 | 4.730 | 3.6 | 1142 | 1232 | 241 | |
| 19 | 4.862 | 4.758 | 2.1 | 1165 | 599 | 269 | 560 |
| 20 | 5.004 | 4.658 | 6.9 | 1904 | 1758 | 364 | 532 |
| 21 | 4.900 | 4.800 | 2.0 | 1070 | 1557 | 258 | 599 |
| 22 | 4.908 | 4.726 | 3.7 | 1187 | 1456 | 302 | 627 |
| 23 | 5.078 | 4.806 | 5.4 | 1120 | 1215 | 314 | 560 |
| 24 | 5.766 | 4.816 | 16.5 | 1176 | 1478 | 286 | 532 |
| 25 | 5.390 | 4.850 | 10.0 | 1322 | 1383 | 280 | 571 |
| 26 | 5.894 | 4.740 | 19.6 | 1260 | 1137 | 263 | 476 |
| 27 | 5.548 | 4.648 | 16.2 | 1204 | 1215 | 291 | 420 |
| 28 | 5.150 | 4.708 | 8.6 | 1243 | 1210 | 263 | 510 |
| 29 | 5.422 | 4.828 | 11.0 | 1294 | 1170 | 241 | 532 |
| 30 | 5.426 | 4.842 | 10.8 | 1182 | 1187 | 224 | 526 |
| 31 | 5.472 | 4.832 | 11.7 | 1187 | 1198 | 286 | 493 |
| 32 | 5.606 | 4.892 | 12.7 | 1232 | 1204 | 235 | 504 |
| 33 | 5.564 | 5.036 | 9.5 | 1266 | 1086 | 280 | 426 |
| 34 | 6.056 | 4.782 | 21.0 | 1176 | 1142 | 224 | 420 |
| 35 | 5.958 | 4.712 | 20.9 | 1187 | 1254 | 263 | 459 |
| 36 | 6.120 | 4.708 | 23.1 | 1165 | 1131 | 235 | 431 |
| 37 | 5.632 | 4.830 | 14.2 | 1109 | 1148 | 241 | 493 |
| 38 | 5.356 | 5.092 | 4.9 | 1058 | 980 | 280 | 442 |
| 39 | 5.544 | 4.554 | 17.9 | 1137 | 1042 | 252 | 493 |
| 40 | 5.016 | 5.210 | -3.9 | 1092 | 1137 | 302 | 487 |

Table C2: List of parameters measured daily and parameters calculated from (cont) these measured parameters for digester D2

| Day No. | Non-volatile Solids | | | TKN | | Ammonia | |
|---|---|---|---|---|---|---|---|
| | influent | effluent | removed | influent | effluent | influent | effluent |
| | (g/l) | (g/l) | (%) | (mg/l) | (mg/l) | (mg/l) | (mg/l) |
| 41 | 5.388 | 5.134 | 4.7 | 1165 | 1165 | 375 | 510 |
| 42 | 5.568 | 5.248 | 5.7 | 1092 | 1215 | 241 | 532 |
| 43 | 5.098 | 5.020 | 1.5 | 1092 | 1176 | 291 | 521 |
| 44 | 5.176 | 4.834 | 6.6 | 1098 | 1238 | 274 | 504 |
| 45 | 5.058 | 5.094 | -0.7 | 1081 | 1081 | 224 | 482 |
| 46 | 5.010 | 5.068 | -1.2 | 1176 | 1187 | 286 | 510 |
| 47 | 5.158 | 4.676 | 9.3 | 1086 | 1165 | 286 | 448 |
| 48 | 4.522 | 4.844 | -7.1 | 1008 | 1075 | 252 | 414 |
| 49 | 5.392 | 4.854 | 10.0 | 1221 | 1086 | 280 | 482 |
| 50 | 6.182 | 4.724 | 23.6 | 1389 | 1092 | 246 | 454 |
| 51 | 5.466 | 4.932 | 9.8 | 1260 | 1165 | 308 | 459 |
| 52 | 5.696 | 4.892 | 14.1 | 1137 | 1092 | 286 | 532 |
| 53 | 5.674 | 5.000 | 11.9 | 1176 | 1142 | 286 | 549 |
| 54 | 5.226 | 4.952 | 5.2 | 1154 | 1103 | 297 | 526 |
| 55 | 5.146 | 4.956 | 3.7 | 1064 | 1092 | 297 | 470 |
| 56 | 5.038 | 4.810 | 4.5 | 1086 | 1131 | 297 | 577 |
| 57 | 7.368 | 4.896 | 33.6 | 1092 | 1086 | 274 | 521 |
| 58 | 4.922 | 4.706 | 4.4 | 1109 | 1154 | 263 | 448 |
| 59 | 4.922 | 4.730 | 3.9 | 1182 | 1131 | 246 | 459 |
| 60 | 4.982 | 4.646 | 6.7 | 1182 | 1114 | 297 | 487 |
| 61 | 5.152 | 5.088 | 1.2 | 1109 | 1103 | 297 | 470 |
| 62 | 5.944 | 4.892 | 17.7 | 1159 | 1126 | 263 | 498 |
| | | | | | | | |
| 113 | | 2.988 | | | 1193 | | 549 |
| 114 | | 4.332 | | | | | 370 |
| 115 | 3.874 | | | | | 291.2 | |
| 116 | | | | | | | |
| 117 | | 4.422 | | | 991 | | 566 |
| 118 | | 4.744 | | | 1187 | | 532 |
| 119 | 4.102 | 4.544 | -10.8 | 1036 | 1064 | 263.2 | 538 |
| 120 | 3.936 | 4.320 | -9.8 | 974.4 | 1064 | 252 | 504 |
| 121 | 3.846 | 4.192 | -9.0 | 986 | 1064 | 269 | 504 |
| 122 | 3.930 | 4.270 | -8.7 | 1002 | 1064 | 235 | 504 |
| 123 | 4.148 | 4.118 | 0.7 | 952 | 1042 | 258 | 487 |
| 124 | 4.330 | 4.082 | 5.7 | 980 | 1002 | | 465 |
| 125 | 4.210 | 4.058 | 3.6 | | | 241 | 465 |
| 126 | 6.002 | 4.036 | 32.8 | 974 | 980 | 263 | 437 |
| 127 | 5.366 | 3.858 | 28.1 | 952 | 980 | 185 | 487 |
| 128 | 6.652 | 3.958 | 40.5 | 1036 | 924 | 314 | 465 |
| 129 | 5.710 | 3.796 | 33.5 | 980 | 1002 | 235 | 442 |
| 130 | 5.648 | 4.022 | 28.8 | 1002 | 1232 | 263 | |

Table C2: List of parameters measured daily and parameters calculated from these measured parameters for digester D2 (cont)

| Day No | Non-volatile Solids | | | TKN | | Ammonia | |
|---|---|---|---|---|---|---|---|
| | influent (g/l) | effluent (g/l) | removed (%) | influent (mg/l) | effluent (mg/l) | influent (mg/l) | effluent (mg/l) |
| 131 | 5.190 | 4.166 | 19.7 | | 1019 | | 409 |
| 132 | 5.180 | 4.268 | 17.6 | 1047 | 997 | 269 | 465 |
| 133 | 6.308 | 4.406 | 30.2 | 1030 | 1042 | 241 | 420 |
| 134 | 4.988 | 4.448 | 10.8 | 1081 | 1064 | 241 | 442 |
| 135 | 5.034 | 4.510 | 10.4 | 1103 | 1081 | 213 | 442 |
| 136 | 5.000 | 4.664 | 6.7 | 1081 | 1098 | 246 | 448 |
| 137 | 5.048 | 4.326 | 14.3 | 1008 | | 241 | |
| 138 | 5.006 | 4.516 | 9.8 | | 1081 | | 431 |
| 139 | 5.192 | 4.518 | 13.0 | 1086 | 1086 | 263 | 465 |
| 140 | 5.576 | 4.438 | 20.4 | 1109 | 1086 | 241 | 487 |
| 141 | 5.094 | 4.404 | 13.5 | 1086 | 1086 | 263 | 498 |
| 142 | 5.296 | 4.536 | 14.4 | 1109 | 1081 | 230 | 403 |
| 143 | 5.350 | 4.470 | 16.4 | 969 | 1098 | 207 | 459 |
| 144 | 4.924 | 4.522 | 8.2 | 941 | | 258 | |
| 145 | 4.950 | 4.424 | 10.6 | | 980 | | 459 |
| 146 | 4.892 | 4.488 | 8.3 | 1036 | 963 | 246 | 459 |
| 147 | 5.078 | 4.368 | 14.0 | 1019 | 1047 | 235 | 459 |
| 148 | 4.910 | 4.080 | 16.9 | 980 | 1025 | 230 | 487 |
| 149 | 4.786 | 4.202 | 12.2 | 1002 | 1053 | 258 | 442 |
| 150 | 4.406 | 4.178 | 5.2 | 902 | 1042 | 235 | 381 |
| 151 | 5.278 | 4.256 | 19.4 | | | 202 | |
| 152 | 5.566 | 4.116 | 26.1 | | 952 | | 414 |
| 153 | 5.640 | 4.192 | 25.7 | 1092 | 974 | 258 | 476 |
| 154 | 5.696 | 4.410 | 22.6 | 1137 | 1058 | 218 | 465 |
| 155 | 5.578 | 4.356 | 21.9 | 1148 | 1053 | 235 | 437 |
| 156 | 5.454 | 4.472 | 18.0 | 1081 | 986 | 258 | 431 |
| 157 | 5.942 | 4.598 | 22.6 | 1086 | 1114 | 274 | 459 |
| 158 | 5.982 | 4.648 | 22.3 | 1053 | | 241 | |
| 159 | 6.200 | 4.704 | 24.1 | | 1030 | | 420 |
| 160 | 6.112 | 4.784 | 21.7 | 1092 | 1047 | 213 | 386 |
| 161 | 6.092 | 4.806 | 21.1 | 1053 | 1019 | 196 | 437 |
| 162 | 6.010 | 4.784 | 20.4 | 1019 | 1002 | 202 | 431 |
| 163 | 6.100 | 4.748 | 22.2 | 1030 | 997 | 274 | 426 |
| 164 | 5.426 | 4.928 | 9.2 | 991 | 1002 | 213 | 398 |
| 165 | 5.000 | 4.838 | 5.0 | 962 | | 263 | |
| 166 | 5.094 | 4.538 | 10.9 | | 980 | | 392 |
| 167 | 4.756 | 4.540 | 4.5 | 907 | 1036 | 269 | 375 |
| 168 | 4.920 | 4.884 | 0.7 | 1232 | 1008 | 235 | 347 |
| 169 | 5.338 | 4.748 | 11.1 | 1215 | 1025 | 214 | 392 |
| 170 | 5.418 | 4.370 | 19.3 | 1198 | 1019 | 162 | 353 |

Table C2: List of parameters measured daily and parameters calculated from these measured parameters for digester D2 (cont)

| Day No | Non-volatile Solids | | | TKN | | Ammonia | |
|---|---|---|---|---|---|---|---|
| | influent (g/l) | effluent (g/l) | removed (%) | influent (mg/l) | effluent (mg/l) | influent (mg/l) | effluent (mg/l) |
| 171 | 6.292 | 4.604 | 26.8 | 1215 | 1019 | 185 | 403 |
| 172 | 6.712 | 4.552 | 32.2 | 1232 | 1114 | 185 | 487 |
| 173 | 6.340 | 4.372 | 31.0 | | 1092 | | 426 |
| 174 | 4.364 | 4.230 | 3.1 | 1086 | 1053 | 185 | 375 |
| 175 | 4.378 | 4.212 | 3.8 | 1075 | 1036 | 157 | 409 |
| 176 | 4.360 | 4.326 | 0.8 | 1064 | 1081 | 162 | 403 |
| 177 | 5.542 | 4.372 | 21.1 | 1098 | 1008 | 179 | 414 |
| 178 | 5.218 | 4.312 | 17.4 | 1198 | 1154 | 224 | 442 |
| 179 | 5.154 | 4.276 | 17.0 | 1120 | | 146 | |
| 180 | 5.244 | 4.554 | 13.2 | | 1058 | | 448 |

Table C2: List of parameters measured daily and parameters calculated from (cont) these measured parameters for digester D2

| Day No. | COD | | | | | Conductivity | |
|---|---|---|---|---|---|---|---|
| | influent (g/l) | added (g/day) | effluent (g/l) | removed (g/l) | removed (%) | influent (mS/m) | effluent (mS/m) |
| 1 | | | | | | | |
| 2 | 43891 | 42136 | 17556 | 25281 | 60.0 | 320 | 490 |
| 3 | 46492 | 44632 | 18044 | 27310 | 61.2 | 280 | 550 |
| 4 | 49093 | 47129 | 17882 | 29963 | 63.6 | 310 | 530 |
| 5 | 43241 | 41511 | 19020 | 23253 | 56.0 | 290 | 530 |
| 6 | 45842 | 44008 | 16612 | 28060 | 63.8 | 320 | 500 |
| 7 | 45396 | 43581 | 20231 | 24159 | 55.4 | 310 | 480 |
| 8 | 39475 | 37896 | 20724 | 18001 | 47.5 | 300 | 470 |
| 9 | 44410 | 42633 | | | | 270 | |
| 10 | | | | | | | |
| 11 | | | 21218 | | | | 430 |
| 12 | 38817 | 37265 | 21053 | 17053 | 45.8 | 280 | 445 |
| 13 | 47699 | 45791 | 18894 | 27653 | 60.4 | 275 | 410 |
| 14 | 47887 | 45971 | 19220 | 27520 | 59.9 | 290 | 380 |
| 15 | 50167 | 48160 | 19220 | 29709 | 61.7 | 270 | 325 |
| 16 | 40720 | 39091 | 18405 | 21422 | 54.8 | 250 | 385 |
| 17 | 38765 | 37215 | 17754 | 20171 | 54.2 | 260 | 415 |
| 18 | 38900 | 37344 | 18894 | 19206 | 51.4 | 255 | 385 |
| 19 | 39091 | 37528 | 16419 | 21766 | 58.0 | 250 | 390 |
| 20 | 34138 | 32772 | 16906 | 16542 | 50.5 | 270 | 430 |
| 21 | 38689 | 37142 | 18207 | 19663 | 52.9 | 260 | 430 |
| 22 | 39014 | 37454 | 19182 | 19039 | 50.8 | 260 | 430 |
| 23 | 34788 | 33396 | 13005 | 20912 | 62.6 | 270 | 430 |
| 24 | 34788 | 33396 | 17556 | 16542 | 49.5 | 240 | 430 |
| 25 | 44541 | 42760 | 17719 | 25750 | 60.2 | 250 | 410 |
| 26 | 52995 | 50875 | 19020 | 32616 | 64.1 | 245 | 410 |
| 27 | 46492 | 44632 | 14956 | 30275 | 67.8 | 250 | 400 |
| 28 | 38364 | 36830 | 15401 | 22045 | 59.9 | 240 | 390 |
| 29 | 35389 | 33971 | 18678 | 16043 | 47.2 | 240 | 360 |
| 30 | 46203 | 44355 | 22118 | 23121 | 52.1 | 230 | 370 |
| 31 | 49807 | 47815 | 18678 | 29884 | 62.5 | 250 | 350 |
| 32 | 42598 | 40894 | 19661 | 22020 | 53.8 | 235 | 360 |
| 33 | 48497 | 46557 | 19005 | 28312 | 60.8 | 240 | 355 |
| 34 | 42598 | 40894 | 18842 | 22807 | 55.8 | 240 | 360 |
| 35 | 48497 | 46557 | 21135 | 26267 | 56.4 | 240 | 365 |
| 36 | 41288 | 39636 | 21193 | 19003 | 47.9 | 230 | 380 |
| 37 | 52035 | 49954 | 19392 | 31337 | 62.7 | 220 | 380 |
| 38 | 40100 | 38784 | 19392 | 20168 | 52.0 | 220 | 370 |
| 39 | 38461 | 36922 | 15190 | 22340 | 60.5 | 230 | 415 |
| 40 | 38138 | 36612 | 17130 | 20168 | 55.1 | 250 | 420 |

Table C2: List of parameters measured daily and parameters calculated from (cont) these measured parameters for digester D2

| Day No. | COD | | | | | Conductivity | |
|---|---|---|---|---|---|---|---|
| | influent (g/l) | added (g/day) | effluent (g/l) | removed (g/l) | removed (%) | influent (mS/m) | effluent (mS/m) |
| 41 | 39107 | 37543 | 22169 | 16261 | 43.3 | 270 | 330 |
| 42 | 44669 | 42882 | 21176 | 22553 | 52.6 | 240 | 350 |
| 43 | 43345 | 41611 | 20184 | 22235 | 53.4 | 220 | 340 |
| 44 | 37720 | 36212 | 22665 | 14453 | 39.9 | 230 | 355 |
| 45 | 43345 | 41611 | 18033 | 24300 | 58.4 | 240 | 400 |
| 46 | 40367 | 38753 | 21342 | 18265 | 47.1 | 260 | 380 |
| 47 | 40036 | 38435 | 20184 | 19059 | 49.6 | 240 | 355 |
| 48 | 35404 | 33988 | 20349 | 14453 | 42.5 | 250 | 360 |
| 49 | 56250 | 54000 | 20184 | 34623 | 64.1 | 280 | 370 |
| 50 | 50294 | 48282 | 20845 | 28270 | 58.6 | 280 | 400 |
| 51 | 44007 | 42247 | 23162 | 20012 | 47.4 | 280 | 410 |
| 52 | 47647 | 45741 | 20349 | 26206 | 57.3 | 275 | 415 |
| 53 | 46985 | 45106 | 19191 | 26682 | 59.2 | 270 | 410 |
| 54 | 40036 | 38435 | 19026 | 20170 | 52.5 | 270 | 415 |
| 55 | 42022 | 40341 | 19522 | 21600 | 53.5 | 265 | 410 |
| 56 | 38382 | 36847 | 19191 | 18423 | 50.0 | 255 | 410 |
| 57 | 40036 | 38435 | 19853 | 19376 | 50.4 | 260 | 400 |
| 58 | 37059 | 35576 | 18860 | 17470 | 49.1 | 280 | 405 |
| 59 | 41360 | 39706 | 19026 | 21441 | 54.0 | 280 | 405 |
| 60 | 41691 | 40023 | 20685 | 20166 | 50.4 | 290 | 410 |
| 61 | 42662 | 40956 | 21816 | 20013 | 48.9 | 285 | 380 |
| 62 | 41046 | 39405 | 21654 | 18616 | 47.2 | 290 | 390 |
| 113 | | | 22446 | | | | 400 |
| 114 | | | 18842 | | | | 400 |
| 115 | 31785 | | | | | 280 | |
| 116 | | | | | | | |
| 117 | | | 18514 | | | | 400 |
| 118 | | | 17695 | | | | 390 |
| 119 | 31457 | 22020 | 18022 | 9404 | 42.7 | 280 | 390 |
| 120 | 34734 | 24314 | 16056 | 13074 | 53.8 | 300 | 400 |
| 121 | 28836 | 40370 | 18952 | 13837 | 34.3 | 280 | 400 |
| 122 | 41530 | 58141 | 18128 | 32762 | 56.3 | 290 | 385 |
| 123 | 31312 | 43837 | 16810 | 20303 | 46.3 | 285 | 390 |
| 124 | 31642 | 44298 | 16150 | 21688 | 49.0 | 290 | 390 |
| 125 | 34608 | 48451 | 17304 | 24226 | 50.0 | 300 | 400 |
| 126 | 35267 | 49374 | 16315 | 26533 | 53.7 | 240 | 370 |
| 127 | 37245 | 52143 | 16150 | 29532 | 56.6 | 240 | 365 |
| 128 | 39552 | 55373 | 16150 | 32762 | 59.2 | 225 | 360 |
| 129 | 36256 | 50758 | 18952 | 24226 | 47.7 | 210 | 355 |
| 130 | 39552 | 55373 | 18622 | 29301 | 52.9 | 210 | 385 |

Table C2: List of parameters measured daily and parameters calculated from these measured parameters for digester D2 (cont)

| Day No. | COD | | | | | Conductivity | |
|---|---|---|---|---|---|---|---|
| | influent (g/l) | added (g/day) | effluent (g/l) | removed (g/l) | removed (%) | influent (mS/m) | effluent (mS/m) |
| 131 | | | 18293 | | | | 335 |
| 132 | 38893 | 54450 | 18293 | 28840 | 53.0 | 280 | 340 |
| 133 | 45155 | 63217 | 19776 | 35531 | 56.2 | 280 | 350 |
| 134 | 36586 | 51220 | 19941 | 23303 | 45.5 | 280 | 345 |
| 135 | 38893 | 54450 | 19988 | 26466 | 48.6 | 290 | 340 |
| 136 | 41237 | 57732 | 20808 | 28601 | 49.5 | 285 | 340 |
| 137 | 43581 | 61014 | | | | 280 | |
| 138 | 40724 | 57014 | 20808 | 27883 | 48.9 | | 340 |
| 139 | 38994 | 54591 | 21135 | 25002 | 45.8 | 280 | 340 |
| 140 | 38994 | 54591 | 19988 | 26608 | 48.7 | 280 | 335 |
| 141 | 34406 | 48169 | 19169 | 21332 | 44.3 | 285 | 365 |
| 142 | 36045 | 50463 | 19497 | 23167 | 45.9 | 290 | 370 |
| 143 | 37028 | 51839 | 19871 | 24019 | 46.3 | 240 | 370 |
| 144 | 32902 | 46062 | | | | 240 | |
| 145 | | | 18894 | | | | 350 |
| 146 | 42023 | 58832 | 18405 | 33065 | 56.2 | 230 | 360 |
| 147 | 37462 | 52447 | 19708 | 24855 | 47.4 | 270 | 360 |
| 148 | 41697 | 58376 | 19383 | 31240 | 53.5 | 240 | 360 |
| 149 | 42349 | 59288 | 18731 | 33065 | 55.8 | 250 | 360 |
| 150 | 35508 | 49711 | 18731 | 23487 | 47.2 | 240 | 355 |
| 151 | 40068 | 56096 | | | | 225 | |
| 152 | 41372 | 57920 | 18568 | 31924 | 55.1 | | 340 |
| 153 | 42675 | 59744 | 20197 | 31468 | 52.7 | 235 | 340 |
| 154 | 44955 | 62937 | 20197 | 34661 | 55.1 | 240 | 340 |
| 155 | 44629 | 62481 | 19871 | 34661 | 55.5 | 230 | 335 |
| 156 | 46258 | 64761 | 20686 | 35801 | 55.3 | 230 | 335 |
| 157 | 52122 | 72970 | 20360 | 44466 | 60.9 | 210 | 340 |
| 158 | 44629 | 62481 | 20116 | 34319 | 54.9 | 220 | |
| 159 | | | 19871 | | | | 325 |
| 160 | 47235 | 66129 | 21663 | 35801 | 54.1 | 220 | 315 |
| 161 | 44303 | 62025 | 22315 | 30784 | 49.6 | 215 | 305 |
| 162 | 47561 | 66585 | 21964 | 35836 | 53.8 | 210 | 300 |
| 163 | 48117 | 67783 | 21804 | 37258 | 55.0 | 215 | 300 |
| 164 | 44890 | 62845 | 21643 | 32545 | 51.8 | 220 | 300 |
| 165 | 38156 | 53419 | | | | 225 | |
| 166 | 37355 | 52296 | 21323 | 22445 | 42.9 | | 280 |
| 167 | 36553 | 51174 | 23407 | 18405 | 36.0 | 220 | 285 |
| 168 | 39759 | 55663 | 20040 | 27607 | 49.6 | 220 | 290 |
| 169 | 43286 | 60601 | 20521 | 31872 | 52.6 | 220 | 285 |
| 170 | 40721 | 57010 | 20842 | 27832 | 48.8 | 225 | 290 |



Table C2: List of parameters measured daily and parameters calculated from these measured parameters for digester D2 (cont)

| Day No. | COD | | | | | Conductivity | |
|---|---|---|---|---|---|---|---|
| | influent (g/l) | added (g/day) | effluent (g/l) | removed (g/l) | removed (%) | influent (mS/m) | effluent (mS/m) |
| 171 | 40721 | 57010 | 20200 | 28729 | 50.4 | 230 | 300 |
| 172 | 44248 | 61948 | 20521 | 33218 | 53.6 | 240 | |
| 173 | | | 21162 | | | | 300 |
| 174 | 39759 | 55663 | 18437 | 29852 | 53.6 | 230 | 310 |
| 175 | 35591 | 49827 | 19031 | 23184 | 46.5 | 230 | 310 |
| 176 | 39675 | 55545 | 20321 | 27095 | 48.8 | 230 | 310 |
| 177 | 55158 | 77221 | 20483 | 48545 | 62.9 | 170 | 310 |
| 178 | 44513 | 62319 | 20483 | 33643 | 54.0 | 190 | 300 |
| 179 | 41933 | 58706 | 20724 | 29692 | 50.6 | 190 | |
| 180 | 42123 | 58972 | 20966 | 29619 | 50.2 | | 310 |

Table C2: List of parameters measured daily and parameters calculated from (cont) these measured parameters for digester D2

| Day No. | pH | | Alkalinity(as CaCO3) | | SCFA (as HAc) | | SCFA/Alk | |
|---|---|---|---|---|---|---|---|---|
| | influent | effluent | influent (mg/l) | effluent (mg/l) | influent (mg/l) | effluent (mg/l) | influent | effluent |
| 1 | | | | | | | | |
| 2 | 5.33 | 7.43 | 78 | 2202 | 2158 | 230 | 27.7 | 0.104 |
| 3 | 5.31 | 7.21 | 61 | 2623 | 1787 | 264 | 29.3 | 0.101 |
| 4 | 5.36 | 7.23 | 67 | 2627 | 2025 | 257 | 30.2 | 0.098 |
| 5 | 5.31 | 7.28 | 57 | 2639 | 1951 | 226 | 34.2 | 0.086 |
| 6 | 5.34 | 7.36 | 67 | 2497 | 2317 | 139 | 34.6 | 0.056 |
| 7 | 5.3 | 7.24 | 67 | 2351 | 2183 | 56 | 32.6 | 0.024 |
| 8 | 5.33 | 7.24 | 48 | 2309 | 2126 | 48 | 44.3 | 0.021 |
| 9 | 5.33 | | 46 | | 1896 | | 41.2 | |
| 10 | | | | | | | | |
| 11 | | 7.28 | | 2256 | | 45 | | 0.020 |
| 12 | 5.41 | 7.22 | 50 | 2233 | 1972 | 39 | 39.4 | 0.017 |
| 13 | 5.37 | 7.23 | 47 | 2090 | 1997 | 12 | 42.5 | 0.006 |
| 14 | 5.44 | 7.23 | 60 | 2013 | 1897 | 28 | 31.6 | 0.014 |
| 15 | 5.42 | | 57 | 1901 | 1875 | 15 | 32.9 | 0.008 |
| 16 | | 7.31 | 50 | 2012 | 1922 | 22 | 38.4 | 0.011 |
| 17 | 5.42 | 7.33 | 42 | 2136 | 1866 | 20 | 44.4 | 0.009 |
| 18 | 5.41 | 7.20 | 40 | 1951 | 1838 | 19 | 46.0 | 0.010 |
| 19 | 5.40 | 7.24 | 37 | 1991 | 1840 | 26 | 49.7 | 0.013 |
| 20 | 5.42 | 7.23 | 46 | 2203 | 1977 | 8 | 43.0 | 0.004 |
| 21 | 5.41 | 7.24 | 42 | 2243 | 1889 | 13 | 45.0 | 0.006 |
| 22 | 5.43 | 7.20 | 43 | 2218 | 1878 | 14 | 43.7 | 0.006 |
| 23 | 5.38 | 7.28 | 46 | 2153 | 1951 | 2 | 42.4 | 0.001 |
| 24 | 5.28 | 7.25 | 39 | 2176 | 1849 | 17 | 47.4 | 0.008 |
| 25 | 5.23 | 7.24 | 46 | 2175 | 2011 | 20 | 43.7 | 0.009 |
| 26 | 5.17 | 7.16 | 39 | 2129 | 2085 | 31 | 53.5 | 0.015 |
| 27 | 5.16 | 7.18 | 43 | 2107 | 2116 | 16 | 49.2 | 0.008 |
| 28 | 5.18 | 7.18 | 42 | 2055 | 2068 | 28 | 49.2 | 0.014 |
| 29 | 5.17 | 7.21 | 41 | 1890 | 2018 | 41 | 49.2 | 0.022 |
| 30 | 5.15 | 7.17 | 40 | 1874 | 1966 | 17 | 49.2 | 0.009 |
| 31 | 5.19 | 7.19 | 47 | 1892 | 2192 | 31 | 46.6 | 0.016 |
| 32 | 5.21 | 7.11 | 45 | 1918 | 2014 | 25 | 44.8 | 0.013 |
| 33 | 5.17 | 7.18 | 45 | 1836 | 2160 | 32 | 48.0 | 0.017 |
| 34 | 5.21 | 7.17 | 49 | 2025 | 2082 | 19 | 42.5 | 0.009 |
| 35 | 5.17 | 7.15 | 45 | 1938 | 2194 | 25 | 48.8 | 0.013 |
| 36 | 5.20 | 7.10 | 45 | 1979 | 1999 | 71 | 44.4 | 0.036 |
| 37 | 5.11 | 7.09 | 40 | 2004 | 1873 | 121 | 46.8 | 0.060 |
| 38 | 5.17 | 7.07 | 40 | 2010 | 2061 | 48 | 51.5 | 0.024 |
| 39 | 5.18 | 7.07 | 49 | 1935 | 2134 | 52 | 43.6 | 0.027 |
| 40 | 5.16 | 7.06 | 45 | 2011 | 2099 | 54 | 46.6 | 0.027 |

Note: Alkalinity = $H_2CO_3^*$ alkalinity

Table C2: List of parameters measured daily and parameters calculated from (cont) these measured parameters for digester D2

| Day No. | pH | | Alkalinity(as CaCO3) | | SCFA (as HAc) | | SCFA/Alk | |
|---|---|---|---|---|---|---|---|---|
| | influent | effluent | influent (mg/l) | effluent (mg/l) | influent (mg/l) | effluent (mg/l) | influent | effluent |
| 41 | 5.15 | 7.12 | 52 | 1752 | 2286 | 26 | 44.0 | 0.015 |
| 42 | 5.20 | 7.13 | 46 | 1988 | 1994 | 25 | 43.3 | 0.013 |
| 43 | 5.16 | 7.16 | 39 | 1860 | 1879 | 37 | 48.2 | 0.020 |
| 44 | 5.19 | 7.13 | 46 | 1982 | 2059 | 23 | 44.8 | 0.012 |
| 45 | 5.18 | 7.08 | 41 | 2045 | 1950 | 47 | 47.6 | 0.023 |
| 46 | 5.17 | 7.15 | 46 | 1932 | 2097 | 39 | 45.6 | 0.020 |
| 47 | 5.15 | 7.12 | 42 | 1904 | 2108 | 23 | 50.2 | 0.012 |
| 48 | 5.17 | 7.12 | 71 | 1966 | 3425 | 15 | 48.2 | 0.008 |
| 49 | 5.13 | 7.15 | 55 | 1993 | 2636 | 31 | 47.9 | 0.016 |
| 50 | 5.11 | 7.14 | 53 | 1970 | 2626 | 39 | 49.5 | 0.020 |
| 51 | 5.16 | 7.18 | 48 | 1987 | 2356 | 20 | 49.1 | 0.010 |
| 52 | 5.20 | 7.18 | 88 | 1979 | 2002 | 33 | 22.8 | 0.017 |
| 53 | 5.22 | 7.19 | 48 | 1966 | 2159 | 30 | 45.0 | 0.015 |
| 54 | 5.20 | 7.17 | 45 | 1982 | 2065 | 33 | 45.9 | 0.017 |
| 55 | 5.20 | 7.15 | 46 | 1977 | 2026 | 44 | 44.0 | 0.022 |
| 56 | 5.20 | 7.17 | 45 | 1953 | 1912 | 20 | 42.5 | 0.010 |
| 57 | 5.28 | 7.18 | 50 | 1954 | 1923 | 28 | 38.5 | 0.014 |
| 58 | 5.24 | 7.17 | 48 | 1968 | 2139 | 30 | 44.6 | 0.015 |
| 59 | 5.23 | 7.16 | 50 | 1899 | 2110 | 35 | 42.2 | 0.018 |
| 60 | 5.25 | 7.18 | 54 | 1939 | 2153 | 22 | 39.9 | 0.011 |
| 61 | 5.28 | 7.16 | 54 | 1907 | 2104 | 33 | 39.0 | 0.017 |
| 62 | 5.29 | 7.17 | 61 | 1899 | 2183 | 38 | 35.8 | 0.020 |
| | | | | | | | | |
| 113 | | 7.26 | | 2055 | | 22 | | 0.011 |
| 114 | | 7.19 | | 1952 | | 41 | | 0.021 |
| 115 | 5.19 | | 70 | | | | | |
| 116 | | | | | | | | |
| 117 | | 7.27 | | 1944 | | 24 | | 0.012 |
| 118 | | 7.19 | | 1949 | | 23 | | 0.012 |
| 119 | 5.21 | 7.23 | 70 | 1998 | | 38 | | 0.019 |
| 120 | 5.21 | 7.25 | 72 | 2006 | | 20 | | 0.010 |
| 121 | 5.22 | 7.23 | 65 | 1993 | 2308 | 20 | 35.5 | 0.010 |
| 122 | 5.24 | 7.22 | 68 | 2005 | 2316 | 0 | 34.1 | 0.000 |
| 123 | 5.23 | 7.21 | 74 | 1929 | 2323 | 22 | 31.4 | 0.011 |
| 124 | 5.23 | 7.20 | | 1924 | | 25 | | 0.013 |
| 125 | 5.23 | 7.21 | 73 | 1917 | 2329 | 35 | 31.9 | 0.018 |
| 126 | 5.19 | 7.20 | 59 | 1912 | 1770 | 30 | 30.0 | 0.016 |
| 127 | 5.15 | 7.18 | 57 | 1897 | 1705 | 40 | 29.9 | 0.021 |
| 128 | 5.17 | 7.19 | 54 | 1854 | 1636 | 23 | 30.3 | 0.012 |
| 129 | 5.15 | 7.18 | 53 | 1840 | 1572 | 40 | 29.7 | 0.022 |
| 130 | 5.14 | 7.15 | 49 | 1951 | 1558 | 19 | 31.8 | 0.010 |

Table C2: List of parameters measured daily and parameters calculated from these measured parameters for digester D2 (cont)

| Day No. | pH | | Alkalinity(as CaCO3) | | SCFA (as HAc) | | SCFA/Alk | |
|---|---|---|---|---|---|---|---|---|
| | influent | effluent | influent (mg/l) | effluent (mg/l) | influent (mg/l) | effluent (mg/l) | influent | effluent |
| 131 | 5.24 | 7.20 | | 1806 | | 37 | | 0.020 |
| 132 | 5.08 | 7.15 | 71 | 1840 | 2730 | 33 | 38.5 | 0.018 |
| 133 | 5.1 | 7.17 | 85 | 1988 | 2822 | 44 | 33.2 | 0.022 |
| 134 | 5.11 | 7.18 | 86 | 1875 | 2891 | 44 | 33.6 | 0.023 |
| 135 | 5.12 | 7.17 | 86 | 1939 | 2814 | 48 | 32.7 | 0.025 |
| 136 | 5.1 | 7.19 | 85 | 1938 | 2912 | 39 | 34.3 | 0.020 |
| 137 | 5.09 | 7.18 | 82 | | 2971 | | 36.2 | |
| 138 | 5.21 | 7.19 | | 1962 | | 37 | | 0.019 |
| 139 | 5.09 | 7.19 | 92 | 1942 | 3084 | 34 | 33.5 | 0.018 |
| 140 | 5.11 | 7.19 | 91 | 2005 | 2993 | 39 | 32.9 | 0.019 |
| 141 | 5.1 | 7.19 | 88 | 2026 | 3069 | 29 | 34.9 | 0.014 |
| 142 | 5.1 | 7.21 | 87 | 2138 | 2998 | 32 | 34.5 | 0.015 |
| 143 | 5.26 | 7.17 | 76 | 2027 | 2049 | 18 | 27.0 | 0.009 |
| 144 | 5.38 | 7.10 | 79 | | 1841 | | 23.3 | |
| 145 | 5.4 | 7.14 | | 1983 | | 30 | | 0.015 |
| 146 | 5.43 | 7.16 | 62 | 2034 | 1754 | 29 | 28.3 | 0.014 |
| 147 | 5.42 | 7.13 | 165 | 2055 | 1807 | 40 | 11.0 | 0.019 |
| 148 | 5.45 | 7.16 | 87 | 2008 | 1826 | 26 | 21.0 | 0.013 |
| 149 | 5.49 | 7.14 | 103 | 2001 | 1878 | 15 | 18.2 | 0.007 |
| 150 | 5.56 | 7.12 | 93 | 2020 | 1766 | 24 | 19.0 | 0.012 |
| 151 | 5.56 | 7.13 | 80 | | 1610 | | 20.1 | |
| 152 | 5.49 | 7.10 | | 2034 | | 25 | | 0.012 |
| 153 | 5.45 | 7.15 | 82 | 2009 | 1890 | 25 | 23.0 | 0.012 |
| 154 | 5.45 | 7.14 | 82 | 2009 | 1895 | 30 | 23.1 | 0.015 |
| 155 | 5.45 | 7.17 | 88 | 2067 | 1924 | 26 | 21.9 | 0.013 |
| 156 | 5.47 | 7.11 | 85 | 2000 | 1929 | 16 | 22.7 | 0.008 |
| 157 | 5.37 | 7.18 | 78 | 2032 | 1740 | 34 | 22.3 | 0.017 |
| 158 | 5.36 | 7.13 | 83 | | 1773 | | 21.4 | |
| 159 | 5.41 | 7.15 | | 1978 | | 39 | | 0.020 |
| 160 | 5.45 | 7.13 | 84 | 1948 | 1679 | 38 | 20.0 | 0.020 |
| 161 | 5.44 | 7.15 | 85 | 1913 | 1681 | 48 | 19.8 | 0.025 |
| 162 | 5.44 | 7.11 | 84 | 1844 | 1711 | 36 | 20.4 | 0.020 |
| 163 | 5.45 | 7.14 | 85 | 1848 | 1712 | 40 | 20.1 | 0.022 |
| 164 | 5.46 | 7.11 | 85 | 1842 | 1746 | 35 | 20.5 | 0.019 |
| 165 | 5.46 | 7.09 | 95 | | 1745 | | 18.4 | |
| 166 | 5.46 | 7.17 | | 1795 | | 34 | | 0.019 |
| 167 | 5.48 | 7.10 | 82 | 1786 | 1632 | 29 | 19.9 | 0.016 |
| 168 | 5.3 | 7.11 | 71 | 1780 | 1824 | 32 | 25.7 | 0.018 |
| 169 | 5.32 | 7.09 | 73 | 1786 | 1871 | 38 | 25.6 | 0.021 |
| 170 | 5.33 | 7.11 | 81 | 1821 | 1970 | 27 | 24.3 | 0.015 |

Note: Alkalinity = $H_2CO_3^*$ alkalinity

Table C2: List of parameters measured daily and parameters calculated from these measured parameters for digester D2 (cont)

| Day No. | pH | | Alkalinity(as CaCO3) | | SCFA (as HAc) | | SCFA/Alk | |
|---|---|---|---|---|---|---|---|---|
| | influent | effluent | influent (mg/l) | effluent (mg/l) | influent (mg/l) | effluent (mg/l) | influent | effluent |
| 171 | 5.31 | 7.11 | 83 | 1881 | 2199 | 30 | 26.5 | 0.016 |
| 172 | 5.32 | 7.09 | 86 | 1939 | 2188 | 22 | 25.4 | 0.011 |
| 173 | 5.37 | 7.17 | | 1963 | | 29 | | 0.015 |
| 174 | 5.34 | 7.13 | 95 | 2005 | 2105 | 21 | 22.2 | 0.010 |
| 175 | 5.34 | 7.12 | 86 | 2040 | 2103 | 28 | 24.5 | 0.014 |
| 176 | 5.35 | 7.11 | 86 | 2068 | 2136 | 25 | 24.8 | 0.012 |
| 177 | 5.33 | 7.07 | 79 | 2034 | 1281 | 36 | 16.2 | 0.018 |
| 178 | 5.36 | 7.11 | 70 | 1990 | 1609 | 12 | 23.0 | 0.006 |
| 179 | 5.36 | 7.1 | 69 | | 1606 | | 23.3 | |
| 180 | 5.43 | 7.11 | | 1926 | | 15 | | 0.008 |

Table C2: List of parameters measured daily and parameters calculated from these measured parameters for digester D2 (cont)

| Day No. | Gas productio | Carbon dioxide | Methane | Gas produced per.... | | | |
|---|---|---|---|---|---|---|---|
| | | | | COD remo | CODadd | VS remo | VS added |
| | (l/day) | (%) | (%) | (l/g) | (l/g) | (l/g) | (l/g) |
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | 8.145 | | | 0.68 | 0.36 | 0.30 | 0.18 |
| 4 | | | | | | | |
| 5 | 14.205 | | | 1.38 | 0.67 | 0.61 | 0.34 |
| 6 | | | | | | | |
| 7 | | | | | | | |
| 8 | 16.945 | | | 2.22 | 0.90 | 0.94 | 0.45 |
| 9 | | | | | | | |
| 10 | | | | | | | |
| 11 | | | | | | | |
| 12 | | | | | | | |
| 13 | 9.456 | | | 0.82 | 0.42 | 0.34 | 0.21 |
| 14 | 12.794 | | | 1.04 | 0.55 | 0.46 | 0.28 |
| 15 | 13.386 | | | 0.93 | 0.53 | 0.45 | 0.28 |
| 16 | | | | | | | |
| 17 | 11.448 | | | 1.15 | 0.54 | 0.57 | 0.31 |
| 18 | 12.585 | | | 1.35 | 0.61 | 0.66 | 0.34 |
| 19 | | | | | | | |
| 20 | 11.968 | | | 1.25 | 0.59 | 0.72 | 0.37 |
| 21 | 11.195 | | | 1.23 | 0.55 | 0.57 | 0.30 |
| 22 | | | | | | | |
| 23 | 11.789 | | | 1.15 | 0.55 | 0.56 | 0.35 |
| 24 | 11.801 | | | 1.04 | 0.52 | 0.71 | 0.35 |
| 25 | | | | | | | |
| 26 | 12.924 | | | 1.01 | 0.54 | 0.40 | 0.25 |
| 27 | 13.051 | | | 0.94 | 0.52 | 0.43 | 0.29 |
| 28 | | | | | | | |
| 29 | 12.950 | | | 0.97 | 0.52 | 0.81 | 0.38 |
| 30 | 12.845 | | | 1.14 | 0.53 | 0.56 | 0.29 |
| 31 | | | | | | | |
| 32 | 13.558 | | | 1.12 | 0.55 | 0.62 | 0.33 |
| 33 | 14.071 | | | 1.04 | 0.55 | 0.50 | 0.30 |
| 34 | | | | | | | |
| 35 | 11.269 | | | 1.03 | 0.54 | 0.54 | 0.31 |
| 36 | 13.292 | | | 1.20 | 0.57 | 0.70 | 0.34 |
| 37 | | | | | | | |
| 38 | 13.160 | | | 1.31 | 0.57 | 0.67 | 0.35 |
| 39 | 11.412 | | | 1.20 | 0.61 | 0.65 | 0.39 |
| 40 | | | | | | | |

Note: All gas volumes measured at 1 atmosphere pressure and 20$^{o}$C.

Table C2: List of parameters measured daily and parameters calculated from these measured parameters for digester D2 (cont)

| Day No. | Gas productio | Carbon dioxide | Methane | Gas produced per.... | | | |
|---|---|---|---|---|---|---|---|
| | | | | COD rem. | COD add | VS rem. | VS add. |
| | (l/day) | (%) | (%) | (l/g) | (l/g) | (l/g) | (l/g) |
| 41 | 13.749 | | | 1.14 | 0.55 | 0.85 | 0.37 |
| 42 | 13.519 | | | 1.33 | 0.58 | 0.60 | 0.32 |
| 43 | | | | | | | |
| 44 | 12.691 | | | 1.32 | 0.56 | 0.88 | 0.35 |
| 45 | 13.118 | | | 1.22 | 0.56 | 0.54 | 0.32 |
| 46 | | | | | | | |
| 47 | 13.202 | | | 1.09 | 0.54 | 0.69 | 0.34 |
| 48 | 11.921 | | | 2.02 | 0.65 | 0.82 | 0.35 |
| 49 | | | | | | | |
| 50 | 14.903 | | | 0.86 | 0.50 | 0.53 | 0.31 |
| 51 | 14.131 | | | 1.06 | 0.54 | 0.71 | 0.33 |
| 52 | | | | | | | |
| 53 | 14.649 | 35.2 | 64.8 | 1.12 | 0.56 | 0.55 | 0.32 |
| 54 | 14.339 | 35.9 | 64.1 | 1.32 | 0.59 | 0.71 | 0.37 |
| 55 | | 35.7 | 64.3 | | | | |
| 56 | 13.288 | 35.7 | 64.3 | 1.25 | 0.56 | 0.72 | 0.36 |
| 57 | 12.711 | 35.5 | 64.5 | 1.41 | 0.58 | 0.66 | 0.33 |
| 58 | | 35.7 | 64.3 | | | | |
| 59 | 14.773 | 34.7 | 65.3 | 1.26 | 0.61 | 0.69 | 0.37 |
| 60 | 13.986 | 35.9 | 64.1 | 1.19 | 0.57 | 0.69 | 0.35 |
| 61 | | 35.7 | 64.3 | | | | |
| 62 | | 36.4 | 63.6 | | | | |
| 113 | | 36.5 | 63.5 | | | | |
| 114 | 8.754 | 36.5 | 63.5 | | | | |
| 115 | | 36.5 | 63.5 | | | | |
| 116 | | 36.5 | 63.5 | | | | |
| 117 | 7.195 | 36.5 | 63.5 | | | | |
| 118 | 7.865 | 36.5 | 63.5 | | | | |
| 119 | | 36.5 | 63.5 | | | | |
| 120 | 7.136 | 36.5 | 63.5 | 1.56 | 0.55 | 0.55 | 0.29 |
| 121 | | 36.5 | 63.5 | | | | |
| 122 | 12.293 | 36.5 | 63.5 | 1.20 | 0.46 | 0.38 | 0.21 |
| 123 | | 36.5 | 63.5 | | | | |
| 124 | 14.139 | 36.5 | 63.5 | 1.17 | 0.51 | 0.65 | 0.32 |
| 125 | | 36.5 | 63.5 | | | | |
| 126 | 14.289 | 36.5 | 63.5 | 0.87 | 0.45 | 0.54 | 0.29 |
| 127 | | 36.5 | 63.5 | | | | |
| 128 | 15.678 | 36.5 | 63.5 | 1.07 | 0.53 | 0.48 | 0.28 |
| 129 | | 36.5 | 63.5 | | | | |
| 130 | 15.444 | 36.5 | 63.5 | 0.96 | 0.48 | 0.53 | 0.28 |

Table C2: List of parameters measured daily and parameters calculated from (cont) these measured parameters for digester D2

| Day No. | Gas production (l/day) | Carbon dioxide (%) | Methane (%) | Gas produced per.... COD rem. (l/g) | COD add (l/g) | VS rem. (l/g) | VS add. (l/g) |
|---|---|---|---|---|---|---|---|
| 131 | | 36.5 | 63.5 | | | | |
| 132 | 18.872 | 36.5 | 63.5 | 1.15 | 0.57 | 0.65 | 0.35 |
| 133 | 18.587 | 35.4 | 64.6 | 1.13 | 0.55 | 0.52 | 0.29 |
| 134 | | 35.6 | 64.4 | | | | |
| 135 | | 35.1 | 64.9 | | | | |
| 136 | 17.727 | 33.9 | 66.1 | 1.16 | 0.53 | 0.62 | 0.31 |
| 137 | | 37.8 | 62.2 | | | | |
| 138 | 19.243 | 36.5 | 63.5 | 1.36 | 0.59 | 0.69 | 0.34 |
| 139 | | 36.5 | 63.5 | | | | |
| 140 | 18.898 | 36.5 | 63.5 | 1.19 | 0.55 | 0.71 | 0.35 |
| 141 | | 36.5 | 63.5 | | | | |
| 142 | 19.425 | 38.3 | 61.7 | 1.23 | 0.57 | 0.84 | 0.38 |
| 143 | | 35.4 | 64.6 | | | | |
| 144 | | 37.6 | 62.4 | | | | |
| 145 | | 36.5 | 63.5 | | | | |
| 146 | 18.194 | 37.6 | 62.4 | 1.08 | 0.53 | 0.55 | 0.31 |
| 147 | | 38.3 | 61.7 | | | | |
| 148 | 18.154 | 35.7 | 64.3 | 1.09 | 0.53 | 0.58 | 0.31 |
| 149 | | 37.6 | 62.4 | | | | |
| 150 | 14.036 | 36.2 | 63.8 | 0.98 | 0.45 | 0.60 | 0.28 |
| 151 | | 35.9 | 64.1 | | | | |
| 152 | 21.981 | | 100.0 | 0.99 | 0.57 | 0.69 | 0.38 |
| 153 | | 38.5 | 61.5 | | | | |
| 154 | 23.091 | 35.4 | 64.6 | 1.07 | 0.59 | 0.67 | 0.37 |
| 155 | | 38.7 | 61.3 | | | | |
| 156 | 22.070 | 37.3 | 62.7 | 1.06 | 0.57 | 0.62 | 0.34 |
| 157 | | 37.6 | 62.4 | | | | |
| 158 | 23.290 | 34.3 | 65.7 | 1.12 | 0.59 | 0.68 | 0.37 |
| 159 | | | 100.0 | | | | |
| 160 | 24.977 | 36.6 | 63.4 | 1.23 | 0.64 | 0.70 | 0.38 |
| 161 | | 37.1 | 62.9 | | | | |
| 162 | 24.027 | 37.6 | 62.4 | 1.21 | 0.62 | 0.67 | 0.36 |
| 163 | | 39.4 | 60.6 | | | | |
| 164 | 21.352 | 36.2 | 63.8 | 1.31 | 0.60 | 0.66 | 0.34 |
| 165 | | 39.2 | 60.8 | | | | |
| 166 | 18.584 | 37.9 | 62.1 | 1.41 | 0.57 | 0.83 | 0.36 |
| 167 | | 38.0 | 62.0 | | | | |
| 168 | 19.812 | 36.2 | 63.8 | 1.10 | 0.54 | 0.72 | 0.36 |
| 169 | | 37.6 | 62.4 | | | | |
| 170 | 19.606 | 37.6 | 62.4 | 1.10 | 0.54 | 0.70 | 0.34 |

Table C2: List of parameters measured daily and parameters calculated from (cont) these measured parameters for digester D2

| Day No. | Gas production (l/day) | Carbon dioxide (%) | Methane (%) | Gas produced per.... COD rem. (l/g) | COD add (l/g) | VS rem (l/g) | VS add. (l/g) |
|---|---|---|---|---|---|---|---|
| 171 | | 39.2 | 60.8 | | | | |
| 172 | 22.504 | 39.4 | 60.6 | 1.18 | 0.59 | 0.68 | 0.36 |
| 173 | | 37.9 | 62.1 | | | | |
| 174 | 19.467 | 38.0 | 62.0 | 1.49 | 0.63 | 0.65 | 0.35 |
| 175 | | 38.0 | 62.0 | | | | |
| 176 | 18.911 | 37.8 | 62.2 | 1.42 | 0.60 | 0.70 | 0.34 |
| 177 | 20.317 | 36.4 | 63.6 | 0.91 | 0.50 | 0.42 | 0.26 |
| 178 | | 37.6 | 62.4 | | | | |
| 179 | 20.297 | 38.5 | 61.5 | 1.09 | 0.54 | 0.68 | 0.35 |
| 180 | 22.462 | 37.9 | 62.1 | 1.09 | 0.57 | 0.76 | 0.38 |

Note: All gas volumes measured at 1 atmosphere pressure and 20$^{o}$C.

Table C2: List of parameters measured daily and parameters calculated from (cont) these measured parameters for digester D2

| Day No. | Methane produced per..... | | | | Carbon dioxide produced per... | | | |
|---|---|---|---|---|---|---|---|---|
| | VS rem. | VS add. | COD rem. | COD add. | VS rem. | VS add. | COD re | COD add |
| | l/g | l/g | l/g | l/g | l/g | l/g | l/g | l/g |
| 1 | | | | | | | | |
| 2 | | | | | | | | |
| 3 | 0.44 | 0.23 | 0.19 | 0.12 | 0.24 | 0.13 | 0.11 | 0.07 |
| 4 | | | | | | | | |
| 5 | 0.89 | 0.43 | 0.39 | 0.22 | 0.49 | 0.24 | 0.22 | 0.12 |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | 1.43 | 0.58 | 0.61 | 0.29 | 0.79 | 0.32 | 0.34 | 0.16 |
| 9 | | | | | | | | |
| 10 | | | | | | | | |
| 11 | | | | | | | | |
| 12 | | | | | | | | |
| 13 | 0.53 | 0.27 | 0.22 | 0.13 | 0.29 | 0.15 | 0.12 | 0.07 |
| 14 | 0.67 | 0.36 | 0.30 | 0.18 | 0.37 | 0.20 | 0.17 | 0.10 |
| 15 | 0.60 | 0.34 | 0.29 | 0.18 | 0.33 | 0.19 | 0.16 | 0.10 |
| 16 | | | | | | | | |
| 17 | 0.74 | 0.34 | 0.37 | 0.20 | 0.41 | 0.19 | 0.20 | 0.11 |
| 18 | 0.87 | 0.40 | 0.42 | 0.22 | 0.48 | 0.22 | 0.23 | 0.12 |
| 19 | | | | | | | | |
| 20 | 0.81 | 0.38 | 0.47 | 0.24 | 0.45 | 0.21 | 0.26 | 0.13 |
| 21 | 0.79 | 0.36 | 0.37 | 0.19 | 0.44 | 0.20 | 0.20 | 0.11 |
| 22 | | | | | | | | |
| 23 | 0.74 | 0.36 | 0.36 | 0.23 | 0.41 | 0.20 | 0.20 | 0.13 |
| 24 | 0.67 | 0.33 | 0.46 | 0.23 | 0.37 | 0.19 | 0.25 | 0.13 |
| 25 | | | | | | | | |
| 26 | 0.65 | 0.34 | 0.26 | 0.16 | 0.36 | 0.19 | 0.14 | 0.09 |
| 27 | 0.61 | 0.33 | 0.28 | 0.19 | 0.34 | 0.19 | 0.15 | 0.10 |
| 28 | | | | | | | | |
| 29 | 0.62 | 0.33 | 0.52 | 0.25 | 0.34 | 0.18 | 0.29 | 0.14 |
| 30 | 0.73 | 0.31 | 0.36 | 0.19 | 0.40 | 0.19 | 0.20 | 0.10 |
| 31 | | | | | | | | |
| 32 | 0.72 | 0.35 | 0.40 | 0.21 | 0.40 | 0.20 | 0.22 | 0.12 |
| 33 | 0.67 | 0.36 | 0.32 | 0.19 | 0.37 | 0.20 | 0.18 | 0.11 |
| 34 | | | | | | | | |
| 35 | 0.66 | 0.35 | 0.35 | 0.20 | 0.37 | 0.19 | 0.19 | 0.11 |
| 36 | 0.77 | 0.37 | 0.45 | 0.22 | 0.43 | 0.20 | 0.25 | 0.12 |
| 37 | | | | | | | | |
| 38 | 0.81 | 0.37 | 0.43 | 0.22 | 0.47 | 0.20 | 0.24 | 0.12 |
| 39 | 0.77 | 0.39 | 0.42 | 0.25 | 0.43 | 0.22 | 0.23 | 0.14 |
| 40 | | | | | | | | |

Table C2: List of parameters measured daily and parameters calculated from (cont) these measured parameters for digester D2

| Day No. | Methane produced per..... | | | | Carbon dioxide produced per... | | | |
|---|---|---|---|---|---|---|---|---|
| | VS rem. | VS add. | COD rem. | COD add. | VS rem. | VS add. | COD re | COD add |
| | l/g | l/g | l/g | l/g | l/g | l/g | l/g | l/g |
| 41 | 0.73 | 0.35 | 0.54 | 0.24 | 0.41 | 0.20 | 0.30 | 0.13 |
| 42 | 0.86 | 0.38 | 0.39 | 0.20 | 0.47 | 0.21 | 0.21 | 0.11 |
| 43 | | | | | | | | |
| 44 | 0.85 | 0.36 | 0.57 | 0.23 | 0.47 | 0.20 | 0.31 | 0.12 |
| 45 | 0.78 | 0.36 | 0.35 | 0.20 | 0.43 | 0.20 | 0.19 | 0.11 |
| 46 | | | | | | | | |
| 47 | 0.70 | 0.35 | 0.45 | 0.22 | 0.39 | 0.19 | 0.25 | 0.12 |
| 48 | 1.30 | 0.42 | 0.53 | 0.23 | 0.72 | 0.23 | 0.29 | 0.13 |
| 49 | | | | | | | | |
| 50 | 0.55 | 0.32 | 0.34 | 0.20 | 0.31 | 0.18 | 0.19 | 0.11 |
| 51 | 0.68 | 0.35 | 0.45 | 0.22 | 0.38 | 0.19 | 0.25 | 0.12 |
| 52 | | | | | | | | |
| 53 | 0.73 | 0.36 | 0.36 | 0.21 | 0.40 | 0.20 | 0.19 | 0.11 |
| 54 | 0.84 | 0.38 | 0.46 | 0.24 | 0.47 | 0.21 | 0.26 | 0.13 |
| 55 | | | | | | | | |
| 56 | 0.80 | 0.36 | 0.46 | 0.23 | 0.45 | 0.20 | 0.26 | 0.13 |
| 57 | 0.91 | 0.37 | 0.42 | 0.21 | 0.50 | 0.20 | 0.23 | 0.12 |
| 58 | | | | | | | | |
| 59 | 0.82 | 0.40 | 0.45 | 0.24 | 0.44 | 0.21 | 0.24 | 0.13 |
| 60 | 0.76 | 0.37 | 0.44 | 0.22 | 0.43 | 0.21 | 0.25 | 0.13 |
| 61 | | | | | | | | |
| 62 | | | | | | | | |
| 113 | | | | | | | | |
| 114 | | | | | | | | |
| 115 | | | | | | | | |
| 116 | | | | | | | | |
| 117 | | | | | | | | |
| 118 | | | | | | | | |
| 119 | | | | | | | | |
| 120 | 0.99 | 0.35 | 0.35 | 0.19 | 0.57 | 0.20 | 0.20 | 0.11 |
| 121 | | | | | | | | |
| 122 | 0.76 | 0.29 | 0.24 | 0.13 | 0.44 | 0.17 | 0.14 | 0.08 |
| 123 | | | | | | | | |
| 124 | 0.75 | 0.33 | 0.41 | 0.20 | 0.43 | 0.19 | 0.24 | 0.12 |
| 125 | | | | | | | | |
| 126 | 0.55 | 0.29 | 0.34 | 0.18 | 0.32 | 0.16 | 0.20 | 0.11 |
| 127 | | | | | | | | |
| 128 | 0.68 | 0.33 | 0.30 | 0.18 | 0.39 | 0.19 | 0.17 | 0.10 |
| 129 | | | | | | | | |
| 130 | 0.61 | 0.30 | 0.33 | 0.18 | 0.35 | 0.17 | 0.19 | 0.10 |

Note: All gas volumes measured at 1 atmosphere pressure and 20$^{o}$C.

Table C2: List of parameters measured daily and parameters calculated from these measured parameters for digester D2 (cont)

| Day No. | Methane produced per..... | | | | Carbon dioxide produced per... | | | |
|---|---|---|---|---|---|---|---|---|
| | VS rem. | VS add. | COD rem. | COD add. | VS rem. | VS add. | COD re | COD add |
| | l/g | l/g | l/g | l/g | l/g | l/g | l/g | l/g |
| 131 | | | | | | | | |
| 132 | 0.73 | 0.36 | 0.42 | 0.22 | 0.42 | 0.21 | 0.24 | 0.13 |
| 133 | 0.73 | 0.36 | 0.34 | 0.19 | 0.40 | 0.19 | 0.19 | 0.10 |
| 134 | | | | | | | | |
| 135 | | | | | | | | |
| 136 | 0.77 | 0.35 | 0.41 | 0.20 | 0.39 | 0.18 | 0.21 | 0.10 |
| 137 | | | | | | | | |
| 138 | 0.86 | 0.37 | 0.44 | 0.21 | 0.50 | 0.21 | 0.25 | 0.12 |
| 139 | | | | | | | | |
| 140 | 0.76 | 0.35 | 0.45 | 0.22 | 0.43 | 0.20 | 0.26 | 0.13 |
| 141 | | | | | | | | |
| 142 | 0.76 | 0.35 | 0.52 | 0.24 | 0.47 | 0.22 | 0.32 | 0.15 |
| 143 | | | | | | | | |
| 144 | | | | | | | | |
| 145 | | | | | | | | |
| 146 | 0.67 | 0.33 | 0.34 | 0.19 | 0.40 | 0.20 | 0.21 | 0.12 |
| 147 | | | | | | | | |
| 148 | 0.70 | 0.34 | 0.37 | 0.20 | 0.39 | 0.19 | 0.21 | 0.11 |
| 149 | | | | | | | | |
| 150 | 0.63 | 0.29 | 0.38 | 0.18 | 0.35 | 0.16 | 0.22 | 0.10 |
| 151 | | | | | | | | |
| 152 | 0.99 | 0.57 | 0.69 | 0.38 | 0.00 | 0.00 | 0.00 | 0.00 |
| 153 | | | | | | | | |
| 154 | 0.69 | 0.38 | 0.43 | 0.24 | 0.38 | 0.21 | 0.24 | 0.13 |
| 155 | | | | | | | | |
| 156 | 0.66 | 0.36 | 0.39 | 0.21 | 0.40 | 0.21 | 0.23 | 0.13 |
| 157 | | | | | | | | |
| 158 | 0.74 | 0.39 | 0.45 | 0.24 | 0.38 | 0.20 | 0.23 | 0.13 |
| 159 | | | | | | | | |
| 160 | 0.78 | 0.40 | 0.44 | 0.24 | 0.45 | 0.23 | 0.26 | 0.14 |
| 161 | | | | | | | | |
| 162 | 0.75 | 0.39 | 0.42 | 0.23 | 0.45 | 0.23 | 0.25 | 0.14 |
| 163 | | | | | | | | |
| 164 | 0.84 | 0.38 | 0.42 | 0.22 | 0.48 | 0.22 | 0.24 | 0.12 |
| 165 | | | | | | | | |
| 166 | 0.88 | 0.35 | 0.51 | 0.22 | 0.53 | 0.22 | 0.31 | 0.13 |
| 167 | | | | | | | | |
| 168 | 0.70 | 0.35 | 0.46 | 0.23 | 0.40 | 0.20 | 0.26 | 0.13 |
| 169 | | | | | | | | |
| 170 | 0.68 | 0.34 | 0.44 | 0.21 | 0.41 | 0.20 | 0.26 | 0.13 |

Table C2: List of parameters measured daily and parameters calculated from these measured parameters for digester D2 (cont)

| Day No. | Methane produced per..... | | | | Carbon dioxide produced per... | | | |
|---|---|---|---|---|---|---|---|---|
| | VS rem. | VS add. | COD rem. | COD add. | VS rem. | VS add. | COD re | COD add |
| | l/g | l/g | l/g | l/g | l/g | l/g | l/g | l/g |
| 171 | | | | | | | | |
| 172 | 0.71 | 0.36 | 0.41 | 0.22 | 0.47 | 0.23 | 0.27 | 0.14 |
| 173 | | | | | | | | |
| 174 | 0.92 | 0.39 | 0.40 | 0.22 | 0.57 | 0.24 | 0.25 | 0.13 |
| 175 | | | | | | | | |
| 176 | 0.88 | 0.37 | 0.43 | 0.21 | 0.54 | 0.23 | 0.26 | 0.13 |
| 177 | 0.58 | 0.32 | 0.27 | 0.17 | 0.33 | 0.18 | 0.15 | 0.10 |
| 178 | | | | | | | | |
| 179 | 0.67 | 0.33 | 0.42 | 0.21 | 0.42 | 0.21 | 0.26 | 0.13 |
| 180 | 0.67 | 0.36 | 0.47 | 0.24 | 0.41 | 0.22 | 0.29 | 0.14 |

Note: All gas volumes measured at 1 atmosphere pressure and 20$^{o}$C.

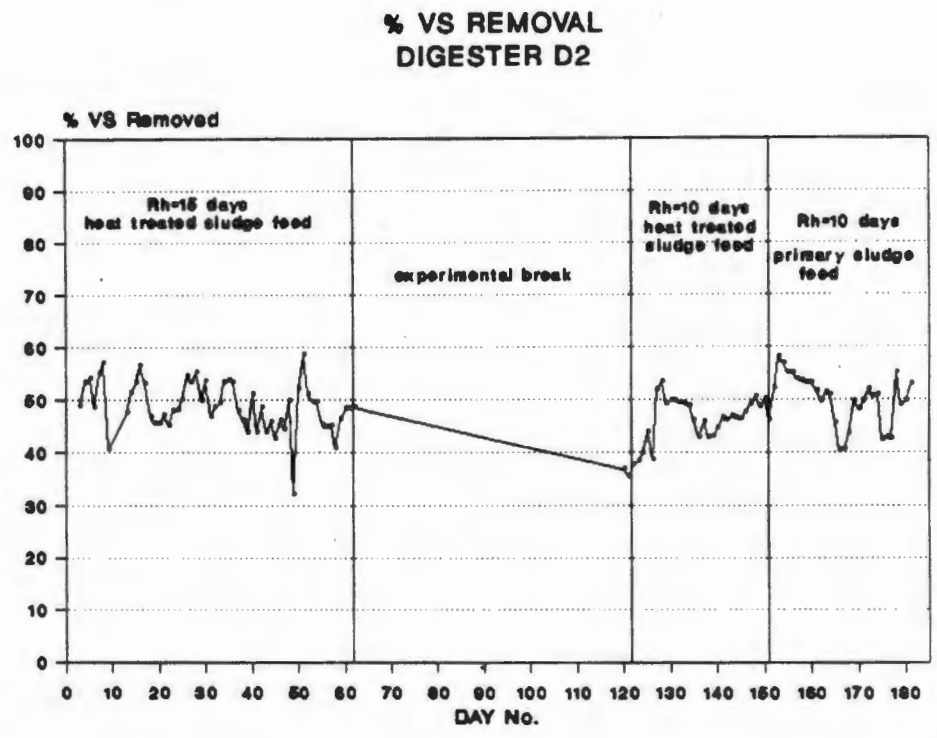


*Figure C13*: *Graph showing the day-to-day % VS removed in digester D2 for the period day 1 to day 181.*

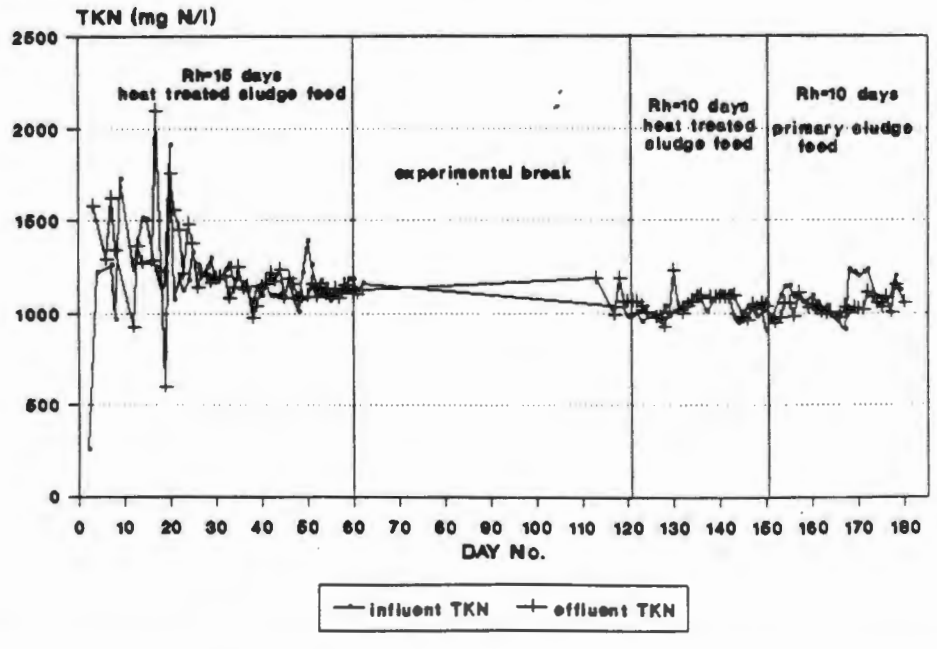


*Figure C14*: *Graph showing the day-to-day influent and effluent TKN in digester D2 for the period day 1 to day 181.*

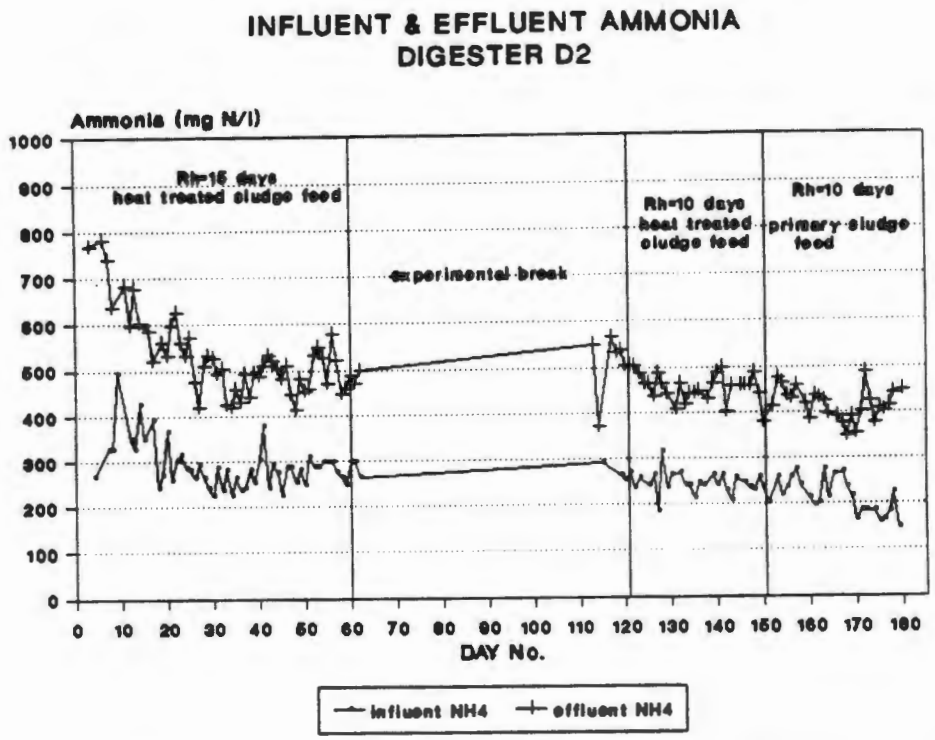


*Figure C15*: *Graph showing the day-to-day influent and effluent free and saline ammonia concentration in digester D2 for the period day 1 to day 181.*

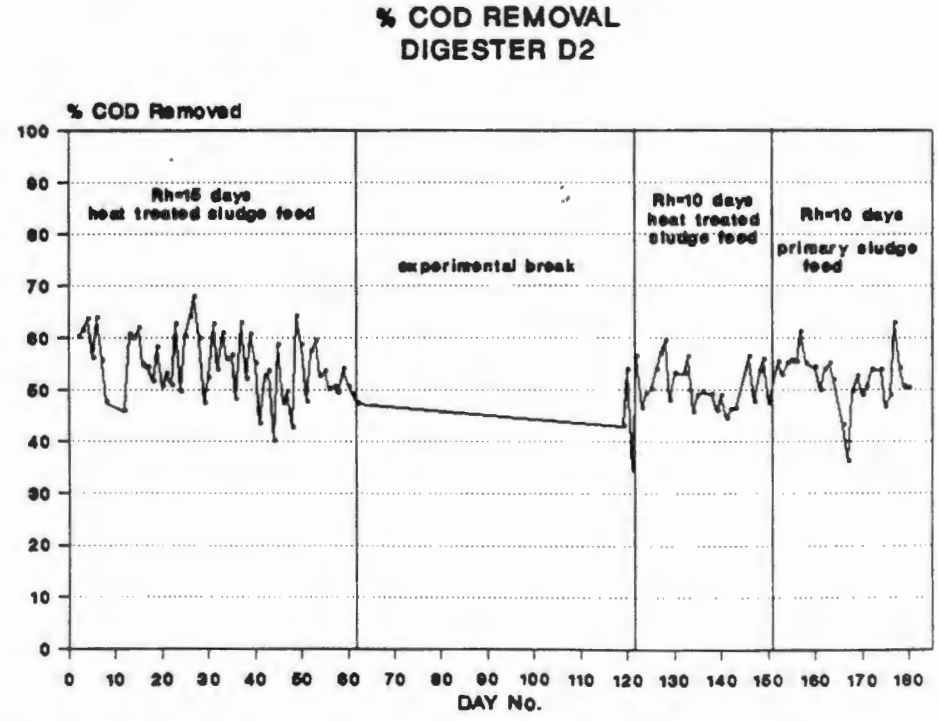


*Figure C16*: *Graph showing the day-to-day % COD removed in digester D2 for the period day 1 to day 181.*

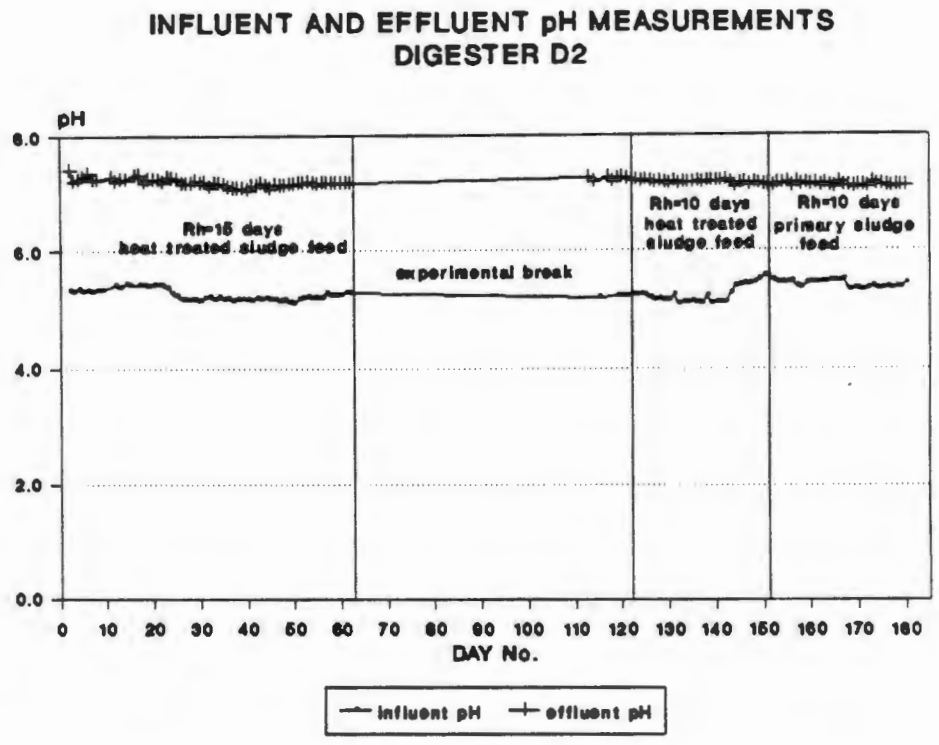


*Figure C17*: *Graph showing the day-to-day influent and effluent pH for digester D2 during the period day 1 to day 181.*

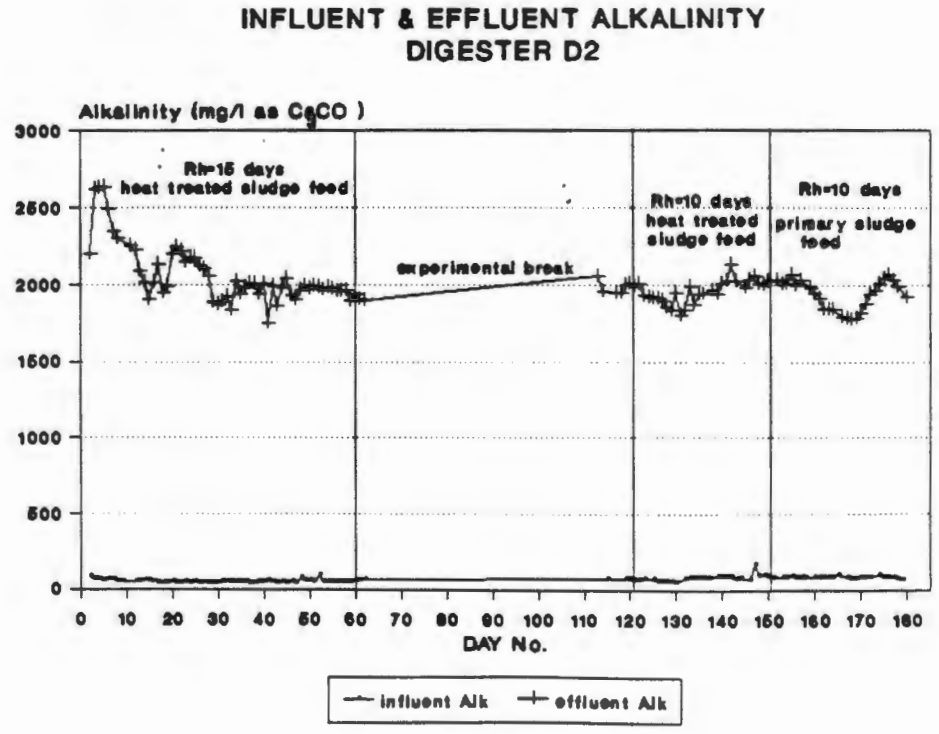


*Figure C18*: *Graph showing the day-to-day influent and effluent $H_2CO_3^*$ alkalinities for digester D2 during the period day 1 to day 181.*

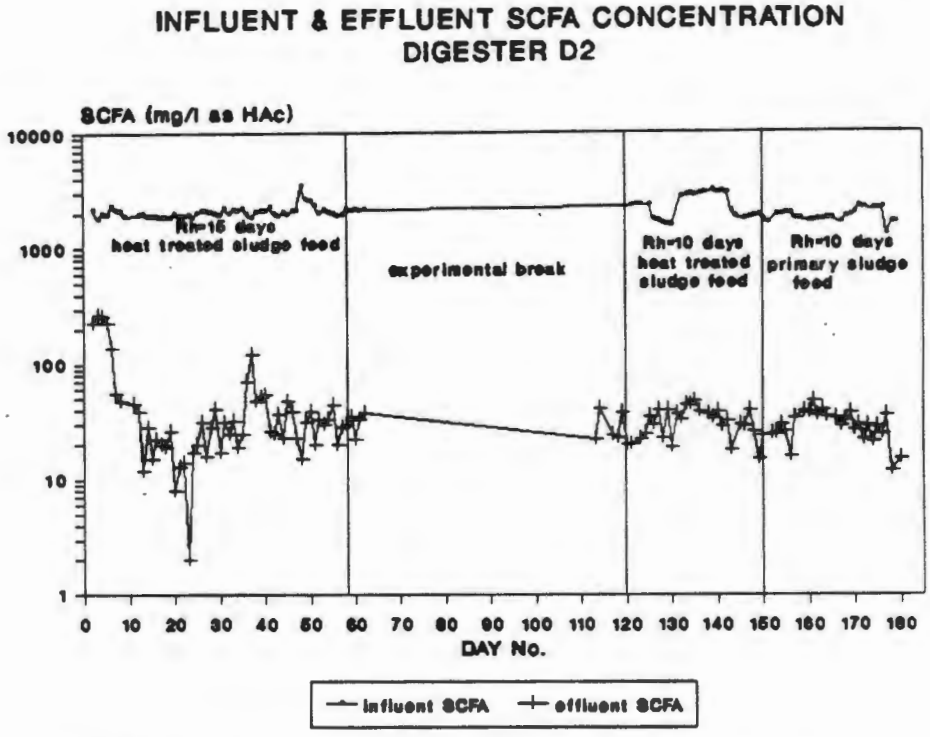


*Figure C19*: *Graph showing the day-to-day influent and effluent SCFA concentrations for digester D2 during the period day 1 to day 181.*

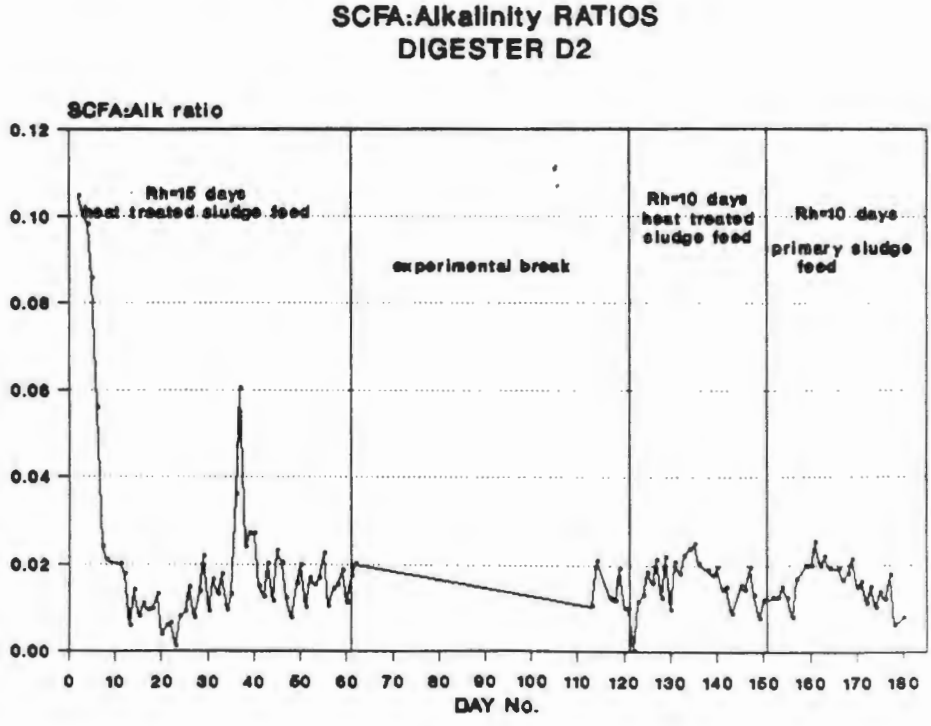


*Figure C20*: *Graph showing the day-to-day SCFA:alk ratios in digester D2 for the period day 1 to day 181.*

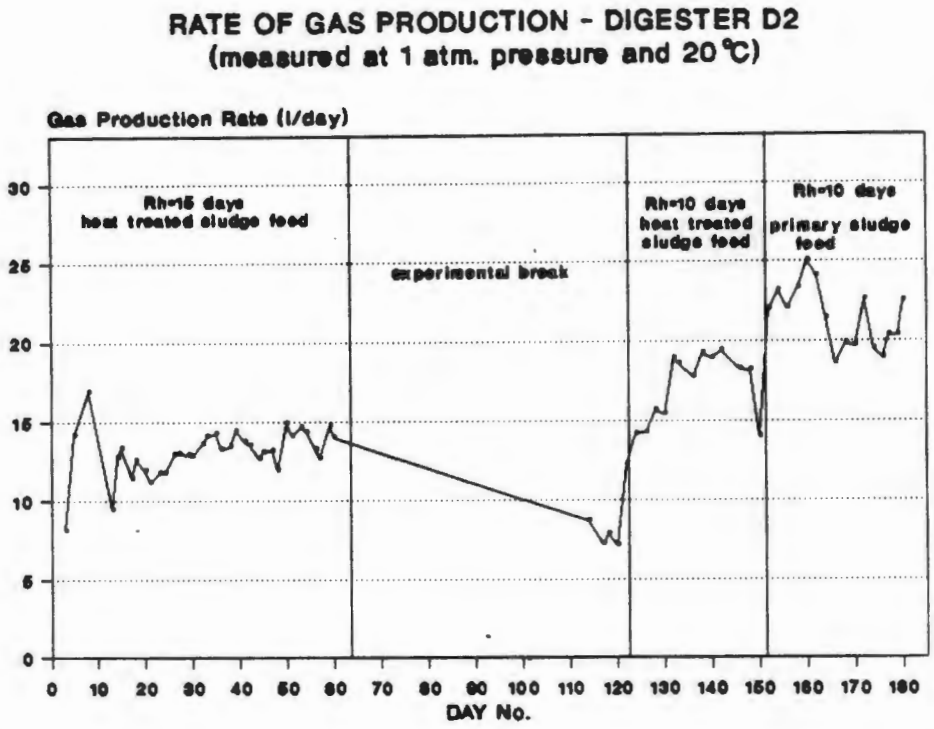


*Figure C21*: *Graph showing the day-to-day gas production rates in digester D2 for the period day 1 to day 181.*

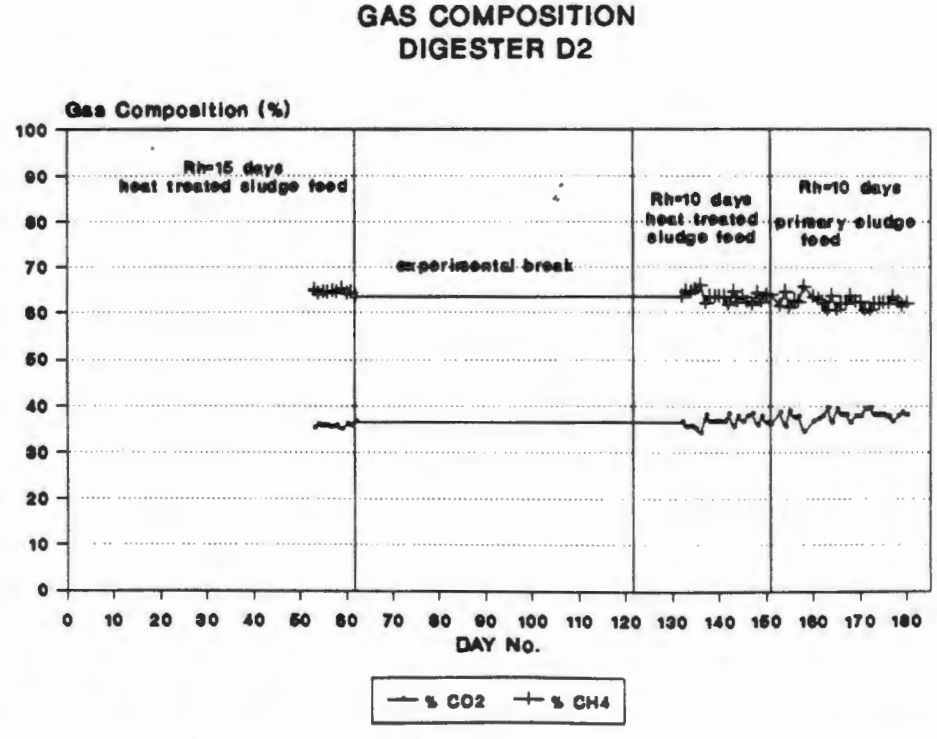


*Figure C22*: *Graph showing the day-to-day gas composition (% carbon dioxide and % methane) for digester D2 during the period day 1 to day 181.*

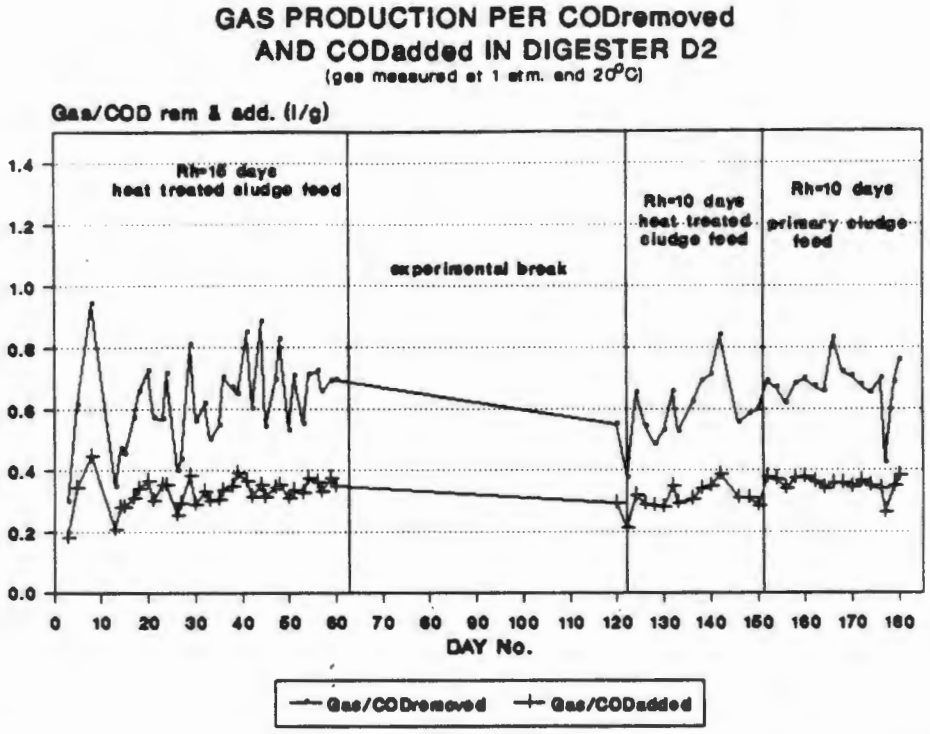


*Figure C23*: *Graph showing the day-to-day gas production per mass of COD removed and COD added for digester D2 during the period day 1 to day 181.*

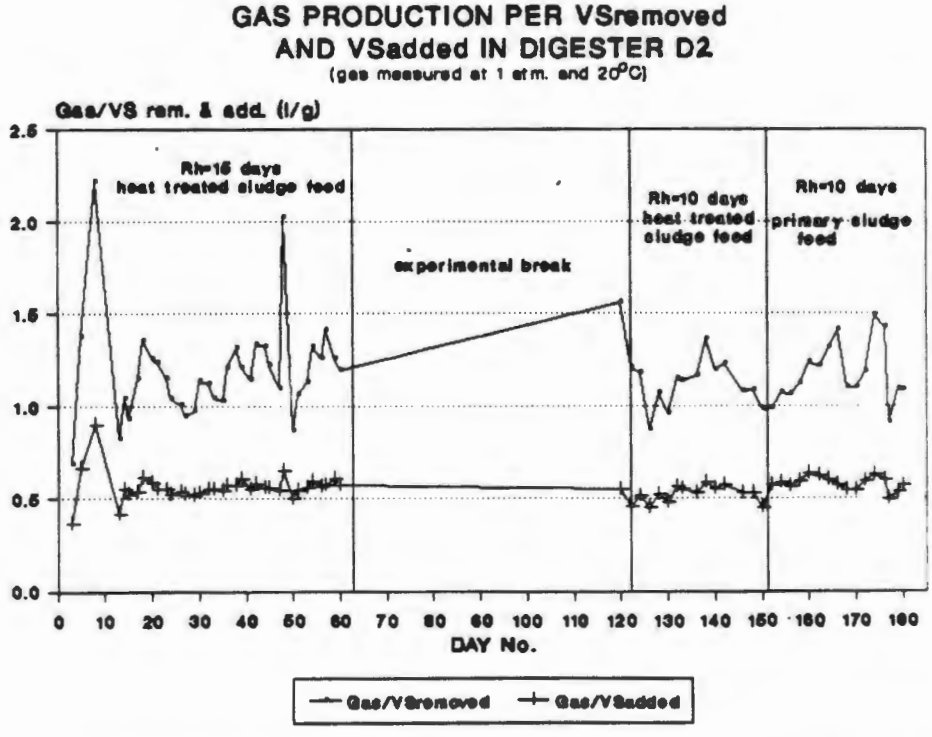


*Figure C24*: *Graph showing the day-to-day gas production per mass of VS removed and VS added for digester D2 during the period day 1 to day 181.*

Table C3: List of parameters measured daily and parameters calculated from these measured parameters for digester D3

| Day No. | Volume Feed | Total Solids | | Volatile Solids | | | | |
|---|---|---|---|---|---|---|---|---|
| | | influent | effluent | influent | added | effluent | removed | removed |
| | (l/day) | (g/l) | (g/l) | (g/l) | (g/day) | (g/l) | (g/day) | (%) |
| 1 | 0.7 | | 15.370 | | | 11.364 | | |
| 2 | 0.7 | 29.226 | 14.732 | 23.672 | 16570 | 10.820 | 8996 | 54.3 |
| 3 | 0.7 | 29.148 | 13.848 | 23.528 | 16470 | 10.206 | 9325 | 56.6 |
| 4 | 0.7 | 29.086 | 13.916 | 23.646 | 16552 | 10.178 | 9428 | 57.0 |
| 5 | 0.7 | 29.448 | 13.808 | 23.882 | 16717 | 10.218 | 9565 | 57.2 |
| 6 | 0.7 | 30.116 | 13.700 | 24.546 | 17182 | 10.068 | 10135 | 59.0 |
| 7 | 0.7 | 29.466 | 13.698 | 24.960 | 17472 | 9.936 | 10517 | 60.2 |
| 8 | 0.7 | 29.082 | 13.144 | 23.604 | 16523 | 9.450 | 9908 | 60.0 |
| 9 | 0.7 | 27.732 | | 22.426 | 15698 | 9.500 | 9048 | 57.6 |
| 10 | 0.7 | | | | | | | |
| 11 | 0.7 | | 14.218 | | | 10.290 | | |
| 12 | 0.7 | 33.168 | 14.032 | 27.180 | 19026 | 10.134 | 11932 | 62.7 |
| 13 | 0.7 | 33.238 | 14.690 | 27.026 | 18918 | 10.548 | 11535 | 61.0 |
| 14 | 0.7 | 32.466 | 15.114 | 26.312 | 18418 | 10.796 | 10861 | 59.0 |
| 15 | 0.7 | 28.224 | 15.036 | 22.826 | 15978 | 10.740 | 8460 | 52.9 |
| 16 | 0.7 | 27.606 | 13.066 | 22.342 | 15639 | 9.370 | 9080 | 58.1 |
| 17 | 0.7 | 26.952 | 14.278 | 21.838 | 15287 | 10.144 | 8186 | 53.5 |
| 18 | 0.7 | 27.408 | 15.274 | 22.286 | 15600 | 10.830 | 8019 | 51.4 |
| 19 | 0.7 | 27.372 | 15.556 | 22.286 | 15600 | 11.010 | 7893 | 50.6 |
| 20 | 0.7 | 27.288 | 15.876 | 22.172 | 15520 | 11.238 | 7654 | 49.3 |
| 21 | 0.7 | 27.144 | 16.162 | 21.964 | 15375 | 11.568 | 7277 | 47.3 |
| 22 | 0.7 | 27.520 | 15.876 | 22.368 | 15658 | 11.182 | 7830 | 50.0 |
| 23 | 0.7 | 32.400 | 15.566 | 26.216 | 18351 | 11.004 | 10648 | 58.0 |
| 24 | 0.7 | 32.946 | 15.326 | 26.798 | 18759 | 10.800 | 11199 | 59.7 |
| 25 | 0.7 | 33.222 | 15.162 | 26.928 | 18850 | 10.652 | 11393 | 60.4 |
| 26 | 0.7 | 32.898 | 15.148 | 26.608 | 18626 | 10.694 | 11140 | 59.8 |
| 27 | 0.7 | 33.070 | 15.686 | 26.712 | 18698 | 11.204 | 10856 | 58.1 |
| 28 | 0.7 | 32.680 | 16.746 | 26.498 | 18549 | 12.018 | 10136 | 54.6 |
| 29 | 0.7 | 32.416 | 16.744 | 26.294 | 18406 | 11.890 | 10083 | 54.8 |
| 30 | 0.7 | 32.430 | 16.662 | 26.314 | 18420 | 11.988 | 10028 | 54.4 |
| 31 | 0.7 | 32.310 | 16.530 | 26.304 | 18413 | 11.886 | 10093 | 54.8 |
| 32 | 0.7 | 32.594 | 16.810 | 26.436 | 18505 | 12.040 | 10077 | 54.5 |
| 33 | 0.7 | 32.558 | 16.702 | 26.380 | 18466 | 11.768 | 10228 | 55.4 |
| 34 | 0.7 | 31.744 | 17.372 | 25.444 | 17811 | 12.432 | 9108 | 51.1 |
| 35 | 0.7 | 30.654 | 16.576 | 24.950 | 17465 | 11.968 | 9087 | 52.0 |
| 36 | 0.7 | 30.082 | 16.572 | 24.450 | 17115 | 11.872 | 8805 | 51.4 |
| 37 | 0.7 | 29.726 | 16.616 | 24.130 | 16891 | 12.034 | 8467 | 50.1 |
| 38 | 0.7 | 29.926 | 16.608 | 24.406 | 17084 | 11.926 | 8736 | 51.1 |
| 39 | 0.7 | 29.988 | 16.798 | 24.300 | 17010 | 11.596 | 8893 | 52.3 |
| 40 | 0.7 | 29.788 | 17.140 | 24.166 | 16916 | 12.296 | 8309 | 49.1 |

Table C3: List of parameters measured daily and parameters calculated from (cont.) these measured parameters for digester D3

| Day No. | Volume Feed | Total Solids | | Volatile Solids | | | | |
|---|---|---|---|---|---|---|---|---|
| | | influent | effluent | influent | added | effluent | removed | removed |
| | (l/day) | (g/l) | (g/l) | (g/l) | (g/day) | (g/l) | (g/day) | (%) |
| 41 | 0.7 | 29.314 | 17.038 | 23.720 | 16604 | 12.206 | 8060 | 48.5 |
| 42 | 0.7 | 30.470 | 16.828 | 24.716 | 17301 | 12.018 | 8889 | 51.4 |
| 43 | 0.7 | 29.814 | 16.992 | 24.078 | 16855 | 12.244 | 8284 | 49.1 |
| 44 | 0.7 | 30.362 | 16.956 | 24.542 | 17179 | 12.336 | 8544 | 49.7 |
| 45 | 0.7 | 29.598 | 16.908 | 24.178 | 16925 | 12.086 | 8464 | 50.0 |
| 46 | 0.7 | 29.844 | 16.694 | 24.252 | 16976 | 11.982 | 8589 | 50.6 |
| 47 | 0.7 | 29.174 | 16.532 | 25.560 | 17892 | 11.970 | 9513 | 53.2 |
| 48 | 0.7 | 38.762 | 17.210 | 32.678 | 22875 | 12.398 | 14196 | 62.1 |
| 49 | 0.7 | 40.322 | 17.636 | 32.846 | 22992 | 12.720 | 14088 | 61.3 |
| 50 | 0.7 | 31.088 | 17.572 | 25.358 | 17751 | 12.712 | 8852 | 49.9 |
| 51 | 0.7 | 30.846 | 17.532 | 25.224 | 17657 | 12.694 | 8771 | 49.7 |
| 52 | 0.7 | 31.198 | 17.698 | 25.264 | 17685 | 12.756 | 8756 | 49.5 |
| 53 | 0.7 | 31.170 | 17.824 | 25.286 | 17700 | 12.948 | 8637 | 48.8 |
| 54 | 0.7 | 30.400 | 17.806 | 24.652 | 17256 | 12.770 | 8317 | 48.2 |
| 55 | 0.7 | 30.732 | 17.666 | 24.888 | 17422 | 12.784 | 8473 | 48.6 |
| 56 | 0.7 | 31.190 | 17.726 | 25.306 | 17714 | 12.786 | 8764 | 49.5 |
| 57 | 0.7 | 30.712 | 17.928 | 25.000 | 17500 | 13.040 | 8372 | 47.8 |
| 58 | 0.7 | 32.720 | 17.606 | 26.552 | 18586 | 12.840 | 9598 | 51.6 |
| 59 | 0.7 | 32.476 | 17.680 | 26.702 | 18691 | 12.848 | 9698 | 51.9 |
| 60 | 0.7 | 32.724 | 17.890 | 26.726 | 18708 | 12.912 | 9670 | 51.7 |
| 61 | 0.7 | 32.550 | 18.036 | 26.594 | 18616 | 12.852 | 9619 | 51.7 |
| 62 | 0.7 | 33.726 | 18.162 | 27.174 | 19022 | 12.800 | 10062 | 52.9 |
| | | | | | | | | |
| 113 | 1.16 | | 17.088 | | | 12.580 | | |
| 114 | 1.16 | 23.506 | 17.328 | 19.422 | 22530 | 12.706 | 7791 | 34.6 |
| 115 | 0 | 22.832 | | 18.708 | | | | |
| 116 | 0.6 | | | | | | | |
| 117 | 0.6 | | 16.862 | | | 12.250 | | |
| 118 | 0.6 | | 17.068 | | | 12.304 | | |
| 119 | 0.6 | 22.372 | 16.820 | 18.214 | 10928 | 12.030 | 3710 | 34.0 |
| 120 | 0.6 | 22.230 | 16.546 | 18.126 | 10876 | 12.080 | 3628 | 33.4 |
| 121 | 1.16 | 23.478 | 16.198 | 19.270 | 22353 | 11.800 | 8665 | 38.8 |
| 122 | 1.16 | 23.080 | 16.282 | 19.008 | 22049 | 11.866 | 8285 | 37.6 |
| 123 | 1.16 | 23.456 | 16.052 | 19.148 | 22212 | 11.744 | 8589 | 38.7 |
| 124 | 1.16 | 23.376 | 15.550 | 19.180 | 22249 | 11.284 | 9159 | 41.2 |
| 125 | 1.16 | 29.074 | 16.066 | 22.464 | 26058 | 11.574 | 12632 | 48.5 |
| 126 | 1.16 | 28.806 | 15.394 | 22.328 | 25900 | 11.270 | 12827 | 49.5 |
| 127 | 1.16 | 29.618 | 15.020 | 22.772 | 26416 | 10.944 | 13720 | 51.9 |
| 128 | 1.16 | 29.020 | 15.366 | 22.646 | 26269 | 11.274 | 13192 | 50.2 |
| 129 | 1.16 | 29.482 | 15.650 | 22.882 | 26543 | 11.590 | 13099 | 49.3 |
| 130 | 1.16 | 29.090 | 16.296 | 23.766 | 27569 | 12.002 | 13646 | 49.5 |

Table C3: List of parameters measured daily and parameters calculated from (cont.) these measured parameters for digester D3

| Day No. | Volume Feed | Total Solids | | Volatile Solids | | | | |
|---|---|---|---|---|---|---|---|---|
| | | influent | effluent | influent | added | effluent | removed | removed |
| | (l/day) | (g/l) | (g/l) | (g/l) | (g/day) | (g/l) | (g/day) | (%) |
| 131 | 1.16 | 29.444 | 16.784 | 24.016 | 27859 | 12.240 | 13660 | 49.0 |
| 132 | 1.16 | 29.274 | 16.800 | 23.920 | 27747 | 12.308 | 13470 | 48.5 |
| 133 | 1.16 | 29.152 | 17.025 | 23.704 | 27497 | 12.368 | 13150 | 47.8 |
| 134 | 1.16 | 26.970 | 16.872 | 21.714 | 25188 | 12.462 | 10732 | 42.6 |
| 135 | 1.16 | 29.622 | 36.808 | 24.204 | 28077 | 12.348 | 13753 | 49.0 |
| 136 | 1.16 | 29.500 | 16.796 | 24.056 | 27905 | 12.254 | 13690 | 49.1 |
| 137 | 1.16 | 29.554 | 16.806 | 23.890 | 27712 | 12.456 | 13263 | 47.9 |
| 138 | 1.16 | 29.542 | 16.876 | 24.154 | 28019 | 12.422 | 13609 | 48.6 |
| 139 | 1.16 | 29.222 | 16.972 | 23.880 | 27701 | 12.494 | 13208 | 47.7 |
| 140 | 1.16 | 29.170 | 16.964 | 23.832 | 27645 | 12.506 | 13138 | 47.5 |
| 141 | 1.16 | 28.794 | 16.870 | 23.610 | 27388 | 12.416 | 12985 | 47.4 |
| 142 | 1.16 | 29.180 | 16.954 | 24.282 | 28167 | 12.516 | 13649 | 48.5 |
| 143 | 1.16 | 29.106 | 16.862 | 24.150 | 28014 | 12.408 | 13621 | 48.6 |
| 144 | 1.16 | 29.160 | 16.426 | 24.186 | 28056 | 12.098 | 14022 | 50.0 |
| 145 | 1.16 | 29.162 | 16.518 | 24.112 | 27970 | 12.196 | 13823 | 49.4 |
| 146 | 1.16 | 29.216 | 16.518 | 24.334 | 28227 | 12.286 | 13976 | 49.5 |
| 147 | 1.16 | 29.154 | 16.354 | 24.104 | 27961 | 12.096 | 13929 | 49.8 |
| 148 | 1.16 | 28.966 | 16.192 | 24.016 | 27859 | 12.194 | 13714 | 49.2 |
| 149 | 1.16 | 25.442 | 16.044 | 21.088 | 24462 | 11.858 | 10707 | 43.8 |
| 150 | 1.16 | 30.652 | 16.140 | 25.466 | 29541 | 11.966 | 15660 | 53.0 |
| 151 | 1.16 | 30.856 | 16.334 | 25.578 | 29670 | 12.020 | 15727 | 53.0 |
| 152 | 1.16 | 32.974 | 16.430 | 27.408 | 31793 | 12.148 | 17702 | 55.7 |
| 153 | 1.16 | 33.374 | 16.262 | 27.734 | 32171 | 11.974 | 18282 | 56.8 |
| 154 | 1.16 | 33.806 | 16.454 | 28.110 | 32608 | 12.174 | 18486 | 56.7 |
| 155 | 1.16 | 33.668 | 16.856 | 28.090 | 32584 | 12.482 | 18105 | 55.6 |
| 156 | 1.16 | 33.206 | 16.536 | 27.752 | 32192 | 12.204 | 18036 | 56.0 |
| 157 | 2.0 | 34.220 | 17.942 | 28.278 | 56556 | 13.284 | 29988 | 53.0 |
| 158 | 2.0 | 34.010 | 19.164 | 28.028 | 56056 | 14.292 | 27472 | 49.0 |
| 159 | 2.0 | 35.132 | 20.442 | 28.932 | 57864 | 15.304 | 27256 | 47.1 |
| 160 | 2.0 | 34.152 | 20.554 | 28.040 | 56080 | 15.298 | 25484 | 45.4 |
| 161 | 2.0 | 34.026 | 21.224 | 27.934 | 55868 | 15.856 | 24156 | 43.2 |
| 162 | 2.0 | 33.736 | 20.874 | 27.726 | 55452 | 15.553 | 24345 | 43.9 |
| 163 | 2.0 | 34.102 | 20.330 | 28.002 | 56004 | 15.140 | 25724 | 45.9 |
| 164 | 2.0 | 30.934 | 20.584 | 25.508 | 51016 | 15.298 | 20120 | 40.0 |
| 165 | 2.0 | 28.132 | 19.658 | 23.012 | 46084 | 14.556 | 16972 | 36.8 |
| 166 | 2.0 | 28.390 | 19.610 | 23.296 | 46592 | 14.846 | 16900 | 36.3 |
| 167 | 2.0 | 28.480 | 19.830 | 23.334 | 46668 | 14.528 | 17612 | 37.7 |
| 168 | 2.0 | 31.010 | 19.222 | 26.120 | 52240 | 14.088 | 24064 | 46.1 |
| 169 | 2.0 | 31.426 | 19.312 | 26.088 | 52176 | 14.342 | 23492 | 45.0 |
| 170 | 2.0 | 31.300 | 18.880 | 25.882 | 51764 | 14.214 | 23336 | 45.1 |

Table C3: List of parameters measured daily and parameters calculated from (cont.) these measured parameters for digester D3

| Day No. | Volume Feed | Total Solids | | Volatile Solids | | | | |
|---|---|---|---|---|---|---|---|---|
| | | influent | effluent | influent | added | effluent | removed | removed |
| | (l/day) | (g/l) | (g/l) | (g/l) | (g/day) | (g/l) | (g/day) | (%) |
| 171 | 2.0 | 33.756 | 19.218 | 27.464 | 54928 | 14.318 | 26292 | 47.9 |
| 172 | 2.0 | 33.758 | 19.954 | 27.046 | 54092 | 14.976 | 24140 | 44.6 |
| 173 | 2.0 | 33.050 | 19.518 | 26.710 | 53420 | 14.648 | 24124 | 45.2 |
| 174 | 2.0 | 26.434 | 19.010 | 22.070 | 44140 | 14.360 | 15420 | 34.9 |
| 175 | 2.0 | 26.546 | 18.476 | 22.168 | 44336 | 13.934 | 16468 | 37.1 |
| 176 | 2.0 | 26.774 | 17.812 | 22.414 | 44828 | 13.426 | 17976 | 40.1 |
| 177 | 2.0 | 34.746 | 18.718 | 29.204 | 58408 | 14.108 | 30192 | 51.7 |
| 178 | 2.0 | 31.682 | 18.926 | 26.464 | 52928 | 14.504 | 23920 | 45.2 |
| 179 | 2.0 | 32.028 | 18.986 | 26.874 | 53748 | 14.482 | 24784 | 46.1 |
| 180 | 2.0 | 33.264 | 19.382 | 28.020 | 56040 | 14.692 | 26656 | 47.6 |
| 181 | 2.0 | 32.764 | 19.070 | 27.368 | 54736 | 14.514 | 25708 | 47.0 |
| 182 | 2.0 | 33.558 | 19.708 | 28.112 | 56224 | 15.108 | 26008 | 46.3 |
| 183 | 2.0 | 33.594 | 20.202 | 28.170 | 56340 | 15.430 | 25480 | 45.2 |
| 184 | 2.0 | 33.400 | 20.476 | 28.008 | 56016 | 15.700 | 24616 | 43.9 |
| 185 | 3.0 | 33.363 | 22.254 | 27.938 | 83814 | 17.244 | 32082 | 38.3 |
| 186 | 3 | 33.174 | 23.162 | 27.872 | 83616 | 17.902 | 29910 | 35.8 |
| 187 | 3 | 30.652 | 22.968 | 25.642 | 76926 | 17.938 | 23112 | 30.0 |
| 188 | 3 | 30.100 | 23.758 | 25.164 | 75492 | 18.762 | 19206 | 25.4 |
| 189 | 3 | 35.254 | 24.332 | 29.578 | 88734 | 19.342 | 30708 | 34.6 |
| 190 | 0.5 | 33.028 | 23.370 | 27.724 | 13862 | 18.236 | 4744 | 34.2 |
| 191 | 0.5 | 33.388 | 21.942 | 27.954 | 13977 | 16.862 | 5546 | 39.7 |
| 192 | 0.5 | 32.626 | 21.330 | 27.220 | 13610 | 16.060 | 5580 | 41.0 |
| 193 | 0.5 | 33.170 | 20.698 | 27.772 | 13886 | 15.850 | 5961 | 42.9 |
| 194 | 0.5 | 32.970 | 20.540 | 27.532 | 13766 | 15.622 | | |
| 195 | 0 | | 20.442 | | | 15.568 | | |
| 196 | 0 | | 19.976 | | | 15.062 | | |
| 197 | 1 | 32.950 | 20.624 | 27.506 | 27506 | 15.810 | 11696 | 42.5 |
| 198 | 1 | 33.210 | 20.309 | 27.722 | 27722 | 15.482 | 12240 | 44.2 |
| 199 | 1 | 32.762 | 20.282 | 27.574 | 27574 | 15.638 | 11936 | 43.3 |
| 200 | 1 | 32.992 | 20.370 | 28.008 | 28008 | 15.658 | 12350 | 44.1 |
| 201 | 1.71 | 33.124 | 20.860 | 27.798 | 47535 | 16.188 | 19853 | 41.8 |
| 202 | 1.71 | 33.072 | 20.920 | 27.970 | 47829 | 16.240 | 20058 | 41.9 |
| 203 | 1.71 | 42.058 | 20.704 | 36.712 | 62778 | 15.936 | 35527 | 56.6 |
| 204 | 1.71 | 33.950 | 20.412 | 28.616 | 48933 | 15.662 | 22151 | 45.3 |
| 205 | 1.71 | 33.396 | 20.790 | 28.030 | 47931 | 15.992 | 20585 | 42.9 |
| 206 | 1.71 | 33.770 | 20.636 | 28.496 | 48728 | 15.988 | 21389 | 43.9 |
| 207 | 1.71 | 29.750 | 20.450 | 25.210 | 43109 | 15.644 | 16358 | 37.9 |
| 208 | 1.71 | 30.326 | 19.792 | 25.538 | 43670 | 15.180 | 17712 | 40.6 |
| 209 | 1.71 | 29.820 | 19.730 | 25.084 | 42894 | 15.108 | 17059 | 39.8 |
| 210 | 1.71 | 29.784 | 19.334 | 25.068 | 42866 | 14.758 | 17630 | 41.1 |

Table C3: List of parameters measured daily and parameters calculated from (cont.) these measured parameters for digester D3

| Day No. | Non-volatile Solids | | | TKN | | Ammonia | |
|---|---|---|---|---|---|---|---|
| | influent | effluent | removed | influent | effluent | influent | effluent |
| | (g/l) | (g/l) | (%) | (mg/l) | (mg/l) | (mg/l) | (mg/l) |
| 1 | | 4.006 | | | 1450 | | |
| 2 | 5.554 | 3.912 | 29.6 | 1210 | | | |
| 3 | 5.620 | 3.642 | 35.2 | | 1249 | | 756 |
| 4 | 5.440 | 3.738 | 31.3 | 969 | | 249 | |
| 5 | 5.566 | 3.590 | 35.5 | | | | |
| 6 | 5.570 | 3.632 | 34.8 | | 1254 | | 784 |
| 7 | 4.506 | 3.762 | 16.5 | 1114 | 1176 | 314 | 683 |
| 8 | 5.478 | 3.694 | 32.6 | 1210 | 1266 | 286 | 711 |
| 9 | 5.306 | | | 2548 | | 297 | |
| 10 | | | | | | | |
| 11 | | 3.928 | | | 1333 | | 778 |
| 12 | 5.988 | 3.898 | 34.9 | 1607 | 1366 | 392 | 683 |
| 13 | 6.212 | 4.142 | 33.3 | 1473 | 1355 | 330 | 678 |
| 14 | 6.154 | 4.318 | 29.8 | 1579 | | 269 | 840 |
| 15 | 5.398 | 4.296 | 20.4 | 1042 | | 308 | |
| 16 | 5.264 | 3.696 | 29.8 | | 1131 | | 750 |
| 17 | 5.114 | 4.134 | 19.2 | 1215 | 1249 | 549 | 683 |
| 18 | 5.122 | 4.444 | 13.2 | 1938 | 1215 | 258 | 566 |
| 19 | 5.086 | 4.546 | 10.6 | | 1266 | 347 | 594 |
| 20 | 5.116 | 4.638 | 9.3 | 1165 | 1333 | 420 | 594 |
| 21 | 5.180 | 4.594 | 11.3 | 1148 | 1249 | 252 | 627 |
| 22 | 5.152 | 4.694 | 8.9 | 1165 | 1165 | 308 | 560 |
| 23 | 6.184 | 4.562 | 26.2 | 1187 | 1176 | 258 | 582 |
| 24 | 6.148 | 4.526 | 26.4 | 1176 | 1170 | 241 | 543 |
| 25 | 6.294 | 4.510 | 28.3 | 1299 | 1254 | 269 | 560 |
| 26 | 6.290 | 4.454 | 29.2 | 1243 | 1148 | 252 | 560 |
| 27 | 6.358 | 4.482 | 29.5 | 1226 | 1137 | 162 | 487 |
| 28 | 6.182 | 4.728 | 23.5 | 1148 | 1221 | 258 | 532 |
| 29 | 6.122 | 4.854 | 20.7 | 1243 | 1215 | 246 | 560 |
| 30 | 6.116 | 4.674 | 23.6 | 1126 | 1210 | 230 | 571 |
| 31 | 6.006 | 4.644 | 22.7 | 1260 | 1204 | 185 | 582 |
| 32 | 6.158 | 4.770 | 22.5 | 1221 | 1215 | 235 | 566 |
| 33 | 6.178 | 4.934 | 20.1 | 1215 | 1137 | 274 | 442 |
| 34 | 6.300 | 4.940 | 21.6 | 1176 | 1165 | 174 | 470 |
| 35 | 5.701 | 4.608 | 19.2 | 1120 | 1154 | 168 | 426 |
| 36 | 5.632 | 4.700 | 16.5 | 1137 | 1148 | 185 | 437 |
| 37 | 5.596 | 4.582 | 18.1 | 1193 | 1058 | 190 | 510 |
| 38 | 5.520 | 4.682 | 15.2 | 1053 | 1070 | 302 | 510 |
| 39 | 5.688 | 5.202 | 8.5 | 1030 | 1064 | 280 | 465 |
| 40 | 5.622 | 4.844 | 13.8 | 1086 | 1025 | 269 | 493 |



Table C3: List of parameters measured daily and parameters calculated from (cont.) these measured parameters for digester D3

| Day No. | Non-volatile Solids | | | TKN | | Ammonia | |
|---|---|---|---|---|---|---|---|
| | influent | effluent | removed | influent | effluent | influent | effluent |
| | (g/l) | (g/l) | (%) | (mg/l) | (mg/l) | (mg/l) | (mg/l) |
| 41 | 5.594 | 4.832 | 13.6 | 1058 | 1176 | 269 | 504 |
| 42 | 5.754 | 4.810 | 16.4 | 1114 | 1187 | 207 | 560 |
| 43 | 5.736 | 4.748 | 17.2 | 1120 | 1210 | 218 | 532 |
| 44 | 5.820 | 4.620 | 20.6 | 1120 | 1232 | 224 | 515 |
| 45 | 5.420 | 4.822 | 11.0 | 1064 | 1081 | 196 | 493 |
| 46 | 5.592 | 4.712 | 15.7 | 1098 | 1114 | 280 | 493 |
| 47 | 3.614 | 4.562 | -26.2 | 952 | 1142 | 241 | 482 |
| 48 | 6.084 | 4.812 | 20.9 | 1540 | 1075 | 286 | 493 |
| 49 | 7.476 | 4.916 | 34.2 | 1574 | 1103 | 274 | 476 |
| 50 | 5.730 | 4.860 | 15.2 | 1126 | 1165 | 207 | 487 |
| 51 | 5.622 | 4.838 | 13.9 | 1221 | 1187 | 218 | 526 |
| 52 | 5.934 | 4.942 | 16.7 | 1098 | 1198 | 218 | 526 |
| 53 | 5.884 | 4.876 | 17.1 | 1092 | 1126 | 269 | 526 |
| 54 | 5.748 | 5.036 | 12.4 | 1260 | 1148 | 235 | 521 |
| 55 | 5.844 | 4.882 | 16.5 | 1165 | 1137 | 291 | 538 |
| 56 | 5.884 | 4.940 | 16.0 | 1131 | 1131 | 269 | 426 |
| 57 | 5.712 | 4.888 | 14.4 | 1137 | 1126 | 263 | 521 |
| 58 | 6.168 | 4.766 | 22.7 | 1114 | 1154 | 308 | 437 |
| 59 | 5.774 | 4.832 | 16.3 | 1165 | 1221 | 241 | 476 |
| 60 | 5.998 | 4.978 | 17.0 | 1232 | 1204 | 258 | 504 |
| 61 | 5.956 | 5.184 | 13.0 | 1204 | 1154 | 263 | 448 |
| 62 | 6.552 | 5.362 | 18.2 | 1165 | 1142 | 263 | 482 |
| 113 | | 4.508 | | | 1154 | | 627 |
| 114 | 4.084 | 4.622 | -13.2 | 929.6 | | 212.8 | 454 |
| 115 | 4.124 | | | 935.2 | | 240.8 | |
| 116 | | | | | | | |
| 117 | | 4.612 | | | 857 | | 465 |
| 118 | | 4.764 | | | 1114 | | 476 |
| 119 | 4.158 | 4.790 | -15.2 | 901.6 | 1086 | 324.8 | 504 |
| 120 | 4.104 | 4.466 | -8.8 | 912.8 | 1075 | 218.4 | 532 |
| 121 | 4.208 | 4.398 | -4.5 | 985.6 | 1075 | 280 | 476 |
| 122 | 4.072 | 4.416 | -8.4 | 1036 | 1036 | 280 | 420 |
| 123 | 4.308 | 4.308 | 0.0 | 946 | | 241 | |
| 124 | 4.196 | 4.266 | -1.7 | | 1030 | | 431 |
| 125 | 6.610 | 4.492 | 32.0 | 1070 | 980 | 146 | 448 |
| 126 | 6.478 | 4.124 | 36.3 | 1036 | 1025 | 213 | 437 |
| 127 | 6.846 | 4.076 | 40.5 | 930 | 924 | 168 | 493 |
| 128 | 6.374 | 4.092 | 35.8 | 913 | 918 | 224 | 493 |
| 129 | 6.600 | 4.060 | 38.5 | 997 | 980 | 207 | 448 |
| 130 | 5.324 | 4.294 | 19.3 | 1002 | | 213 | |

Table C3: List of parameters measured daily and parameters calculated from these measured parameters for digester D3 (cont.)

| Day No. | Non-volatile Solids | | | TKN | | Ammonia | |
|---|---|---|---|---|---|---|---|
| | influent | effluent | removed | influent | effluent | influent | effluent |
| | (g/l) | (g/l) | (%) | (mg/l) | (mg/l) | (mg/l) | (mg/l) |
| 131 | 5.428 | 4.544 | 16.3 | | 963 | | 437 |
| 132 | 5.354 | 4.492 | 16.1 | 1025 | 986 | 213 | 426 |
| 133 | 5.448 | 4.657 | 14.5 | 1047 | 963 | 263 | 437 |
| 134 | 5.256 | 4.410 | 16.1 | 1019 | 1042 | 218 | 470 |
| 135 | 5.418 | 24.460 | -351.5 | 1092 | 1103 | 252 | 431 |
| 136 | 5.444 | 4.542 | 16.6 | 1064 | 1002 | 224 | 409 |
| 137 | 5.664 | 4.350 | 23.2 | 1019 | | 258 | |
| 138 | 5.388 | 4.454 | 17.3 | | 1042 | | 437 |
| 139 | 5.342 | 4.478 | 16.2 | 1019 | 1047 | 258 | 465 |
| 140 | 5.338 | 4.458 | 16.5 | 1047 | 946 | 246 | 448 |
| 141 | 5.184 | 4.454 | 14.1 | 1070 | 1047 | 246 | 420 |
| 142 | 4.898 | 4.438 | 9.4 | 991 | 980 | 202 | 386 |
| 143 | 4.956 | 4.454 | 10.1 | 930 | 963 | 218 | 414 |
| 144 | 4.974 | 4.328 | 13.0 | 980 | | 202 | |
| 145 | 5.050 | 4.322 | 14.4 | | 1008 | | 465 |
| 146 | 4.882 | 4.232 | 13.3 | 986 | 913 | 213 | 459 |
| 147 | 5.050 | 4.258 | 15.7 | 980 | 1030 | 274 | 454 |
| 148 | 4.950 | 3.998 | 19.2 | 1002 | 997 | 263 | 392 |
| 149 | 4.354 | 4.186 | 3.9 | 902 | 969 | 224 | 459 |
| 150 | 5.186 | 4.174 | 19.5 | 997 | 963 | 207 | 358 |
| 151 | 5.278 | 4.314 | 18.3 | 980 | | 202 | |
| 152 | 5.566 | 4.282 | 23.1 | | 963 | | 437 |
| 153 | 5.640 | 4.288 | 24.0 | 1092 | 963 | 258 | 426 |
| 154 | 5.696 | 4.280 | 24.9 | 1137 | 958 | 218 | 437 |
| 155 | 5.578 | 4.374 | 21.6 | 1148 | 963 | 235 | 409 |
| 156 | 5.454 | 4.332 | 20.6 | 1081 | 969 | 258 | 409 |
| 157 | 5.942 | 4.658 | 21.6 | 1086 | 1053 | 274 | 442 |
| 158 | 5.982 | 4.872 | 18.6 | 1053 | | 241 | |
| 159 | 6.200 | 5.138 | 17.1 | | 963 | | 353 |
| 160 | 6.112 | 5.256 | 14.0 | 1092 | 1030 | 213 | 347 |
| 161 | 6.092 | 5.368 | 11.9 | 1053 | 1030 | 196 | 330 |
| 162 | 6.010 | 5.321 | 11.5 | 1019 | 991 | 202 | 353 |
| 163 | 6.100 | 5.190 | 14.9 | 1030 | 1025 | 274 | 308 |
| 164 | 5.426 | 5.286 | 2.6 | 991 | 1002 | 213 | 325 |
| 165 | 5.090 | 5.102 | -0.2 | 1002 | | 263 | |
| 166 | 5.091 | 4.791 | 5.9 | | 974 | | 342 |
| 167 | 4.756 | 5.302 | -11.5 | 907 | 1042 | 269 | 302 |
| 168 | 4.920 | 5.134 | -4.3 | 1232 | 1002 | 235 | 286 |
| 169 | 5.338 | 4.970 | 6.9 | 1215 | 986 | 214 | 358 |
| 170 | 5.418 | 4.666 | 13.9 | 1198 | 997 | 162 | 325 |

Table C3: List of parameters measured daily and parameters calculated from these measured parameters for digester D3 (cont.)

| Day No. | Non-volatile Solids | | | TKN | | Ammonia | |
|---|---|---|---|---|---|---|---|
| | influent | effluent | removed | influent | effluent | influent | effluent |
| | (g/l) | (g/l) | (%) | (mg/l) | (mg/l) | (mg/l) | (mg/l) |
| 171 | 6.292 | 4.900 | 22.1 | 1215 | 1036 | 185 | 375 |
| 172 | 6.712 | 4.978 | 25.8 | 1232 | | 185 | |
| 173 | 6.340 | 4.870 | 23.2 | | 1098 | | 375 |
| 174 | 4.364 | 4.650 | -6.6 | 1086 | 1008 | 185 | 370 |
| 175 | 4.378 | 4.542 | -3.7 | 1075 | 1086 | 157 | 426 |
| 176 | 4.360 | 4.386 | -0.6 | 1064 | 1086 | 162 | 392 |
| 177 | 5.542 | 4.610 | 16.8 | 1098 | 1053 | 179 | 381 |
| 178 | 5.218 | 4.422 | 15.3 | 1198 | 1047 | 224 | 403 |
| 179 | 5.154 | 4.504 | 12.6 | 1120 | | 146 | |
| 180 | 5.244 | 4.690 | 10.6 | | 1058 | | 392 |
| 181 | 5.396 | 4.556 | 15.6 | 1047 | 1042 | 151 | 420 |
| 182 | 5.446 | 4.600 | 15.5 | 1064 | 1098 | 134 | 426 |
| 183 | 5.424 | 4.772 | 12.0 | 1098 | 1070 | 224 | 426 |
| 184 | 5.392 | 4.776 | 11.4 | 1114 | 1075 | 157 | 420 |
| 185 | 5.425 | 5.010 | 7.7 | 1148 | 1075 | 212.8 | 330 |
| 186 | 5.302 | 5.260 | 0.8 | 1058.4 | 1064 | 100.8 | 353 |
| 187 | 5.010 | 5.030 | -0.4 | 1058.4 | 1098 | 106.4 | 314 |
| 188 | 4.936 | 4.996 | -1.2 | 1030.4 | 1075 | 123.2 | 269 |
| 189 | 5.676 | 4.990 | 12.1 | 1125.6 | | 123.2 | 274 |
| 190 | 5.304 | 5.134 | 3.2 | | 1075 | 117.6 | 426 |
| 191 | 5.434 | 5.080 | 6.5 | 1136.8 | 997 | 156.8 | 353 |
| 192 | 5.406 | 5.270 | 2.5 | 1136.8 | | 123.2 | 398 |
| 193 | 5.398 | 4.848 | 10.2 | | | 162.4 | |
| 194 | | | | | | | |
| 195 | | 4.874 | | | 1075 | | 403 |
| 196 | | 4.914 | | | 1120 | | 403 |
| 197 | 5.444 | 4.814 | 11.6 | 1092 | 1081 | 123.2 | 426 |
| 198 | 5.488 | 4.827 | 12.1 | 1086.4 | 1103 | 184.8 | 409 |
| 199 | 5.188 | 4.644 | 10.5 | 1164.8 | 1002 | 123.2 | 442 |
| 200 | 4.984 | 4.712 | 5.5 | 1198.4 | 1081 | 168 | 465 |
| 201 | 5.326 | 4.672 | 12.3 | 1159.2 | 1070 | 201.6 | 448 |
| 202 | 5.102 | 4.680 | 8.3 | 1192.8 | 1131 | 168 | 470 |
| 203 | 5.346 | 4.768 | 10.8 | 1215.2 | 1176 | 168 | 409 |
| 204 | 5.334 | 4.750 | 10.9 | 1276.8 | 1148 | 128.8 | 437 |
| 205 | 5.366 | 4.798 | 10.6 | 1265.6 | 1170 | 179.2 | 437 |
| 206 | 5.274 | 4.648 | 11.9 | 1220.8 | | 151.2 | |
| 207 | 4.540 | 4.806 | -5.9 | | | | |
| 208 | 4.788 | 4.612 | 3.7 | | 1198 | | 487 |
| 209 | 4.736 | 4.622 | 2.4 | 1142.4 | 1254 | 190.4 | 437 |
| 210 | 4.716 | 4.576 | 3.0 | 1120 | 1136.8 | 190.4 | 397.6 |

Table C3: List of parameters measured daily and parameters calculated from (cont.) these measured parameters for digester D3

| Day No. | COD | | | | | Conductivity | |
|---|---|---|---|---|---|---|---|
| | influent | added | effluent | removed | removed | influent | effluent |
| | (g/l) | (g/day) | (g/l) | (g/day) | (%) | (mS/m) | (mS/m) |
| 1 | | | 19345 | | | | 600 |
| 2 | 43566 | 30496 | 17231 | 18434 | 60.4 | 310 | 570 |
| 3 | 39665 | 27765 | 18044 | 15134 | 54.5 | 370 | 560 |
| 4 | 40965 | 28676 | 17719 | 16272 | 56.7 | 370 | 550 |
| 5 | 41290 | 28903 | 12517 | 20141 | 69.7 | 350 | 535 |
| 6 | 42266 | 29586 | 15626 | 18648 | 63.0 | 360 | 520 |
| 7 | 33225 | 23257 | 16284 | 11859 | 51.0 | 270 | 490 |
| 8 | 40791 | 28554 | 18257 | 15774 | 55.2 | 270 | 490 |
| 9 | 43752 | 30626 | 18110 | 17949 | 58.6 | 270 | |
| 10 | | | | | | | |
| 11 | | | 18093 | | | | 450 |
| 12 | 45396 | 31778 | 19409 | 18191 | 57.2 | 260 | 450 |
| 13 | 48028 | 33620 | 17428 | 21420 | 63.7 | 260 | 420 |
| 14 | 46258 | 32381 | 18243 | 19611 | 60.6 | 275 | 410 |
| 15 | 39417 | 27592 | 18894 | 14366 | 52.1 | 240 | 325 |
| 16 | 39417 | 27592 | 14008 | 17786 | 64.5 | 230 | 410 |
| 17 | 39417 | 27592 | 15311 | 16874 | 61.2 | 245 | 420 |
| 18 | 39743 | 27820 | 16614 | 16190 | 58.2 | 255 | 410 |
| 19 | 40068 | 28048 | 16256 | 16669 | 59.4 | 250 | 430 |
| 20 | 39417 | 27592 | 16581 | 15985 | 57.9 | 265 | 420 |
| 21 | 39340 | 27538 | 20645 | 13086 | 47.5 | 280 | 455 |
| 22 | 37714 | 26400 | 17719 | 13996 | 53.0 | 260 | 450 |
| 23 | 41615 | 29131 | 12680 | 20255 | 69.5 | 260 | 440 |
| 24 | 36739 | 25717 | 16581 | 14110 | 54.9 | 265 | 440 |
| 25 | 45192 | 31634 | 16581 | 20027 | 63.3 | 270 | 420 |
| 26 | 42591 | 29814 | 17069 | 17865 | 59.9 | 270 | 430 |
| 27 | 45517 | 31862 | 12029 | 23141 | 73.6 | 270 | 415 |
| 28 | 37064 | 25945 | 12288 | 17343 | 66.8 | 265 | 410 |
| 29 | 30802 | 21561 | 18350 | 8716 | 40.4 | 265 | 410 |
| 30 | 46203 | 32342 | 19005 | 19038 | 58.9 | 270 | 385 |
| 31 | 52101 | 36471 | 18022 | 23855 | 65.4 | 250 | 360 |
| 32 | 40960 | 28672 | 19333 | 15139 | 52.8 | 255 | 375 |
| 33 | 44892 | 31425 | 19005 | 18121 | 57.7 | 250 | 380 |
| 34 | 42598 | 29819 | 19169 | 16400 | 55.0 | 255 | 390 |
| 35 | 42926 | 30018 | 19333 | 16515 | 55.0 | 250 | 390 |
| 36 | 41558 | 29091 | 18859 | 16233 | 56.2 | 255 | 400 |
| 37 | 40400 | 28280 | 17611 | 15930 | 56.1 | 240 | 395 |
| 38 | 43469 | 30416 | 17611 | 17986 | 59.3 | 250 | 390 |
| 39 | 35552 | 24886 | 19392 | 11312 | 45.5 | 240 | 385 |
| 40 | 41370 | 28959 | 16483 | 17420 | 60.2 | 255 | 450 |

Table C3: List of parameters measured daily and parameters calculated from (cont.) these measured parameters for digester D3

| Day No. | COD | | | | | Conductivity | |
|---|---|---|---|---|---|---|---|
| | influent | added | effluent | removed | removed | influent | effluent |
| | (g/l) | (g/day) | (g/l) | (g/day) | (%) | (mS/m) | (mS/m) |
| 41 | 43955 | 30769 | 21673 | 15598 | 50.7 | 280 | 355 |
| 42 | 42684 | 29878 | 19356 | 16329 | 54.7 | 240 | 370 |
| 43 | 43676 | 30573 | 18529 | 17603 | 57.6 | 250 | 365 |
| 44 | 44338 | 31037 | 19191 | 17603 | 56.7 | 230 | 370 |
| 45 | 42022 | 29415 | 18198 | 16676 | 56.7 | 240 | 430 |
| 46 | 41360 | 28952 | 19026 | 15634 | 54.0 | 270 | 370 |
| 47 | 27794 | 19456 | 18695 | 6369 | 32.7 | 280 | 360 |
| 48 | 55919 | 39143 | 18860 | 25941 | 66.3 | 350 | 380 |
| 49 | 58566 | 40996 | 19853 | 27099 | 66.1 | 280 | 390 |
| 50 | 42022 | 29415 | 20018 | 15402 | 52.4 | 250 | 420 |
| 51 | 44007 | 30805 | 20845 | 16213 | 52.6 | 265 | 430 |
| 52 | 42022 | 29415 | 19356 | 15866 | 53.9 | 280 | 435 |
| 53 | 42684 | 29878 | 20680 | 15402 | 51.6 | 250 | 435 |
| 54 | 45000 | 31500 | 21011 | 16792 | 53.3 | 290 | 440 |
| 55 | 41691 | 29184 | 21342 | 14244 | 48.8 | 290 | 435 |
| 56 | 42684 | 29878 | 20184 | 15750 | 52.7 | 295 | 430 |
| 57 | 40036 | 28026 | 20349 | 13781 | 49.2 | 300 | 420 |
| 58 | 43014 | 30110 | 19853 | 16213 | 53.8 | 300 | 425 |
| 59 | 42353 | 29647 | 21838 | 14360 | 48.4 | 320 | 425 |
| 60 | 46985 | 32889 | 21816 | 17618 | 53.6 | 310 | 425 |
| 61 | 42662 | 29864 | 19554 | 16176 | 54.2 | 315 | 410 |
| 62 | 44278 | 30995 | 19877 | 17081 | 55.1 | 315 | 415 |
| 113 | | | 23265 | | | | 430 |
| 114 | 32440 | 37631 | 19661 | 14824 | 39.4 | 270 | 410 |
| 115 | 33423 | | | | | 300 | |
| 116 | | | | | | | |
| 117 | | | 17695 | | | | 410 |
| 118 | | | 18842 | | | | 410 |
| 119 | 31130 | 18678 | 20480 | 6390 | 34.2 | 290 | 430 |
| 120 | 30147 | 18088 | 18678 | 6881 | 38.0 | 300 | 410 |
| 121 | 32768 | 38011 | 18293 | 16791 | 44.2 | 290 | 410 |
| 122 | 32301 | 37469 | 18293 | 16249 | 43.4 | 300 | 390 |
| 123 | 35926 | 41675 | 16974 | 21984 | 52.8 | 290 | 400 |
| 124 | 32301 | 37469 | 17798 | 16823 | 44.9 | 310 | 390 |
| 125 | 36915 | 42822 | 17798 | 22175 | 51.8 | 220 | 400 |
| 126 | 37574 | 43586 | 17304 | 23514 | 53.9 | 220 | 380 |
| 127 | 37574 | 43586 | 16810 | 24087 | 55.3 | 215 | 370 |
| 128 | 38563 | 44733 | 18293 | 23514 | 52.6 | 200 | 350 |
| 129 | 38234 | 44351 | 17469 | 24087 | 54.3 | 195 | 355 |
| 130 | 39882 | 46263 | | | | 280 | |

Table C3: List of parameters measured daily and parameters calculated from these measured parameters for digester D3 (cont.)

| Day No. | COD | | | | | Conductivity | |
|---|---|---|---|---|---|---|---|
| | influent (g/l) | added (g/day) | effluent (g/l) | removed (g/day) | removed (%) | influent (mS/m) | effluent (mS/m) |
| 131 | 39717 | 46071 | 18458 | 24661 | 53.5 | | 340 |
| 132 | 39552 | 45880 | 18787 | 24087 | 52.5 | 290 | 350 |
| 133 | 38893 | 45116 | 18458 | 23705 | 52.5 | 300 | 360 |
| 134 | 39222 | 45498 | 19446 | 22940 | 50.4 | 300 | 350 |
| 135 | 39222 | 45498 | 23921 | 17750 | 39.0 | 300 | 345 |
| 136 | 40305 | 46753 | 20152 | 23377 | 50.0 | 305 | 345 |
| 137 | 39322 | 45613 | 19333 | 23187 | 50.8 | 300 | |
| 138 | | | 18514 | | | | 350 |
| 139 | 36700 | 42572 | 18678 | 20906 | 49.1 | 300 | 345 |
| 140 | 38666 | 44853 | 19988 | 21666 | 48.3 | 295 | 340 |
| 141 | 38011 | 44093 | 18350 | 22807 | 51.7 | 290 | 370 |
| 142 | 41288 | 47894 | 19497 | 25277 | 52.8 | 210 | 370 |
| 143 | 35717 | 41432 | 19546 | 18759 | 45.3 | 210 | 375 |
| 144 | 36159 | 41945 | | | | 220 | |
| 145 | 37137 | 43079 | 17754 | 22484 | 52.2 | | 360 |
| 146 | 38114 | 44212 | 17917 | 23429 | 53.0 | 210 | 360 |
| 147 | 41697 | 48369 | 17754 | 27774 | 57.4 | 220 | 360 |
| 148 | 37137 | 43079 | 18405 | 21728 | 50.4 | 225 | 360 |
| 149 | 33879 | 39300 | 19057 | 17194 | 43.8 | 220 | 360 |
| 150 | 43652 | 50636 | 17917 | 29853 | 59.0 | 230 | 360 |
| 151 | 40068 | 46479 | 18324 | 25224 | 54.3 | 225 | |
| 152 | | | 18731 | | | | 345 |
| 153 | 42675 | 49502 | 19057 | 27396 | 55.3 | 235 | 350 |
| 154 | 44955 | 52148 | 19383 | 29664 | 56.9 | 240 | 345 |
| 155 | 44629 | 51770 | 20360 | 28152 | 54.4 | 230 | 340 |
| 156 | 46258 | 53659 | 19871 | 30608 | 57.0 | 230 | 340 |
| 157 | 52122 | 104243 | 23618 | 57008 | 54.7 | 210 | 330 |
| 158 | 44629 | 89258 | | | | 220 | 330 |
| 159 | 45932 | 91864 | 24758 | 42349 | 46.1 | | 310 |
| 160 | 47235 | 94470 | 25246 | 43978 | 46.6 | 220 | 300 |
| 161 | 44303 | 88607 | 26387 | 35834 | 40.4 | 215 | 285 |
| 162 | 47561 | 95122 | 25812 | 43499 | 45.7 | 210 | 285 |
| 163 | 48417 | 96833 | 25491 | 45852 | 47.4 | 215 | 285 |
| 164 | 44890 | 89779 | 24369 | 41042 | 45.7 | 220 | 285 |
| 165 | 38156 | 76312 | 24449 | 27415 | 35.9 | 225 | |
| 166 | | | 24529 | | | | 270 |
| 167 | 36553 | 73106 | 21801 | 29499 | 40.4 | 220 | 270 |
| 168 | 39759 | 79519 | 23086 | 33347 | 41.9 | 220 | 280 |
| 169 | 43286 | 86573 | 21964 | 42615 | 49.3 | 220 | 280 |
| 170 | 40721 | 81443 | 22605 | 36232 | 44.5 | 225 | 285 |



Table C3: List of parameters measured daily and parameters calculated from these measured parameters for digester D3 (cont.)

| Day No. | COD | | | | | Conductivity | |
|---|---|---|---|---|---|---|---|
| | influent (g/l) | added (g/day) | effluent (g/l) | removed (g/day) | removed (%) | influent (mS/m) | effluent (mS/m) |
| 171 | 40721 | 81443 | 22926 | 35591 | 43.7 | 230 | 295 |
| 172 | 44248 | 88497 | | | | 240 | |
| 173 | 42004 | 84008 | 23727 | 36553 | 43.5 | | 310 |
| 174 | 39759 | 79519 | 24048 | 31423 | 39.5 | 230 | 310 |
| 175 | 35591 | 71182 | 22418 | 26346 | 37.0 | 230 | 310 |
| 176 | 39675 | 79350 | 22418 | 34514 | 43.5 | 230 | 310 |
| 177 | 45158 | 90317 | 22257 | 45804 | 50.7 | 170 | 300 |
| 178 | 44513 | 89027 | 24031 | 40965 | 46.0 | 190 | 300 |
| 179 | 41933 | 83866 | | | | 190 | |
| 180 | 46932 | 93865 | 23224 | 47416 | 50.5 | | 280 |
| 181 | 51932 | 103864 | 23547 | 56771 | 54.7 | 170 | 255 |
| 182 | 45481 | 90962 | 23869 | 43223 | 47.5 | 180 | 255 |
| 183 | 44191 | 88381 | 25160 | 38062 | 43.1 | 175 | 270 |
| 184 | 47094 | 94188 | 24676 | 44836 | 47.6 | 180 | 255 |
| 185 | 48384 | 145152 | 27256 | 63383 | 43.7 | 180 | 270 |
| 186 | 43868 | 131604 | 29514 | 43062 | 32.7 | 190 | 260 |
| 187 | 43223 | 129669 | 30643 | 37740 | 29.1 | 180 | 260 |
| 188 | 41610 | 124831 | 31772 | 29514 | 23.6 | 180 | 245 |
| 189 | 51287 | 153861 | 31772 | 58545 | 38.1 | 185 | 245 |
| 190 | 47094 | 23547 | 30922 | 8086 | 34.3 | 185 | 240 |
| 191 | 50002 | 25001 | 27633 | 11185 | 44.7 | 180 | 250 |
| 192 | 46383 | 23192 | 26810 | 9787 | 42.2 | 180 | 255 |
| 193 | 45396 | 22698 | 24672 | 10362 | 45.7 | 190 | 255 |
| 194 | | | | | | | |
| 195 | | | 24179 | | | | 255 |
| 196 | | | 25988 | | | | 265 |
| 197 | 48028 | 48028 | 23850 | 24179 | 50.3 | 190 | 260 |
| 198 | 54278 | 54278 | 24508 | 29771 | 54.8 | 185 | 260 |
| 199 | 49673 | 49673 | 25165 | 24508 | 49.3 | 190 | 260 |
| 200 | 45396 | 45396 | 25001 | 20396 | 44.9 | 190 | 255 |
| 201 | 46712 | 79878 | 24836 | 37408 | 46.8 | 195 | 255 |
| 202 | 49015 | 83816 | 25001 | 41064 | 49.0 | 195 | 245 |
| 203 | 42765 | 73128 | 25988 | 28689 | 39.2 | 190 | 240 |
| 204 | 44081 | 75378 | 25823 | 31220 | 41.4 | 190 | 245 |
| 205 | 48686 | 83253 | 25988 | 38814 | 46.6 | 200 | 250 |
| 206 | 49673 | 84941 | 23409 | 44912 | 52.9 | 200 | 265 |
| 207 | 43566 | 74498 | | | | 200 | |
| 208 | | | 23571 | | | | 260 |
| 209 | 45517 | 77834 | 22758 | 38917 | 50.0 | 200 | 260 |
| 210 | 43241 | 73942 | 23734 | 33357 | 45.1 | 200 | 255 |

Table C3: List of parameters measured daily and parameters calculated from (cont.) these measured parameters for digester D3

| Day No. | pH | | Alkalinity(as CaCO3) | | SCFA (as HAc) | | SCFA/Alk | |
|---|---|---|---|---|---|---|---|---|
| | influent | effluent | influent (mg/l) | effluent (mg/l) | influent (mg/l) | effluent (mg/l) | influent | effluent |
| 1 | | 7.43 | | 2886 | | 347 | | |
| 2 | 5.39 | 7.36 | 71 | 2603 | 2093 | 424 | 29.5 | 0.163 |
| 3 | 5.38 | 7.1 | 87 | 2491 | 2579 | 609 | 29.6 | 0.244 |
| 4 | 5.37 | 7.09 | 87 | 2260 | 2612 | 739 | 30.0 | 0.327 |
| 5 | 5.42 | 7.05 | 82 | 2181 | 2793 | 835 | 34.1 | 0.383 |
| 6 | 5.45 | 7.11 | 90 | 1915 | 2721 | 979 | 30.2 | 0.511 |
| 7 | 5.40 | 7.05 | 60 | 1764 | 1862 | 897 | 31.0 | 0.509 |
| 8 | 5.42 | 7.03 | 63 | 1799 | 1737 | 835 | 27.6 | 0.464 |
| 9 | 5.39 | | 70 | | 1732 | | 24.7 | |
| 10 | | | | | | | | |
| 11 | | 7.29 | | 2177 | | 190 | | 0.087 |
| 12 | 5.43 | 7.27 | 69 | 2246 | 1733 | 104 | 25.1 | 0.046 |
| 13 | 5.44 | 7.25 | 67 | 2189 | 1770 | 50 | 26.4 | 0.023 |
| 14 | 5.44 | 7.23 | 75 | 2101 | 1873 | 30 | 25.0 | 0.014 |
| 15 | 5.42 | | 55 | 1901 | 1643 | 10 | 29.9 | 0.005 |
| 16 | | 7.33 | 58 | 2071 | 1644 | 40 | 28.3 | 0.019 |
| 17 | 5.46 | 7.31 | 49 | 2150 | 1738 | 10 | 35.5 | 0.005 |
| 18 | 5.46 | 7.23 | 56 | 2167 | 1780 | 15 | 31.8 | 0.007 |
| 19 | 5.44 | 7.27 | 54 | 2262 | 1750 | 19 | 32.4 | 0.008 |
| 20 | 5.47 | 7.22 | 57 | 2182 | 1887 | 6 | 33.1 | 0.003 |
| 21 | 5.47 | 7.24 | 61 | 2324 | 2078 | 20 | 34.1 | 0.009 |
| 22 | 5.50 | 7.21 | 55 | 2346 | 1888 | 0 | 34.3 | 0.000 |
| 23 | 5.22 | 7.28 | 52 | 2296 | 2241 | 15 | 43.1 | 0.007 |
| 24 | 5.25 | 7.22 | 43 | 2260 | 2238 | 12 | 52.0 | 0.005 |
| 25 | 5.27 | 7.22 | 56 | 2233 | 2261 | 11 | 40.4 | 0.005 |
| 26 | 5.23 | 7.17 | 55 | 2243 | 2284 | 27 | 41.5 | 0.012 |
| 27 | 5.25 | 7.13 | 50 | 2224 | 2296 | 11 | 45.9 | 0.005 |
| 28 | 5.26 | 7.22 | 52 | 2184 | 2282 | 11 | 43.9 | 0.005 |
| 29 | 5.26 | 7.2 | 56 | 2166 | 2301 | 18 | 41.1 | 0.008 |
| 30 | 5.27 | 7.17 | 54 | 2000 | 2326 | 12 | 43.1 | 0.006 |
| 31 | 5.28 | 7.22 | 56 | 2001 | 2120 | 24 | 37.9 | 0.012 |
| 32 | 5.30 | 7.14 | 58 | 2026 | 2249 | 17 | 38.8 | 0.008 |
| 33 | 5.26 | 7.23 | 54 | 2023 | 2198 | 23 | 40.7 | 0.011 |
| 34 | 5.31 | 7.23 | 57 | 2195 | 2221 | 19 | 39.0 | 0.009 |
| 35 | 5.30 | 7.2 | 60 | 2135 | 2220 | 2 | 37.0 | 0.001 |
| 36 | 5.33 | 7.13 | 60 | 2171 | 2217 | 30 | 37.0 | 0.014 |
| 37 | 5.31 | 7.11 | 50 | 2205 | 2223 | 84 | 44.5 | 0.038 |
| 38 | 5.28 | 7.11 | 61 | 2163 | 2253 | 42 | 36.9 | 0.019 |
| 39 | 5.29 | 7.07 | 66 | 1851 | 2254 | 44 | 34.2 | 0.024 |
| 40 | 5.30 | 7.08 | 50 | 2178 | 2234 | 68 | 44.7 | 0.031 |

Note: Alkalinity = $H_2CO_3^*$ alkalinity



Table C3: List of parameters measured daily and parameters calculated from (cont.) these measured parameters for digester D3

| Day No. | pH | | Alkalinity(as CaCO3) | | SCFA (as HAc) | | SCFA/Alk | |
|---|---|---|---|---|---|---|---|---|
| | influent | effluent | influent (mg/l) | effluent (mg/l) | influent (mg/l) | effluent (mg/l) | influent | effluent |
| 41 | 5.28 | 7.12 | 67 | 1901 | 2189 | 22 | 32.7 | 0.012 |
| 42 | 5.30 | 7.14 | 57 | 2066 | 1991 | 23 | 34.9 | 0.011 |
| 43 | 5.31 | 7.18 | 60 | 2101 | 2267 | 33 | 37.8 | 0.016 |
| 44 | 5.33 | 7.13 | 61 | 2037 | 2049 | 18 | 33.6 | 0.009 |
| 45 | 5.34 | 7.09 | 63 | 2056 | 2030 | 44 | 32.2 | 0.021 |
| 46 | 5.30 | 7.15 | 54 | 2017 | 2305 | 25 | 42.7 | 0.012 |
| 47 | 5.27 | 7.2 | 59 | 2040 | 2432 | 21 | 41.2 | 0.010 |
| 48 | 5.09 | 7.15 | 51 | 2116 | 2221 | 24 | 43.5 | 0.011 |
| 49 | 5.18 | 7.09 | 63 | 2096 | 2879 | 22 | 45.7 | 0.010 |
| 50 | 5.21 | 7.14 | 51 | 2114 | 2217 | 26 | 43.5 | 0.012 |
| 51 | 5.25 | 7.19 | 52 | 2053 | 2205 | 43 | 42.4 | 0.021 |
| 52 | 5.27 | 7.18 | 107 | 2080 | 2054 | 25 | 19.2 | 0.012 |
| 53 | 5.30 | 7.2 | 56 | 2040 | 2021 | 35 | 36.1 | 0.017 |
| 54 | 5.28 | 7.16 | 56 | 2081 | 2229 | 13 | 39.8 | 0.006 |
| 55 | 5.30 | 7.18 | 56 | 2094 | 2238 | 16 | 40.0 | 0.008 |
| 56 | 5.31 | 7.19 | 57 | 2137 | 2239 | 33 | 39.3 | 0.015 |
| 57 | 5.33 | 7.18 | 57 | 2080 | 2234 | 23 | 39.2 | 0.011 |
| 58 | 5.31 | 7.2 | 65 | 2055 | 2389 | 5 | 36.8 | 0.002 |
| 59 | 5.31 | 7.19 | 65 | 2021 | 2383 | 30 | 36.7 | 0.015 |
| 60 | 5.33 | 7.19 | 69 | 2060 | 2395 | 26 | 34.7 | 0.013 |
| 61 | 5.34 | 7.14 | 66 | 2069 | 2360 | 23 | 35.8 | 0.011 |
| 62 | 5.32 | 7.17 | 65 | 2074 | 2525 | 22 | 38.8 | 0.011 |
| | | | | | | | | |
| 113 | | 7.26 | | 2151 | | 31 | | 0.014 |
| 114 | 5.2 | 7.22 | 72 | 2010 | 2111 | 58 | 29.3 | 0.029 |
| 115 | 5.23 | | 79 | | 2404 | | 30.4 | |
| 116 | | | | | | | | |
| 117 | | 7.26 | | 2004 | | 27 | | 0.013 |
| 118 | | 7.21 | | 2012 | | 25 | | 0.012 |
| 119 | 5.29 | 7.2 | 84 | 2042 | 2342 | 35 | 27.9 | 0.017 |
| 120 | 5.29 | 7.21 | 93 | 2056 | 2300 | 28 | 24.7 | 0.014 |
| 121 | 5.28 | 7.19 | 89 | 2064 | 2334 | 11 | 26.2 | 0.005 |
| 122 | 5.29 | 7.2 | 88 | 2034 | 2179 | 11 | 24.8 | 0.005 |
| 123 | 5.29 | 7.18 | 86 | 1999 | 2220 | 25 | 25.8 | 0.013 |
| 124 | 5.3 | 7.2 | | 1972 | | 27 | | 0.014 |
| 125 | 5.18 | 7.17 | 50 | 1935 | 1542 | 62 | 30.8 | 0.032 |
| 126 | 5.2 | 7.17 | 53 | 1898 | 1565 | 34 | 29.5 | 0.018 |
| 127 | 5.22 | 7.17 | 54 | 1850 | 1564 | 28 | 29.0 | 0.015 |
| 128 | 5.21 | 7.15 | 54 | 1863 | 1454 | 38 | 26.9 | 0.020 |
| 129 | 5.23 | 7.16 | 51 | 1798 | 1443 | 30 | 28.3 | 0.017 |
| 130 | 5.14 | 7.15 | 80 | | 2543 | | 31.8 | |

Table C3: List of parameters measured daily and parameters calculated from (cont.) these measured parameters for digester D3

| Day No. | pH | | Alkalinity(as CaCO3) | | SCFA (as HAc) | | SCFA/Alk | |
|---|---|---|---|---|---|---|---|---|
| | influent | effluent | influent (mg/l) | effluent (mg/l) | influent (mg/l) | effluent (mg/l) | influent | effluent |
| 131 | 5.16 | 7.16 | | 1832 | | 45 | | 0.025 |
| 132 | 5.16 | 7.17 | 91 | 1894 | 2872 | 28 | 31.6 | 0.015 |
| 133 | 5.18 | 7.18 | 89 | 1939 | 2873 | 36 | 32.3 | 0.019 |
| 134 | 5.19 | 7.19 | 93 | 1973 | 2947 | 31 | 31.7 | 0.016 |
| 135 | 5.19 | 7.16 | 92 | 1944 | 2817 | 49 | 30.6 | 0.025 |
| 136 | 5.18 | 7.2 | 93 | 2008 | 3053 | 26 | 32.8 | 0.013 |
| 137 | 5.19 | 7.17 | 94 | | 3050 | | 32.4 | |
| 138 | 5.2 | 7.2 | | 2023 | | 26 | | 0.013 |
| 139 | 5.19 | 7.2 | 107 | 2072 | 3021 | 32 | 28.2 | 0.015 |
| 140 | 5.2 | 7.2 | 105 | 2073 | 3067 | 30 | 29.2 | 0.014 |
| 141 | 5.21 | 7.22 | 105 | 2075 | 3085 | 13 | 29.4 | 0.006 |
| 142 | 5.41 | 7.21 | 74 | 2108 | 1593 | 23 | 21.5 | 0.011 |
| 143 | 5.42 | 7.16 | 69 | 2087 | 1562 | 28 | 22.6 | 0.013 |
| 144 | 5.44 | 7.1 | 74 | | 1624 | | 21.9 | |
| 145 | 5.41 | 7.21 | | 2055 | | 18 | | 0.009 |
| 146 | 5.43 | 7.14 | 74 | 2266 | 1612 | 62 | 21.8 | 0.027 |
| 147 | 5.44 | 7.09 | 71 | 2058 | 1673 | 47 | 23.6 | 0.023 |
| 148 | 5.48 | 7.09 | 72 | 2093 | 1710 | 30 | 23.8 | 0.014 |
| 149 | 5.54 | 7.15 | 89 | 2066 | 1585 | 35 | 17.8 | 0.017 |
| 150 | 5.55 | 7.13 | 77 | 2090 | 1610 | 23 | 20.9 | 0.011 |
| 151 | 5.56 | 7.13 | 80 | | 1610 | | 20.1 | |
| 152 | 5.49 | 7.15 | | 2108 | | 39 | | 0.019 |
| 153 | 5.45 | 7.08 | 82 | 2094 | 1890 | 31 | 23.0 | 0.015 |
| 154 | 5.45 | 7.13 | 82 | 2091 | 1895 | 50 | 23.1 | 0.024 |
| 155 | 5.45 | 7.15 | 88 | 2133 | 1924 | 34 | 21.9 | 0.016 |
| 156 | 5.47 | 7.15 | 85 | 2082 | 1929 | 29 | 22.7 | 0.014 |
| 157 | 5.37 | 7.12 | 78 | 1980 | 1740 | 67 | 22.3 | 0.034 |
| 158 | 5.36 | 7.13 | 83 | 1932 | 1773 | 79 | 21.4 | 0.041 |
| 159 | 5.41 | 7.05 | | 1808 | | 110 | | 0.061 |
| 160 | 5.45 | 7.07 | 84 | 1797 | 1679 | 98 | 20.0 | 0.055 |
| 161 | 5.44 | 7.10 | 85 | 1755 | 1681 | 82 | 19.8 | 0.047 |
| 162 | 5.44 | 7.05 | 84 | 1726 | 1711 | 77 | 20.4 | 0.045 |
| 163 | 5.45 | 7.06 | 85 | 1735 | 1712 | 62 | 20.1 | 0.036 |
| 164 | 5.46 | 7.09 | 85 | 1749 | 1746 | 52 | 20.5 | 0.030 |
| 165 | 5.46 | 7.08 | 95 | | 1745 | | 18.4 | |
| 166 | 5.46 | 7.12 | | 1693 | | 63 | | 0.037 |
| 167 | 5.48 | 7.06 | 82 | 1673 | 1632 | 50 | 19.9 | 0.030 |
| 168 | 5.30 | 7.08 | 71 | 1707 | 1824 | 54 | 25.7 | 0.032 |
| 169 | 5.32 | 7.07 | 73 | 1715 | 1871 | 56 | 25.6 | 0.033 |
| 170 | 5.33 | 7.15 | 81 | 1785 | 1970 | 59 | 24.3 | 0.033 |

Note: Alkalinity = $H_2CO_3^*$ alkalinity



Table C3: List of parameters measured daily and parameters calculated from (cont.) these measured parameters for digester D3

| Day No. | pH | | Alkalinity(as CaCO3) | | SCFA (as HAc) | | SCFA/Alk | |
|---|---|---|---|---|---|---|---|---|
| | influent | effluent | influent (mg/l) | effluent (mg/l) | influent (mg/l) | effluent (mg/l) | influent | effluent |
| 171 | 5.31 | 7.11 | 83 | 1873 | 2199 | 61 | 26.5 | 0.033 |
| 172 | 5.32 | 7.12 | 86 | | 2188 | | 25.4 | |
| 173 | 5.37 | 7.13 | | 1988 | | 54 | | 0.027 |
| 174 | 5.34 | 7.14 | 95 | 2039 | 2105 | 51 | 22.2 | 0.025 |
| 175 | 5.34 | 7.20 | 86 | 2051 | 2103 | 35 | 24.5 | 0.017 |
| 176 | 5.35 | 7.18 | 86 | 2092 | 2136 | 46 | 24.8 | 0.022 |
| 177 | 5.33 | 7.16 | 79 | 1999 | 1281 | 40 | 16.2 | 0.020 |
| 178 | 5.36 | 7.09 | 70 | 1972 | 1609 | 30 | 23.0 | 0.015 |
| 179 | 5.36 | 7.11 | 69 | | 1606 | | 23.3 | |
| 180 | 5.43 | 7.07 | | 1882 | | 45 | | 0.024 |
| 181 | 5.40 | 7.12 | 60 | 1795 | 1329 | 55 | 22.2 | 0.031 |
| 182 | 5.39 | 7.10 | 69 | 1805 | 1487 | 49 | 21.6 | 0.027 |
| 183 | 5.43 | 7.09 | 73 | 1840 | 1532 | 48 | 21.0 | 0.026 |
| 184 | 5.43 | 7.09 | 68 | 1819 | 1549 | 54 | 22.8 | 0.030 |
| 185 | 5.4 | 7 | 73 | 1594 | 1612 | 124 | 22.1 | 0.078 |
| 186 | 5.4 | 6.95 | 74 | 1438 | 1628 | 249 | 22.0 | 0.173 |
| 187 | 5.46 | 6.91 | 74 | 1296 | 1433 | 290 | 19.4 | 0.224 |
| 188 | 5.47 | 6.89 | 75 | 1214 | 1415 | 324 | 18.9 | 0.267 |
| 189 | 5.43 | 6.86 | 78 | 1156 | 1594 | 399 | 20.4 | 0.345 |
| 190 | 5.46 | 6.99 | 78 | 1465 | 1549 | 104 | 19.9 | 0.071 |
| 191 | 5.47 | 7.05 | 72 | 1615 | 1565 | 72 | 21.7 | 0.045 |
| 192 | 5.48 | 7.13 | 72 | 1579 | 1609 | 62 | 22.3 | 0.039 |
| 193 | 5.48 | 7.13 | 75 | 1661 | 1607 | 51 | 21.4 | 0.031 |
| 194 | | | | | | | | |
| 195 | | 7.16 | | 1792 | | 48 | | 0.027 |
| 196 | | 7.19 | | 1841 | | 42 | | 0.023 |
| 197 | 5.49 | 7.13 | 76 | 1801 | 1614 | 40 | 21.2 | 0.022 |
| 198 | 5.48 | 7.1 | 73 | 1803 | 1646 | 38 | 22.5 | 0.021 |
| 199 | 5.42 | 7.08 | 77 | 1835 | 1740 | 47 | 22.6 | 0.026 |
| 200 | 5.42 | 7.12 | 79 | 1806 | 1801 | 40 | 22.8 | 0.022 |
| 201 | 5.44 | 7.13 | 81 | 1816 | 1817 | 40 | 22.4 | 0.022 |
| 202 | 5.46 | 7.12 | 81 | 1780 | 1857 | 42 | 22.9 | 0.024 |
| 203 | 5.43 | 7.05 | 82 | 1828 | 1921 | 65 | 23.4 | 0.036 |
| 204 | 5.44 | 7.1 | 88 | 1744 | 1971 | 60 | 22.4 | 0.034 |
| 205 | 5.44 | 7.09 | 85 | 1793 | 2042 | 59 | 24.0 | 0.033 |
| 206 | 5.43 | 7.15 | 89 | 1860 | 2088 | 54 | 23.5 | 0.029 |
| 207 | 5.46 | 7.16 | 94 | | 1928 | | 20.5 | |
| 208 | 5.47 | 7.14 | | 1908 | | 35 | | 0.018 |
| 209 | 5.49 | 7.13 | 91 | 1928 | 1975 | 31 | 21.7 | 0.016 |
| 210 | 5.47 | 7.1 | 100 | 1889 | 1996 | 31 | 20.0 | 0.016 |

Table C3: List of parameters measured daily and parameters calculated from (cont.) these measured parameters for digester D3

| Day No. | Gas production | Carbon dioxide | Methane | Gas produced per.... | | | |
|---|---|---|---|---|---|---|---|
| | | | | COD rem. | COD add | VS rem. | VS add. |
| | (l/day) | (%) | (%) | (l/g) | (l/g) | (l/g) | (l/g) |
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | 11.171 | | | 1.10 | 0.65 | 0.60 | 0.38 |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | 16.368 | | | 1.81 | 1.04 | 0.91 | 0.53 |
| 10 | | | | | | | |
| 11 | | | | | | | |
| 12 | | | | | | | |
| 13 | | | | | | | |
| 14 | 13.096 | | | 1.21 | 0.71 | 0.67 | 0.40 |
| 15 | | | | | | | |
| 16 | 11.806 | | | 1.30 | 0.75 | 0.66 | 0.43 |
| 17 | 10.759 | | | 1.31 | 0.70 | 0.64 | 0.39 |
| 18 | | | | | | | |
| 19 | 10.430 | | | 1.32 | 0.67 | 0.63 | 0.37 |
| 20 | 9.739 | | | 1.27 | 0.63 | 0.61 | 0.35 |
| 21 | | | | | | | |
| 22 | 9.321 | | | 1.19 | 0.60 | 0.67 | 0.35 |
| 23 | 9.372 | | | 0.88 | 0.51 | 0.46 | 0.32 |
| 24 | | | | | | | |
| 25 | 10.154 | | | 0.89 | 0.54 | 0.51 | 0.32 |
| 26 | 11.082 | | | 0.99 | 0.60 | 0.62 | 0.37 |
| 27 | | | | | | | |
| 28 | 7.295 | | | 0.72 | 0.39 | 0.42 | 0.28 |
| 29 | 11.465 | | | 1.14 | 0.62 | 1.32 | 0.53 |
| 30 | | | | | | | |
| 31 | 10.727 | | | 1.06 | 0.58 | 0.45 | 0.29 |
| 32 | 13.148 | | | 1.30 | 0.71 | 0.87 | 0.46 |
| 33 | | | | | | | |
| 34 | 11.239 | | | 1.23 | 0.63 | 0.69 | 0.38 |
| 35 | 11.088 | | | 1.22 | 0.63 | 0.67 | 0.37 |
| 36 | | | | | | | |
| 37 | 10.413 | | | 1.23 | 0.62 | 0.65 | 0.37 |
| 38 | 11.023 | | | 1.26 | 0.65 | 0.61 | 0.36 |
| 39 | | | | | | | |
| 40 | 10.860 | | | 1.31 | 0.64 | 0.62 | 0.38 |

**Note: All gas volumes measured at 1 atmosphere pressure and 20$^{o}$C.**



Table C3: List of parameters measured daily and parameters calculated from (cont.) these measured parameters for digester D3

| Day No. | Gas production | Carbon dioxide | Methane | Gas produced per.... | | | |
|---|---|---|---|---|---|---|---|
| | | | | COD rem. | COD add | VS rem. | VS add. |
| | (l/day) | (%) | (%) | (l/g) | (l/g) | (l/g) | (l/g) |
| 41 | 11.082 | | | 1.38 | 0.67 | 0.71 | 0.36 |
| 42 | | | | | | | |
| 43 | 10.425 | | | 1.26 | 0.62 | 0.59 | 0.34 |
| 44 | 12.038 | | | 1.41 | 0.70 | 0.68 | 0.39 |
| 45 | | | | | | | |
| 46 | 11.432 | | | 1.33 | 0.67 | 0.73 | 0.39 |
| 47 | 9.969 | | | 1.05 | 0.56 | 1.57 | 0.51 |
| 48 | | | | | | | |
| 49 | 13.226 | | | 0.94 | 0.58 | 0.49 | 0.32 |
| 50 | | | | | | | |
| 51 | | | | | | | |
| 52 | 12.405 | 36.7 | 63.3 | 1.42 | 0.70 | 0.78 | 0.42 |
| 53 | 12.320 | 36.4 | 63.6 | 1.43 | 0.70 | 0.80 | 0.41 |
| 54 | | 36.5 | 63.5 | | | | |
| 55 | 11.194 | 36.9 | 63.1 | 1.32 | 0.64 | 0.79 | 0.38 |
| 56 | 11.672 | 36.2 | 63.8 | 1.33 | 0.66 | 0.74 | 0.39 |
| 57 | | 36.4 | 63.6 | | | | |
| 58 | 12.807 | 37.4 | 62.6 | 1.33 | 0.69 | 0.79 | 0.43 |
| 59 | 12.735 | 36.7 | 63.3 | 1.31 | 0.68 | 0.89 | 0.43 |
| 60 | | 35.7 | 64.3 | | | | |
| 61 | 11.348 | 36.7 | 63.3 | 1.18 | 0.61 | 0.70 | 0.38 |
| 62 | 11.838 | 37.9 | 62.1 | 1.18 | 0.62 | 0.69 | 0.38 |
| | | | | | | | |
| 113 | | 36.7 | 63.3 | | | | |
| 114 | 6.845 | 36.7 | 63.3 | 0.88 | 0.30 | 0.46 | 0.18 |
| 115 | 4.315 | 36.7 | 63.3 | | | | |
| 116 | 6.342 | 36.7 | 63.3 | | | | |
| 117 | | 36.7 | 63.3 | | | | |
| 118 | 5.538 | 36.7 | 63.3 | | | | |
| 119 | | 36.7 | 63.3 | | | | |
| 120 | 6.028 | 36.7 | 63.3 | 1.66 | 0.55 | 0.88 | 0.33 |
| 121 | | 36.7 | 63.3 | | | | |
| 122 | | 36.7 | 63.3 | | | | |
| 123 | 11.944 | 36.7 | 63.3 | | | | |
| 124 | | 36.7 | 63.3 | | | | |
| 125 | 11.005 | 36.7 | 63.3 | 0.87 | 0.42 | 0.50 | 0.26 |
| 126 | | 36.7 | 63.3 | | | | |
| 127 | 12.153 | 36.7 | 63.3 | 0.89 | 0.46 | 0.50 | 0.28 |
| 128 | | 36.7 | 63.3 | | | | |
| 129 | 12.955 | 36.7 | 63.3 | 0.99 | 0.49 | 0.54 | 0.29 |
| 130 | | 36.7 | 63.3 | | | | |

Table C3: List of parameters measured daily and parameters calculated from (cont.) these measured parameters for digester D3

| Day No. | Gas production | Carbon dioxide | Methane | Gas produced per.... | | | |
|---|---|---|---|---|---|---|---|
| | | | | COD rem. | COD add | VS rem. | VS add. |
| | (l/day) | (%) | (%) | (l/g) | (l/g) | (l/g) | (l/g) |
| 131 | 17.976 | 36.7 | 63.3 | 1.32 | 0.65 | 0.73 | 0.39 |
| 132 | | 36.7 | 63.3 | | | | |
| 133 | 16.598 | 36.7 | 63.3 | 1.26 | 0.60 | 0.70 | 0.37 |
| 134 | | 36.7 | 63.3 | | | | |
| 135 | 16.696 | 36.7 | 63.3 | 1.21 | 0.59 | 0.94 | 0.37 |
| 136 | | 36.7 | 63.3 | | | | |
| 137 | 16.449 | 36.7 | 63.3 | 1.24 | 0.59 | 0.71 | 0.36 |
| 138 | | 36.7 | 63.3 | | | | |
| 139 | 17.770 | 36.7 | 63.3 | 1.35 | 0.64 | 0.85 | 0.42 |
| 140 | | 36.7 | 63.3 | | | | |
| 141 | 17.402 | 36.7 | 63.3 | 1.34 | 0.64 | 0.76 | 0.39 |
| 142 | | 36.7 | 63.3 | | | | |
| 143 | 15.873 | 36.7 | 63.3 | 1.17 | 0.57 | 0.85 | 0.38 |
| 144 | | 36.7 | 63.3 | | | | |
| 145 | 17.199 | 36.7 | 63.3 | 1.24 | 0.61 | 0.76 | 0.40 |
| 146 | | 36.7 | 63.3 | | | | |
| 147 | 16.387 | 36.7 | 63.3 | 1.18 | 0.59 | 0.59 | 0.34 |
| 148 | | 36.7 | 63.3 | | | | |
| 149 | 19.126 | 36.7 | 63.3 | 1.79 | 0.78 | 1.11 | 0.49 |
| 150 | | 36.7 | 63.3 | | | | |
| 151 | 15.322 | 36.7 | 63.3 | 0.97 | 0.52 | 0.61 | 0.33 |
| 152 | | 36.7 | 63.3 | | | | |
| 153 | 19.500 | 36.7 | 63.3 | 1.07 | 0.61 | 0.71 | 0.39 |
| 154 | | 36.7 | 63.3 | | | | |
| 155 | 18.257 | 36.7 | 63.3 | 1.01 | 0.56 | 0.65 | 0.35 |
| 156 | | 36.7 | 63.3 | | | | |
| 157 | 25.760 | 37.1 | 62.9 | 0.86 | 0.46 | 0.45 | 0.25 |
| 158 | | 35.9 | 64.1 | | | | |
| 159 | 29.902 | 36.8 | 63.2 | 1.10 | 0.52 | 0.71 | 0.33 |
| 160 | | 38.3 | 61.7 | | | | |
| 161 | 30.537 | 38.0 | 62.0 | 1.26 | 0.55 | 0.85 | 0.34 |
| 162 | | 36.9 | 63.1 | | | | |
| 163 | 30.520 | 37.6 | 62.4 | 1.19 | 0.54 | 0.67 | 0.32 |
| 164 | | 36.6 | 63.4 | | | | |
| 165 | 27.140 | 37.6 | 62.4 | 1.62 | 0.60 | 1.00 | 0.36 |
| 166 | | 36.8 | 63.2 | | | | |
| 167 | 26.710 | 38.2 | 61.8 | 1.52 | 0.57 | 0.91 | 0.37 |
| 168 | | 38.5 | 61.5 | | | | |
| 169 | 27.667 | 38.0 | 62.0 | 1.18 | 0.53 | 0.65 | 0.32 |
| 170 | | 38.3 | 61.7 | | | | |

Table C3: List of parameters measured daily and parameters calculated from (cont.) these measured parameters for digester D3

| Day No. | Gas production | Carbon dioxide | Methane | Gas produced per.... | | | |
|---|---|---|---|---|---|---|---|
| | | | | COD rem. | COD add | VS rem. | VS add. |
| | (l/day) | (%) | (%) | (l/g) | (l/g) | (l/g) | (l/g) |
| 171 | 28.197 | 37.3 | 62.7 | 1.07 | 0.51 | 0.79 | 0.35 |
| 172 | | 35.7 | 64.3 | | | | |
| 173 | 28.690 | 36.8 | 63.2 | 1.19 | 0.54 | 0.78 | 0.34 |
| 174 | | 37.3 | 62.7 | | | | |
| 175 | 25.328 | 36.4 | 63.6 | 1.54 | 0.57 | 0.96 | 0.36 |
| 176 | | 36.6 | 63.4 | | | | |
| 177 | 26.438 | 35.9 | 64.1 | 0.88 | 0.45 | 0.58 | 0.29 |
| 178 | 27.371 | 36.6 | 63.4 | 1.14 | 0.52 | 0.67 | 0.31 |
| 179 | | 37.6 | 62.4 | | | | |
| 180 | 28.437 | 36.8 | 63.2 | 1.07 | 0.51 | 0.60 | 0.30 |
| 181 | 27.516 | 35.7 | 64.3 | 1.07 | 0.50 | 0.48 | 0.26 |
| 182 | 28.246 | 37.6 | 62.4 | 1.09 | 0.50 | 0.65 | 0.31 |
| 183 | 27.597 | 35.2 | 64.8 | 1.08 | 0.49 | 0.73 | 0.31 |
| 184 | 28.210 | 35.2 | 64.8 | 1.15 | 0.50 | 0.63 | 0.30 |
| 185 | 25.879 | 32.2 | 67.8 | 0.81 | 0.31 | 0.41 | 0.18 |
| 186 | 26.288 | 36.2 | 63.8 | 0.88 | 0.31 | 0.61 | 0.20 |
| 187 | 24.497 | 37.1 | 62.9 | 1.06 | 0.32 | 0.65 | 0.19 |
| 188 | 22.849 | 36.6 | 63.4 | 1.19 | 0.30 | 0.77 | 0.18 |
| 189 | 21.759 | 34.7 | 65.3 | 0.71 | 0.25 | 0.37 | 0.14 |
| 190 | 23.671 | 31.7 | 68.3 | 4.99 | 1.71 | 2.93 | 1.01 |
| 191 | 17.919 | 29.6 | 70.4 | 3.23 | 1.28 | 1.60 | 0.72 |
| 192 | 15.812 | 27.5 | 72.5 | 2.83 | 1.16 | 1.62 | 0.68 |
| 193 | 13.934 | 25.8 | 74.2 | 2.34 | 1.00 | 1.34 | 0.61 |
| 194 | 14.173 | 29.1 | 70.9 | | | | |
| 195 | 10.225 | 28.0 | 72.0 | | | | |
| 196 | 7.329 | 23.5 | 76.5 | | | | |
| 197 | 12.185 | 26.8 | 73.2 | 1.04 | 0.44 | 0.50 | 0.25 |
| 198 | 15.006 | 28.4 | 71.6 | 1.23 | 0.54 | 0.50 | 0.28 |
| 199 | 15.911 | 31.7 | 68.3 | 1.33 | 0.58 | 0.65 | 0.32 |
| 200 | 16.040 | 28.9 | 71.1 | 1.30 | 0.57 | 0.79 | 0.35 |
| 201 | 19.956 | 30.3 | 69.7 | 1.01 | 0.42 | 0.53 | 0.25 |
| 202 | 22.918 | 28.9 | 71.1 | 1.14 | 0.48 | 0.56 | 0.27 |
| 203 | 25.797 | 36.4 | 63.6 | 0.73 | 0.41 | 0.90 | 0.35 |
| 204 | 29.591 | 34.7 | 65.3 | 1.34 | 0.60 | 0.95 | 0.39 |
| 205 | 26.510 | 33.6 | 66.4 | 1.29 | 0.55 | 0.68 | 0.32 |
| 206 | 25.399 | 34.0 | 66.0 | 1.19 | 0.52 | 0.57 | 0.30 |
| 207 | 24.661 | 35.2 | 64.8 | 1.51 | 0.57 | 0.00 | 0.33 |
| 208 | | 31.0 | 69.0 | | | | |
| 209 | 23.460 | 33.3 | 66.7 | 1.38 | 0.55 | 0.60 | 0.30 |
| 210 | 26.361 | 35.2 | 64.8 | 1.50 | 0.61 | 0.79 | 0.36 |

**Note: All gas volumes measured at 1 atmosphere pressure and 20$^{o}$C.**

Table C3: List of parameters measured daily and parameters calculated from these measured parameters for digester D3 (cont.)

| Day No. | Methane produced per..... | | | | Carbon dioxide produced per... | | | |
|---|---|---|---|---|---|---|---|---|
| | VS rem. | VS add. | COD rem. | COD add. | VS rem. | VS add. | COD re | COD add |
| | l/g | l/g | l/g | l/g | l/g | l/g | l/g | l/g |
| 1 | | | | | | | | |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | 0.70 | 0.41 | 0.38 | 0.24 | 0.40 | 0.24 | 0.22 | 0.14 |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | 1.15 | 0.66 | 0.58 | 0.34 | 0.66 | 0.38 | 0.33 | 0.20 |
| 10 | | | | | | | | |
| 11 | | | | | | | | |
| 12 | | | | | | | | |
| 13 | | | | | | | | |
| 14 | 0.76 | 0.45 | 0.42 | 0.26 | 0.44 | 0.26 | 0.24 | 0.15 |
| 15 | | | | | | | | |
| 16 | 0.82 | 0.48 | 0.42 | 0.27 | 0.48 | 0.28 | 0.24 | 0.16 |
| 17 | 0.83 | 0.45 | 0.40 | 0.25 | 0.48 | 0.26 | 0.23 | 0.14 |
| 18 | | | | | | | | |
| 19 | 0.84 | 0.42 | 0.40 | 0.24 | 0.48 | 0.25 | 0.23 | 0.14 |
| 20 | 0.81 | 0.40 | 0.39 | 0.22 | 0.47 | 0.23 | 0.22 | 0.13 |
| 21 | | | | | | | | |
| 22 | 0.75 | 0.38 | 0.42 | 0.22 | 0.44 | 0.22 | 0.24 | 0.13 |
| 23 | 0.56 | 0.32 | 0.29 | 0.20 | 0.32 | 0.19 | 0.17 | 0.12 |
| 24 | | | | | | | | |
| 25 | 0.56 | 0.34 | 0.32 | 0.20 | 0.33 | 0.20 | 0.19 | 0.12 |
| 26 | 0.63 | 0.38 | 0.39 | 0.24 | 0.36 | 0.22 | 0.23 | 0.14 |
| 27 | | | | | | | | |
| 28 | 0.46 | 0.25 | 0.27 | 0.18 | 0.26 | 0.14 | 0.15 | 0.10 |
| 29 | 0.72 | 0.39 | 0.83 | 0.34 | 0.42 | 0.23 | 0.48 | 0.20 |
| 30 | | | | | | | | |
| 31 | 0.67 | 0.37 | 0.28 | 0.19 | 0.39 | 0.21 | 0.16 | 0.11 |
| 32 | 0.83 | 0.45 | 0.55 | 0.29 | 0.48 | 0.26 | 0.32 | 0.17 |
| 33 | | | | | | | | |
| 34 | 0.78 | 0.40 | 0.43 | 0.24 | 0.45 | 0.23 | 0.25 | 0.14 |
| 35 | 0.77 | 0.40 | 0.43 | 0.23 | 0.45 | 0.23 | 0.25 | 0.14 |
| 36 | | | | | | | | |
| 37 | 0.78 | 0.39 | 0.41 | 0.23 | 0.45 | 0.23 | 0.24 | 0.14 |
| 38 | 0.80 | 0.41 | 0.39 | 0.23 | 0.46 | 0.24 | 0.22 | 0.13 |
| 39 | | | | | | | | |
| 40 | 0.83 | 0.41 | 0.39 | 0.24 | 0.48 | 0.24 | 0.23 | 0.14 |

Table C3: List of parameters measured daily and parameters calculated from these measured parameters for digester D3 (cont.)

| Day No. | Methane produced per..... | | | | Carbon dioxide produced per... | | | |
|---|---|---|---|---|---|---|---|---|
| | VS rem. | VS add. | COD rem. | COD add. | VS rem | VS add. | COD re | COD add |
| | l/g | l/g | l/g | l/g | l/g | l/g | l/g | l/g |
| 41 | 0.87 | 0.42 | 0.45 | 0.23 | 0.50 | 0.24 | 0.26 | 0.13 |
| 42 | | | | | | | | |
| 43 | 0.80 | 0.39 | 0.37 | 0.22 | 0.46 | 0.23 | 0.22 | 0.13 |
| 44 | 0.89 | 0.44 | 0.43 | 0.25 | 0.52 | 0.26 | 0.25 | 0.14 |
| 45 | | | | | | | | |
| 46 | 0.84 | 0.43 | 0.46 | 0.25 | 0.49 | 0.25 | 0.27 | 0.14 |
| 47 | 0.66 | 0.35 | 0.99 | 0.32 | 0.38 | 0.20 | 0.57 | 0.19 |
| 48 | | | | | | | | |
| 49 | 0.59 | 0.36 | 0.31 | 0.20 | 0.34 | 0.21 | 0.18 | 0.12 |
| 50 | | | | | | | | |
| 51 | | | | | | | | |
| 52 | 0.90 | 0.44 | 0.50 | 0.27 | 0.52 | 0.26 | 0.29 | 0.15 |
| 53 | 0.91 | 0.44 | 0.51 | 0.26 | 0.52 | 0.25 | 0.29 | 0.15 |
| 54 | | | | | | | | |
| 55 | 0.83 | 0.41 | 0.50 | 0.24 | 0.49 | 0.24 | 0.29 | 0.14 |
| 56 | 0.85 | 0.42 | 0.47 | 0.25 | 0.48 | 0.24 | 0.27 | 0.14 |
| 57 | | | | | | | | |
| 58 | 0.84 | 0.43 | 0.49 | 0.27 | 0.50 | 0.26 | 0.30 | 0.16 |
| 59 | 0.83 | 0.43 | 0.56 | 0.27 | 0.48 | 0.25 | 0.33 | 0.16 |
| 60 | | | | | | | | |
| 61 | 0.75 | 0.39 | 0.44 | 0.24 | 0.43 | 0.22 | 0.26 | 0.14 |
| 62 | 0.73 | 0.39 | 0.43 | 0.24 | 0.45 | 0.24 | 0.26 | 0.14 |
| | | | | | | | | |
| 113 | | | | | | | | |
| 114 | 0.56 | 0.19 | 0.29 | 0.12 | 0.32 | 0.11 | 0.17 | 0.07 |
| 115 | | | | | | | | |
| 116 | | | | | | | | |
| 117 | | | | | | | | |
| 118 | | | | | | | | |
| 119 | | | | | | | | |
| 120 | 1.05 | 0.35 | 0.55 | 0.21 | 0.61 | 0.20 | 0.32 | 0.12 |
| 121 | | | | | | | | |
| 122 | | | | | | | | |
| 123 | | | | | | | | |
| 124 | | | | | | | | |
| 125 | 0.55 | 0.27 | 0.31 | 0.16 | 0.32 | 0.15 | 0.18 | 0.09 |
| 126 | | | | | | | | |
| 127 | 0.56 | 0.29 | 0.32 | 0.18 | 0.32 | 0.17 | 0.19 | 0.10 |
| 128 | | | | | | | | |
| 129 | 0.63 | 0.31 | 0.34 | 0.18 | 0.36 | 0.18 | 0.20 | 0.11 |
| 130 | | | | | | | | |

**Note: All gas volumes measured at 1 atmosphere pressure and 20°C.**

Table C3: List of parameters measured daily and parameters calculated from these measured parameters for digester D3 (cont.)

| Day No. | Methane produced per..... | | | | Carbon dioxide produced per... | | | |
|---|---|---|---|---|---|---|---|---|
| | VS rem. | VS add. | COD rem. | COD add. | VS rem. | VS add. | COD re | COD add |
| | l/g | l/g | l/g | l/g | l/g | l/g | l/g | l/g |
| 131 | 0.83 | 0.41 | 0.46 | 0.25 | 0.48 | 0.24 | 0.27 | 0.14 |
| 132 | | | | | | | | |
| 133 | 0.80 | 0.38 | 0.44 | 0.23 | 0.46 | 0.22 | 0.26 | 0.13 |
| 134 | | | | | | | | |
| 135 | 0.77 | 0.38 | 0.60 | 0.23 | 0.45 | 0.22 | 0.35 | 0.13 |
| 136 | | | | | | | | |
| 137 | 0.79 | 0.38 | 0.45 | 0.23 | 0.45 | 0.22 | 0.26 | 0.13 |
| 138 | | | | | | | | |
| 139 | 0.85 | 0.41 | 0.54 | 0.26 | 0.49 | 0.24 | 0.31 | 0.15 |
| 140 | | | | | | | | |
| 141 | 0.85 | 0.40 | 0.48 | 0.25 | 0.49 | 0.23 | 0.28 | 0.14 |
| 142 | | | | | | | | |
| 143 | 0.74 | 0.36 | 0.54 | 0.24 | 0.43 | 0.21 | 0.31 | 0.14 |
| 144 | | | | | | | | |
| 145 | 0.79 | 0.39 | 0.48 | 0.25 | 0.46 | 0.23 | 0.28 | 0.15 |
| 146 | | | | | | | | |
| 147 | 0.74 | 0.37 | 0.37 | 0.21 | 0.43 | 0.21 | 0.22 | 0.12 |
| 148 | | | | | | | | |
| 149 | 1.13 | 0.50 | 0.70 | 0.31 | 0.66 | 0.29 | 0.41 | 0.18 |
| 150 | | | | | | | | |
| 151 | 0.62 | 0.33 | 0.38 | 0.21 | 0.36 | 0.19 | 0.22 | 0.12 |
| 152 | | | | | | | | |
| 153 | 0.68 | 0.38 | 0.45 | 0.25 | 0.39 | 0.22 | 0.26 | 0.14 |
| 154 | | | | | | | | |
| 155 | 0.64 | 0.35 | 0.41 | 0.22 | 0.37 | 0.21 | 0.24 | 0.13 |
| 156 | | | | | | | | |
| 157 | 0.54 | 0.29 | 0.28 | 0.16 | 0.32 | 0.17 | 0.17 | 0.09 |
| 158 | | | | | | | | |
| 159 | 0.69 | 0.33 | 0.45 | 0.21 | 0.40 | 0.19 | 0.26 | 0.12 |
| 160 | | | | | | | | |
| 161 | 0.78 | 0.34 | 0.53 | 0.21 | 0.48 | 0.21 | 0.32 | 0.13 |
| 162 | | | | | | | | |
| 163 | 0.71 | 0.34 | 0.42 | 0.20 | 0.45 | 0.20 | 0.25 | 0.12 |
| 164 | | | | | | | | |
| 165 | 1.01 | 0.37 | 0.62 | 0.22 | 0.61 | 0.22 | 0.38 | 0.14 |
| 166 | | | | | | | | |
| 167 | 0.98 | 0.37 | 0.59 | 0.21 | 0.53 | 0.20 | 0.32 | 0.13 |
| 168 | | | | | | | | |
| 169 | 0.73 | 0.33 | 0.40 | 0.20 | 0.45 | 0.20 | 0.25 | 0.12 |
| 170 | | | | | | | | |

Table C3: List of parameters measured daily and parameters calculated from these measured parameters for digester D3 (cont.)

| Day No. | Methane produced per..... | | | | Carbon dioxide produced per... | | | |
|---|---|---|---|---|---|---|---|---|
| | VS rem. | VS add. | COD rem. | COD add. | VS rem. | VS add. | COD re | COD add |
| | l/g | l/g | l/g | l/g | l/g | l/g | l/g | l/g |
| 171 | 0.67 | 0.32 | 0.50 | 0.22 | 0.40 | 0.19 | 0.30 | 0.13 |
| 172 | | | | | | | | |
| 173 | 0.75 | 0.34 | 0.50 | 0.22 | 0.44 | 0.20 | 0.29 | 0.13 |
| 174 | | | | | | | | |
| 175 | 0.98 | 0.36 | 0.61 | 0.23 | 0.56 | 0.21 | 0.35 | 0.13 |
| 176 | | | | | | | | |
| 177 | 0.56 | 0.29 | 0.37 | 0.19 | 0.31 | 0.16 | 0.21 | 0.11 |
| 178 | 0.73 | 0.33 | 0.42 | 0.19 | 0.42 | 0.19 | 0.24 | 0.11 |
| 179 | | | | | | | | |
| 180 | 0.67 | 0.32 | 0.38 | 0.19 | 0.39 | 0.19 | 0.22 | 0.11 |
| 181 | 0.69 | 0.32 | 0.31 | 0.17 | 0.38 | 0.18 | 0.17 | 0.09 |
| 182 | 0.68 | 0.31 | 0.41 | 0.19 | 0.41 | 0.19 | 0.25 | 0.12 |
| 183 | 0.70 | 0.32 | 0.47 | 0.20 | 0.38 | 0.17 | 0.26 | 0.11 |
| 184 | 0.74 | 0.33 | 0.41 | 0.19 | 0.40 | 0.18 | 0.22 | 0.11 |
| 185 | 0.55 | 0.21 | 0.28 | 0.12 | 0.26 | 0.10 | 0.13 | 0.06 |
| 186 | 0.56 | 0.20 | 0.39 | 0.13 | 0.32 | 0.11 | 0.22 | 0.07 |
| 187 | 0.67 | 0.20 | | 0.12 | 0.39 | 0.12 | 0.24 | 0.07 |
| 188 | 0.75 | 0.19 | 0.49 | 0.12 | 0.44 | 0.11 | 0.28 | 0.07 |
| 189 | 0.46 | 0.16 | 0.24 | 0.09 | 0.25 | 0.09 | 0.13 | 0.05 |
| 190 | 3.41 | 1.17 | 2.00 | 0.69 | 1.58 | 0.54 | 0.93 | 0.32 |
| 191 | 2.28 | 0.90 | 1.13 | 0.50 | 0.96 | 0.38 | 0.47 | 0.21 |
| 192 | 2.06 | 0.84 | 1.17 | 0.49 | 0.78 | 0.32 | 0.44 | 0.19 |
| 193 | 1.73 | 0.74 | 1.00 | 0.46 | 0.60 | 0.26 | 0.35 | 0.16 |
| 194 | | | | | | | | |
| 195 | | | | | | | | |
| 196 | | | | | | | | |
| 197 | 0.76 | 0.32 | 0.37 | 0.19 | 0.28 | 0.12 | 0.14 | 0.07 |
| 198 | 0.88 | 0.39 | 0.36 | 0.20 | 0.35 | 0.15 | 0.14 | 0.08 |
| 199 | 0.91 | 0.39 | 0.44 | 0.22 | 0.42 | 0.18 | 0.21 | 0.10 |
| 200 | 0.92 | 0.41 | 0.56 | 0.25 | 0.38 | 0.17 | 0.23 | 0.10 |
| 201 | 0.70 | 0.29 | 0.37 | 0.17 | 0.30 | 0.13 | 0.16 | 0.08 |
| 202 | 0.81 | 0.34 | 0.40 | 0.19 | 0.33 | 0.14 | 0.16 | 0.08 |
| 203 | 0.46 | 0.26 | 0.57 | 0.22 | 0.26 | 0.15 | 0.33 | 0.13 |
| 204 | 0.87 | 0.39 | 0.62 | 0.26 | 0.46 | 0.21 | 0.33 | 0.14 |
| 205 | 0.86 | 0.37 | 0.45 | 0.21 | 0.43 | 0.19 | 0.23 | 0.11 |
| 206 | 0.78 | 0.34 | 0.37 | 0.20 | 0.40 | 0.18 | 0.19 | 0.10 |
| 207 | 0.98 | 0.37 | | 0.21 | 0.53 | 0.20 | | 0.12 |
| 208 | | | | | | | | |
| 209 | 0.92 | 0.36 | 0.40 | 0.20 | 0.46 | 0.18 | 0.20 | 0.10 |
| 210 | 0.97 | 0.40 | 0.51 | 0.23 | 0.53 | 0.22 | 0.28 | 0.13 |

**Note: All gas volumes measured at 1 atmosphere pressure and 20°C.**

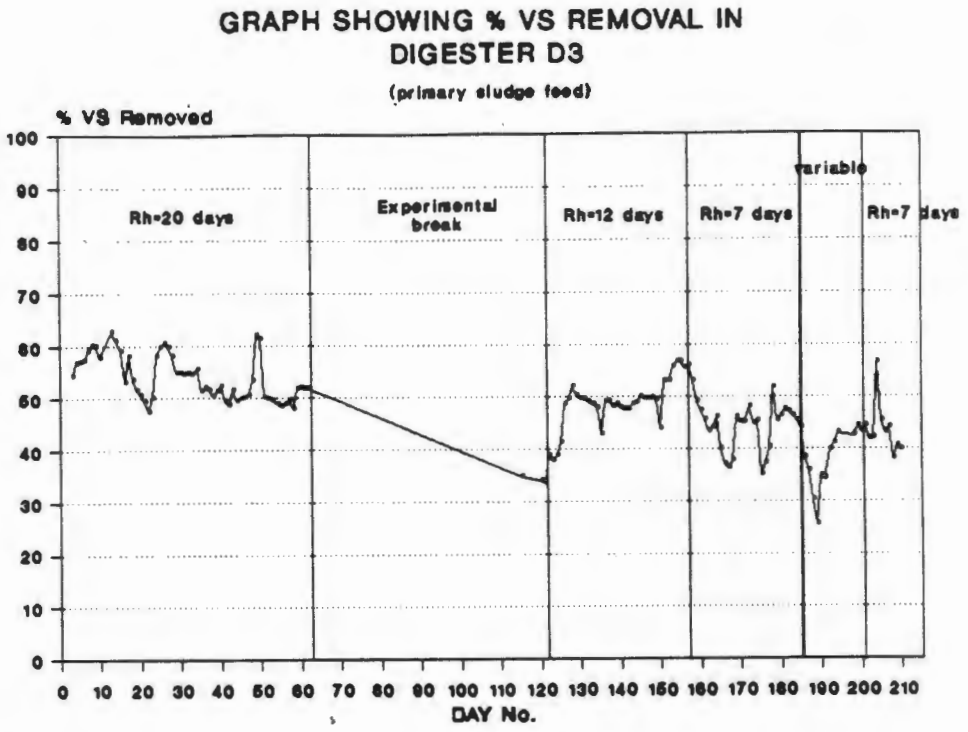


*Figure C25*: *Graph showing the day-to-day % VS removed in digester D3 for the period day 1 to day 211.*

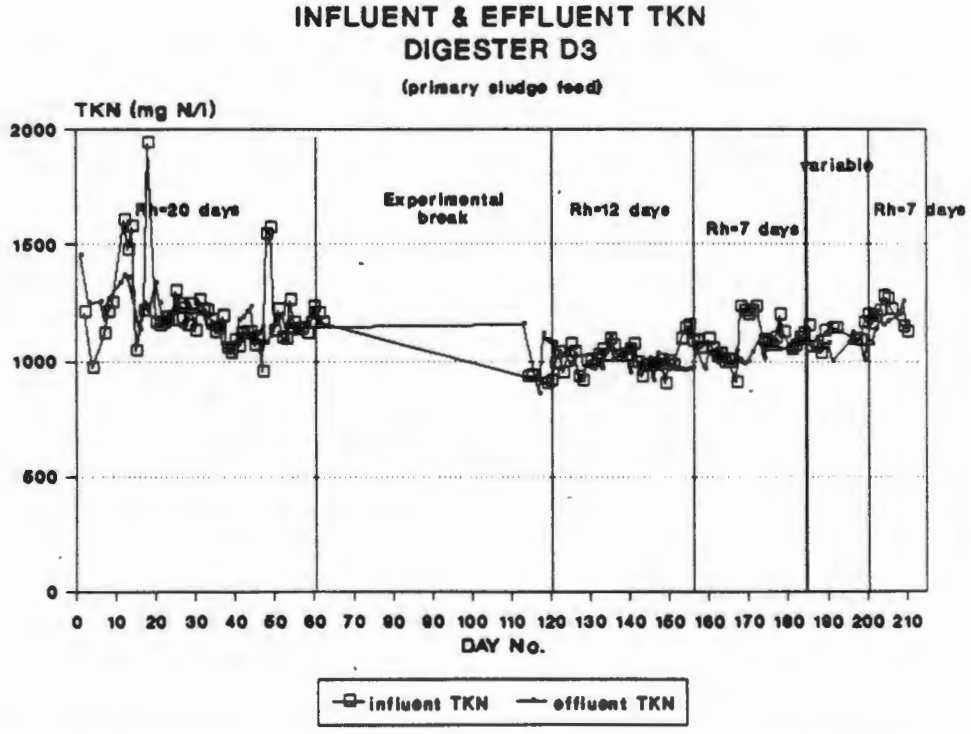


*Figure C26*: *Graph showing the day-to-day influent and effluent TKN in digester D3 for the period day 1 to day 211.*

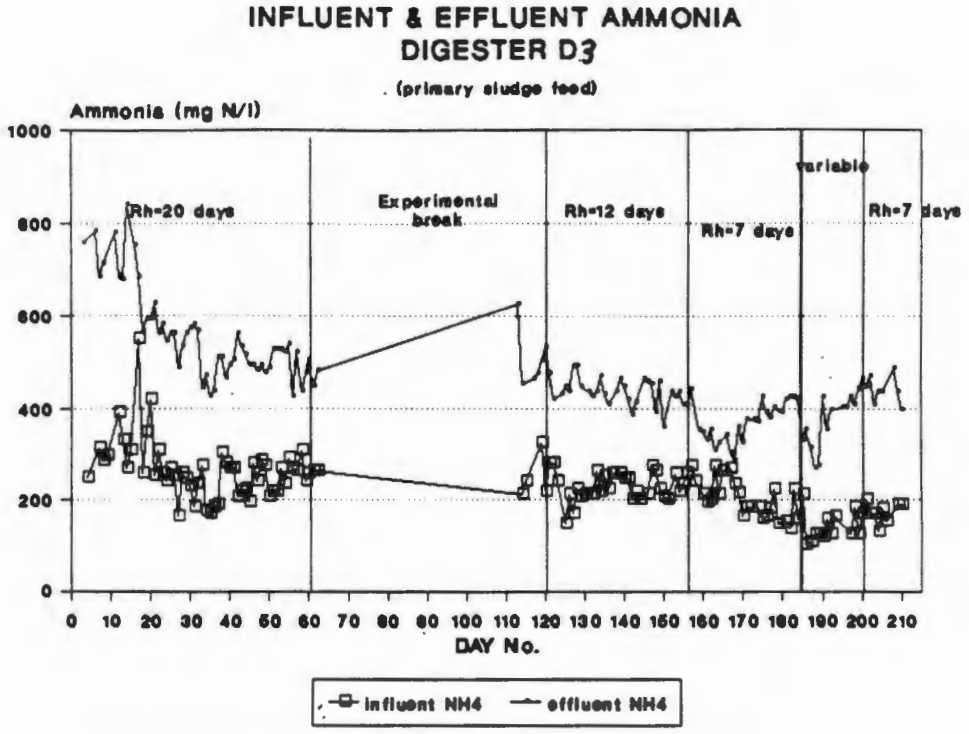


*Figure C27*: *Graph showing the day-to-day influent and effluent free and saline ammonia concentration in digester D3 for the period day 1 to day 211.*

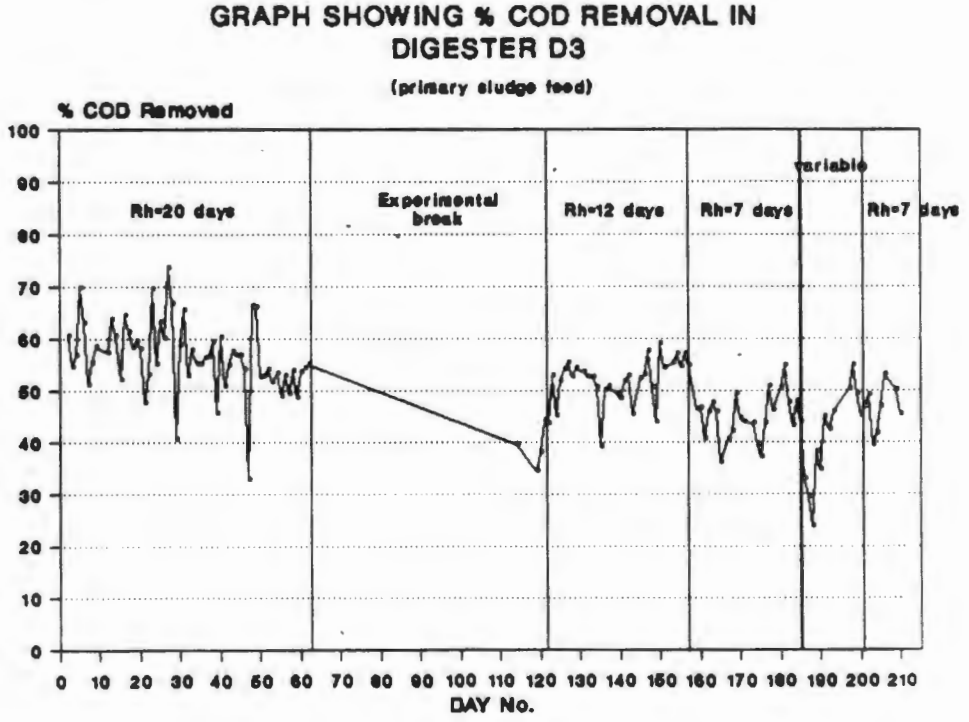


*Figure C28*: *Graph showing the day-to-day % COD removed in digester D3 for the period day 1 to day 211.*

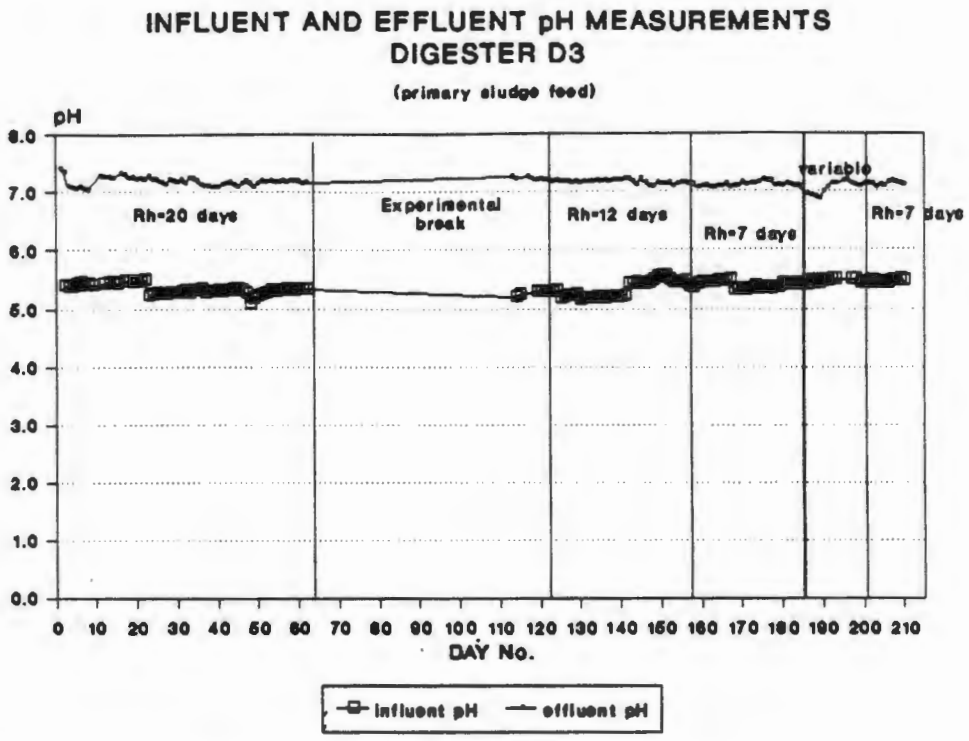


*Figure C29*: *Graph showing the day-to-day influent and effluent pH for digester D3 during the period day 1 to day 211.*

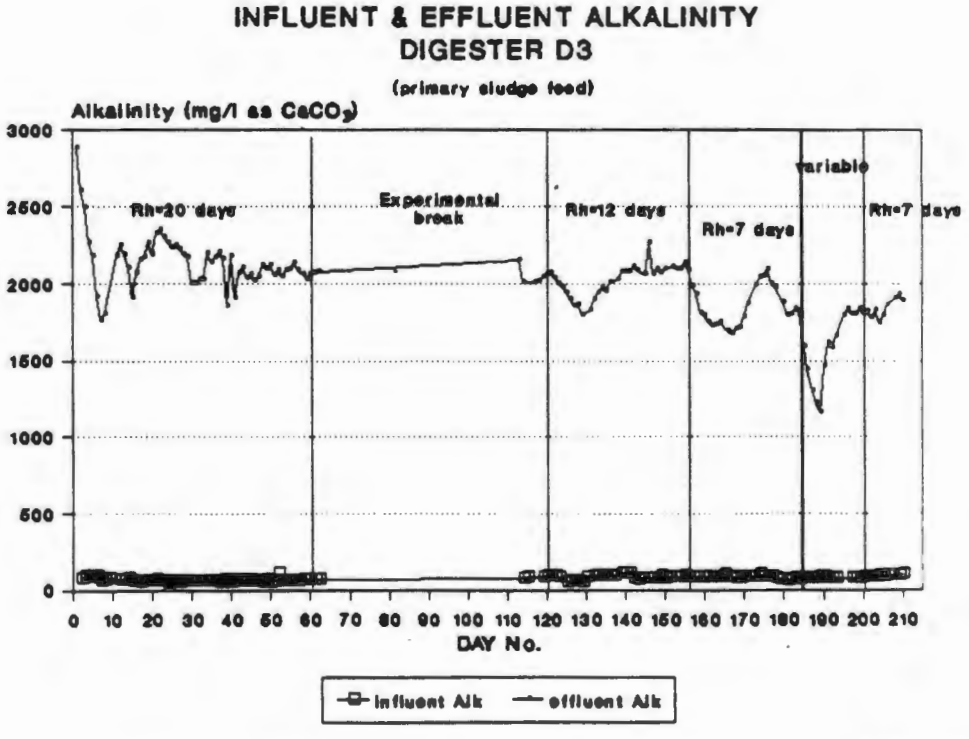


*Figure C30*: *Graph showing the day-to-day influent and effluent $H_2CO_3^*$ alkalinities for digester D3 during the period day 1 to day 211.*

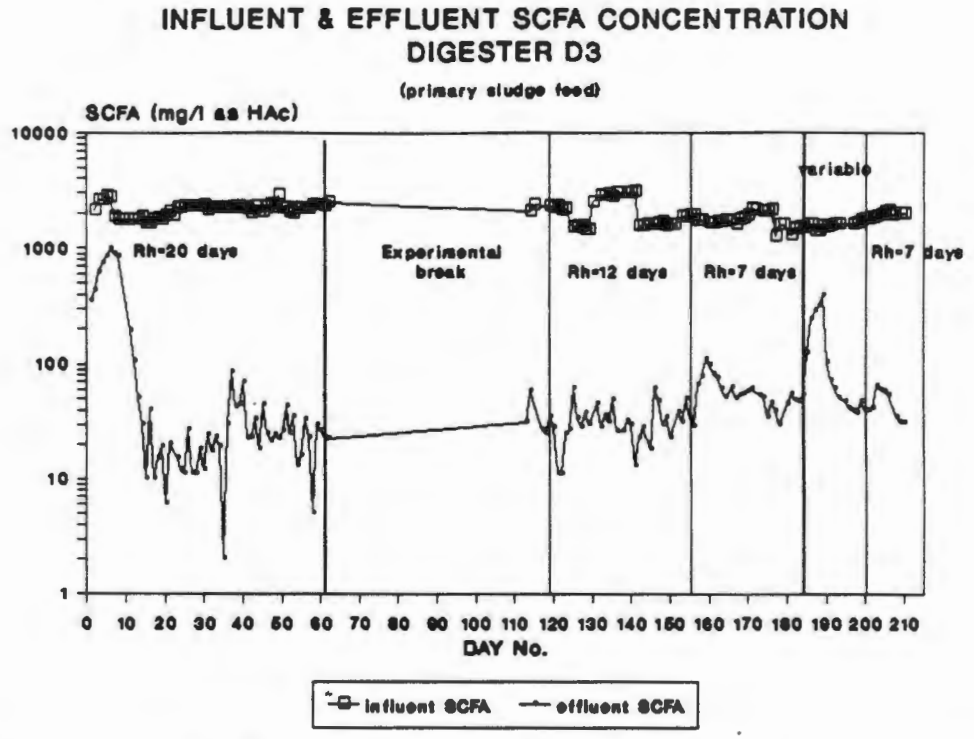


*Figure C31*: *Graph showing the day-to-day influent and effluent SCFA concentrations for digester D3 during the period day 1 to day 211.*

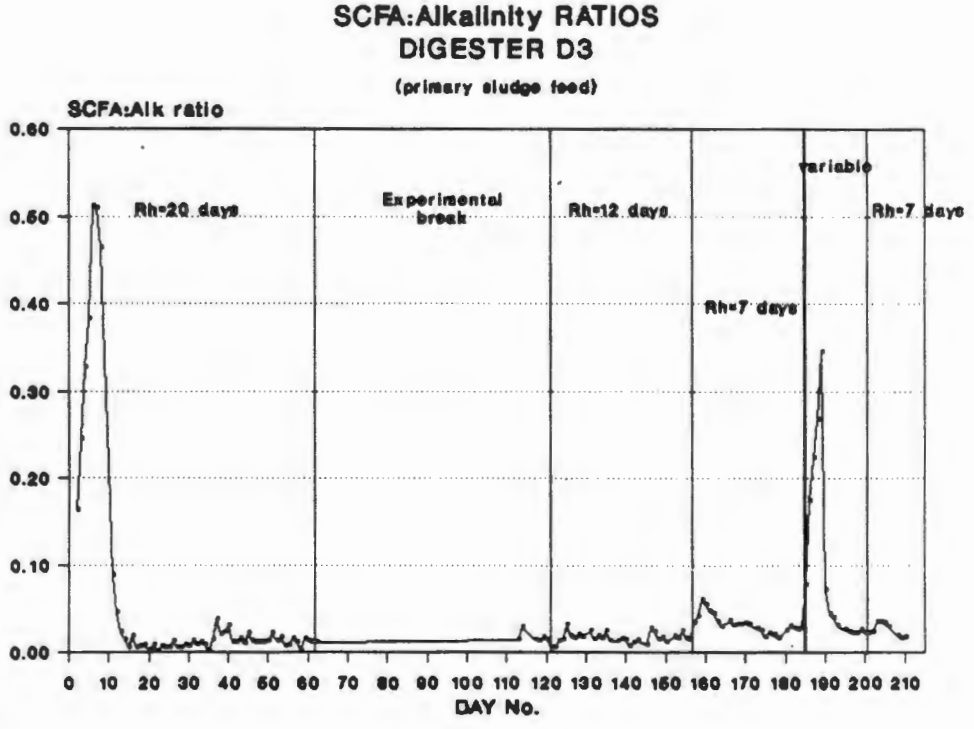


*Figure C32*: *Graph showing the day-to-day SCFA:alk ratios in digester D3 for the period day 1 to day 211.*

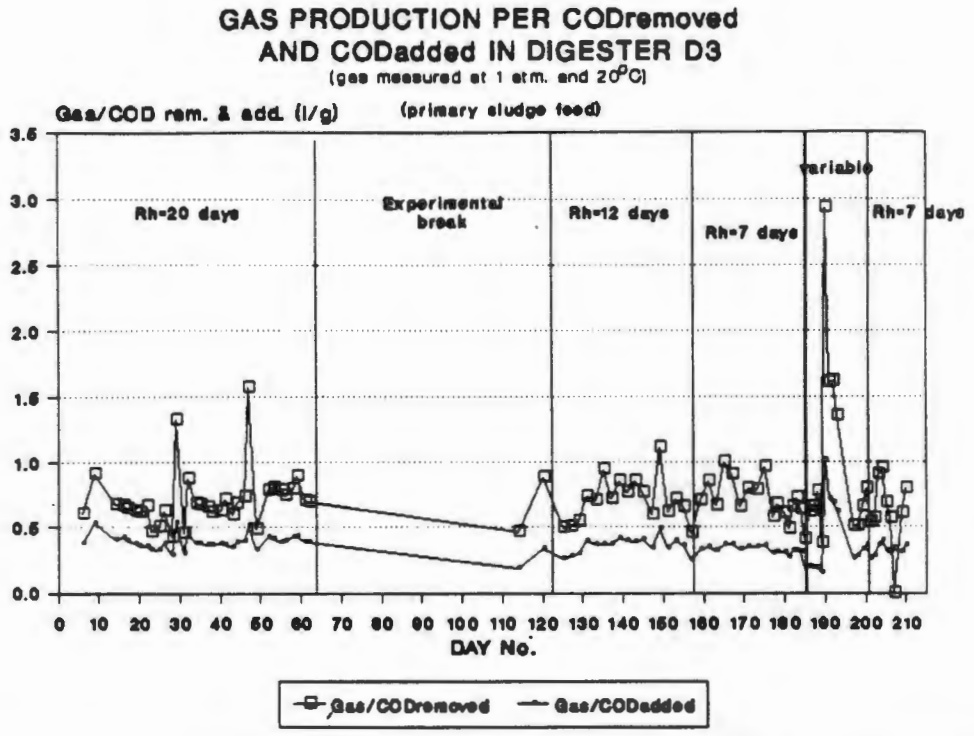


*Figure C33*: *Graph showing the day-to-day gas production rates in digester D3 for the period day 1 to day 211.*

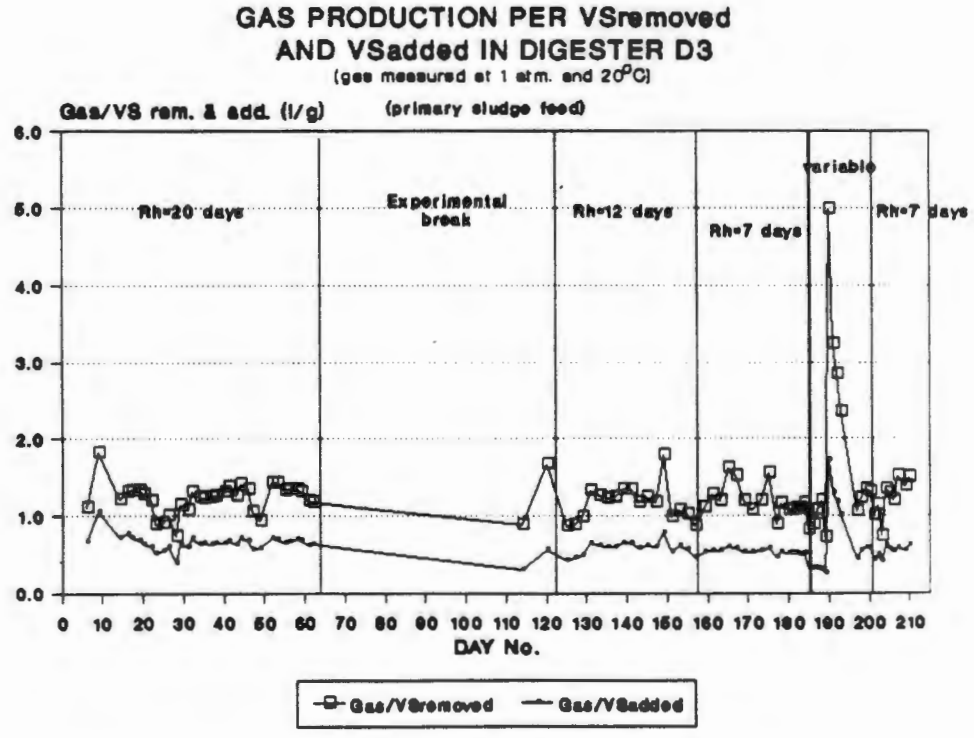


*Figure C34*: *Graph showing the day-to-day gas composition (% carbon dioxide and % methane) for digester D3 during the period day 1 to day 211.*

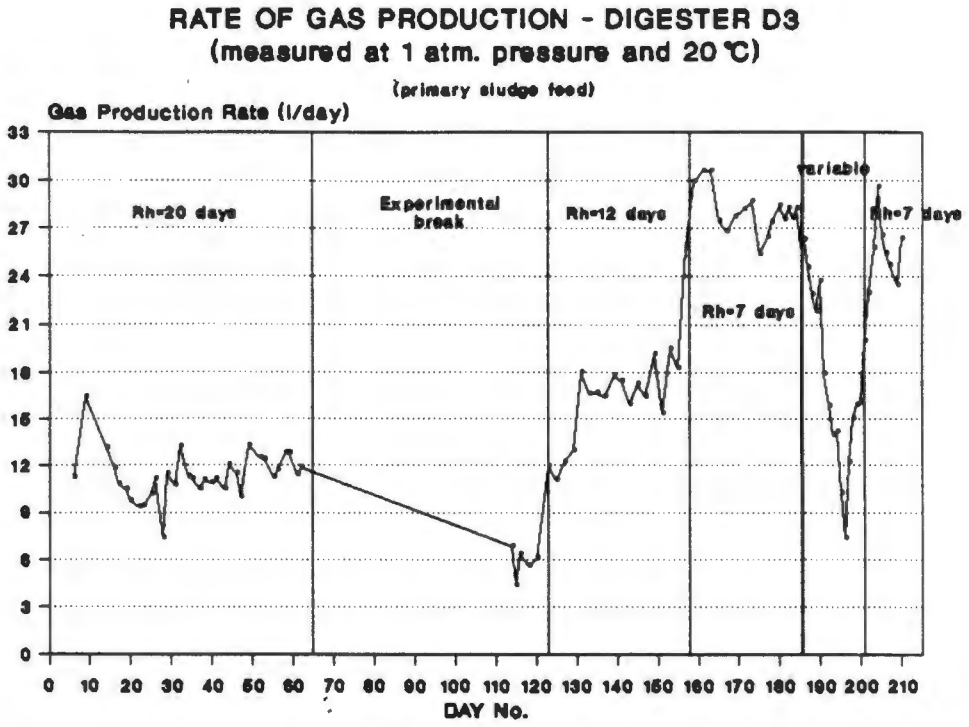


*Figure C35*: *Graph showing the day-to-day gas production per mass of COD removed and COD added for digester D3 during the period day 1 to day 211.*

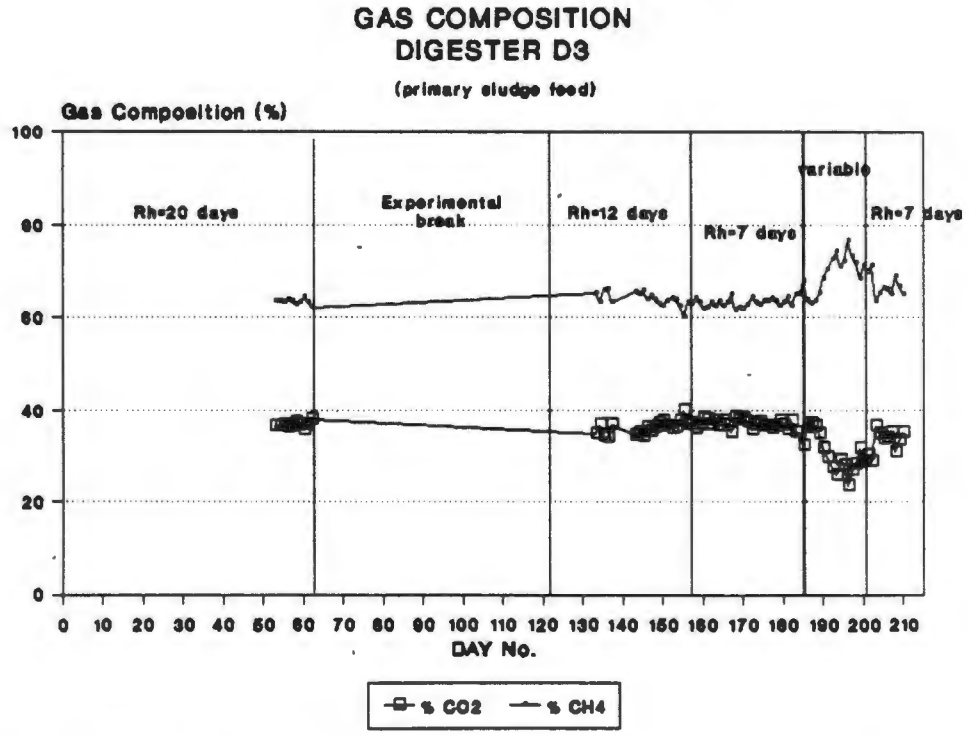


*Figure C36*: *Graph showing the day-to-day gas production per mass of VS removed and VS added for digester D3 during the period day 1 to day 211.*

Table C4: List of parameters measured daily and parameters calculated from these measured parameters for digester D4

| Day No. | Volume Feed | Total Solids | | Volatile Solids | | | | |
|---|---|---|---|---|---|---|---|---|
| | | influent | effluent | influent | added | effluent | removed | removed |
| | (l/day) | (g/l) | (g/l) | (g/l) | (g/day) | (g/l) | (g/day) | (%) |
| 1 | 0.93 | | 17.674 | | | 13.078 | | |
| 2 | 0.93 | 23.506 | | 19.422 | 18062 | | 18062 | |
| 3 | 0.00 | 22.832 | | 18.708 | | | | |
| 4 | 0.50 | | | | | | | |
| 5 | 0.50 | | 15.494 | | | 12.040 | | |
| 6 | 0.50 | | 15.026 | | | 11.718 | | |
| 7 | 0.50 | 22.372 | 15.092 | 18.214 | 9107 | 11.576 | 3319 | 36.4 |
| 8 | 0.50 | 22.230 | 14.864 | 18.126 | 9063 | 11.580 | 3273 | 36.1 |
| 9 | 0.50 | 23.478 | 15.080 | 19.270 | 9635 | 11.746 | 3762 | 39.0 |
| 10 | 0.50 | 23.080 | 14.618 | 19.008 | 9504 | 11.280 | 3864 | 40.7 |
| 11 | 0.50 | 23.456 | 14.896 | 19.148 | 9574 | 11.512 | 3818 | 39.9 |
| 12 | 0.50 | 23.376 | 14.472 | 19.180 | 9590 | 11.050 | 4065 | 42.4 |
| 13 | 0.50 | 29.074 | 14.918 | 22.464 | 11232 | 11.316 | 5574 | 49.6 |
| 14 | 0.50 | 28.806 | 14.228 | 22.328 | 11164 | 10.716 | 5806 | 52.0 |
| 15 | 0.50 | 29.618 | 14.400 | 22.772 | 11386 | 10.810 | 5981 | 52.5 |
| 16 | 0.50 | 29.020 | 13.914 | 22.646 | 11323 | 10.352 | 6147 | 54.3 |
| 17 | 0.50 | 29.482 | 14.264 | 22.882 | 11441 | 10.766 | 6058 | 52.9 |
| 18 | 0.50 | 29.090 | 14.672 | 23.766 | 11883 | 10.984 | 6391 | 53.8 |
| 19 | 0.93 | 29.444 | 14.554 | 24.016 | 22335 | 10.828 | 12265 | 54.9 |
| 20 | 0.93 | 29.274 | 15.484 | 23.920 | 22246 | 11.334 | 11705 | 52.6 |
| 21 | 0.93 | 29.152 | 14.534 | 23.704 | 22045 | 10.760 | 12038 | 54.6 |
| 22 | 0.93 | 26.970 | 14.306 | 21.714 | 20194 | 10.570 | 10364 | 51.3 |
| 23 | 0.93 | 29.622 | 14.896 | 24.204 | 22510 | 11.058 | 12226 | 54.3 |
| 24 | 0.93 | 29.500 | 14.762 | 24.056 | 22372 | 10.826 | 12304 | 55.0 |
| 25 | 0.93 | 29.554 | 15.004 | 23.890 | 22218 | 11.182 | 11818 | 53.2 |
| 26 | 0.93 | 29.542 | 15.322 | 24.154 | 22463 | 11.338 | 11919 | 53.1 |
| 27 | 0.93 | 29.222 | 15.232 | 23.880 | 22208 | 11.232 | 11763 | 53.0 |
| 28 | 0.93 | 29.170 | 15.248 | 23.832 | 22164 | 11.348 | 11610 | 52.4 |
| 29 | 0.93 | 28.794 | 15.232 | 23.610 | 21957 | 11.276 | 11471 | 52.2 |
| 30 | 0.93 | 29.180 | 15.216 | 24.282 | 22582 | 11.208 | 12159 | 53.8 |
| 31 | 0.93 | 29.106 | 15.308 | 24.150 | 22459 | 11.316 | 11936 | 53.1 |
| 32 | 0.93 | 29.160 | 15.168 | 24.186 | 22493 | 11.174 | 12101 | 53.8 |

Table C4: List of parameters measured daily and parameters calculated from these measured parameters for digester D4 (cont.)

| Day No. | Volume Feed | Total Solids | | Volatile Solids | | | | |
|---|---|---|---|---|---|---|---|---|
| | | influent | effluent | influent | added | effluent | removed | removed |
| | (l/day) | (g/l) | (g/l) | (g/l) | (g/day) | (g/l) | (g/day) | (%) |
| 33 | 0.93 | 29.162 | 15.402 | 24.112 | 22424 | 11.394 | 11828 | 52.7 |
| 34 | 0.93 | 29.216 | 15.502 | 24.334 | 22631 | 11.370 | 12057 | 53.3 |
| 35 | 0.93 | 29.154 | 15.540 | 24.104 | 22417 | 11.476 | 11744 | 52.4 |
| 36 | 0.93 | 28.966 | 15.150 | 24.016 | 22335 | 11.334 | 11794 | 52.8 |
| 37 | 0.93 | 25.442 | 15.238 | 21.088 | 19612 | 11.304 | 9099 | 46.4 |
| 38 | 0.93 | 30.652 | 15.026 | 25.466 | 23683 | 11.114 | 13347 | 56.4 |
| 39 | 0.93 | 30.856 | 15.526 | 25.578 | 23788 | 11.444 | 13145 | 55.3 |
| 40 | 0.93 | 32.974 | 15.652 | 27.408 | 25489 | 11.528 | 14768 | 57.9 |
| 41 | 0.93 | 33.374 | 16.110 | 27.734 | 25793 | 11.952 | 14677 | 56.9 |
| 42 | 0.93 | 33.806 | 16.240 | 28.110 | 26142 | 12.018 | 14966 | 57.2 |
| 43 | 0.93 | 33.668 | 16.636 | 28.090 | 26124 | 12.402 | 14590 | 55.8 |
| 44 | 0.93 | 33.206 | 16.436 | 27.752 | 25809 | 12.222 | 14443 | 56.0 |
| 45 | 0.93 | 34.220 | 17.362 | 28.278 | 26299 | 12.856 | 14342 | 54.5 |
| 46 | 0.93 | 34.010 | 17.364 | 28.028 | 26066 | 12.838 | 14127 | 54.2 |
| 47 | 0.93 | 35.132 | 18.344 | 28.932 | 26907 | 13.654 | 14209 | 52.8 |
| 48 | 0.93 | 34.152 | 18.278 | 28.040 | 26077 | 13.382 | 13632 | 52.3 |
| 49 | 0.93 | 34.026 | 18.350 | 27.934 | 25979 | 13.598 | 13332 | 51.3 |
| 50 | 0.93 | 33.736 | 18.474 | 27.726 | 25785 | 13.644 | 13096 | 50.8 |
| 51 | 0.93 | 34.102 | 18.784 | 28.002 | 26042 | 13.866 | 13146 | 50.5 |
| 52 | 0.93 | 30.934 | 18.926 | 25.508 | 23722 | 13.900 | 10795 | 45.5 |
| 53 | 0.93 | 28.132 | 18.682 | 23.042 | 21429 | 13.800 | 8595 | 40.1 |
| 54 | 0.93 | 28.390 | 18.226 | 23.296 | 21665 | 13.662 | 8960 | 41.4 |
| 55 | 0.93 | 28.090 | 18.044 | 23.334 | 21701 | 13.270 | 9360 | 43.1 |
| 56 | 0.93 | 31.040 | 18.298 | 26.120 | 24292 | 13.172 | 12042 | 49.6 |
| 57 | 0.93 | 31.426 | 18.296 | 26.088 | 24262 | 13.460 | 11744 | 48.4 |
| 58 | 0.93 | 31.300 | 18.164 | 25.882 | 24070 | 13.454 | 11558 | 48.0 |
| 59 | 0.93 | 33.756 | 17.848 | 27.464 | 25542 | 13.124 | 13336 | 52.2 |
| 60 | 0.93 | 33.758 | 16.892 | 27.046 | 25153 | 12.454 | 13571 | 54.0 |
| 61 | 0.93 | 33.050 | 16.830 | 26.710 | 24840 | 12.394 | 13314 | 53.6 |
| 62 | 0.93 | 26.434 | 16.614 | 22.070 | 20525 | 12.310 | 9077 | 44.2 |
| 63 | 0.93 | 26.546 | 16.646 | 22.168 | 20616 | 12.396 | 9088 | 44.1 |
| 64 | 0.93 | 26.774 | 16.028 | 22.414 | 20845 | 11.806 | 9865 | 47.3 |

Table C4: List of parameters measured daily and parameters calculated from these measured parameters for digester D4 (cont.)

| Day No. | Non-volatile Solids | | | TKN | | Ammonia | |
|---|---|---|---|---|---|---|---|
| | influent | effluent | removed | influent | effluent | influent | effluent |
| | (g/l) | (g/l) | (%) | (mg/l) | (mg/l) | (mg/l) | (mg/l) |
| 1 | | 4.596 | | | 1131 | | 498 |
| 2 | 4.084 | | -13.2 | 929.6 | | 212.8 | |
| 3 | 4.124 | | | 935.2 | | 240.8 | |
| 4 | | | | | | | |
| 5 | | 3.454 | | | 1148 | | 582 |
| 6 | | 3.308 | | | 1120 | | 616 |
| 7 | 4.158 | 3.516 | 15.4 | 901.6 | 1114 | 324.8 | 638 |
| 8 | 4.104 | 3.284 | 20.0 | 912.8 | 1064 | 218.4 | 627 |
| 9 | 4.208 | 3.334 | 20.8 | 985.6 | 1086 | 280 | 560 |
| 10 | 4.072 | 3.338 | 18.0 | 1036 | 1047 | 280 | 560 |
| 11 | 4.308 | 3.384 | 21.4 | 946 | | 241 | |
| 12 | 4.196 | 3.422 | 18.4 | | 1070 | | 515 |
| 13 | 6.610 | 3.602 | 45.5 | 1070 | 1042 | 146 | 487 |
| 14 | 6.478 | 3.512 | 45.8 | 1036 | 974 | 213 | 465 |
| 15 | 6.846 | 3.590 | 47.6 | 930 | 1019 | 168 | 532 |
| 16 | 6.374 | 3.562 | 44.1 | 913 | 974 | 224 | 493 |
| 17 | 6.600 | 3.498 | 47.0 | 997 | | 207 | |
| 18 | 5.324 | 3.688 | 30.7 | 1002 | | 213 | |
| 19 | 5.428 | 3.726 | 31.4 | | 1008 | | 554 |
| 20 | 5.354 | 4.150 | 22.5 | 1025 | 952 | 213 | 493 |
| 21 | 5.448 | 3.774 | 30.7 | 1047 | 1064 | 263 | 543 |
| 22 | 5.256 | 3.736 | 28.9 | 1019 | 941 | 218 | 476 |
| 23 | 5.418 | 3.838 | 29.2 | 1092 | 1036 | 252 | 454 |
| 24 | 5.444 | 3.936 | 27.7 | 1064 | 952 | 224 | 526 |
| 25 | 5.664 | 3.822 | 32.5 | 1019 | | 258 | |
| 26 | 5.388 | 3.984 | 26.1 | | 896 | | 504 |
| 27 | 5.342 | 4.000 | 25.1 | | 902 | 258 | 482 |
| 28 | 5.338 | 3.900 | 26.9 | 1047 | 997 | 246 | 498 |
| 29 | 5.184 | 3.956 | 23.7 | 1070 | 997 | 246 | 448 |
| 30 | 4.898 | 4.008 | 18.2 | 991 | 974 | 202 | 476 |
| 31 | 4.956 | 3.992 | 19.5 | 930 | 924 | 218 | 493 |
| 32 | 4.974 | 3.994 | 19.7 | 980 | | 202 | |

Table C4: List of parameters measured daily and parameters calculated from these measured parameters for digester D4 (cont.)

| Day No. | Non-volatile Solids | | | TKN | | Ammonia | |
|---|---|---|---|---|---|---|---|
| | influent | effluent | removed | influent | effluent | influent | effluent |
| | (g/l) | (g/l) | (%) | (mg/l) | (mg/l) | (mg/l) | (mg/l) |
| 33 | 5.050 | 4.008 | 20.6 | | 1081 | | 442 |
| 34 | 4.882 | 4.132 | 15.4 | 986 | 907 | 213 | 431 |
| 35 | 5.050 | 4.064 | 19.5 | 980 | 1064 | 274 | 470 |
| 36 | 4.950 | 3.816 | 22.9 | 1002 | 1002 | 263 | 414 |
| 37 | 4.354 | 3.934 | 9.6 | 902 | 935 | 224 | 476 |
| 38 | 5.186 | 3.912 | 24.6 | 997 | | 207 | 353 |
| 39 | 5.278 | 4.082 | 22.7 | | | 202 | |
| 40 | 5.566 | 4.124 | 25.9 | | 935 | | 370 |
| 41 | 5.640 | 4.158 | 26.3 | 1092 | 986 | 258 | 431 |
| 42 | 5.696 | 4.222 | 25.9 | 1137 | 997 | 218 | 437 |
| 43 | 5.578 | 4.234 | 24.1 | 1148 | 952 | 235 | 414 |
| 44 | 5.454 | 4.214 | 22.7 | 1081 | 924 | 258 | 442 |
| 45 | 5.942 | 4.506 | 24.2 | 1086 | 986 | 274 | 437 |
| 46 | 5.982 | 4.526 | 24.3 | 1053 | | 241 | |
| 47 | 6.200 | 4.690 | 24.4 | | 946 | | 386 |
| 48 | 6.112 | 4.896 | 19.9 | 1092 | 952 | 213 | 375 |
| 49 | 6.092 | 4.752 | 22.0 | 1053 | 935 | 196 | 398 |
| 50 | 6.010 | 4.830 | 19.6 | 1019 | 1030 | 202 | 437 |
| 51 | 6.100 | 4.918 | 19.4 | 1030 | 958 | 274 | 386 |
| 52 | 5.426 | 5.026 | 7.4 | 991 | | 213 | 386 |
| 53 | 5.090 | 4.882 | 4.1 | | | 263 | |
| 54 | 5.094 | 4.564 | 10.4 | | 946 | | 370 |
| 55 | 4.756 | 4.774 | -0.4 | 907 | 997 | 269 | 381 |
| 56 | 4.920 | 5.126 | -4.2 | 1232 | 958 | 235 | 364 |
| 57 | 5.338 | 4.836 | 9.4 | 1215 | 1042 | 200 | 370 |
| 58 | 5.418 | 4.710 | 13.1 | 1198 | 935 | 162 | 370 |
| 59 | 6.292 | 4.724 | 24.9 | 1215 | 1030 | 185 | 437 |
| 60 | 6.712 | 4.438 | 33.9 | 1232 | | 185 | |
| 61 | 6.340 | 4.436 | 30.0 | | 1014 | | 409 |
| 62 | 4.364 | 4.304 | 1.4 | 1086 | 941 | 185 | 386 |
| 63 | 4.378 | 4.250 | 2.9 | 1075 | 1008 | 157 | 375 |
| 64 | 4.360 | 4.222 | 3.2 | 1064 | 1025 | 162 | 414 |

Table C4: List of parameters measured daily and parameters calculated from these measured parameters for digester D4 (cont.)

| Day No. | COD | | | | | Conductivity | |
|---|---|---|---|---|---|---|---|
| | influent | added | effluent | removed | removed | influent | effluent |
| | (g/l) | (g/day) | (g/l) | (g/day) | (%) | (mS/m) | (mS/m) |
| 1 | | | 21463 | | | | 510 |
| 2 | 32440 | 30169 | 38666 | | | 270 | |
| 3 | 33423 | | | | | 300 | |
| 4 | | | | | | | |
| 5 | | | 21299 | | | | 460 |
| 6 | | | 19988 | | | | 440 |
| 7 | 31130 | 15565 | 20480 | 5325 | 34.2 | 290 | 450 |
| 8 | 30147 | 15073 | 19497 | 5325 | 35.3 | 300 | 430 |
| 9 | 32768 | 16384 | 21259 | 5754 | 35.1 | 290 | 450 |
| 10 | 32301 | 16150 | 19941 | 6180 | 38.3 | 300 | 430 |
| 11 | 35926 | 17963 | 18458 | 8734 | 48.6 | 290 | 440 |
| 12 | 32301 | 16150 | 19446 | 6427 | 39.8 | 310 | 440 |
| 13 | 36915 | 18458 | 19446 | 8734 | 47.3 | 220 | 425 |
| 14 | 37574 | 18787 | 19941 | 8817 | 46.9 | 220 | 420 |
| 15 | 37574 | 18787 | 18622 | 9476 | 50.4 | 215 | 405 |
| 16 | 38563 | 19282 | 16810 | 10877 | 56.4 | 200 | 400 |
| 17 | 38234 | 19117 | 16810 | 10712 | 56.0 | 195 | 395 |
| 18 | 39882 | 19941 | | 19941 | | 280 | |
| 19 | 39102 | 36365 | 17139 | 20425 | 56.2 | | 370 |
| 20 | 39552 | 36783 | 18458 | 19618 | 53.3 | 290 | 380 |
| 21 | 38893 | 36170 | 17304 | 20078 | 55.5 | 300 | 380 |
| 22 | 39222 | 36477 | 16150 | 21457 | 58.8 | 300 | 375 |
| 23 | 39222 | 36477 | 16220 | 21392 | 58.6 | 300 | 365 |
| 24 | 40305 | 37483 | 17039 | 21637 | 57.7 | 305 | 370 |
| 25 | 39322 | 36569 | 17417 | 20371 | 55.7 | 300 | |
| 26 | | | 17859 | | | | 360 |
| 27 | 36700 | 34131 | 17367 | 17980 | 52.7 | 300 | 360 |
| 28 | 38666 | 35960 | 17695 | 19504 | 54.2 | 295 | 355 |
| 29 | 38011 | 35350 | 17695 | 18894 | 53.4 | 290 | 380 |
| 30 | 41288 | 38398 | 17531 | 22094 | 57.5 | 210 | 380 |
| 31 | 35717 | 33217 | 17428 | 17009 | 51.2 | 210 | 390 |
| 32 | 36159 | 33628 | | | | 220 | |

Table C4: List of parameters measured daily and parameters calculated from these measured parameters for digester D4 (cont.)

| Day No. | COD | | | | | Conductivity | |
|---|---|---|---|---|---|---|---|
| | influent | added | effluent | removed | removed | influent | effluent |
| | (g/l) | (g/day) | (g/l) | (g/day) | (%) | (mS/m) | (mS/m) |
| 33 | 37126 | 34527 | 17754 | 18016 | 52.2 | | 380 |
| 34 | 38114 | 35446 | 19057 | 17723 | 50.0 | 210 | 370 |
| 35 | 41697 | 38778 | 16614 | 23328 | 60.2 | 220 | 365 |
| 36 | 37137 | 34537 | 17591 | 18177 | 52.6 | 225 | 360 |
| 37 | 33879 | 31508 | 17591 | 15148 | 48.1 | 220 | 360 |
| 38 | 43652 | 40596 | 17102 | 24691 | 60.8 | 230 | 360 |
| 39 | 40068 | 37264 | 18013 | 20512 | 55.0 | 225 | |
| 40 | | | 18243 | | | | 345 |
| 41 | 42675 | 39687 | 18894 | 22116 | 55.7 | 235 | 345 |
| 42 | 44955 | 41808 | 19383 | 23782 | 56.9 | 240 | 340 |
| 43 | 44629 | 41505 | 19383 | 23479 | 56.6 | 230 | 340 |
| 44 | 46258 | 43020 | 19708 | 24691 | 57.4 | 230 | 335 |
| 45 | 52122 | 48473 | 20197 | 29690 | 61.3 | 210 | 340 |
| 46 | 44629 | 41505 | | | | 220 | |
| 47 | 45897 | 42684 | 20686 | 23446 | 54.9 | | 320 |
| 48 | 47235 | 43929 | 21012 | 24388 | 55.5 | 220 | 320 |
| 49 | 44303 | 41202 | 22315 | 20450 | 49.6 | 215 | 305 |
| 50 | 47561 | 44232 | 21323 | 24402 | 55.2 | 210 | 305 |
| 51 | 48417 | 45027 | 22605 | 24005 | 53.3 | 215 | 305 |
| 52 | 44890 | 41747 | 22284 | 21023 | 50.4 | 220 | 305 |
| 53 | 38156 | 35485 | 21649 | 15352 | 43.3 | 225 | |
| 54 | | | 21002 | | | | 290 |
| 55 | 36553 | 33994 | 22605 | 12971 | 38.2 | 220 | 290 |
| 56 | 39759 | 36976 | 21002 | 17444 | 47.2 | 220 | 295 |
| 57 | 43286 | 40256 | 20681 | 21023 | 52.2 | 220 | 290 |
| 58 | 40721 | 37871 | 20842 | 18488 | 48.8 | 225 | 300 |
| 59 | 40721 | 37871 | 20681 | 18637 | 49.2 | 230 | 305 |
| 60 | 44248 | 41151 | | | | 240 | |
| 61 | 42045 | 39102 | 20521 | 20017 | 51.2 | | 305 |
| 62 | 39759 | 36976 | 18597 | 19681 | 53.2 | 230 | 310 |
| 63 | 35591 | 33100 | 19515 | 14951 | 45.2 | 230 | 310 |
| 64 | 39675 | 36898 | 19999 | 18299 | 49.6 | 230 | 310 |

Table C4: List of parameters measured daily and parameters calculated from (cont.) these measured parameters for digester D4

| Day No. | pH | | Alkalinity(as CaCO3) | | SCFA (as HAc) | | SCFA/Alk | |
|---|---|---|---|---|---|---|---|---|
| | influent | effluent | influent (mg/l) | effluent (mg/l) | influent (mg/l) | effluent (mg/l) | influent | effluent |
| 1 | | 7.06 | | 1233 | | 1564 | | 1.268 |
| 2 | 5.2 | | 72 | | 2111 | | 29.3 | |
| 3 | 5.23 | | 79 | | 2404 | | 30.4 | |
| 4 | | | | | | | | |
| 5 | | 7.20 | | 1626 | | 768 | | 0.472 |
| 6 | | 7.21 | | 1723 | | 568 | | 0.330 |
| 7 | 5.29 | 7.14 | 84 | 1728 | 2342 | 557 | 27.9 | 0.322 |
| 8 | 5.29 | 7.17 | 93 | 1783 | 2300 | 525 | 24.7 | 0.294 |
| 9 | 5.28 | 7.15 | 89 | 1790 | 2334 | 460 | 26.2 | 0.257 |
| 10 | 5.29 | 7.21 | 88 | 1874 | 2179 | 358 | 24.8 | 0.191 |
| 11 | 5.29 | 7.23 | 86 | 1878 | 2220 | 321 | 25.8 | 0.171 |
| 12 | 5.3 | 7.24 | | 1865 | | 337 | | 0.181 |
| 13 | 5.18 | 7.30 | 50 | 1888 | 1542 | 209 | 30.8 | 0.111 |
| 14 | 5.2 | 7.31 | 53 | 1934 | 1565 | 178 | 29.5 | 0.092 |
| 15 | 5.22 | 7.33 | 54 | 1996 | 1564 | 123 | 29.0 | 0.062 |
| 16 | 5.21 | 7.32 | 54 | 2004 | 1454 | 97 | 26.9 | 0.048 |
| 17 | 5.23 | 7.28 | 51 | 2006 | 1443 | 85 | 28.3 | 0.042 |
| 18 | 5.14 | 7.24 | 80 | | 2543 | | 31.8 | |
| 19 | 5.16 | 7.26 | | 1953 | | 96 | | |
| 20 | 5.16 | 7.22 | 91 | 2001 | 2872 | 102 | 31.6 | 0.051 |
| 21 | 5.18 | 7.19 | 89 | 2044 | 2873 | 99 | 32.3 | 0.048 |
| 22 | 5.19 | 7.25 | 93 | 2029 | 2947 | 86 | 31.7 | 0.042 |
| 23 | 5.19 | 7.27 | 92 | 2028 | 2817 | 89 | 30.6 | 0.044 |
| 24 | 5.18 | 7.25 | 93 | 2074 | 3053 | 82 | 32.8 | 0.040 |
| 25 | 5.19 | 7.21 | 94 | | 3050 | | 32.4 | |
| 26 | 5.2 | 7.23 | | 2058 | | 42 | | 0.020 |
| 27 | 5.19 | 7.25 | 107 | 2094 | 3021 | 14 | 28.2 | 0.007 |
| 28 | 5.2 | 7.24 | 105 | 2124 | 3067 | 33 | 29.2 | 0.016 |
| 29 | 5.21 | 7.24 | 105 | 2133 | 3085 | 17 | 29.4 | 0.008 |
| 30 | 5.41 | 7.20 | 74 | 2154 | 1593 | 21 | 21.5 | 0.010 |
| 31 | 5.42 | 7.22 | 69 | 2123 | 1562 | 37 | 22.6 | 0.017 |
| 32 | 5.44 | 7.18 | 74 | | 1624 | | 21.9 | |

Note: Alkalinity = $H_2CO_3^*$ alkalinity

Table C4: List of parameters measured daily and parameters calculated from (cont.) these measured parameters for digester D4

| Day No. | pH | | Alkalinity(as CaCO3) | | SCFA (as HAc) | | SCFA/Alk | |
|---|---|---|---|---|---|---|---|---|
| | influent | effluent | influent (mg/l) | effluent (mg/l) | influent (mg/l) | effluent (mg/l) | influent | effluent |
| 33 | 5.41 | 7.20 | | 2091 | | 24 | | 0.011 |
| 34 | 5.43 | 7.20 | 74 | 2139 | 1612 | 30 | 21.8 | 0.014 |
| 35 | 5.44 | 7.16 | 71 | 2131 | 1673 | 33 | 23.6 | 0.015 |
| 36 | 5.48 | 7.16 | 72 | 2126 | 1710 | 29 | 23.8 | 0.014 |
| 37 | 5.54 | 7.17 | 89 | 2112 | 1585 | 25 | 17.8 | 0.012 |
| 38 | 5.55 | 7.15 | 77 | 2079 | 1610 | 18 | 20.9 | 0.009 |
| 39 | 5.56 | 7.15 | 80 | | 1610 | | 20.1 | |
| 40 | 5.49 | 7.18 | | 2050 | | 20 | | 0.010 |
| 41 | 5.45 | 7.14 | 82 | 2031 | 1890 | 24 | 23.0 | 0.012 |
| 42 | 5.45 | 7.17 | 82 | 2065 | 1895 | 25 | 23.1 | 0.012 |
| 43 | 5.45 | 7.17 | 88 | 2077 | 1924 | 32 | 21.9 | 0.015 |
| 44 | 5.47 | 7.15 | 85 | 2026 | 1929 | 25 | 22.7 | 0.012 |
| 45 | 5.37 | 7.16 | 78 | 2055 | 1740 | 22 | 22.3 | 0.011 |
| 46 | 5.36 | 7.13 | 83 | | 1773 | | 21.4 | |
| 47 | 5.41 | 7.18 | | 1934 | | 38 | | 0.020 |
| 48 | 5.45 | 7.12 | 84 | 1968 | 1679 | 36 | 20.0 | 0.018 |
| 49 | 5.44 | 7.15 | 85 | 1949 | 1681 | 33 | 19.8 | 0.017 |
| 50 | 5.44 | 7.12 | 84 | 1931 | 1711 | 27 | 20.4 | 0.014 |
| 51 | 5.45 | 7.10 | 85 | 1936 | 1712 | 37 | 20.1 | 0.019 |
| 52 | 5.46 | 7.15 | 85 | 1907 | 1746 | 37 | 20.5 | 0.019 |
| 53 | 5.46 | 7.10 | 95 | | 1745 | | 18.4 | |
| 54 | 5.46 | 7.14 | | 1833 | | 28 | | 0.015 |
| 55 | 5.48 | 7.09 | 82 | 1829 | 1632 | 18 | 19.9 | 0.010 |
| 56 | 5.3 | 7.11 | 71 | 1874 | 1824 | 21 | 25.7 | 0.011 |
| 57 | 5.32 | 7.09 | 73 | 1879 | 1871 | 30 | 25.6 | 0.016 |
| 58 | 5.33 | 7.14 | 81 | 1913 | 1970 | 14 | 24.3 | 0.007 |
| 59 | 5.31 | 7.14 | 83 | 1947 | 2199 | 20 | 26.5 | 0.010 |
| 60 | 5.32 | 7.12 | 86 | | 2188 | | 25.4 | |
| 61 | 5.37 | 7.15 | | 1987 | | 28 | | 0.014 |
| 62 | 5.34 | 7.14 | 95 | 2020 | 2105 | 24 | 22.2 | 0.012 |
| 63 | 5.34 | 7.17 | 86 | 2048 | 2103 | 31 | 24.5 | 0.015 |
| 64 | 5.35 | 7.12 | 86 | | 2136 | | 24.8 | |

Table C4: List of parameters measured daily and parameters calculated from (cont.) these measured parameters for digester D4

| Day No. | Gas production | Carbon dioxide | Methane | Gas produced per.... | | | |
|---|---|---|---|---|---|---|---|
| | | | | COD rem. | COD add | VS rem. | VS add. |
| | (l/day) | (%) | (%) | (l/g) | (l/g) | (l/g) | (l/g) |
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | 2.918 | | | | | | |
| 7 | | | | | | | |
| 8 | 4.272 | | | 1.31 | 0.47 | 0.80 | 0.28 |
| 9 | | | | | | | |
| 10 | 6.835 | | | 1.77 | 0.72 | 1.11 | 0.42 |
| 11 | | | | | | | |
| 12 | 10.388 | | | 2.56 | 1.08 | 1.62 | 0.64 |
| 13 | | | | | | | |
| 14 | 11.880 | | | 2.05 | 1.06 | 1.35 | 0.63 |
| 15 | | | | | | | |
| 16 | 8.725 | | | 1.42 | 0.77 | 0.80 | 0.45 |
| 17 | | | | | | | |
| 18 | 8.662 | | | 1.36 | 0.73 | 0.43 | 0.43 |
| 19 | 8.662 | | | 0.71 | 0.39 | 0.42 | 0.24 |
| 20 | | | | | | | |
| 21 | | 33.7 | 66.3 | | | | |
| 22 | | 32.9 | 67.1 | | | | |
| 23 | 12.794 | 35.4 | 64.6 | 1.05 | 0.57 | 0.60 | 0.35 |
| 24 | | 38.5 | 61.5 | | | | |
| 25 | 12.446 | 36.4 | 63.6 | 1.05 | 0.56 | 0.61 | 0.34 |
| 26 | | 36.4 | 63.6 | | | | |
| 27 | 14.190 | 36.4 | 63.6 | 1.21 | 0.64 | 0.79 | 0.42 |
| 28 | | 36.4 | 63.6 | | | | |
| 29 | 14.015 | 36.4 | 63.6 | 1.22 | 0.64 | 0.74 | 0.40 |
| 30 | | 35.4 | 64.6 | | | | |
| 31 | 12.860 | 37.3 | 62.7 | 1.08 | 0.57 | 0.76 | 0.39 |
| 32 | | 36.4 | 63.6 | | | | |

Table C4: List of parameters measured daily and parameters calculated from (cont.) these measured parameters for digester D4

| Day No. | Gas production | Carbon dioxide | Methane | Gas produced per.... | | | |
|---|---|---|---|---|---|---|---|
| | | | | COD rem. | COD add | VS rem. | VS add. |
| | (l/day) | (%) | (%) | (l/g) | (l/g) | (l/g) | (l/g) |
| 33 | 14.131 | 38.5 | 61.5 | 1.19 | 0.63 | 0.78 | 0.41 |
| 34 | | 35.2 | 64.8 | | | | |
| 35 | 13.677 | 36.2 | 63.8 | 1.16 | 0.61 | 0.59 | 0.35 |
| 36 | | 37.3 | 62.7 | | | | |
| 37 | 11.653 | 36.9 | 63.1 | 1.28 | 0.59 | 0.77 | 0.37 |
| 38 | | 36.4 | 63.6 | | | | |
| 39 | 12.355 | 36.4 | 63.6 | 0.94 | 0.52 | 0.60 | 0.33 |
| 40 | | 37.1 | 62.9 | | | | |
| 41 | 14.905 | 38.5 | 61.5 | 1.02 | 0.58 | 0.67 | 0.38 |
| 42 | | 35.2 | 64.8 | | | | |
| 43 | 15.369 | 37.6 | 62.4 | 1.05 | 0.59 | 0.65 | 0.37 |
| 44 | | 36.2 | 63.8 | | | | |
| 45 | 14.953 | 36.4 | 63.6 | 1.04 | 0.57 | 0.50 | 0.31 |
| 46 | | 36.4 | 63.6 | | | | |
| 47 | 17.111 | 35.4 | 64.6 | 1.20 | 0.64 | 0.73 | 0.40 |
| 48 | | 34.5 | 65.5 | | | | |
| 49 | 15.191 | 38.7 | 61.3 | 1.14 | 0.58 | 0.74 | 0.37 |
| 50 | | 36.2 | 63.8 | | | | |
| 51 | 14.899 | 36.4 | 63.6 | 1.13 | 0.57 | 0.62 | 0.33 |
| 52 | | 37.1 | 62.9 | | | | |
| 53 | 14.885 | 36.4 | 63.6 | 1.73 | 0.69 | 0.97 | 0.42 |
| 54 | | 34.0 | 66.0 | | | | |
| 55 | 12.138 | 37.1 | 62.9 | 1.30 | 0.56 | 0.94 | 0.36 |
| 56 | | 37.1 | 62.9 | | | | |
| 57 | 12.941 | 36.6 | 63.4 | 1.10 | 0.53 | 0.62 | 0.32 |
| 58 | | 37.1 | 62.9 | | | | |
| 59 | 12.946 | 37.3 | 62.7 | 0.97 | 0.51 | 0.69 | 0.34 |
| 60 | | 36.4 | 63.6 | | | | |
| 61 | 13.894 | 37.3 | 62.7 | 1.04 | 0.56 | 0.69 | 0.36 |
| 62 | | 35.4 | 64.6 | | | | |
| 63 | 12.460 | 34.5 | 65.5 | 1.37 | 0.60 | 0.83 | 0.38 |
| 64 | | 35.0 | 65.0 | | | | |

Note: All gas volumes measured at 1 atmosphere pressure and 20$^{o}$C.

Table C4: List of parameters measured daily and parameters calculated from these measured parameters for digester D4 (cont.)

| Day No. | Methane produced per..... | | | | Carbon dioxide produced per... | | | |
|---|---|---|---|---|---|---|---|---|
| | VS rem. | VS add. | COD rem. | COD add. | VS rem. | VS add. | COD re | COD add |
| | l/g | l/g | l/g | l/g | l/g | l/g | l/g | l/g |
| 1 | | | | | | | | |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | 0.83 | 0.30 | 0.51 | 0.18 | 0.48 | 0.17 | 0.29 | 0.10 |
| 9 | | | | | | | | |
| 10 | 1.12 | 0.46 | 0.70 | 0.27 | 0.65 | 0.26 | 0.41 | 0.16 |
| 11 | | | | | | | | |
| 12 | 1.62 | 0.69 | 1.02 | 0.41 | 0.94 | 0.40 | 0.59 | 0.24 |
| 13 | | | | | | | | |
| 14 | 1.30 | 0.67 | 0.85 | 0.40 | 0.75 | 0.39 | 0.49 | 0.23 |
| 15 | | | | | | | | |
| 16 | 0.90 | 0.49 | 0.51 | 0.29 | 0.52 | 0.28 | 0.29 | 0.17 |
| 17 | | | | | | | | |
| 18 | 0.86 | 0.46 | 0.28 | 0.28 | 0.50 | 0.27 | 0.16 | 0.16 |
| 19 | 0.71 | 0.39 | 0.42 | 0.24 | 0.00 | 0.00 | 0.00 | 0.00 |
| 20 | | | | | | | | |
| 21 | | | | | | | | |
| 22 | | | | | | | | |
| 23 | 0.68 | 0.37 | 0.39 | 0.23 | 0.37 | 0.20 | 0.21 | 0.12 |
| 24 | | | | | | | | |
| 25 | 0.67 | 0.36 | 0.39 | 0.22 | 0.38 | 0.20 | 0.22 | 0.12 |
| 26 | | | | | | | | |
| 27 | 0.77 | 0.41 | 0.50 | 0.26 | 0.44 | 0.23 | 0.29 | 0.15 |
| 28 | | | | | | | | |
| 29 | 0.78 | 0.41 | 0.47 | 0.25 | 0.44 | 0.23 | 0.27 | 0.14 |
| 30 | | | | | | | | |
| 31 | 0.68 | 0.36 | 0.47 | 0.24 | 0.40 | 0.21 | 0.28 | 0.14 |
| 32 | | | | | | | | |

Table C4: List of parameters measured daily and parameters calculated from these measured parameters for digester D4 (cont.)

| Day No. | Methane produced per..... | | | | Carbon dioxide produced per... | | | |
|---|---|---|---|---|---|---|---|---|
| | VS rem. | VS add. | COD rem. | COD add. | VS rem. | VS add. | COD re | COD add |
| | l/g | l/g | l/g | l/g | l/g | l/g | l/g | l/g |
| 33 | 0.73 | 0.39 | 0.48 | 0.25 | 0.46 | 0.24 | 0.30 | 0.16 |
| 34 | | | | | | | | |
| 35 | 0.74 | 0.39 | 0.37 | 0.23 | 0.42 | 0.22 | 0.21 | 0.13 |
| 36 | | | | | | | | |
| 37 | 0.81 | 0.38 | 0.49 | 0.23 | 0.47 | 0.22 | 0.28 | 0.14 |
| 38 | | | | | | | | |
| 39 | 0.60 | 0.33 | 0.38 | 0.21 | 0.34 | 0.19 | 0.22 | 0.12 |
| 40 | | | | | | | | |
| 41 | 0.62 | 0.36 | 0.41 | 0.23 | 0.39 | 0.22 | 0.26 | 0.14 |
| 42 | | | | | | | | |
| 43 | 0.66 | 0.37 | 0.41 | 0.23 | 0.40 | 0.22 | 0.25 | 0.14 |
| 44 | | | | | | | | |
| 45 | 0.66 | 0.36 | 0.32 | 0.20 | 0.38 | 0.21 | 0.18 | 0.11 |
| 46 | | | | | | | | |
| 47 | 0.78 | 0.41 | 0.47 | 0.26 | 0.43 | 0.23 | 0.26 | 0.14 |
| 48 | | | | | | | | |
| 49 | 0.70 | 0.36 | 0.46 | 0.23 | 0.44 | 0.23 | 0.29 | 0.14 |
| 50 | | | | | | | | |
| 51 | 0.72 | 0.36 | 0.39 | 0.21 | 0.41 | 0.21 | 0.23 | 0.12 |
| 52 | | | | | | | | |
| 53 | 1.10 | 0.44 | 0.62 | 0.27 | 0.63 | 0.25 | 0.35 | 0.15 |
| 54 | | | | | | | | |
| 55 | 0.82 | 0.35 | 0.59 | 0.22 | 0.48 | 0.21 | 0.35 | 0.13 |
| 56 | | | | | | | | |
| 57 | 0.70 | 0.34 | 0.39 | 0.20 | 0.40 | 0.20 | 0.23 | 0.12 |
| 58 | | | | | | | | |
| 59 | 0.61 | 0.32 | 0.44 | 0.21 | 0.36 | 0.19 | 0.26 | 0.13 |
| 60 | | | | | | | | |
| 61 | 0.65 | 0.35 | 0.44 | 0.22 | 0.39 | 0.21 | 0.26 | 0.13 |
| 62 | | | | | | | | |
| 63 | 0.90 | 0.40 | 0.55 | 0.25 | 0.47 | 0.21 | 0.29 | 0.13 |
| 64 | | | | | | | | |

**Note: All gas volumes measured at 1 atmosphere pressure and 20°C.**

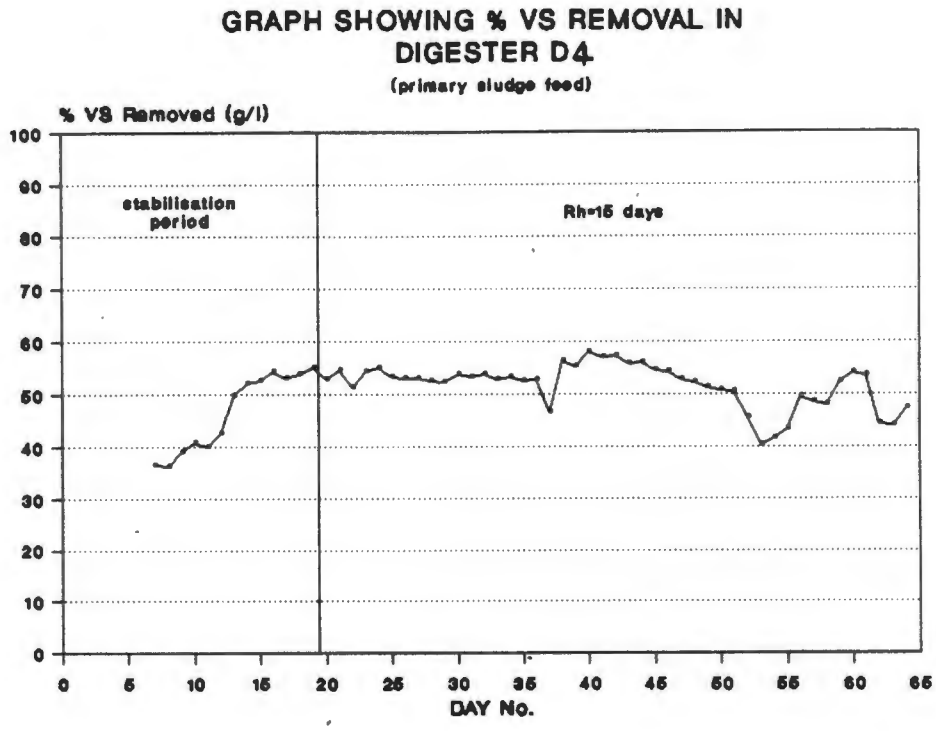


*Figure C37*: *Graph showing the day-to-day % VS removed in digester D4 for the period day 1 to day 64.*

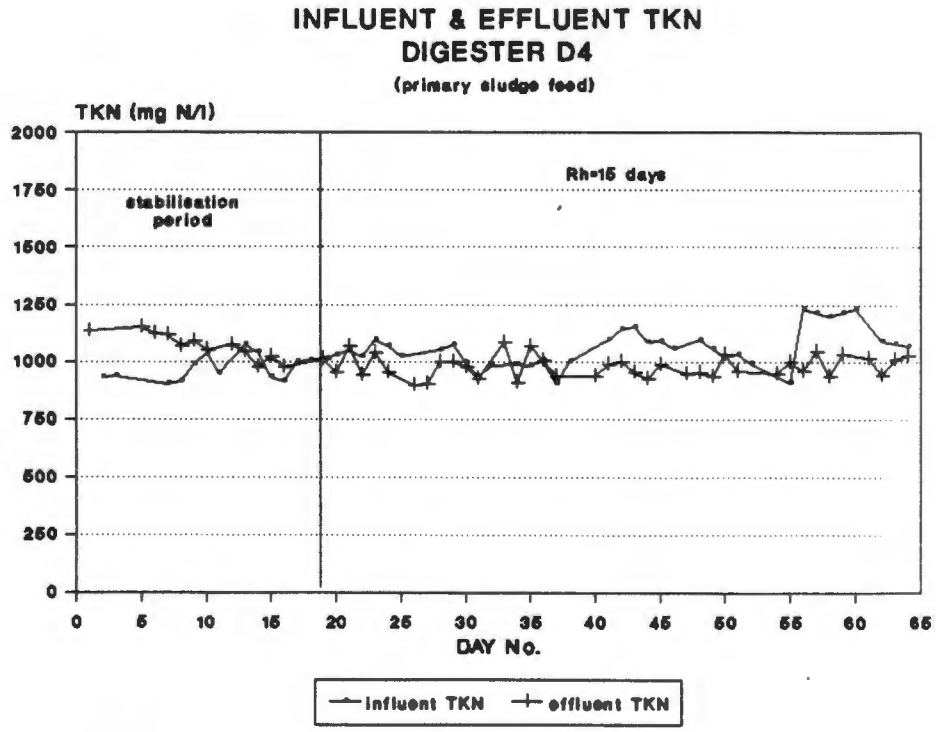


*Figure C38*: *Graph showing the day-to-day influent and effluent TKN in digester D4 for the period day 1 to day 64.*

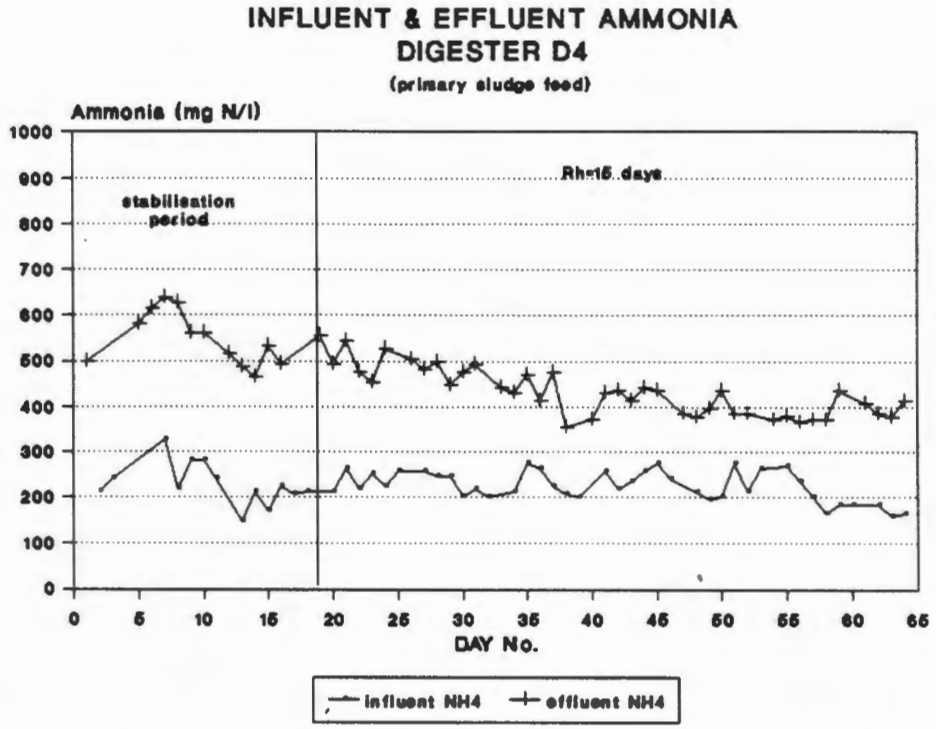


*Figure C39*: *Graph showing the day-to-day influent and effluent free and saline ammonia concentration in digester D4 for the period day 1 to day 64.*

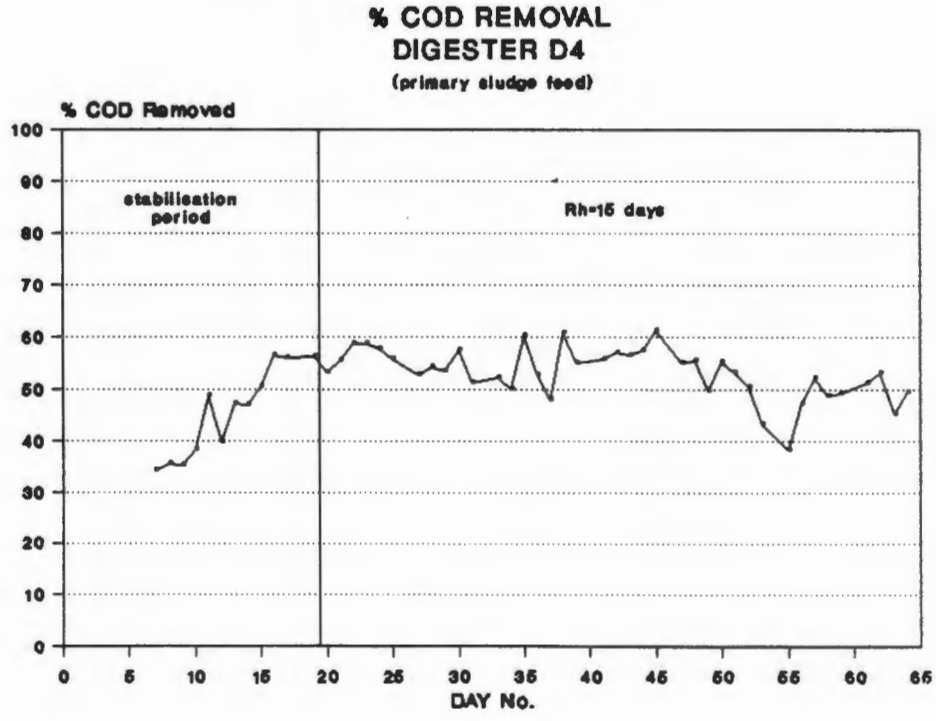


*Figure C40*: *Graph showing the day-to-day % COD removed in digester D4 for the period day 1 to day 64.*

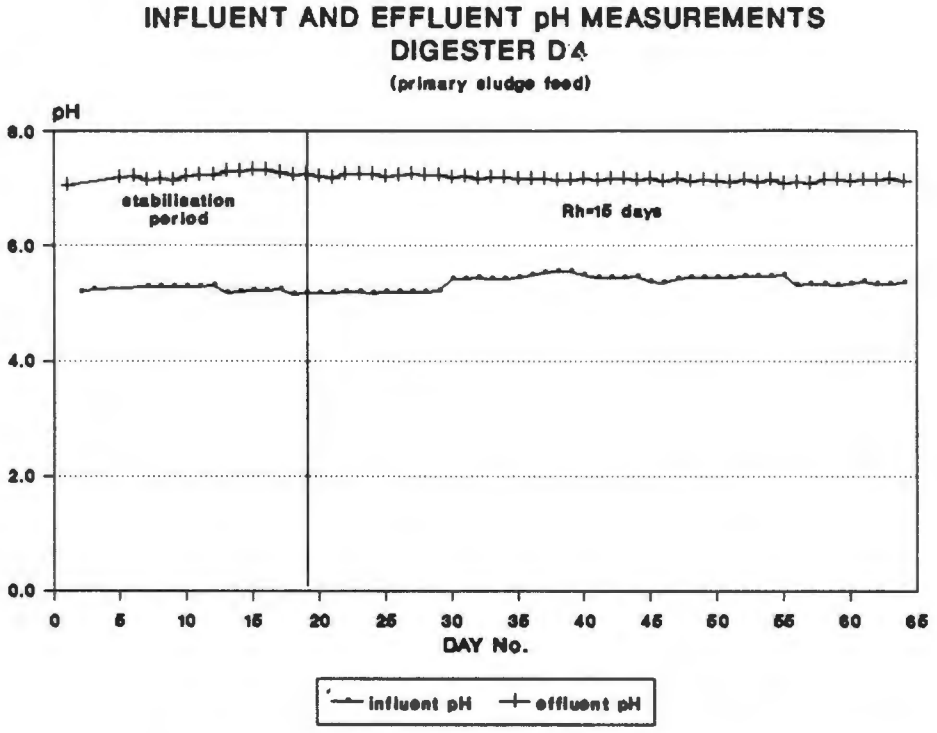


*Figure C41*: *Graph showing the day-to-day influent and effluent pH for digester D4 during the period day 1 to day 64.*

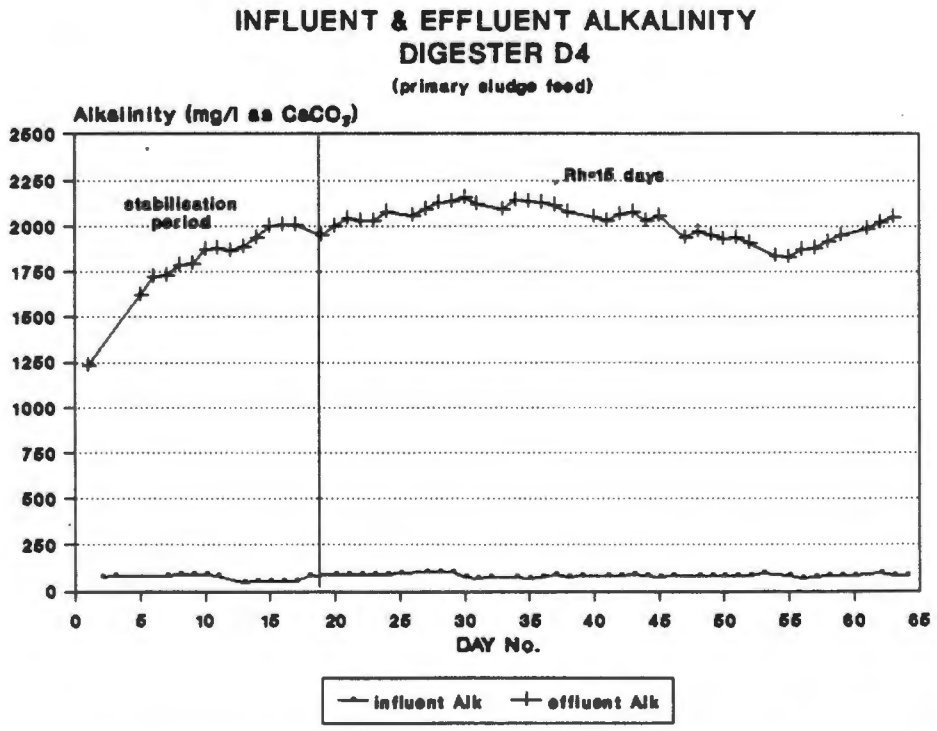


*Figure C42*: *Graph showing the day-to-day influent and effluent $H_2CO_3^*$ alkalinities for digester D4 during the period day 1 to day 64.*

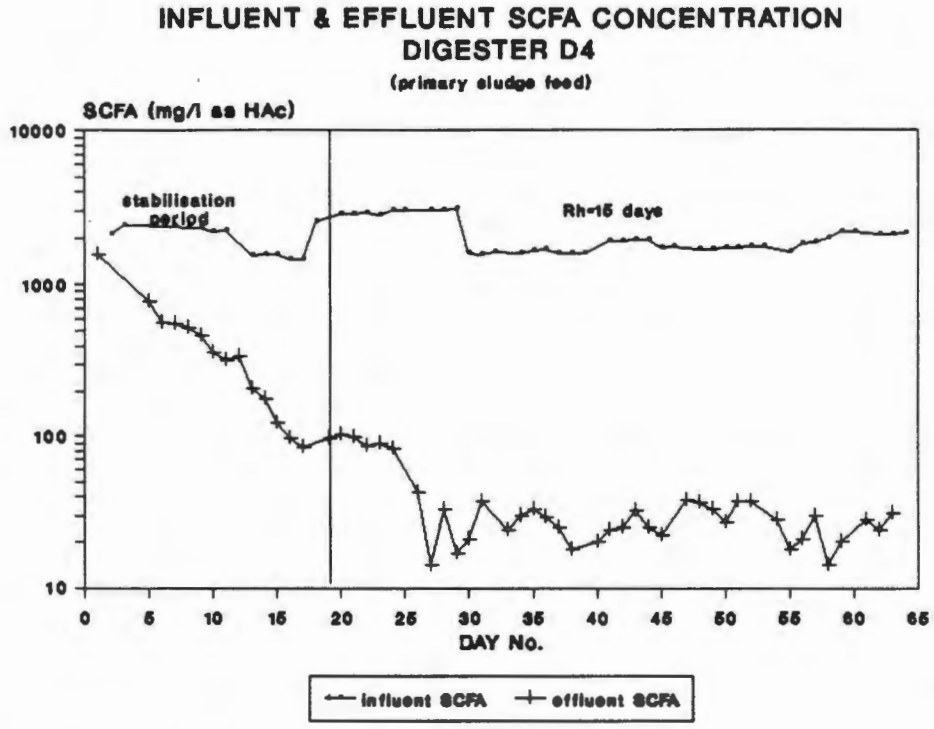


*Figure C43*: *Graph showing the day-to-day influent and effluent SCFA concentrations for digester D4 during the period day 1 to day 64.*

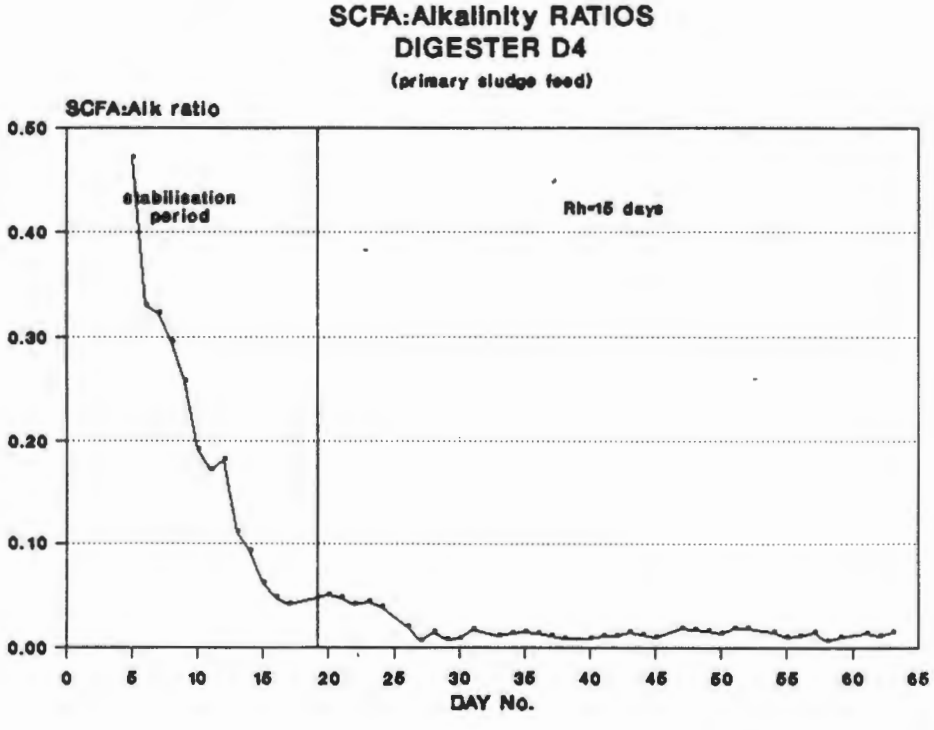


*Figure C44*: *Graph showing the day-to-day SCFA:alk ratios in digester D4 for the period day 1 to day 64.*

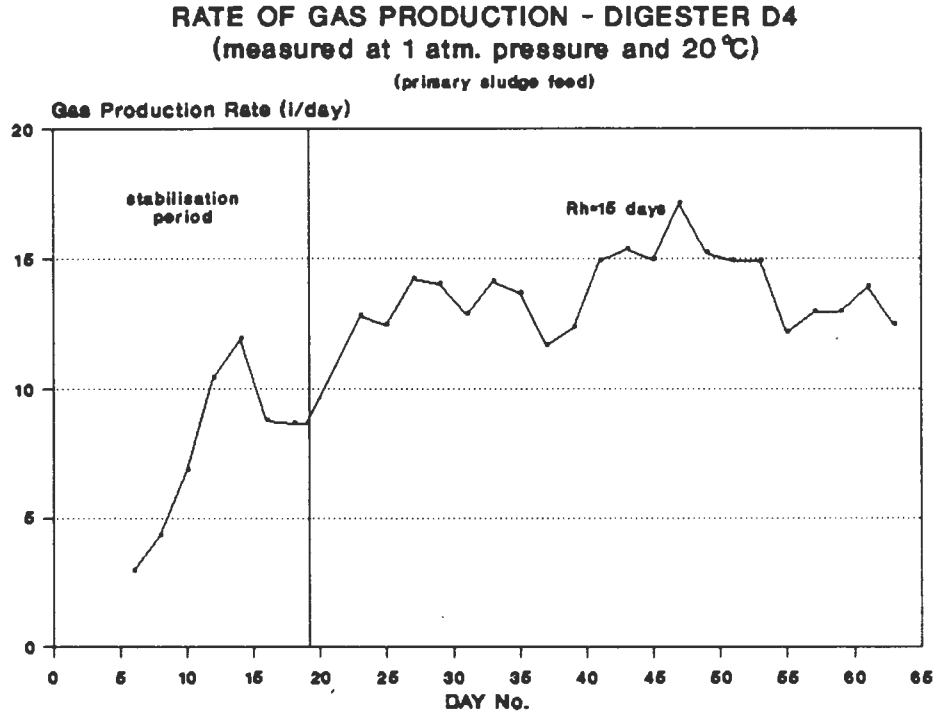


*Figure C45*: *Graph showing the day-to-day gas production rates in digester D4 for the period day 1 to day 64.*

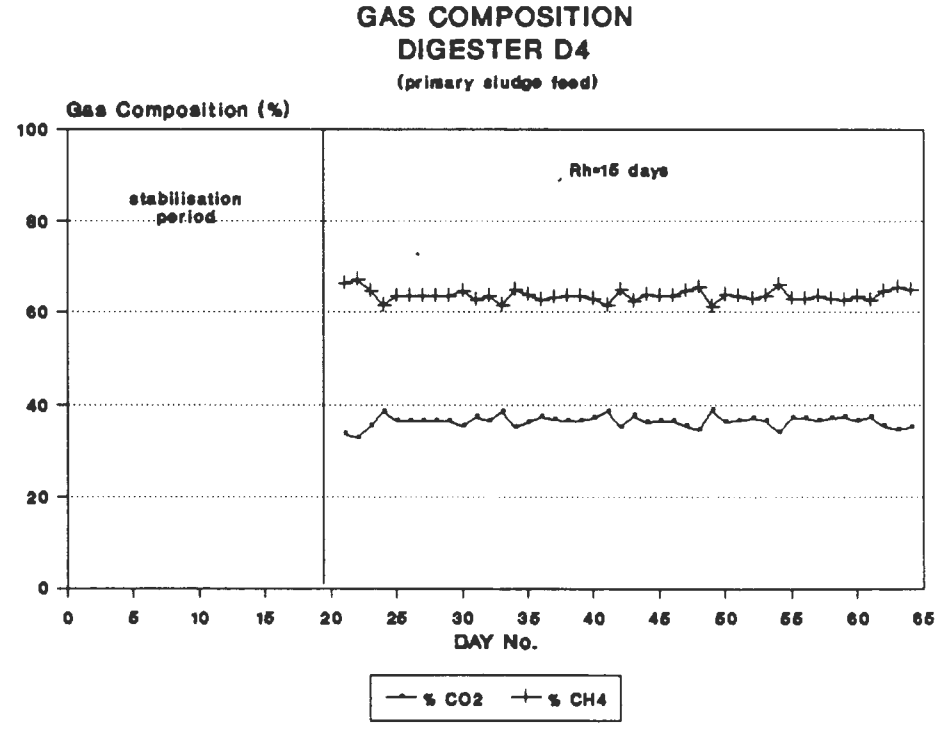


*Figure C46*: *Graph showing the day-to-day gas composition (% carbon dioxide and % methane) for digester D4 during the period day 1 to day 64.*

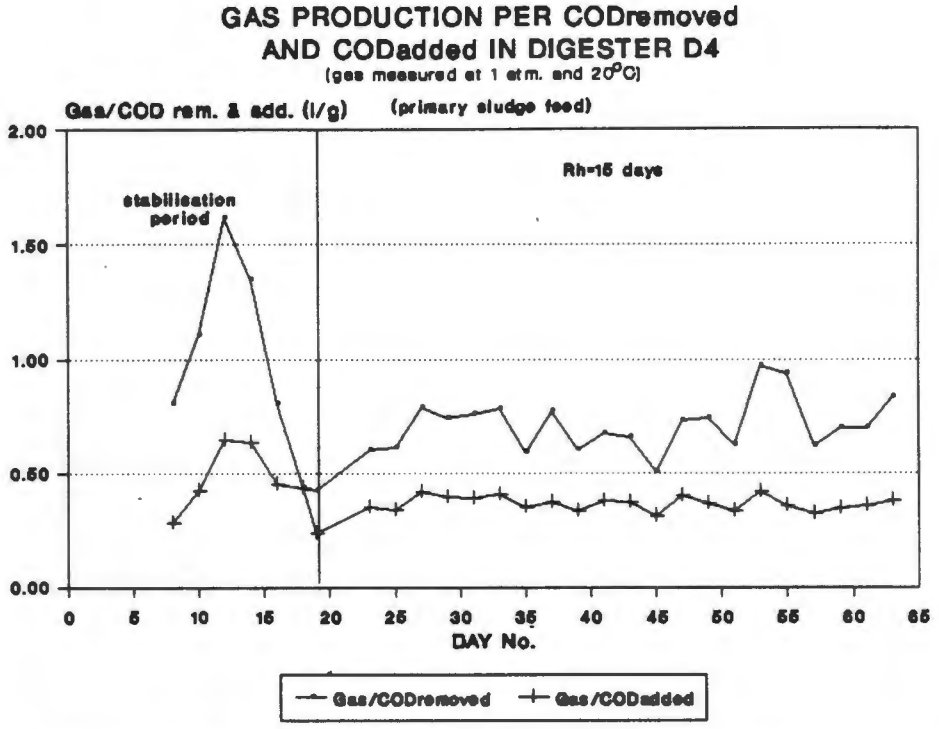


*Figure C47*: *Graph showing the day-to-day gas production per mass of COD removed and COD added for digester D4 during the period day 1 to day 64.*

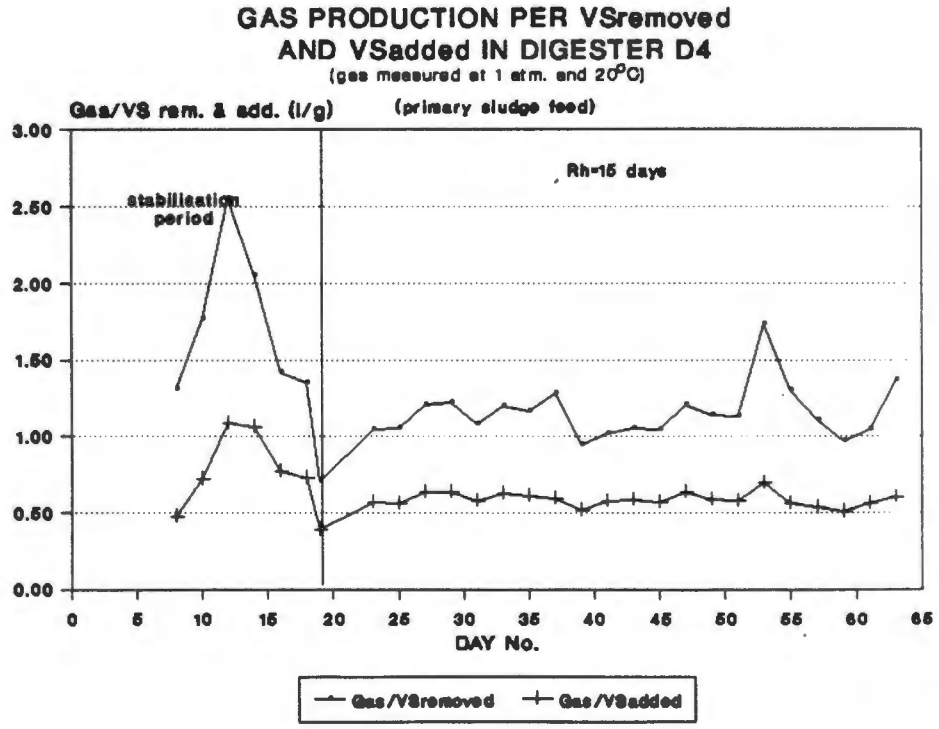


*Figure C48*: *Graph showing the day-to-day gas production per mass of VS removed and VS added for digester D4 during the period day 1 to day 64.*