THE EFFECT OF TOTAL SOLID CONCENTRATION ON BIOGAS PRODUCTION.

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ABSTRACT.
Global energy demand is rapidly increasing. In contrast, fossil fuel reserves are decreasing. Today, one of the major challenges is energy supply for the future. Furthermore, effects of global warming cannot be neglected anymore. Alternative energy sources such as biogas should be developed. This work investigated the effect of total solid concentration on anaerobic digestion and biogas production. Six laboratory scale digesters of 10 litres each were set up for the experiment. The digesters were charge with 5kg each of different waste (Goat, Pig, Cow and poultry droppings). The experiment were performed in batches with six digesters in a batch, the slurry in the digesters were raised to temperature of 40 ℃, 45 ℃, 50℃, 55℃ and 60℃ with one digester being used as control experiment. Sample was taken every two days from each digesters and total solid concentration in percent (%) were determined and recorded. The graph of total solid concentration against number of days was plotted.

Keywords: Total Solid, Anaerobic Digestion, Biogas Production, Temperature, Digester.

1.0 INTRODUCTION.

Biogas production is an anaerobic digestion process which involves microbial activity on the substrate. The rate of biogas yield is highly dependent on total solid content of the feedstock. The total solids (TS) concentration of the waste influences the pH, temperature and effectiveness of the microorganisms in the decomposition process [1].

The potential for biogas production in the world is very large [2] and in
Sweden this potential is approximately 10 times higher than the present production [3]. In the 1970s, many biogas plants were constructed in municipal wastewater treatment plants [4]. The main aim was to reduce the biomass that was produced from anaerobic digestion [5], and it was not to obtain methane. Biogas was often released into the atmosphere. The number of farm-size biogas plants increased in the 1970s due to an oil crisis but farmers often had problems with the operation [6]. The methane recovery from landfills started in the 1980s [7]. This was an important issue, since methane released into the atmosphere is nearly 30 times much more effective than CO_2 in trapping the earth's radiated heat and contributes 18% to the greenhouse effect [8]. Today, in Sweden there are more than 233 biogas plants [9].

Due to carbon abatement policies and in order to achieve energy policy targets, use of bio energy is projected to increase in Sweden [10].

Biogas production according to feeding process:

There are many processes adopted for the treatment of organic wastes with different purposes in feeding. This can also be referred to as method of biogas production according to feeding process.

(A) **Continuous feeding**. In continuous operation the substrate is fed to the digester continuously (daily interval, weekly or hourly) after the production of gas been established so that the rates of gas production, input and output are steady with time. Majority of the digesters designs are intended for continuous operation. It is often claim that continuous operation is more efficient (i.e. has higher gas production rates per unit digester given volume) than batch operation. It was also observed that the pre-treated feedstock has more biogas yield than the untreated feedstock [11].

(b) **Batch fermentation:** Here, the digester are fed once, when gas yield drops to a low level after a period of fermentation, the

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digesters can be emptied and fed once again. Infact, one advantages of batch operation is that attention is not as crucial with continuous operation where maintenance of steady operation condition is virtually important. Biogas production according to operating temperature.

(i) **Thermophilic fermentation:** This is characterized by a temperature range of 45-60℃ with rapid digestion, high gas yield and short retention time. This process is used for disposal of excretes and other wastes because of its food disinfection. The waste from wineries with high temperature is suitable for thermophilic fermentation.

(ii) **Mesophillic fermentation:** Mesophillic temperature is 30-45 ℃ characterised by slow decomposition feedstock and less energy consumption. This range gives highest yield of methane i.e. methane production is prime objective compared to other temperatures.

2. MATERIALS AND METHODS.

2.1. Collection of Materials.

The Pig, Cow and Goat dung were collected from Ugwuoke’s farm in Iheakpu- Awka, Igbo Eze South Local Government of Enugu State, Nigeria. While the Poultry droppings were collected from Eze's farm in Nsude, Udi Local Government Area, in Enugu, State.

2.2 Digester Experimentation Six laboratory-scale anaerobic batch digesters each of 10 litres volume were set up for this experiment. Hobson *et al* (1981),[12] say “with a batch digester a smaller experimental system may be suitable as the digester has only to be loaded once and may not even need to be stirred. One or two litres could be big enough”. The first digester was used as a control experiment and was fed with waste at atmospheric temperature and pressure. The other five digesters were fed with waste at different temperatures ranging from 40℃-60℃ at 5℃ interval.

2.3 Statistical Analysis.

ANOVA test was performed with software SPSS 16.0 to see the statistical significant differences between the pre-treatment with different substrates. The statistical significance level was selected at P-value<0.05.

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3.0 RESULTS AND CONCLUSIONS.

The results showed that total solid contribute to anaerobic degradation and as well biogas production. From fig 1, fig2, fig3 and fig4 below the graph sloped downward from left to right which indicate that the total solid degradation increased. The higher the total solid in a feedstock the lesser the biogas production.

Therefore experiment two represented with fig 2 had higher biogas yield due to more degradation of total solid. The control experiment in the graphs has low total solid degradation compare to other experiment with each dung.

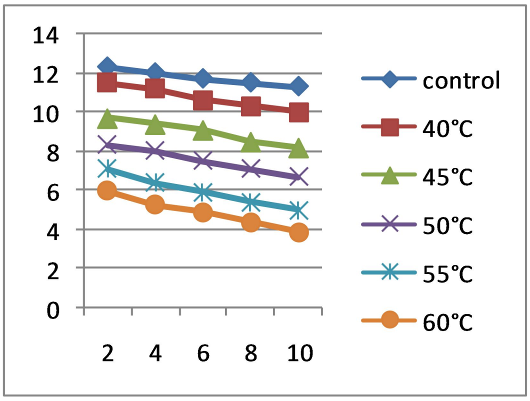

Figure 1: Graph of total solid concentration against time (days) of Goat dung.

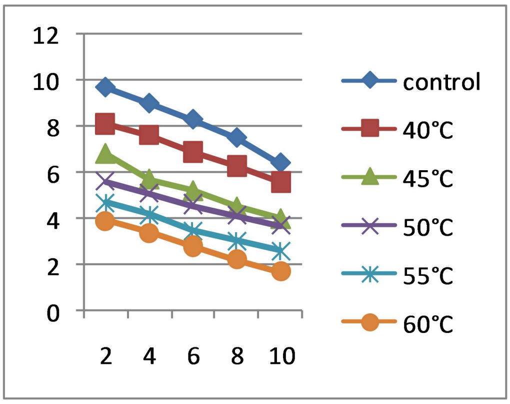

Figure 2: Graph of total solid concentration against time (days) of Pig dung.

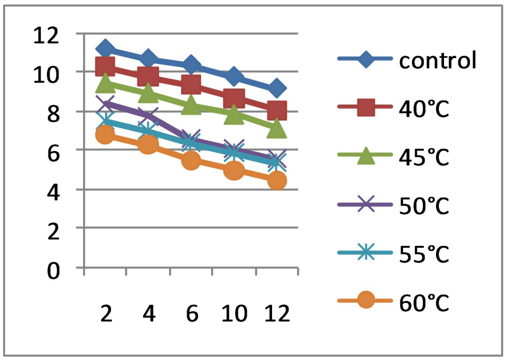

Figure 3: Graph of total solid concentration against time (days) of Cow dung.

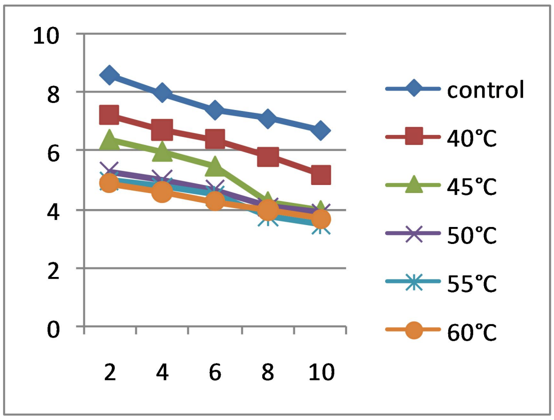

Figure 4: Graph of total solid concentration against time (days) of Poultry droppings.

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