ISSN (Online) 2456 -1304

International Journal of Science, Engineering and Management (IJSEM)
Vol 3, Issue 4, April 2018

Effect Size Reduction on Parameters Affecting Anaerobic Biodegradability in High Organic Biomass

[1] B.Vignesh, [2] J.Rajesh Banu, [3] R.Yukesh Kannah, [4] S.Adish Kumar
[1][2][3] Department of Civil Engineering, Regional Campus Anna University, Tirunelveli, Tamil Nadu, India.
[4] Department of Civil Engineering,University VOC College of Engineering Anna University Thoothukudi.

Abstract:- **Bio-energy seems to be the most probable solution to the replace conventional energy to save our natural resources and our environment. In India, many water bodies have been damaged because of the excessive growth of aquatic weed. Aquatic waste mainly affects the water bodies, results in discoloration and leads to environmental problem such as eutrophication and creates an unpleasant odor. The Aquatic plants are considered to be a fast growing aquatic weed. These aquatic weeds require special adaptation to living habitat either submerged in water (or) at the water surface. The aim of present study is to size distribution curve graded in the form of the high organic biomass from unavoidable aquatic weed and this action impacts on disposal issue. Pretreatment of Aquatic waste is an essential tool to enhance the particle size reduction. At 6000 rpm the obtained values of SCOD, Protein, Carbohydrate released 3100, 0.673, 1.026 at optimal pretreatment time of 10 min. The effect of particle size reduction pretreatment will be carried from 6000 to 8000 rpm respectively. Therefore, based on the result, it could be concluded 6000 rpm was considered as optimal for the cumulative percentage finer (10-30%) than the sieve size (0.425mm).The results suggest that small particle size favours methane yield.**

Keywords: Aquatic weed, mechanical pretreatment, particle size reduction, size distribution curve, finer percentage.

INTRODUCTION

Biomass resources are readily accessible around the world as residual wastes and agricultural biomass. The most important and abundant renewable biomass resources include crop residues, such as corn straw, wheat straw and rice straw. China has abundant biomass resources, as it is one of the largest agriculture-based economies in the world. China produces approximately 216 million metric tons of corn straw per annum, and more than half of that remains unutilized [1]. Corn straw contains non-edible plant material so called lignocellulose and is mainly composed of cellulose, hemicellulose, and lignin [2]. Hemicellulose is present as the matrix that surrounds the cellulose skeleton, while lignin is present as an encrusting material and serves as a protective layer. All three components have covalent cross-linkages between the polysaccharides and lignin, therefore, making biomass a composite material [3].Various researchers has investigated the influence of the different waste particles on anaerobic digestion [4, 5]. It is known that the reduction of particles size and the resulting increase in their specific surface lead to increase in gas production especially in the case of digesting the substrates having high contents of slowly biodegradable materials. The effect of particle size of seven agricultural and forest residue used as feedstock for biogas generation through an- aerobic digestion were investigated in batch digesters at 37 °C. Among the five particle size (0.088, 0.40, 1.0, 6.0 and 30.0 mm), studied, maximum quantity of biogas was produced from raw materials of 0.088 and 0.40 mm particles [6].The effects of particles size of sisal waste and its degradation and biogas production potential were investigated in batch anaerobic digestion with fibre sizes ranging from 2 to 100 mm at an ambient temperature of 33 °C. The results confirmed that methane yield was inversely proportional to particle size. An increase of 23 % was observed when the fibres were cut to 2 mm size and yield 0.22 m3 CH4 /kg volatile solids, compared to 0.18 m3 CH4 /kg volatile solids for untreated fibres [7].

MATERIALS AND METHODS

Aquatic weed

The aquatic weed is a fast growing perennial aquatic plant widely distributed throughout the world [8]. This tropical plant which belongs to the family Pontederiaceae can cause infestations over large areas of water resources and consequently lead to series of problems. These include reduction of biodiversity, blockage of rivers and drainage system, depletion of dissolved oxygen, alteration on water chemistry, and involvement in environmental pollution. Several authors have tried to put an approximate figure to the economic consequences caused due to aquatic waste problem specifically on utilization of water for irrigation. The annual water loss through evapo-transpiration due to water hyacinth in Sudan would be enough to irrigate more than 400 ha of land. Aquatic weed proves to be a promising renewable source of energy in the form of biogas [9].In this study, the aquatic weed was collected from river and lakes in nearby areas. The collected sample was sundried outdoor condition. Next, the sample was manual size reduction and weed sample is stored in the refrigerator at 4°C for further study.

Pretreatment of lignocellulosic biomass

Various researchers has investigated the milling (cutting the lignocellulosic biomass into smaller pieces) is a mechanical pretreatment of the lignocellulosic biomass. The objective of a mechanical pretreatment is reduction of particle size and crystallinity. The reduction in particle size leads to an increase of available specific surface and a reduction of the degree of polymerization (DP). The energy requirements for size reduction of lignocellulosic materials depend on the final particle size and biomass characteristics. Although mechanical pretreatment methods increase cellulose reactivity towards enzymatic hydrolysis, they are unattractive due to their high energy and capital costs [10].In this study, the weed sample was manual size reduction and sample was taken into pretreatment.

Size distribution of aquatic weed biomass particle

Particle shape and particle size distribution are both important factors which could influence the physical properties of biomass materials. Due to the high content of cellulose, hemicellulose and lignin, biomass material is anisotropic in spatial structure, which induces the evident difference in mechanical property in different directions. In this work, we studied the particle size distributions of the aquatic weed biomass by sieve analysis method. The pretreated samples are dried and shaken through a set of sieves of descending size. The weight retained in each sieve is measured. The cumulative percentage quantities finer than the sieve size (passing each given sieve size) are then determined. The resulting data is presented as a distribution curve with grain size along x-axis (log scale) and percentage passing along y-axis (arithmetic scale).

RESULTS AND DISCUSSIONS

Effect of Soluble COD

The extent of pretreatment was predicted by measuring the SCOD release during the mechanical pretreatment process.rpm is the major governing factor for disperser pretreatment. The influence of rpm (6000-14000) and then treatment time (5-30mins) on SCOD release. The release of SCOD during the mechanical pretreatment was carried rotor-stator effect. During the mechanical pretreatment process, the plant biomass to be will be disintegrated was pulled axially to the dispersion head and then transferred radially in to the slits present in the rotor-stator .The greater the space and the less than gap there is between the rotor and the stator, the greater are the mechanical shear forces, which improves disintegration.

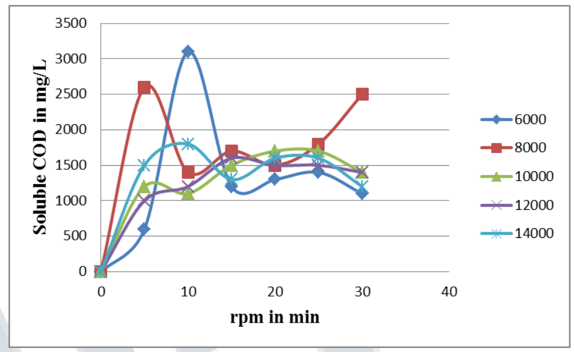

Figure 1.SCOD release of aquatic weed biomass

From the graph (Fig.1) it was found that SCOD release increases with increment in rpm up to 6000. At 6000 rpm, 3100 mg/L of SCOD release was achieved at optimal pretreatment of 10 min. The further increasing rpm, no significant increase in SCOD release was noted .Therefore based on the above discussion, it could be concluded that 10 rpm was considered as an optimal for SCOD in disperser pretreatment of aquatic weed.

Effect of protein

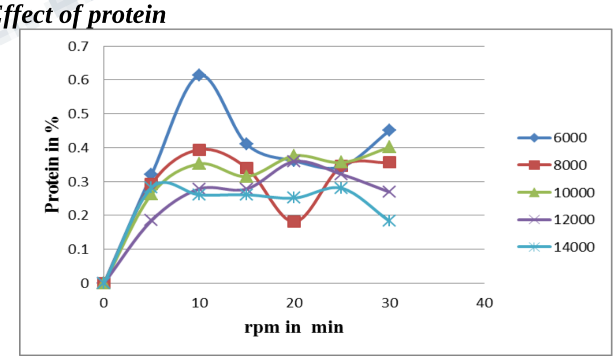

Figure 2. Protein release of aquatic weed biomass

Presence of the biopolymers protein in the medium increases the efficiency of methane generation. From the graph (Fig.2) it was found that protein increases with increment in rpm upto 6000.From the Figure 2, at 6000 rpm the obtained values for protein was observed to be 0.673 at optimal pretreatment time of 10 min, respectively. Therefore based on the above discussion, it could be concluded that 6000 rpm

ISSN (Online) 2456 -1304

International Journal of Science, Engineering and Management (IJSEM)
Vol 3, Issue 4, April 2018

was considered as optimal for protein release pretreatment of aquatic weed.

Effect of carbohydrate

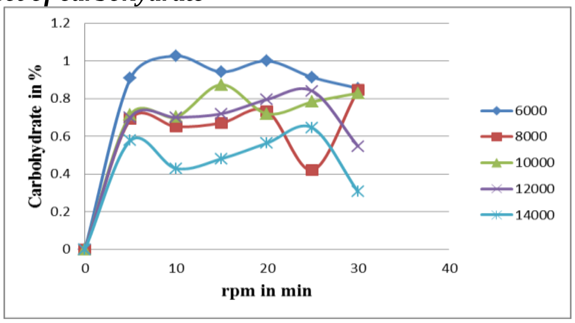

Figure 3. Carbohydrate release of aquatic weed biomass

Presence of the biopolymers carbohydrate in the medium increases the efficiency of methane generation. From the graph (Fig.3) it was found that carbohydrate increases with increment in rpm upto 6000.From the Figure.3, At 6000 rpm the obtained values for carbohydrate was observed to be 1.026 at optimal pretreatment time of 10 min, respectively. Therefore based on the above discussion, it could be concluded that 6000 rpm was considered as optimal for carborhydrate release pretreatment of aquatic weed.

Effect of temperature

When pretreatment was carried out at different temperatures and different screw speeds (6000 to 14000 rpm), maximum concentrations sCOD, Protein, Carbohydrate (3100, 0.673 and 1.026).These clearly indicated that optimization of the pretreatment process condition and enzyme concentrations had a synergetic effect on the overall yields of reducing sugars. From the graph (Fig.4),therefore based on the above discussion, it could be concluded that 6000 rpm was considered as optimal for temperature was gradually increase on pretreatment of aquatic biomass.

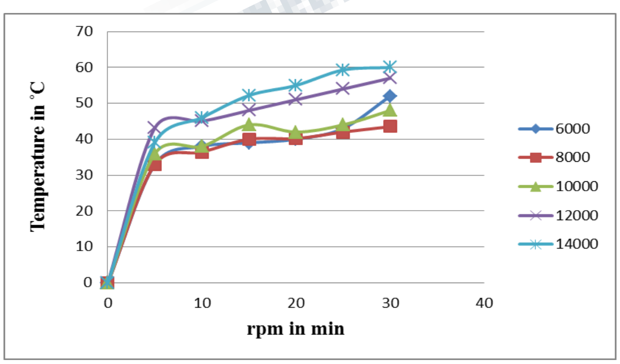

Figure 4.Temperature release of aquatic weed biomass

Effect of particle size distribution curve

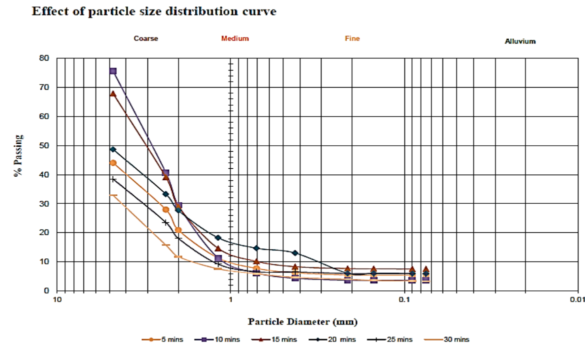

Figure 5. Particle size distribution curve for aquatic weed biomass at 6000 rpm

The effect of particle size reduction of the aquatic weed biomass in the high organic medium increases the efficiency of methane generation. From the graph (Fig.5) it was found that distribution curve with grain size and percentage passing graph plots from the pretreatment rpm 6000. At 6000 rpm the obtained values for distribution curve was observed to be gradually decreased at optimal pretreatment sieve size of 0.425 mm, respectively. Therefore based on the above discussion, it could be concluded that 6000 rpm was considered as optimal for the cumulative percentage quantities finer (10-30%) than the sieve size (0.425mm) are determine.

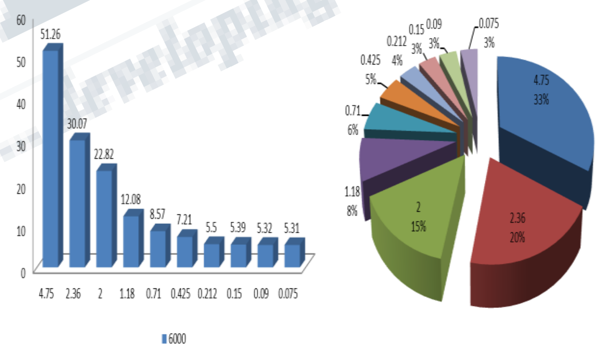

Figure 6. Effective size distribution and percentage of finer for 6000 rpm

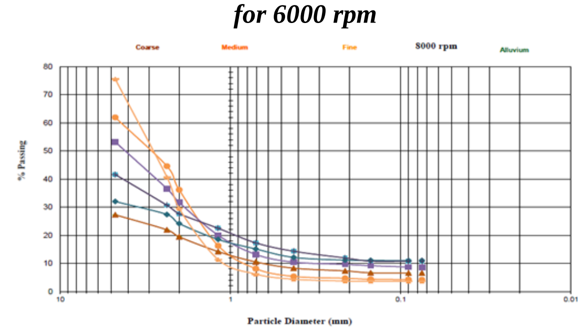

Figure 7 Particle size distribution curve for aquatic weed biomass at 8000 rpm

From the graph (Fig.7) it was found that distribution curve with grain size and percentage passing graph plots from the pretreatment rpm 8000. At 8000 rpm the obtained values for distribution curve was observed to be gradually decreased at optimal pretreatment sieve size of 0.425 mm, respectively. Therefore based on the above discussion, it could be concluded that 8000 rpm was considered as optimal for the cumulative percentage quantities finer (10-15%) than the sieve size (0.425mm) are determine.

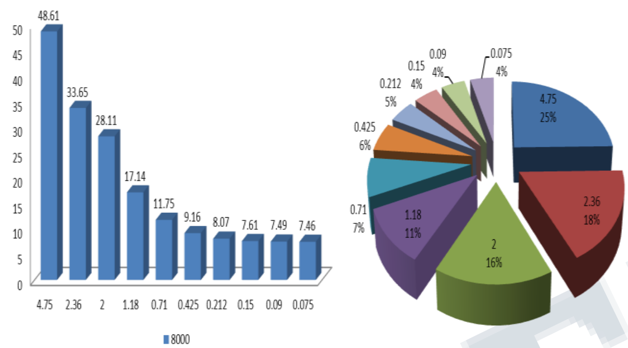

Figure 8. Effective size distribution and percentage of finer for 8000 rpm

CONCLUSION

The study has shown that large amount of particle size distribution was obtained from the grounded aquatic waste that chopped aquatic waste. The study also highlights that aquatic weed is very good biogas producer when dried and pulverized (crushed) into very fine particles (powder).Degradation of the substrate and biogas production potential of the aquatic weed could be significantly increased by pre-treatment such as reduction of particles size. These results suggest that reduction of the particles size of the substrate in conjunction with the optimized microbial growth could improve the methane yields in anaerobic digestion processes.

REFERENCES

1.Zhong W, Zhang Z, Luo Y, Sun S, Qiao W, Xiao M (2011) Effect of biological pretreatments in enhancing corn straw biogas production. Bioresour Technol 102:11177–11182.

2.Jørgensen H, Kristensen JB, Felby C (2007) Enzymatic conversion of lignocel- lulose into fermentable sugars: challenges and opportunities. Biofuels Bioprod Biorefining 1:119–134.

3.Binder JB, Raines RT (2010) Fermentable sugars by chemical hydrolysis of biomass. PNAS2010:1–6.

4.Katima, J., Production of biogas from water hyacinth: effect of subtrate concentration, particle size and incubation period. Tanzania Journal of Science, 2001. 27(1): p. 107-119.

5.Jędrczak, A. and D. Krolik, Influence of paper particle size on the efficiency of digestion process. Environment Protection Engineering, 2007. 33(2): p. 147-155.

6.Sharma, S.K., et al., Effect of particle size on biogas generation from biomass residues. Biomass, 1988. 17(4): p. 251-263.

7.Mshandete, A., et al., Effect of particle size on biogas yield from sisal fibre waste. Renewable energy, 2006. 31(14): p. 2385-2392.

8.Anushree, "Environmental challenge a vis opportunity: The case of water hyacinth". Environment International 33: 122–138. 2007.

9.Kunatsa T , Madiye L, Chikuku T, Shonhiwa C, Musademba D, "Feasibility Study of Biogas Production from Water Hyacinth", International Journal of Engineering and Technology Volume 3 No. 2, February, 2013.

10. Ghosh, P. and Ghose, T.K. "Ethanol in India: recent past and emerging future", Adv. Biochem. Eng. Biot., Vol. 85, No. 1, pp. 1-27, 2003.

11.Yasini Nalinga and Isack Legonda. "The Effect of particles size on biogas production", International Journal of Innovative Research in Technology & Science, Volume 2 No.2, March, 20016.ISSE:2321-1156.

12.Sharma, S.K., et al., Effect of particle size on biogas generation from biomass residues. Biomass, 1988. 17(4): p. 251-263.

13.Mshandete, A., et al., Effect of particle size on biogas yield from sisal fibre waste. Renewable energy, 2006. 31(14): p. 2385-2392.

14.Mshandete, A., et al., Anaerobic batch co-digestion of sisal pulp and fish wastes. Bioresource technology, 2004. 95(1): p. 19-24.

15.Chen, X., R.T. Romano, and R. Zhang, Anaerobic digestion of food wastes for biogas production. International Journal of Agricultural and Biological Engineering, 2010. 3(4): p. 61-72.

16.Moorhead, K. and R. Nordstedt, Batch anaerobic digestion of water hyacinth: effects of particle size, plant nitrogen content, and inoculum volume. Bioresource technology, 1993. 44(1): p. 71-76.

17.Kivaisi, A.K. and S. Eliapenda, Pretreatment of bagasse and coconut fibres for enhanced anaerobic degradation by rumen microorganisms. Renewable energy, 1994. 5(5): p. 791-795.

18.Nallathambi, V., Anaerobic digestion of biomass for methane production: a review. Biomass and bioenergy, 1997. 13(1): p. 83-114.

19.Kunatsa, T. and A. Mufundirwa, Biogas Production from Water Hyacinth Case of Lake Chivero Zimbabwe A review. Int J of Recent Tech and Engin, 2013. 2(2): p. 138-142.

20.Patil, J.H., M. AntonyRaj, and C. Gavimath, Study on effect of pretreatment methods on biomethanation of water hyacinth. International Journal of Adv. Biotech. and Research, 2011. 2(1): p. 143-147.

