Animal's Waste Treatment Using Biodigester

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***Abstract*—** This paper present the investigation on animal's waste treatment by using biodigester. Previously, biodigester has been used widely around the world as an alternative disposal method beside landfill that is more environmental friendly. In the awareness of environmental issue such as leachate pollution, the biodigester is capable to improve surface water and increase water resources quality. The objective of the study is to identify the effeciency of the treatment method for animal's waste using biodigester. In this study, animal's waste were collected from Zoo Negara Malaysia as sources to the biodigester. It is consisted of selected animal's waste from elephants, giraffe, zebra, rhinoceros and etc. The waste was manually screened to remove the course contaminants before be grinded to form a stable paste. Then, the stable paste were diluted and pumped into biodigester tank to be treated in few days and resulting better effluent discharged. The inffluent that had been treated through biodigester had significantly decreased the water quality parameter such as biological oxygen demands (BOD), chemical oxygen demands (COD), ammoniacal nitrogen (NH3-N) and total suspended solid (TSS) in range from 32% to 81%. This had identified that wastewater treatment from animal's waste wastewater could possible using biodigester technology. The biodigester had been proven that the method could treat the animal's inffluent efficiently for a better water quality result, competing the conventional wastewater treatment plant in reducing operational area and cost. Further study could be done for any type of animal's waste at zoo in future as an added value in order to save environment.

***Index Terms*—** Biodigester, Water Pollution, Wastewater Treatment, Animal's Waste Treatment.

I. Introduction

All over the world, animal's waste from agricultural sector and zoo had been focused in order to go for concpet of from waste to wealth. In this study, animal's waste from zoo will be as a study for implimenting biodigester technology in order to reducing pollution loads to the river [1,2]. Small size of biodigester plant had become famous option for biodigester studies [4].

According to previous research, it was possible to use biodigestion concept for water treatment and at the same time having alternative energy production [5]. Today, all over the world, biodigestor plant is the latest practices for reducing methane gases discharged in order to lowing carbon emmision [7,8].

In this study, the design of the biodigester vessel will be in tower type. Tower type design had been used in order to assura the anaerobic digestion (AD) works continously [3]. Any study had similarity findings that methane-rich biogas manufactured from the AD of animal manures had potential in controlling GHG, air pollution and reducing river water pollution [5]. Some research had succesful in comercializing methane for energy generation [9].

II. Objectives And Scope Of Study

The objectives of this research is to study the possiblity of biodigester system for the animal's waste treatment in order to reduce surface water pollution. The scope of study covered the installation of the apperentice's scale of biodigester plant, the preparation of animal's waste mixtured converting from solid forms of animal's waste into liquid forms become as an animal's wastewater forms (AWW), determining optimum AWW feeding frequency suit into biodigester vessel for evaluating methane gases production and monitoring the AWW discharged from the biodigester vessel.

III. Methodology

The complete biodigester system will be installed near to the animal's waste collection area. In this study the area located at Malaysian's Zoo Negara (MZN), nearby to the river of Sungai Kemensah for natural water supply. Animal's waste from MZN will be collected every day at around 800 kilogram a day. However only some animal's waste from selected animal will be use as to have a stable mixturing with river water untill it will became animal's wastewater (AWW). The AWW will be feeding into the biodigester vessel and leave for sometime observing the discharged water from the vessel. At the final discharged at the bottom of the vessel, the sample or treated AWW will be sampling for laboratory testing. Result will be monitored and discussed either the biodigester could possible treated the AWW.

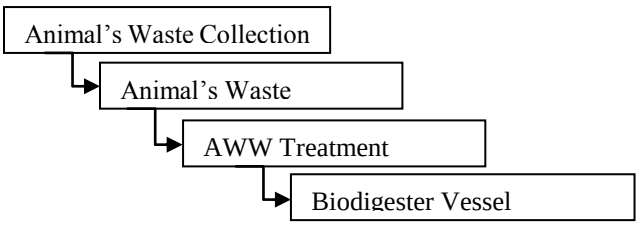

Fig.1. Block diagram of the apperentices biodigester plant.

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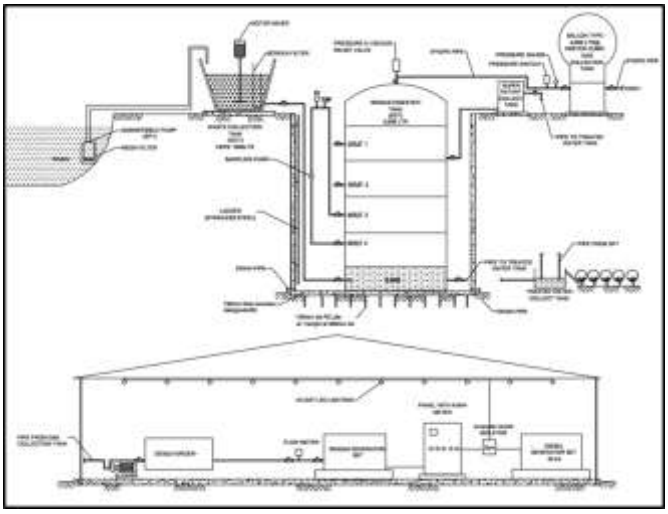

Fig.2. After the installation of apperentices biodigester plant.

IV. Results And Discussion

All research data had been measured, recorded into its performance versus date as in Fig.3(a)-(e). From the graph, the comparison between maximum readings with the final day sampling, it shows that most of the parameters had been much changes between 81.9%-99.7%. This findings lead to the possiblity of biodigester used for animal's wastewater treatment. This will help in future for reducing pollution loads into the rivers. Below are the summary of AWW treatment performance:

BOD 81.9%, COD 99.7%,TSS 96.4%, NH3N 86.1% and TP 90.6%. This mean that the biodigester vessel could treat AWW and make MWQI improvement to the river. It showed that the process of AD had been actived inside biodigester vessel. Performance of the biodigester vessel had taken from 20-50 days to performed until meet stable pH and temperature readings.

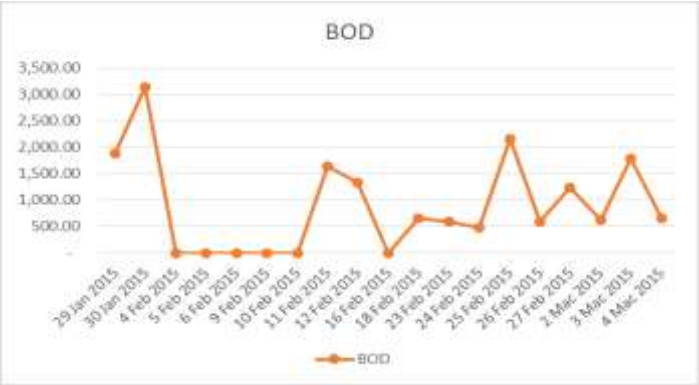

Fig.3(a). Represents animal's waste treatment performance – reduction in BOD.

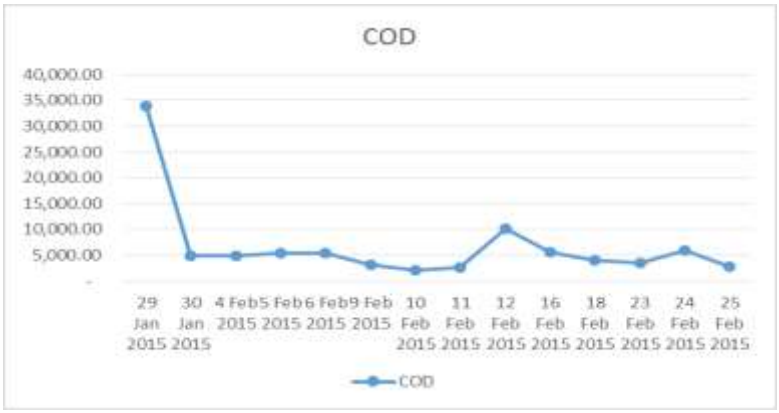

Fig.3(b). Represents animal's waste treatment performance – reduction in COD.

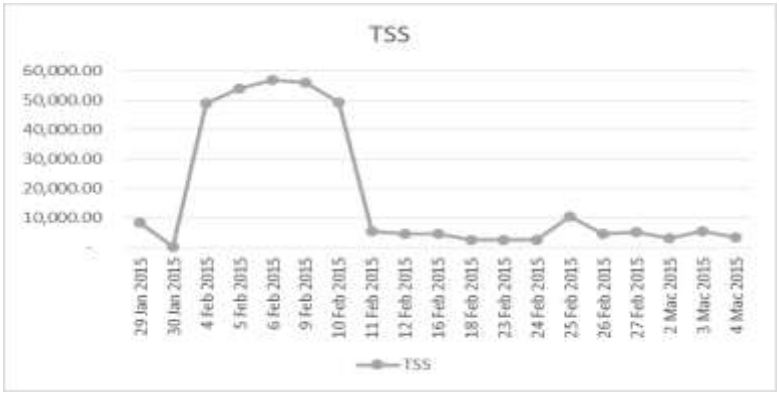

Fig.3(c). Represents animal's waste treatment performance – reduction in TSS.

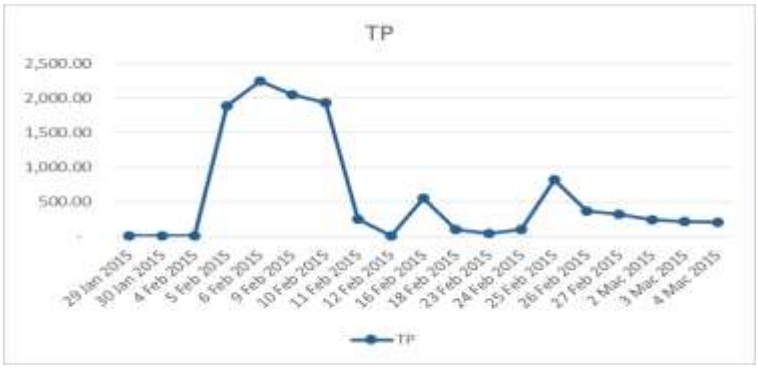

Fig.3(d). Represents animal's waste treatment performance – reduction in TP.

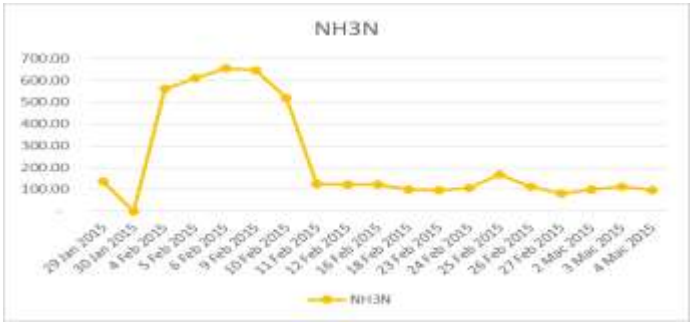

Fig.3(e). Represents animal's waste treatment performance – reduction in NH_3N.

V. CONCLUSION

After observation at the site for over the past three months (Dec 2014 - Feb 2015), some improvements could be made in terms of technical and mixing process. Firstly, AWW should be supplied regularly to ensure that the bacteria have nutrients (food source) that are sufficient to continue to function and live. Using a new clean (fresh) AWW for every unclean mix for a long time and are exposed to the environment will decompose thus reducing the quality of the biodigester system. The optimum conditions the whole process needs to be maintained to avoid the risk of death anaerobic bacteria that can cause subsequent inhibition of biogas production failure.

Using the mixing ratio of 1:3, to avoid anaerobic digestion mixture from becoming too thick that complicate the process of decomposition by bacteria and also too mild to be caused insufficient nutrient content. The ratio factor affecting the readings C/N ratio and the F/M ratio in the bio digester tank. During the process, the mixture is made for every 500 L of water to ensure the avoidance of difficulties mixture while mixing thoroughly.

Continuous monitoring of pH and temperature parameters to ensure the optimum conditions for the bio digester tank for the production of biogas and anaerobic processes occur. Identified optimum temperature between 45 - 60^{0}C, and pH from 6-8. Addition of "crusher" for a bio digester that requires the destruction of organic material to be more easily digested by microorganisms.

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REFERENCES

[1] Arini Wrestaa, Dian Andriania, Aep Saepudina, Henny Sudibyoa (2015). Economic Analysis of Cow Manure Biogas as Energy Source for Electricity Power Generation in Small Scale Ranch, Elsevier Ltd., Energy Procedia 68 (2015). [Online] pp.122–131. Available: http://www.sciencedirect.com/science/article/pii/S1876610215005469

[2] Environmental Quality Report 2015, Department of Environment, Malaysia.[Online] Available: https://enviro.doe.gov.my/ekmc/digital-content/environmental-quality-report-2015/

[3] F. Cotanaa, L. Pellicciaa, A. Petrozzia,*, V. Cocciaa, G. Cavalaglioa (2015). Multifunctional Environmental Energy Tower: A Case Study Of An Innovative System For Renewable Energy Exploitation, Elsevier Ltd., Energy Procedia 81 (2015). [Online] pp. 1222 – 1230 Available: http://www.sciencedirect.com/science/article/pii/S1876610215030143 https://doi.org/10.1016/j.egypro.2015.12.333

[4] Jyothilakshmi R., S.V.Prakash (2016). Design, Fabrication and Experimentation of a Small Scale Anaerobic Biodigester for Domestic Biodegradable Solid Waste with Energy Recovery and Sizing Calculation, Elsevier Ltd., Procedia Environmental Sciences 35 (2016).[Online] pp.749-755. Available: http://www.sciencedirect.com/science/article/pii/S1878029616301748

[5] K. Thomas Klasson and Nhuan (John) P. Nghiem (2003). Energy Production from Zoo Animal Wastes.[Online] Available: http://web.ornl.gov/~webworks/cppr/y2001/rpt/116441.pdf

[6] Methane Recovery from Animal Manures The Current Opportunities Casebook(1998). National Renewable Energy Laboratory. [Online] Available: http://www.nrel.gov/docs/fy99osti/25145.pdf

[7] National Climate Change Policy (2009). Ministry of Natural Resources and Environment, Malaysia. [Online] Available:http://www.nre.gov.my/ms my/PustakaMedia/Penerbitan/Dasar%20Perubahan%20Iklim%20Negara.pdf

[8] National Policy on Environment (2002). Department of Environment, Malaysia.[Online] Available: https://www.doe.gov.my/portalv1/wp-content/uploads/2013/01/dasar_alam_sekitar_negara.pdf

[9] Puttipong Chunarka, Bundit Limmeechokchaia (2015). Energy Saving Potential and CO2 Mitigation Assessment Using the Asia-Pacific Integrated Model/Enduse in Thailand Energy Sectors, Elsevier Ltd., Energy Procedia 79 (2015). [Online] pp.871–878. Available: http://www.sciencedirect.com/science/article/pii/S1876610215023127

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