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Thermal Drying of Malaysian Sewage Sludge

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Abstract –*Sewage sludge or biosolids is a type of solid waste that has been left after wastewater is treated in a domestic wastewater treatment facility. The most common way of sludge disposal is to dispose them on the land, sea or air. However, these methods are not environmentally-friendly, costly and time consuming, which requires expertise and knowledge. An ideal way to manage sewage sludge is to convert the sludge into energy. Conversion of this waste material into solid fuel can be an effective solution, as it does not only contribute as an energy source, but also solves environmental issues related to sewage sludge disposal. The main problem for sewage sludge is the high moisture content, which is higher than 80%. In order to convert the waste into useful energy, the moisture content of the sludge needs to reduce to an acceptable level. The aim of this study is to develop a horizontal indirect dryer that can be effectively used to dry sewage sludge and convert it into solid fuel in briquette form. A new design of thermal dryer was developed, which could dry a huge volume of sludge in a short time with less energy consumption. In this study, 240kW, 200kW, 160kW, 120kW and 80 kW of power provided by the burner were used to investigate the effect of heat on the final moisture content of sewage sludge. The results show that the burner must provide more than 200kW of power in order to dry the sewage sludge to less than 20% of moisture content.* ***Copyright © 2014 Penerbit Akademia Baru - All rights reserved.***

Keywords: Thermal drying, Sewage sludge, Moisture content, Energy

1.0 INTRODUCTION

The development, economic growth and industrial sector require energy to operate. Most of the energy is generated by fossil fuels such as natural gas, petroleum and coal. However, the available fossil fuels are depleting rapidly due to the high consumption of fossil fuel [1]. Besides that, emission from the combustion of fossil fuel has led to environmental problems such as acid rain and the greenhouse effect [2]. Therefore, many researchers try to explore new sources of energy that can reduce the dependency on fossil fuel and sustain the energy sources, as well as environmental friendly [3-5]. Presently, renewable energy from municipal solid wastes and wastewater effluents has become an interest among researchers as this waste has a high potential to be converted into energy and reduce hazardous emission compared to fossil fuel [6].

The amount of wastewater that enters the wastewater treatment plants in Malaysia was estimated at 4.9 million cubic meters in 2007 [7]. Recently, Malaysia produced approximately 3 million cubic meters per annum of sewage sludge in wastewater treatment plants, with the annual management and treatment cost of about RM 1 billion [8]. The production of sewage sludge is expected to increase rapidly, which is about 7 million cubic meters in 2020 [9]. Products from wastewater treatment plants are hardly accepted for agricultural use due to the presence of harmful pathogen and also high moisture content. In addition, high content of heavy metal in treating sewage sludge may retard the use of sewage sludge for agricultural

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sector without additional treatment [10]. In this study, the potential of sewage sludge for the conversion into energy was determined to obtain sustainable development for energy production. Sewage sludge contains heavy metal zinc (Zn), copper (Cu), nickel (Ni), cadmium (Cd), lead (Pb), mercury (Hg) and chromium (Cr) that can affect human health, as well as the environment due to the potential to accumulate in human tissues and biomagnification through food chain [11].

Converting these wastes into useful energy is one of the ideal solutions to overcome this problem. The process does not only solve the sewage sludge disposal problem, but also create energy sources. As mentioned previously, the main problem in converting sewage sludge into energy is the high moisture content, which is more than 80% of moisture [12]. In the current practice, conventional oven dryer is used to dry sewage sludge. However, this dryer requires high energy consumption, as well as takes longer time. In order to dry millions tons of sludge, a new design and drying concept of the dryer is required in order to dry sludge to an acceptable level, which is less than 20%.

2.0 METHODOLOGY

A sample of sewage sludge was obtained from a local wastewater treatment plant in Kuala Lumpur according to the standard method of ASTM D346-90. The sources of the sample are mainly from municipal and industrial wastes. The sample of sewage sludge was dried thoroughly in a process to determine the initial moisture content of the sludge. The initial moisture content of the sample was 87%. The sewage sludge was subjected to thermal drying to reduce the moisture content to an acceptable level, which is less than 20%. A screw conveyor in the feeder transported the wet sewage sludge into a dryer continuously, whereas a screw conveyor in the dryer transported the sewage sludge into an outlet. A burner provided heat to vaporize moisture in sewage sludge indirectly.

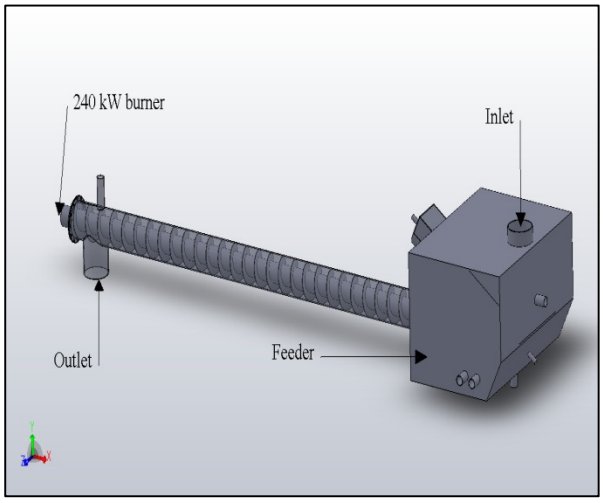

Figure 1: Schematic for the thermal dryer

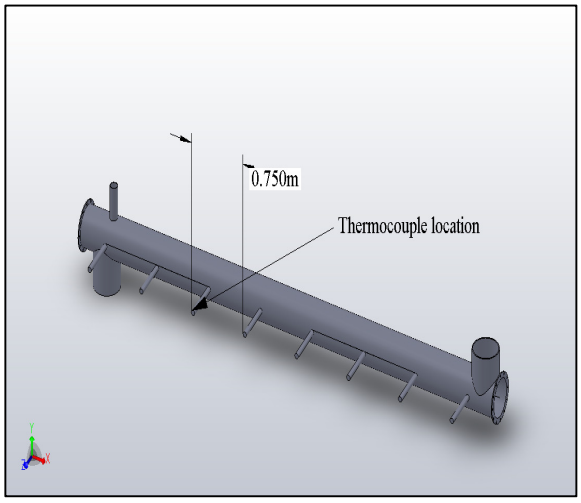

Figure 2: Thermocouple location

A full schematic of the thermal dryer is presented in Figure 1. In order to investigate the effect of heat on the final moisture content of sewage sludge, the thermal dryer was subjected to 240kW, 200kW, 160kW, 120kW and 80 kW of power that was provided by the burner.

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3.0 RESULTS AND DISCUSSION

Various power of burner were used to investigate the effect of temperature on the final moisture content of sewage sludge. It was found that the heating value of sewage sludge was influenced by temperature as the power of burner increased. A detailed result is presented in Table 1 and Table 2.

Table 1: Moisture content of sewage sludge with different power of burner.

Power (kW)	Moisture content (weight %)
240	15
200	19
160	24
120	31
80	35

Table 2: Heating value of sewage sludge with different power of burner.

Power (kW)	Heating value (MJ/kg)
240	8.6
200	9.7
160	11.2
120	13.4
80	15.2

An acceptable moisture content of sewage sludge could be obtained by using 240kW and 200kW to power the burner, with less than 20% of moisture content. In order to convert the sewage sludge into energy, the moisture content of sewage sludge must be lower than 20% to avoid low quality combustion. Therefore, the power of the burner that to dry the sewage sludge using the proposed thermal dryer must be more than 200kW in order to obtain dried sewage sludge with less than 20% of moisture content.

4.0 CONCLUSION

The power required to reduce the moisture content of sewage sludge to an acceptable level using the proposed thermal dryer must be above 200kW. The proposed thermal dryer can dry a lot of sewage sludge in Malaysia per batch and consume less time compared to the oven dryer from the previous researcher. Analysis on the characterization of sewage sludge should be done since there no analysis has been done yet on sewage sludge that is dried using thermal dryer.

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