Small Scale Pilot Plant Thermal Dryer for Sewage Sludge Dewatering System – A Preliminary Study

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Introduction

- Recently, the Malaysian produced approximately 3 million cubic meters per annum of sewage sludge in waste water treatment plants with annual management and treatment cost about RM 1 billion [1].

- Usually sludge from the treatment plant may be used in agricultural land, forest and landfill or in provided disposal sites [2,3].

- This method has no more interested since the production of sewage sludge rapidly increasing while most of the landfill has been closed since reaches its capacity.
• According the previous work by Abbas et al [4], Malaysian domestic sewage sludge has potential to convert into energy as it has a high heating value which is being predicted to be between 14 MJ/Kg to 16 MJ/Kg using proximate and ultimate analysis.

• Based on the characteristic of sewage sludge with high heating value and lower contents of sulfur and ash, Malaysian sewage sludge has high potential of being converted into solid fuel for energy generation purpose.

• Based on the literature survey reviewed, there is no such effort carried out on design and develop the efficient dryer for sewage sludge in Malaysia. The conventional drying method applicable on research purpose only but not in practise for conversion into energy since required high energy, required larger space and takes time to dry the sludge.
Methodology

- The sample of sewage sludge was obtained from the sewage treatment plant in Bunus and the initial moisture content of the sewage sludge was recorded.

- The schematic of thermal dryer as shown in Fig. 1 and Fig. 2. This dryer has 6 meter lengths and connected to the light oil burner in order to supply heat to evaporate the water from sewage sludge.

- The feeder will bring the wet sewage sludge into the inlet of the dryer by using screwfeeder. As the sludge enters the dryer, the screw feeder in the dryer will bring the sludge to the outlet while the burner provides the heat to the screw feeder.

- The sample of dried sewage sludge was taken in order to investigate the moisture content and calorific value. The moisture content of sewage sludge measured by taking the sample and fully dried using an oven at 105°C for 10 hours and measure the weight.
Fig. 1 Schematic of thermal dryer

Fig. 2 Full schematic of thermal dryer
The different of weight percentage is the moisture content of the sludge. The heating value of sludge was obtained by using Bomb Calorimeter accordance to ASTM D2015.

The screwfeeder maintain at constant speed of 10 rpm and 10 pieces of K-type thermocouple were placed along the dryer with same distance and connected to the data logger.
Results and Discussion

- The schematic of temperature profile along the insulated dryer and non insulated dryer as presented in Fig.3 and Fig.4.

- The total energy consumption by the dryer in term of electricity and diesel within an hour for both dryer were recorded as well for comparing the total energy consumed with total energy produced by both dryer.

- Details result for both dryers as presented in Table 1.
Table 1. Result for insulation dryer and without insulation dryer

<table>
<thead>
<tr>
<th>Parameters</th>
<th>With Insulation</th>
<th>Without Insulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial moisture content (wt %)</td>
<td>89.45</td>
<td>89.45</td>
</tr>
<tr>
<td>Final moisture content (wt %)</td>
<td>17.94</td>
<td>19.76</td>
</tr>
<tr>
<td>Total energy consumed per hour (MJ/h)</td>
<td>392.39</td>
<td>392.39</td>
</tr>
<tr>
<td>Total energy produced per hour (MJ/h)</td>
<td>927.86</td>
<td>1019.63</td>
</tr>
<tr>
<td>Production rate (kg/h)</td>
<td>63.32</td>
<td>69.58</td>
</tr>
</tbody>
</table>
• The moisture content of the sewage sludge after drying process for insulated dryer, lower than non insulated dryer.

• The insulated dryer has high efficiency compared to the non insulated dryer since consumed same energy for drying process but difference in final moisture content.

• The moisture content after drying process for both dryer are acceptable for conversion into energy since less than 20% of moisture content.
Conclusion

- The moisture content of sewage sludge after drying process for both dryer was successfully reduced into acceptable level for conversion into energy which is less than 20% of moisture content.

- This experiment proves that insulated dryer has high efficiency compared to the non insulated dryer.

- This thermal dryer also produced higher amount of dried sludge in a short time compared to the conventional oven dryer.

- The energy required for the dryer much more less compared to the energy produced makes this dryer is applicable to use for sewage sludge dewatering.
References


