From Total Suspended Solid to Energy: Potential Energy Recovery for Fecal Treatment Plan in Jakarta

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Abstract. One type of domestic waste that needs to be treated is explicitly in the form of fecal sludge. The sludge needs to be taken into account because it can become an environmental problem if landfills only treat it. This study aimed to determine the energy potential of the mass balance for the total suspended solids (TSS)parameter. This study uses secondary data by measuring the mass balance on the TSS parameter. At the sametime, mathematical equations do the calculation of potential energy. The TSS allowance in the study area was94.9% (n = 12). Where the ANOVA test significantly changed at the inlet and outlet. The average TSS at the inlet reached 2869.1 mg/L while it was 49.5 mg/L at the outlet. The resulting fecal sludge can reach 1268.82 tons/day. With this generation, at least the energy that can be recovered is 14083985.25 MJ/day.

Keywords: TSS, Fecal, Energy, Recovery

1 Introduction

Domestic wastewater can cause environmental damage if it is not treated properly because it contains several organic materials and pathogenic bacteria [1][2][3]. One type of household waste that needs to be treated is explicitly in the form of fecal sludge [4]. The sludge needs to be considered because it can become an environmental problem if it is only treated by landfill. Therefore, sludge treatment is carried out on a local system centered on the IPLT (Sludge Treatment Plant). Wastewater quality standards are made to preserve the ecosystem of water bodies in Indonesia by maintaining wastewater discharges quality [5][6]. Parameters of concern in the regulation include pH and TSS. The concentration of solids in fecal sludge comes from various organic (volatile solid) and inorganic (fixed solidly) materials in the form of floating, settled, colloidal, and suspended matter [7]. The parameters needed to measure the solids contained in thesewage sludge consist of

ICONIC-RS 2022, March 31-April 01, DKI Jakarta, Indonesia

DOI 10.4108/eai.31-3-2022.2320685

total solids (TS), total suspended solids (TSS), and total volatile solids (TVS). The physical parameter to determine the content of organic and inorganic materials from liquid waste is to measure the value of the TSS content. Suspended solids or TSS are all solid substances or particles suspended in waterand can be in the form of living (biotic) components such as phytoplankton, zooplankton, bacteria, fungi, or dead (abiotic) components such as detritus and inorganic particles (sand, mud, and clay). Suspended solids arewhere heterogeneous chemical reactions occur and function as the earliest sediment-forming material and canhinder the ability to produce organic substances in waters [8].

The need for environmentally friendly fuel for household and industrial purposes is increasing. Fuel oil and gas availability and the price continue to rise, production and distribution are often constrained. Fuel has become a major need for society to drive the nation's economy. Apart from being used for daily household needs, fuel is also a source of energy to drive production machines for small and medium industries. Fuel is a necessary raw material for production in industry, small and medium enterprises, and households. The increasein fuel will be an economic pressure for them. Using the 3R (Reuse, Reduce, Recycle) waste handling technique is highly recommended. The waste to energy process is a process that undergoes grinding treatment, mixing raw materials, molding, and drying under certain conditions, to obtain briquettes with certain shapes, physicalsizes, and chemical properties [9][10][11]. This study aimed to determine the energy potential for the total suspended solids (TSS) parameter.

2 Method

Sludge treatment has a higher load when compared to domestic wastewater in general. The quality standard of sewage sludge treatment needs to be distinguished from domestic wastewater because the sewage sludge has a more concentrated sludge content, so it has different characteristics. It tests water quality from the IPLT treatment every two times a month on Wednesdays. However, several parameters still do not meet the quality standards. Here are the sampling data at the inlet and outlet of Duri Kosambi IPLT. TSS was determined using the gravimetric method.

3 Result and discussion

The initial TSS value of domestic waste was 3236.8 mg/L, down to 28.7 mg/L on average (Figure 1). The TSSvalue affects the anaerobic waste treatment process. Complex organic matter is hydrolyzed into simple organics (organic acids) [12]. In this non-methanogenic phase, the TSS value will decrease, and the TDS value will increase because large organic materials are converted into smaller sizes (degradation process).In the methanogenic phase, organic acids are converted into carbon dioxide (CO_2) and methane (CH_4) [13][14].

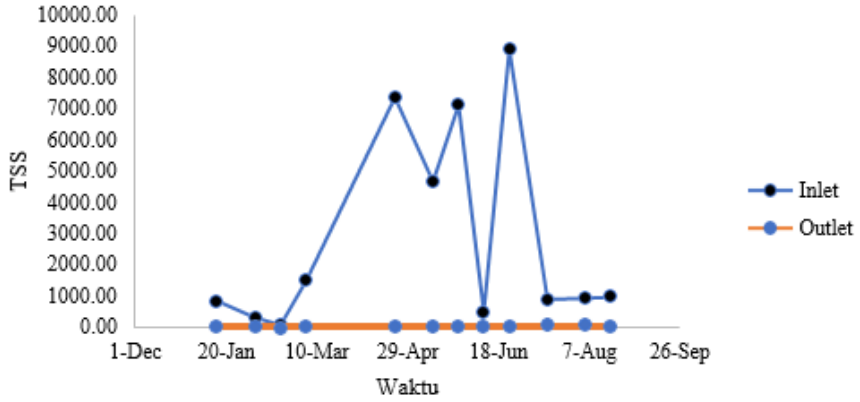

Fig. 1. Measurement of TSS at the inlet and outlet of IPLT.

Figure 1 shows the results of the TSS test during observation, the decrease in TSS before the type of waste input influences processing to the IPLT. The decrease in TSS scores reached an average of 94.9%. High levelsof TSS can cause a reduction in dissolved oxygen levels. In the surface layer, oxygen levels will be higher due to diffusion between water and free air and the process of photosynthesis. Therefore, there will be a decrease in dissolved oxygen levels with increasing depth. As a result, the photosynthesis process decreases, and the oxygen content is widely used for respiration and oxidation of organic and inorganic materials [15].

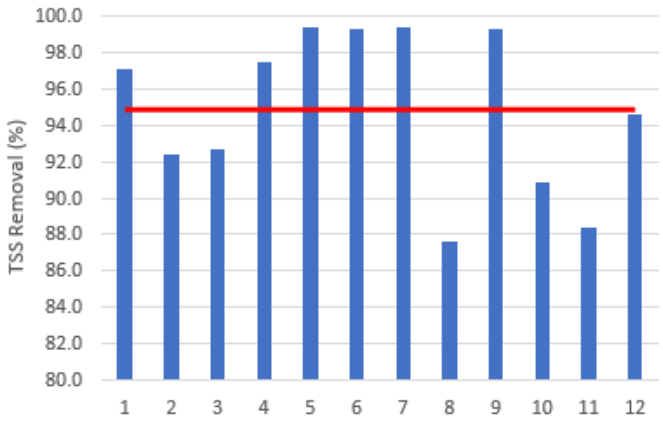

Fig. 2. The efficiency of TSS Provision in IPLT.

ANOVA was used to compare the mean of the two populations of samples of TSS concentrations at the IPLTinlet and outlet. Table 1 shows the results of the inlet and outlet TSS values significantly different.

Table 1. Inlet and outlet ANOVA test results.

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	47701428.9	1.0	47701428.9	9.106	0.006
Within Groups	115251816.6	22.0	5238718.9		
Total	162953245.5	23.0			

From the characteristics, uses, and shape, the slurry briquettes produced at Duri Kosambi IPLT can be compared with Refuse Derived Fuel (RDF). RDF is used as an ingredient in the fuel for the cement industry. Generally, the raw material for RDF is domestic waste, which is also one of the problems in Indonesia. Compared to coal, RDF based on domestic waste has a lower sulfur content but a higher chlorine content [16]. High calorific value comes from plastic, paper, and cardboard. Sludge briquettes have the potential to be used as fuel for furnaces and industry, but they need to be considered in terms of health and public perception [17]. A bomb calorimeter is used to measure the amount of heat (calorific value) released during complete combustion. In the measurement of the Sludgesample, the calorific value of the Sludgeis 11.1 MJ/kg. So theoretically, the potential calorific value produced in the IPLT can reach 14083985.3 MJ/day (Table 2).

Table 2. Potential theoretical calorific value.

Parameter	Value	Unit
Inlet mean TSS concentration	2869.1425	mg/L
Outlet mean TSS concentration	49.526	mg/L
Sludge average TSS concentration	2819.61667	mg/L
Sludge density	2.81961667	kg/m^3
Sludgetime	1268.8275	ton/day
The calorific value of mud	11.1	MJ/kg
Potential calorific value	14083985.3	MJ/day

4 Conclusion

TSS inlet from IPLT reached 3236.8 mg/L decreased to 28.7 mg/L at an outlet in 12 observations. The efficiency of reducing the TSS value earned an average of 94.9%. The measurement of the mud sample obtained the calorific value of the mud is 11.1 MJ/kg. So that theoretically, the potential calorific value produced in the IPLT can reach 14083985.3 MJ/day.

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