The potential of methane gas production at Klotok Landfill Kediri City

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Abstract. This research aimed to determine CH$_4$ levels and its potential of usage in Klotok Landfill Kediri City. The measurement of CH$_4$ was performed at six points, three points at Klotok I and Klotok II Landfill in each cell. CH$_4$ was measured using portable gas detector with the MQ-04 type of gas sensor. The measurement of CH$_4$ was performed in seven times of observation in the morning and in the evening. The average of CH$_4$ levels at Klotok I Landfill were (1.8±0.71); (62.46±3.19); and (3.07±2.65) % Vol, respectively. The highest CH$_4$ levels at Klotok I Landfill was in Cell 2, which was almost similar to Klotok II Landfill. The CH$_4$ levels in each measurement points in the Klotok II Landfill were (63.21±2.61); (62.46±4.70); and (19.76±17) % Vol, respectively. The highest CH$_4$ levels at Klotok II Landfill was in Point 1. The CH$_4$ levels were affected by environmental condition in terms of soil temperature, soil moisture, and pH of soil, etc; the existence of methanogenic microorganisms, and the composition of waste in the landfill. A high CH$_4$ levels at Klotok Landfill Kediri City can be utilized as an alternative fuel for renewable energy source appropriate with the concept of green technology.

1. Introduction

CH$_4$ is one of the greenhouse gases that are 20 to 30 times stronger than CO$_2$ gas that causes global warming [1]. It is capable of absorbing and passing the radiation of the sun (shortwave) as well as reflecting the long wave radiation emitted on the surface of the earth; this results in an increase in temperature [2]. CH$_4$ is proven to be very hazardous if a landfill is not equipped with gas management facilities. Explosions in landfills may occur due to the chemical reaction between the air and CH$_4$ emitted by the waste. Those large tonnages of waste do not have a proper ventilation, causing the CH$_4$ gas to be trapped inside and keep increasing in volume as the gas becomes trapped and the volume continues to increase along with the garbage that keeps piling up. When large volumes of gas are in contact with the air, a flame will appear, followed by explosion [3][4].

CH$_4$ is one of the biogases that can be used as both fuel and alternative energy sources. It serves as an alternative energy sources for electric power generator, heat generator, and LPG gas that is widely utilized for domestic purposes. Burning 1 cubic foot (0.028 m$^3$) of biogas produces heat energy of 10 Btu (2.25 kcal). This is equivalent to 6 kWh / m$^3$ electrical energy or 0.61 l of gasoline; 0.58 l kerosene; 0.55 l diesel; 0.45 LPG (Natural Gas); 1.50 kg firewood; and 0.79 l bio ethanol [5].

On average, every ton of solid waste generates 50 kg of CH$_4$ gas [2]. The waste that piled up in Klotok Landfill of Kediri City in 2014 reached 242.4 tons/day. This indicates that by 2014, 12,120 kg of CH$_4$ gas had been emitted by Klotok Landfill [6]. If not properly managed, the gas may possess a potential hazard to human health and environmental sustainability.