Analysis Of Waste Thermal Energy From Banana Peels Using Decomposition Process For Heat Generation

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Abstract—**Decomposition of biomass due to bacterial activity results in the release of energy and warming of the mass. Therefore, the heat produced from the decomposition can be exploited effectively through a construction of a heat exchanger system. The working principle for this system is similar to that of ground source heat pumps. However, the system uses heat released from decaying biomass instead of geothermal heat from the ground. The main objective of this experimental work is to evaluate the potential of designing a heat pump system utilising the heat recovered from banana peels as a source of energy.**

The heat exchanger system consists of pipes with a circulating medium (water) running through the piles of decaying biomass to extract heat released during the decomposition process. A heat pump could also be applied to the heat exchanger to increase its efficiency. The amount of energy extracted from the system is given by the temperature difference of circulating medium between the inlet and outlet pipe of the system.

This system will analyse and evaluate the dependence of heat release rate on temperature. Results obtained during experimental testing are presented and discussed here. The rate of heat extraction from the compost will be determined and analysed throughout the system.

Heat exchanger system constructed from banana peels managed to secure an estimated amount of 3 to 4 watt heat power per kilogram dry matter.

Keywords- Biomass; decomposition; geothermal heat pump; heat exchanger

I. INTRODUCTION

Decomposition is a natural process of disintegrating organic material into smaller pieces of compost and being returned to the earth as soil. It is natural because it happens to all organic material on the earth based on the biological cycle. In general, there are two types of decomposition which are aerobic decomposition and anaerobic decomposition [6]. Aerobic decomposition involves organic material that is allowed to decay with the presence of oxygen whereas anaerobic decomposition involves the decomposition of organic material without oxygen. This decomposition will result in the release of energy and heat will be rejected from the decaying body.

The principle application of a geothermal heat pump is the utilization of heat produced under the ground with its cold upper surface. Similarly, another system can be built on the exact principle utilizing the heat released from a decaying biomass.

According to Di Maria and his co-workers, water, carbon dioxide and heat are the main by-product produced during the aerobic decomposition of the organic substances and this process can be known as oxidation process [3]. The heat produced during the oxidation process is able to increase the temperature of the organic substance and this temperature should be maintained within the range of 55°C to 65°C. This is in fact to make sure the bacteria inside the organic substance will keep doing their decomposition job under the most suitable temperature condition. Bacteria could be destroyed if the temperature is too high. Therefore, excessive heat produced inside the organic substance should be discharged to the environment or else, the decomposition process will be inhibited.

Intensive microbial activities were discovered as there is a significant peak oxygen consumption rate in the first week of the compost. After that, the oxygen consumption rate reduced to lower stage. In the Bonferroni test, the cumulative oxygen uptake increased extensively as the moisture content increased from 30% to 60%. It was also found that at temperature 43°C, the compost have the highest cumulative oxygen consumption [4].

Liang pointed out that the minimum requirement of moisture content to enhance the microbial activity rapidly is around 50% but 60-70% of moisture content would give the maximum activities [4]. It was also found that higher moisture content allows higher microbial activities with moisture content ranged from 30% to 60%. Apart from that, by

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