Estimation of Moisture Content of Oil Palm Fronds through Correlation with Density for the Process of Gasification

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In the gasification process, one prominent factor that affects the quality of the resulting syngas is the moisture content of the biomass feedstock. Determining the moisture content of a feedstock is considered to be one of the challenges of the process. The information about moisture content of a feedstock is required to decide the need for further drying prior to the gasification process. In this study, a novel method was developed for the evaluation of the moisture content from density of oil palm fronds (OPF) in a sufficiently accurate manner for gasification process. A total of 147 samples from different sections of freshly pruned fronds were prepared. The density of each of the samples was determined from its weight and volume. A fine sand displacement method, using fine sand and a graduated cylinder, determined the volume of OPF. The moisture content of the OPF was determined from the weight difference of the samples before and after the drying process. The experiment implied a good correlation between moisture content and density of the biomass, in which the square of the correlation coefficient (R^2) value was found to be satisfactory.

Keywords: Moisture content; Density; Oil palm frond; Biomass; Drying

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INTRODUCTION

One of the prominent factors that affects the process of gasification is the moisture content of the feedstock. The problem is worse in coastal areas, where all the seasons have higher humidity, making it difficult to reduce the moisture content of the feedstock through natural drying processes. Moisture removal during gasification drains much of the deliverable energy in the gasification process (Dong *et al.* 2010). When the biomass is burned, part of the energy released is consumed in the conversion process of water into steam. As a result, if the biomass has a lower moisture content, then the energy available in it will generate more heat, which would enhance the efficiency of gasification (Rosillo-Calle *et al*. 2012; Kumar *et al*. 2014). Therefore, determining the feedstock moisture content and reducing it to the required level are considered as essential steps in the preparation of biomass feedstock for the gasification process.

In biomass, moisture can exist in two forms. The first form is as a free mass that resides outside the cell wall, whereas the second form is an inherent type, such that the water resides inside the cell walls (Simpson 1998; Basu 2010). The most common biomass moisture content evaluation technique, which is used for research and industrial application purpose, is the oven drying technique (Stahl *et al.* 2003). There are also various protocols