UNIVERSITI TEKNOLOGI MARA

MIXING EFFECT OF FOOD WASTE AND EMPTY FRUIT BUNCHES (EFB) ON THE BIOGAS PRODUCTION FROM ANAEROBIC CO-DIGESTION

MUHAMAD ARIFF BIN AMIR HAMZAH

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ABSTRACT

Anaerobic digestion is a biochemical conversion process which utilizes biomass such as food waste and agricultural wastes, and converts them into biogas, a mixture of methane gas (CH_4) and carbon dioxide (CO_2), under the absence of oxygen. This process, although possess a good potential for renewable and sustainable energy generation, is sensitive and highly dependent on the biomass feedstock used, as well as the operating conditions. Hence, in this research, anaerobic digestion experiments were conducted under different feedstock conditions and operating conditions, to determine its effect on the overall biogas productivity. The two main feedstocks used were food waste and empty fruit bunches (EFB), an agricultural waste from palm oil, and were subjected to characterization to determine whether its compositions were favourable to be used in anaerobic digestion. Once characterized, the two feedstocks were mixed at seven different mixing ratios, known as anaerobic co-digestion, to determine the effect of co-digestion on the biogas production. In addition to co-digestion, rice husk biochar adsorbent was added into the anaerobic co-digestion process as a supplementary material, to determine the effect of biochar addition on the biogas production. To further investigate the effect of co-digestion, Response Surface Methodology (RSM) was used to develop a mathematical model which best described the effect of co-digestion on the biogas production. Characterization of the feedstocks in terms of elemental analysis, food waste nutrients analysis, and EFB lignocellulosic analysis determined that the two feedstocks were suitable to be used for anaerobic digestion. When the two feedstocks were mixed under co-digestion, an increment in biogas production, 51%-154%, compared to single feedstock digestion, was recorded. When biochar was added into the co-digested mixture, a further 6.7% increment in biogas production was recorded. From the RSM analysis based on effect of co-digestion, a base-log ($\log_{10}$) transformed model was developed with high accuracy, R^2 value of 0.9682, in which both food waste and EFB weights, and their combined weight ratios, were found to be significant factors in determining the overall biogas production.

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