Synthesis and Characterization of A Novel Mixed Matrix Membrane for CO_2 Removal from Biogas

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Abstrak

The biggest challenge in 21st century is to provide clean energy without affecting the environment. Biomass is one of the promising candidates as a power source solution for the future world energy problem. On the other hands, there are a lot of agricultural activities in Indonesia include the animal manures as a part sub sector of agriculture and one of the source for biomass. Anaerobic digestion (AD) is a natural process that utilizes methanogenic bacteria in an oxygen-limited environment to convert organic waste into biogas. The presence of biodegradable components in the effluents coupled with the advantages of anaerobic process over other treatment methods makes it an attractive option. At the moment, however, the available of anaerobic digestion technology is still had several limitation. The common problem encountered in the industrial anaerobic plants is impurity of biogas product. Because, the biogas product generally is composed of methane, carbon dioxide, water vapor and trace gases such as ammonia and hydrogen sulfide. These problems can be addressed, by using membranes separation after the anaerobic digester for highly purity biogas production system. The combination of anaerobic digestion - membrane technology for animal manure hoped able to gain sustainable clean energy from animal manure.

The general objectives of this research are: (a). To develop mixed matrix membrane module design for biogas purification; (b). Experimentally study the influence of several parameter processes such as temperature, concentration, CO_2 concentration and stability the membrane.

The most important finding of this research can be drawn as follows: (1). The fabrication of the mixed matrix membrane at 24 hour mixing and a temperature 270 ^oC resulted in a dense void free membrane with several characteristics i.e. (a.). The zeolite particles are homogeneously distributed in the PI/PES blend matrix and the membrane has a very smooth surface; (b). Better distribution of zeolite as well as polymer-filler contact than the mixed matrix membrane prepared with evaporation at below glass transition temperature; (c). The polymer adheres well to the zeolite particle; (d). The protruding zeolite particles are at the top of the surface; (e). The application of evaporation at above T_g temperature combined with vacuum degassing and a certain mixing time could reduce the voids between polymer and the zeolite particles. (2). PES-zeolite 4A mixed matrix membrane posses better separation characteristics than PES-zeolite 13X with several characteristics i.e. (a). PES-zeolite 4A mixed matrix membranes exhibited lower permeability and higher selectivity than pure PI/PES membrane; (b). unselective voids or interfacial voids between zeolite particles and polymer in the all of PI/PES mixed matrix membranes were apparently not formed (c). The permeability reduction phenomenon indicated the important role of zeolite pore size in gas transport properties of mixed matrix membrane; (d). The properties of zeolite 4A having open crystal structure and relatively small pore size could induced a resistant to the diffusion of the gas penetrant through the zeolite pore. Moreover, due to its small

pore size, zeolite can discriminate gas penetrant on the basis of the differences in molecular size and shape.

The output of this research are (a). The technological package for biogas purification in a prototype "Process engineering of highly purity of biogas production in a effort to develop biogas energy"; (b). Quantitative technical data and optimum operating condition for process design and operation; and (c). 1 (one) scientific article at national seminar, 1 (one) scientific article in international seminar.