The potential of non-porous polymer membranes in downstream separation processes

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This talk summarizes results and also the potential of separation of fluids through nonporous membranes. Two aproaches were selected for this stuidy ionic liquids membranes and thin film composite (TFC) membranes. TFC have molecular-level sieving structures consisting of multiple layers of polymeric materials. The three-layer film configuration has the proper mechanical stability and high selectivity of undesired materials to generate a high filtration rate [1]. The first (top) layer serves as a dense selective barrier with a thickness of around 1 µm, which is made of polyamide that swells in water and make perm-selective membrane [2]. Two other layers are thicker to ensure mechanical rigidity with higher porosity than the top layer. A water-swollen spiral-wound membrane filter was used to separate CH_4 from two types of feed streams: a synthetic binary mixture of CH_4 and CO_2 and raw agro-biogas. At a pressure of 3 bar of the synthetic biogas, CH_4 content increased from 52 vol% of the feed stream up to 98 vol% of the retentate stream. Two filters aligned in parallel increased the recovery ratio by 8.5% from the single filter operation, which is ascribed to doubling the biogas retention time in the parallel filters by bisecting the feed stream. The water-swollen membrane technology developed in this study proved efficient in producing high-quality biomethane and desulfurizing feed biogas. The retentate streams had a biomethane concentration of 95-98 vol% of pure CH_4 and a low concentration of H_2S of an order of 10 ppmv [3]. Experimental controlling factors may include but are not limited to the feed flow rate, pressure, membrane properties, and module configuration. More extensive experimental research, to be supported by theoretical analysis, is required to further improve biomethane production using water-swollen membrane technology.

Keywords: non-porous membranes, ionic liquids, thin film composite membranes, flue gas, bio gas

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