Evaluation of the polymeric membranes' performance in terms of laboratory-scale CO_2 removal from biogas

Chrysovalantou Koutsiantzi[1, *], Eustathios Kikkinides[1], Manassis Mitrakas[1], Anastasios Zouboulis[2], Ioannis Kellartzis[1], George Stavropoulos[1]

[1] Department of Chemical Engineering, Aristotle University of Thessaloniki

[2]Department of Chemistry, Aristotle University of Thessaloniki

* Presenter, e-mail: vkoutsiantzi@gmail.com

Abstract

The present study evaluates the separation properties of polymeric membranes regarding for the optimization of biogas upgrade process by CH_4 recovery. For that purpose, a pilot-scale membrane set-up was designed and constructed to achieve the production of high purity biomethane (>95%) from a gas mixture consisting of pure CO_2 and CH_4. The mass flow of the inlet streams was controlled by a mass controller and the feed pressure was controlled by a back pressure regulator (BPR). The membrane which was used was a polysulfone hollow fiber (HF) membrane in counter-current flow. The gas streams were analyzed directly with a gas analyzer for CH_4 and CO_2. The feed concentration consisted of 55-70 vol% and 45-30 vol% for CH_4 and CO_2, respectively, while the effects of back-pressure were studied in a range from 0.7 to 1.5 bar. Experimental results revealed that the % purity of CH_4 in the retentate stream exceeds the demanded value of 95% in a range of pressure values over 1 bar. Any increase in the feed pressure leads to higher CH_4 purity on the retentate side, however the retentate mass flow decreases, leading to smaller recovery values of CH_4. CH_4 purity increases significantly when CH_4 recovery reaches smaller values, e.g., < 40%.

Key words: Biogas upgrade, biomethane, membranes, pretreatment, CO_2 removal