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## Preliminary study on the feasibility of using a zeolite A membrane in a membrane reactor for methanol production

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### HIGHLIGHTS

- Permeation of CO<sub>2</sub>, H<sub>2</sub>, H<sub>2</sub>O mixtures through a zeolite A membrane was studied
- Effects of temperature, partial pressures, total pressure were examined
- Experimental results provide insight towards the development of a membrane reactor
- Good water selectivity, with low H<sub>2</sub> and CO<sub>2</sub> flux was seen in many cases
- Surprising high water partial pressure in permeate, caused by a temperature gradient

### Abstract

The permeation of a mixture containing H<sub>2</sub>, CO<sub>2</sub> and water through a zeolite membrane was studied under several operating conditions. The aim was to obtain insight on the feasibility of using such membrane in a zeolite membrane reactor for CO<sub>2</sub> hydrogenation to methanol. The effects of total pressure (100-270 kPa), water partial pressure (10-18 kPa) and temperature (160-260°C) were studied. Promising water-permanent gas separation factors were obtained up to 240°C. A surprisingly high water partial pressure was found in the permeate in some cases, which is explained by the radial temperature gradient in the experimental system. The good capability of this zeolite A membrane to selectively separate water vapor makes it a promising material for its use in a zeolite membrane reactor.

Keywords: zeolite membrane; membrane reactor; methanol synthesis; vapor-gas separation

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