# ADSORPTIVE REMOVAL OF $CO_2$ FROM $CO_2$-$CH_4$ MIXTURE USING CATION-EXCHANGED ZEOLITES

Jong-Nam Kim, Korea Institute of Energy Research, Daejeon, Republic of Korea
jnkim@kier.re.kr
Hyung Chul Yoon, Korea Institute of Energy Research, Daejeon, Republic of Korea
Joo Hyun Park, Korea Institute of Energy Research, Daejeon, Republic of Korea
Kanghee Cho, Korea Institute of Energy Research, Daejeon, Republic of Korea
Sang Sup Han, Korea Institute of Energy Research, Daejeon, Republic of Korea
Hee Tae Beum, Korea Institute of Energy Research, Daejeon, Republic of Korea
Dong Woo Cho, Korea Institute of Energy Research, Daejeon, Republic of Korea

Key Words: $CO_2$, $CH_4$, adsorption, natural gas, landfill gas

Raw natural gas and landfill gas contains methane as its major component, but it also contains considerable amounts of contaminants such as $CO_2$ and $H_2S$ (i.e. acid gases) that can cause corrosion and fouling of the pipeline and equipment during transportation and liquefaction. Amine-based $CO_2$ gas removal processes have been employed in the gas industry, but these processes have disadvantages including high regeneration energy requirements and inefficiencies; these issues have not been adequately solved to date. Currently, adsorptive acid gas removal technologies have received significant interest because of the simplicity of adsorbent regeneration by thermal or pressure variation1). Numerous micro- and mesoporous adsorbents including zeolites [2-3], titanosilicates[4], activated carbons[5-6], metal-organic-framework (MOF) [7], and silica-alumina materials[8-9] were studied for this type of application. However, the $CO_2/CH_4$ selectivity of the aforementioned adsorbents was not high enough for commercial applications.In this study, different cation-exchanged zeolites were synthesized, physicochemically characterized, and evaluated for adsorptive removal of $CO_2$ from $CO_2$-$CH_4$ mixtures. The adsorption isotherms of $CO_2$ and $CH_4$ in the pressure and temperature ranges 0 − 3 MPa and 10 – 40 °C, respectively, for different cation-exchanged zeolites were measured and compared. The ideal-adsorbed solution theory (IAST) was employed for the estimation of $CO_2/CH_4$ selectivity for the different cation-exchanged zeolites.

## References

1) D. Aaron, C. Tsouris, Separ. Sci. Technol. 2005, 40, 321–348
2) J. Collins, US Patent No. 3,751,878. 1973.
3) M. W. Seery, US Patent No. 5,938,819. 1999
4) W. B. Dolan, M.J. Mitariten, US Patent No. 6,610,124 B1. 2003
5) A. Kapoor, R.T. Yang, Chem. Eng. Sci. 1989, 44, 1723–1733
6) A. Jayaraman, Chiao, A. S.; Padin, J.; Yang, R. T.; Munson, C. L., Separ. Sci. Technol. 2002 37, 2505–2528
7) L. Hamon, E. Jolimaitre, G. Pringruber , Ind. Eng. Chem. Res. 2010, 49, 7497-7503
8) W.B. Dolan, M.J. Mitariten, US patent No. 2003/0047071, 2003
9) G. Bellussi, P. Broccia, A. Carati, R. Millini, P. Pollesel, C. Rizzo, M. Tagliabue, Micropor. Mesopor. Mat., 2011, 146, 134–140