385e Parametric Study of High Purity O_2 Three-Bed Pvsa Process for Combustion Processes

Min-Bae Kim, Sang-Jin Lee, Jin-Hwan Jung, Jeong-Geun Jee, and Chang-Ha Lee

Recently, due to the reduction and sequestration of CO_2, O_2 inhalation combustion processes have been developed extensively for use in, among others, the iron, steel and incineration industries. In these industries, O_2 needs to be at least 95% purity to be used cost-effectively in fuel combustion, because of the carbon tax placed on CO_2 capturing. Oxygen combustion processes can contribute to the energy saving and CO_2 capturing due to high combustion energy and pure CO_2 effluent.

In our previous study [Jee et al. (2005)], a three-bed PVSA process with two equilibrium beds and one kinetic bed was presented to produce high purity O_2 with less than 1% N_2 impurity from ambient air. In this study, to improve and optimize the cyclic performance of three-bed PVSA process, a parametric study was done by experimental and theoretical works.

Since the concentration wave fronts of each air component was controlled by equilibrium adsorption amount in zeolite 10X bed, the adsorption pressure and feed flow rate of zeolite 10X bed concerning adsorption amount played as key operating variables in the air bulk separation. Related to the non-isobaric steps such as PR and PE steps of zeolite 10X bed, pertinently adopted step time could improve both the O_2 purity and recovery. The PR and AD steps of CMS bed served as key operating variables in the purification of the oxygen-rich feeds from zeolite 10X bed. The increased PR and AD step time of CMS bed improved the O_2 purity because the step of removing the impurities, Ar and N_2, was prolonged in terms of kinetic separation. However, excessively increased PR and AD step time led to the decrease of O_2 purity because the related AD step time of zeolite 10X bed simultaneously increased and the breakthrough of N_2 and Ar impurities occurred. Therefore, the optimization of PR and AD step times of CMS bed was executed to improve both the performance of equilibrium and kinetic separation beds. As a consequence, the high purity O_2 of around 97% with high recovery of around 75% and the productivity of around $5.8X10^{-5}$ $cm^3/g•sec$ was produced at properly determined operating condition.