Series multi-bed pressure swing adsorption modeling for lean hydrogen gas purification

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Hydrogen (H_2) is now considered as a future clean energy source that can be a solution to mitigate CO_2 greenhouse global warming. To meet the increasing demand for this clean energy of the post-petroleum era, alternative routes of H_2 production are needed to be developed.

H_2 could be recovered from the lean H_2 mixture gas, and pressure swing adsorption (PSA) process is the highest potential to perform it effectively. However, since most of the PSA processes developed are focused on the feed gas with H_2 concentration over 50 vol.%, new concept of PSA process is required to recover H_2 from H_2 lean gases. Series PSA, which consists of the bulk separator and purifier, is developed to recover H_2 efficiently from lean H_2 mixture. In this study, 19.9% H_2 mixture was used as a feed gas in dynamic simulation for series PSA. Activated carbon and zeolite 13X were used to the bulk separator and purifier, respectively. Blowdown gas from the purifier was used to purge the bulk separator, which led to increasing both recovery and purity. Series PSA could produce 99.27-99.96% H_2 with 36.2-84.7% recovery from 19.9% purity H_2, while parallel PSA couldn't reach H_2 purity over 99%.