POLYMER-GRADE OLEFIN PRODUCTION BY GAS-PHASE SMB

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Petrochemicals play a vital role in the chemical and petroleum industry due to their utilization as a base product for the fabrication of a wide range of materials. In fact, these substances have the ability to react with themselves, to serve as starting/intermediates, to create innovative products, which are used in numerous processes, in several industries all over the world, from pharmaceuticals and cosmetics, to all kinds of plastics and textile. Moreover, the production of olefins, mainly ethylene and propylene, has been increasingly important worldwide. These olefins have a great number of commercial applications, particularly in the manufacture of polyethylene and polypropylene, the world's most widely used polymers.
Nowadays, the separation of olefins from paraffins after the cracking process is commonly performed at cryogenic temperatures, in C_2 splitter distillation towers containing about 100 - 130 plates, making it a high cost- and energy-intensive separation processes. The emergence of new materials boosts the opportunities to process enhancement and intensification in adsorption-based technology. In the last years several studies were carried out in order to separate gas mixtures by SMB technology; however, this technology has never been implemented on an industrial scale. In the present work, a gas phase SMB bench unit was tested to produce polymer-grade ethylene (> 99.9% purity) and polymer-grade propylene (> 99.5% purity) from 0.20/0.80 and 0.50/0.50 olefin/paraffin mixtures.
Several experiments were performed to separate propane/propylene by gas phase SMB in the bench scale unit with a 4-2-2 configuration, i.e.,open loop circuit by suppressing section IV (desorbent regeneration followed by a recycle). Experimental results using a 13X zeolite as adsorbent and isobutane as desorbent have shown that it is feasible to separate propylene from propane by gas phase SMB at a bench scale and that this process is a potential candidate to replace the conventional technologies for the propane/propylene separation. The performance parameters obtained are very promising for future development of this technology, since propylene was obtained in the extract stream with a purity of 99.9%, a recovery of 99.5%, and a productivity of 114.1 $kg_{C3H6}h^{-1}m^{-3}{}_{adsorbent}$. Propane was obtained in the raffinate stream with a purity of 98.1%, a recovery of 99.7% and a productivity of 30.4 $kg_{C3H8}h^{-1}m^{-3}{}_{adsorbent}$.
The same gas-phase simulated moving bed (SMB) bench unit was employed to produce polymer-grade ethylene from ethane/ethylene mixtures, using binderless 13X zeolite beads and Cu-BTC beads as adsorbent, and propane as desorbent, with a four zones configuration. The achieved performance parameters with the binderless 13X zeolite beads and a 4-2-1-1 configuration in closed circuit demonstrated the high efficiency of the current technology, since ethylene was obtained with a purity of 99.8%, a recovery of 99.8%, and a productivity of 59.7 $kg_{C2H4}h^{-1}m^{-3}{}_{adsorbent}$. Considering the encouraging results obtained it is fair to say that the gas-phase SMB is a competitive and strong candidate as alternative to the traditional distillation process.

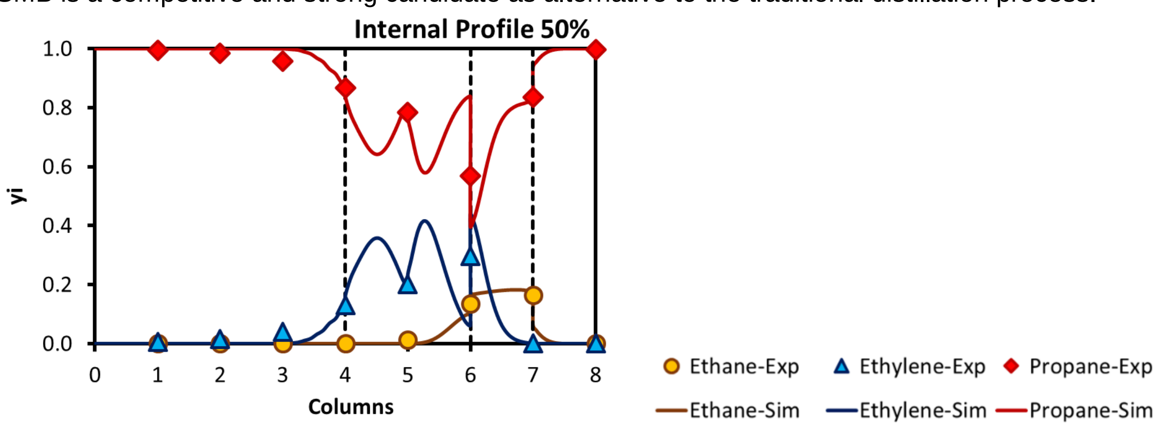

Figure 1 – Internal profile at step half time as function of column number.