

The Use of Hybrid Membrane/Distillation System for the Ethane/Ethylene Separation in Olefin Plants

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Separation of ethylene from ethane in commercial processes is expensive both in capital and operating costs. This study has evaluated the feasibility of using facilitated transport membrane technology for improving the separation process. Simulation and optimization of various distillation/membrane hybrid configurations as well as stand-alone membrane cascade systems have been examined under different operating conditions of temperature and pressure. A detailed analysis has determined the optimum sequence that minimizes the energy consumption of the C₂ splitter while maximizing the profitability of the ethylene plant. This study has shown that the reduction in refrigeration requirement is the key to a successful hybrid system and that the series hybrid configuration is the optimum design, providing the maximum processing savings for a grass-roots ethylene plant. A retrofit design has also been investigated for an existing ethylene plant with the new membrane process. The parallel hybrid scheme, with a permeate pressure of about 50 psia, shows the ultimate design. For this parallel hybrid system, a net annual savings in processing cost of more than 0.86 million US dollars can be achieved to provide a payout period of about 19 months.