Energy Efficient Hybrid Gas Separation with Ionic Liquids

Shale gas, like natural gas, contains H₂, CO₂, CH₄ and other light hydrocarbon gases, which need to be processed to separate the gases for conversion to higher value products. Currently, distillation-based separation is employed, which is energy-intensive. Hybrid gas separation processes, combining absorption and membranes together with distillation, require less energy and have attracted much attention. With the property of non-volatility and good stability, ionic liquids (ILs) have been considered as new potential solvents for the absorption step. However, the enormous number of potential ILs makes it a challenging task to search for the best one for a specific hybrid separation. In order to solve this problem, a systematic screening model for ILs is established by considering the needed properties for gas absorption process design. Rigorous thermodynamic models of IL-absorbed gas systems are established for process design-analysis. A strategy for hybrid gas separation process synthesis where distillation and IL-based absorption are employed for energy-efficient gas processing is developed and its application is highlighted for a model shale gas processing case study.

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