Process Development for CO_2 – Ethane Separation in Oil Recovery Process

K. Swetha Saraswathi and P. R. Naren*

School of Chemical and Biotechnology, SASTRA University

E-mail: swesaras@gmail.com, prnaren@scbt.sastra.edu*

A. Background

CO_2 is a common constituent of natural gas. All natural gas constituents absorb CO_2 to some degree when in the liquid phase, requiring multi-step natural gas treatment processes. The existence of a minimum boiling temperature azeotrope between ethane and carbon dioxide particularly complicates CO_2 separation.

Extractive distillation with higher molecular weight hydrocarbons as the solvent represents the most competitive means for the separating CO_2 from ethane.

B. Description of Flow Sheet

The process was to separate CO_2 and ethane from a mixture of hydrocarbons. Two distillation columns were employed, one for the recovery of CO_2 and other for the recovery of ethane. The columns were operated at high pressure and moderate temperature (~25 atm and ~380 K) and had 50 stages each. Feed was a mixture of CO_2 gas and hydrocarbons. A part of the NGL bottoms was recycled back as solvent for the recovery of CO_2. The bottom product from the CO_2 recovery column is fed to the next tower where ethane is recovered by distillation of the hydrocarbon mixture. About 99% of ethane and 95% CO_2 were recovered in this process.

C. Results

The process flow sheet was simulated for a typical capacity of 14400 kmol/h of feed at a temperature of 320 K and 1 atm pressure. Extractive distillation process is carried out at ~25 atm pressure and a temperature of ~328K. Conversion of 95% of CO_2 was achieved in the “Rigorous distillation column” block in DWSIM. Carbon dioxide was taken as the light key and a mixture of hydrocarbons was taken as the heavy key and was sent to the next distillation column. A “Rigorous Distillation Column” block in DWSIM was used for the recovery of ethane.

D. Conclusion and Recommendation

This work illustrates that open source simulator serves as a good platform for carrying out process development flowsheeting with ease. In the present work, extractive distillation process has been simulated with “Rigorous Distillation Column” block. This operation can also be performed in “CAPE – OPEN Unit Operation” block in DWSIM.

Unit System: (Custom 5 in the DWSIM)

Molar flow rate – kmol/h

Mass flow rate – kg/h

Volumetric flow rate – m^3/h

Density – kg/m^3

Temperature – K

Pressure – Pa

Molecular weight – kg/kmol