

## **Four-Column Extractive Distillation process of CO<sub>2</sub>–C<sub>2</sub>H<sub>6</sub> azeotrope with NGL solvent**

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### **Background:**

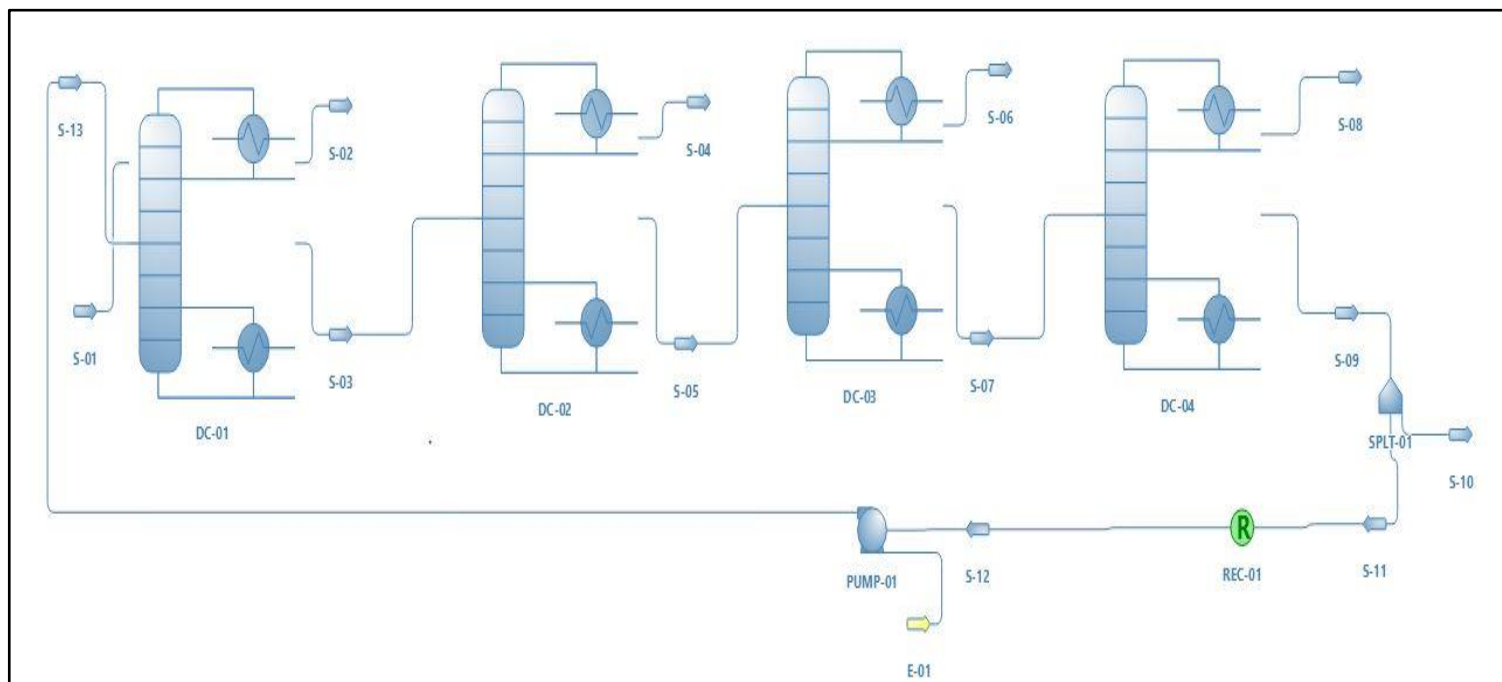
The existence of heterogeneous azeotrope of CO<sub>2</sub>–C<sub>2</sub>H<sub>6</sub> makes it difficult to separate CO<sub>2</sub> from the hydrocarbons in the associated gas by cryogenic extractive distillation process. A four-column extractive distillation system using natural gas liquid as heavy solvent is used to separate CO<sub>2</sub>–C<sub>2</sub>H<sub>6</sub> azeotrope. Carbon dioxide, ethane, propane and butane are recovered from the top of the extractive distillation column, deethanizer, depropanizer and debutanizer respectively. The C<sub>3</sub>+ hydrocarbon mixture called natural gas liquid is recovered at the bottom of the debutanizer, one part of which is transported as NGL product and the other part is pumped back near the top of the extractive distillation column as solvent.

### **Description of the flowsheet:**

Peng-Robinson (PR) was selected as thermodynamic property package.

The flowsheet contains four distillation columns named “DC-01”, “DC-02”, “DC-03” and “DC-04”. DC-01 has 45 trays where 2<sup>nd</sup> tray and 28<sup>th</sup> tray is the feed location for feed S-13 and S-01 respectively. DC-02 has 20 trays and 10<sup>th</sup> tray is the feed location for S-03. DC-03 has 40 trays and 20<sup>th</sup> tray is the feed location for S-05. DC-04 has 60 trays and 30<sup>th</sup> tray is the feed location for the feed S-07. The C<sub>3</sub>+ hydrocarbon mixture S-09 is recovered at the bottom of the debutanizer, one part of which is transported as NGL product S-10 and the other part S-11 is pumped back near the top of the column DC-01 as solvent.

## Flowsheet:



## Results:

Object	S-11	S-10	S-08	S-06	S-04	S-02	S-01	
Temperature	87.2369	87.2369	60.7415	32.8355	4.80128	-10.3778	19.85	C
Pressure	8	8	8	12	27.4	27.5	28.996	bar
Mass Flow	1563.73	1911.75	640.878	1629.1	1581.34	610.19	6373.27	kg/h
Molar Flow	23.14	28.29	11.1499	37.0901	51.6301	14.0399	142.2	kmol/h
Molar Fraction (Mixture) / Carbon dioxide	0	0	0	3.28708E-07	0.0214524	0.954195	0.102	
Molar Fraction (Mixture) / Ethane	3.92318E-22	3.92318E-22	5.00449E-13	0.0161616	0.96	0.0428102	0.357	
Molar Fraction (Mixture) / Propane	0.00273703	0.00273703	0.0459145	0.98	0.0185473	7.61895E-05	0.2665	
Molar Fraction (Mixture) / Isobutane	0.119094	0.119094	0.395878	0.0038118	2.59645E-07	0.000868534	0.0558	
Molar Fraction (Mixture) / N-butane	0.330568	0.330568	0.558201	2.62987E-05	3.23581E-08	0.0015568	0.1097	
Molar Fraction (Mixture) / N-pentane	0.2177	0.2177	2.50713E-08	1.75297E-14	1.80053E-13	0.000198777	0.0435	
Molar Fraction (Mixture) / Isopentane	0.210269	0.210269	6.17829E-06	7.22124E-13	1.22219E-12	0.000274592	0.0417	
Molar Fraction (Mixture) / N-hexane	0.110067	0.110067	1.16674E-20	2.78922E-23	1.4311E-18	1.99477E-05	0.0219	
Molar Fraction (Mixture) / N-heptane	0.00956459	0.00956459	1.49378E-24	0	2.98506E-24	3.5263E-07	0.0019	

CO<sub>2</sub> of 95.41% purity is obtained as DC-01 distillate, ethane of 96 % purity is obtained as DC-02 distillate and propane of 98% purity is obtained as DC-03 distillate.

Reference: <https://doi.org/10.1016/j.compchemeng.2019.06.017>