

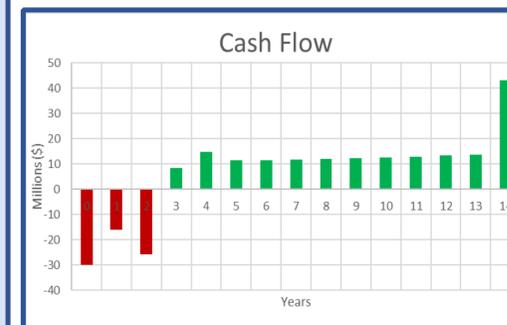
### Simulation Results

Table I displays streams results from Aspen Plus V12 software for inlet and outlet streams of the process. These streams are displayed in our process Flow diagram (PFD) below.

| Stream                   | Benzene | Ethylene | Light Gases | Ethylbenzene    |
|--------------------------|---------|----------|-------------|-----------------|
| tonnes/oper-year         | 65401.1 | 24715.6  | 6845.9      | <b>83270.1</b>  |
| kmol/hr                  | 95      | 100      | 15.2        | 89.5            |
| Molar Fraction $X_B$     | 0.97    | 0        | 0.3         | 0               |
| Molar Fraction $X_{EB}$  | 0       | 0        | 0.057       | 0.998           |
| Molar Fraction $X_{DEB}$ | 0       | 0        | 0           | <b>1.71E-06</b> |

### Economics

The total capital investment of ethylbenzene production process is \$34,249,351. It is projected that the payback period is 2.85 years. The profit on the first operational year is \$8.4M with an average annual profit of 14.8M after the first operational year. The return on investment (ROI) is 29.4% and the investment rate of return (IRR) is 20.95% per year.



### Abstract

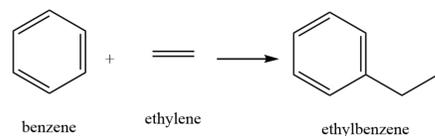
Our Runner Commodity process was able to generate **83K annual tonnes of 99.8% by mass ethylbenzene (EB)**. Our reactor system includes two plug flow reactors used for alkylation and transalkylation. The separation unit includes two distillation columns to extract excess benzene and purify our final product to the required purity 99.8% by mol of EB and < 2ppm of diethylbenzene. **The total capital investment,  $C_{TCI} = \$34M$  with a payback period of 2.85 years.**

### Motivation

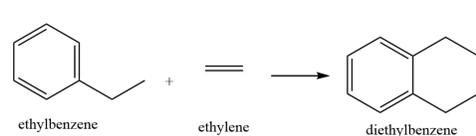
Over 95% of all ethylbenzene is used to produce styrene [1]. Currently, Runner Commodity buys EB to feed its Styrene unit and this project aims to:

- Design and Investigate the feasibility of producing 80K tonnes/year of 99.8% by mol of EB onsite
- Minimize production cost for styrene process by producing EB onsite

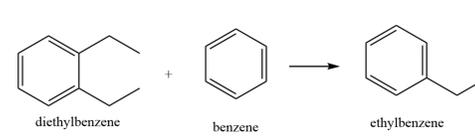
#### Alkylation



#### Alkylation By-Products



#### Transalkylation



### Conclusion

The ethylbenzene process has successfully produced 83270.1 tonnes/oper-year of ethylbenzene with a purity of 99.9%. The average yearly profit is \$14.8M with an IRR of 20.95% per year making this process profitable and feasible.

### Acknowledgments

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