Cracking The Crude

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INTRODUCTION

This research project was based on a chemical engineering IDE project that was conducted last semester. The cracking of crude oil is a multibillion-dollar industry that is vital for creating all different types of fuel such as gasoline, kerosene, and diesel. A by product of this process is the creation of benzene, toluene, and xylene. These products are key components in consumer products such as rubbers and lubricants.

OBJECTIVES

The purpose of this research project is to obtain the highest purity of BTX (benzene, toluene, and xylene) alongside the creation of the major fuels in the Type K crude oil cracking process while processing 35,000 barrels every day. The economics of the process was also taken into account to determine the profitability of the proposed process.

METHODS

- Two separate Aspen Files were created to model the process flow diagrams shown in Figure 3 and Figure 4.
- Aspens economic analysis program was used to estimate the cost of installation and operating costs.

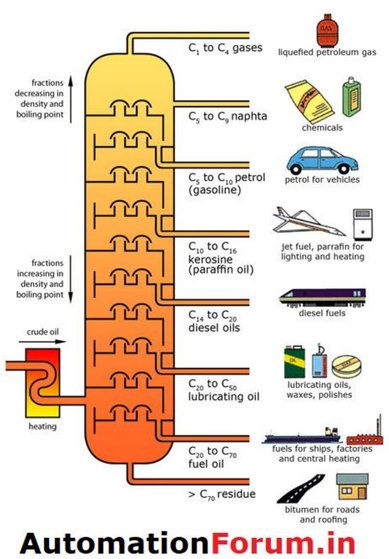

Figure 1. Crude Cracking Products

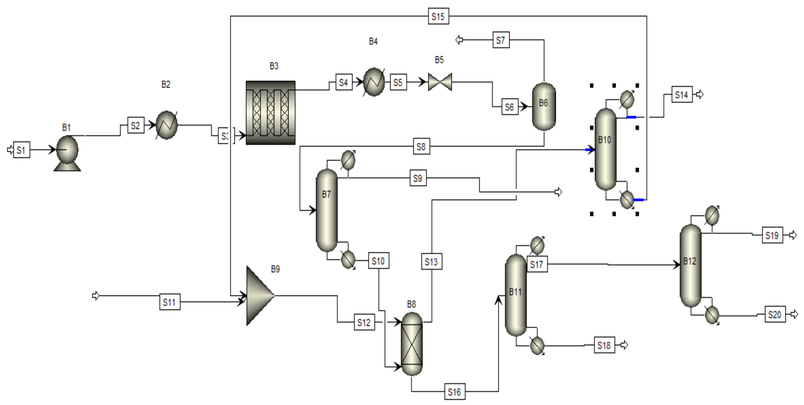

Figure 2. Main Process Flow Diagram

RESULTS

- 95% purity of BTX from Crude Separation
- 2700 kg/h of Benzene, 3750 kg/h of Toluene, and 2750 kg/h of Xylene generated
- Initial Cost of start up: $ 33 million, Raw material Cost per year: $45 million, Utility Cost: $22 million per year.
- Total Income Generated per year: $317 million, net profit per year: $250 million
- The Sale of Benzene accounts for $67 million per year. Diesel generates the largest profit with $219 million per year.

Figure 3. Crude Oil Refinery

CONCLUSIONS

Overall, the process runs at a net profit of $250 million per year and $67 million dollars per year is generated from the added benzene separation process. The benzene separation is a process that can be added to existing crude cracking facilities worldwide. Toluene and xylene are also created in this process design, however, have less value than benzene and were not the focus of the design.

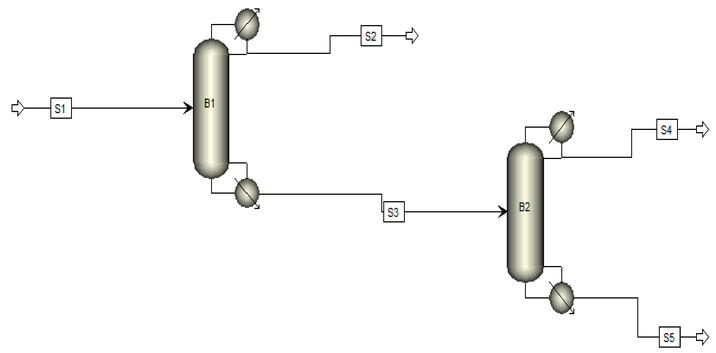

Figure 4. BTX Separation PFD

FUTURE WORK

This process can be optimized further with a deeper dive on the kinetics in the reactor along with further optimization of the number of trays and operating conditions of the various distillation columns. To take this work farther a safety analysis can be done to determine the potential danger of implementing this system.

References

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McCabe, Warren L., et al. Unit Operations of Chemical Engineering. 7th ed., McGraw-Hill, 2005.

Acknowledgments

Liam Podpadec, Tyler Mintus, and Paraskevi Doudakis