



Dehydrogenation of Propane to Propylene : Modeling , Designing and Optimization



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Problem Statement

Due to the growing demand for propylene reaching 100 Billion USD, the petrochemical industry requires innovative solutions to increase the propylene conversion rate.

Elevator Pitch

Our creative engineering approach aims to maximize the conversion rate of propane to propylene through a combination of advanced mechanical and chemical design enhancements, complemented by modern optimization techniques.

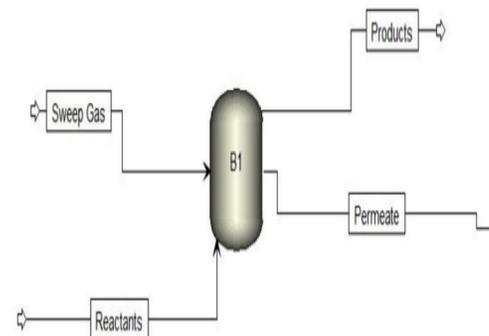
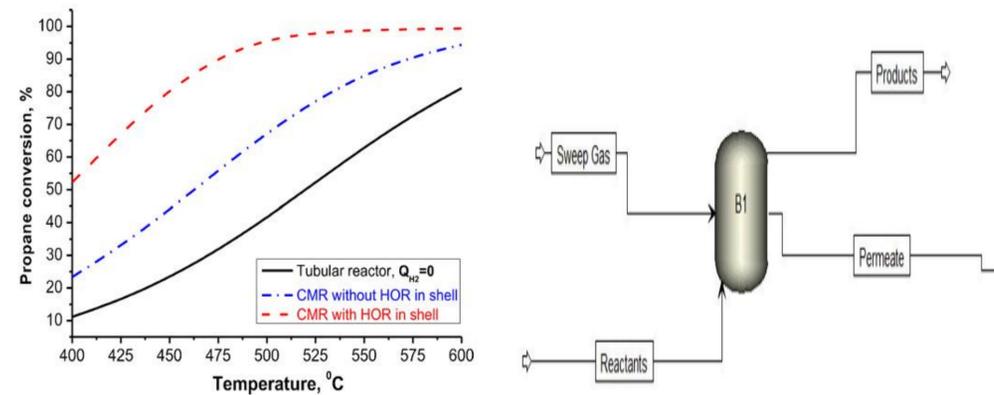
Design Specification

- Conversion rate above 40%
- Membrane reactor integration
- Compact size of the chemical plant
- Durable piping plan
- Minimum 2 mechanical factor of safety

Design Constraints

- Temperature Limitation: should not exceed 600 degrees Celsius
- Pressure Limitation: parameter is capped at 10 bar,
- Flowrate limitation: should not exceed $8 \frac{m^3}{hr}$
- Software limitations: the simulation program may not consider all the parameters..

ACM Simulation

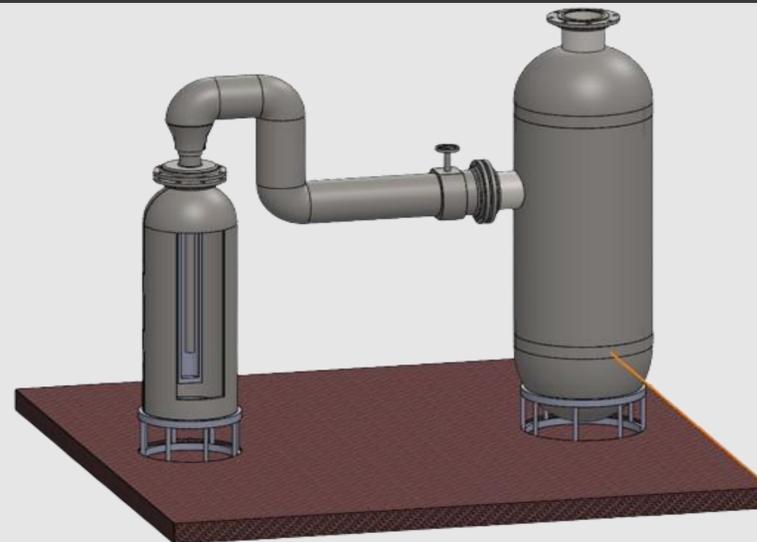


Testing / Validation

| Reactants: All Variables Table | | | Products: All Variables Table | | |
|--------------------------------|----------|-------|-------------------------------|----------|------|
| | Value | Spec | | Value | Spec |
| UserNotes | | | UserNotes | | |
| <ComponentList | Default | | >ComponentList | Default | |
| <F | 10.0 | Fixed | >F | 10.0 | Free |
| <P | 1.0 | Fixed | >P | 1.0 | Free |
| <T | 500.0 | Fixed | >T | 500.0 | Free |
| <z("C2H4") | 0.142857 | Fixed | >z("C2H4") | 0.142857 | Free |
| <z("C2H6") | 0.142857 | Fixed | >z("C2H6") | 0.142857 | Free |
| <z("C3H8") | 0.142857 | Fixed | >z("C3H8") | 0.142857 | Free |
| <z("H2") | 0.142857 | Fixed | >z("H2") | 0.142857 | Free |
| <z("O2") | 0.142857 | Fixed | >z("O2") | 0.142857 | Free |
| <z("PROPY-01") | 0.142857 | Fixed | >z("PROPY-01") | 0.142857 | Free |
| <z("WATER") | 0.142857 | Fixed | >z("WATER") | 0.142857 | Free |

The two selected items are parallel.
Normal Distance: 20.00001 m [20000.01 mm]

Cad Model



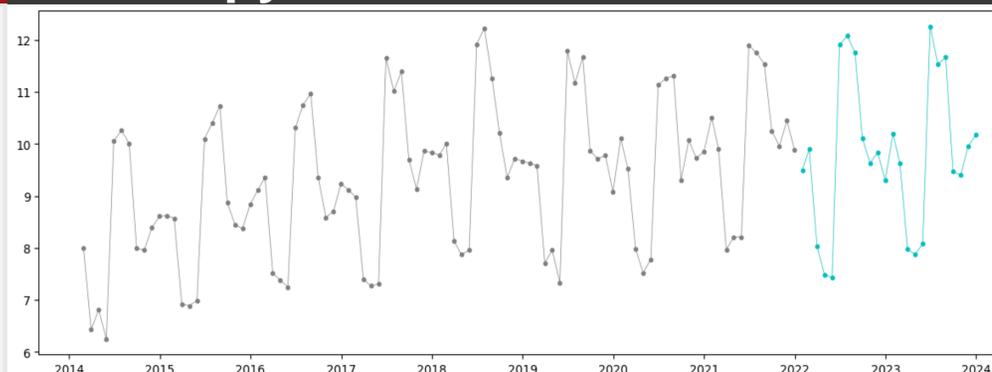
Project Impact

Efficiency in Production: The integration of a membrane reactor significantly increases propylene conversion rates, setting new industry benchmarks for efficiency.

Environmental and Economic Gains: Our design reduces waste and energy usage, minimizing environmental impact while cutting operational costs.

Safety and Sustainability: By optimizing process conditions, the new reactor design ensures safer operations and promotes sustainability by reducing potential hazards and enhancing resource efficiency.

Propylene Demand Prediction



Conclusion

- Successfully integrated membrane reactor through Aspen custom modeler & CAD
- Predicted Increase in propylene demand
- Length of the plant around 20 m (compact)
- All calculation were based on 2 factor of safety
- Based on literature at 525 C with Hydrogen Oxidation , maximum conversion rate (96%) and maximum yield was found