Aspen® VII simulation and techno-economic analysis of fractional condensation and distillation of plastic waste pyrolysis oil for sustainable aviation fuel production

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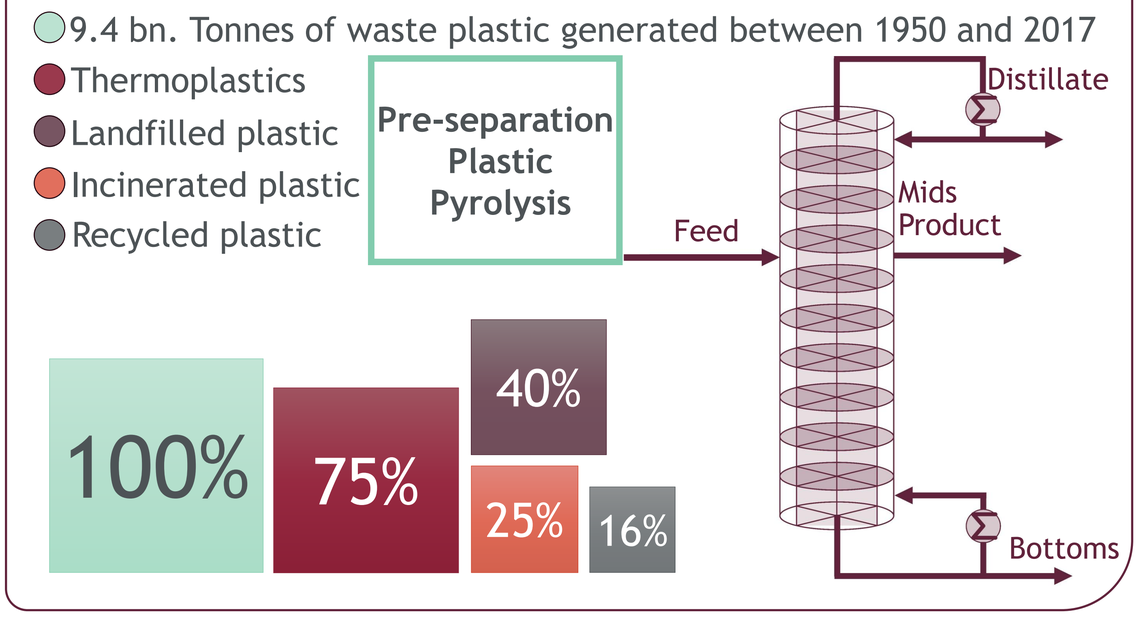
Introduction

- Current plastic waste management practices are unable to curb rate of waste production.
- Pyrolysis can turn plastic waste into gasoline/diesel.
- Pyrolytic gasoline/diesel is not profitable enough for widespread adoption.
- More expensive fuels could possibly mitigate this problem.

Research Questions

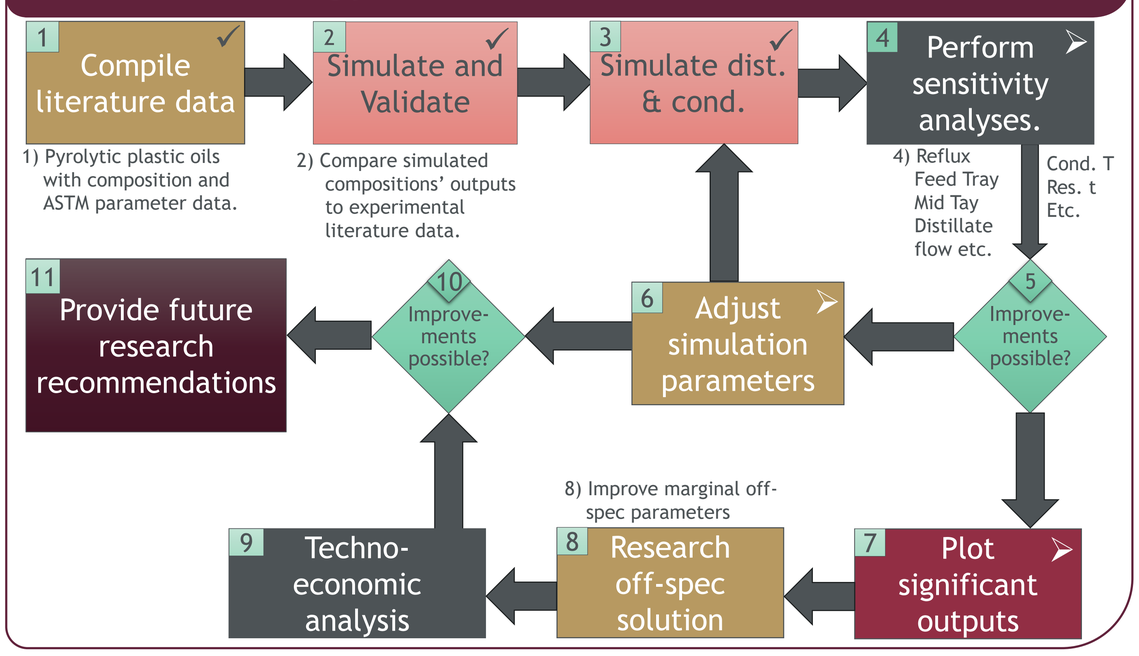
- Can SAF-compliant fuel be produced from plastic waste, according to ASPEN ® VII simulations?
- Which separation method, fractional condensation or fraction distillation is more suitable for this process?
- What alternative solution are possible for post-process of specification parameters?

Total Plastic Waste Management



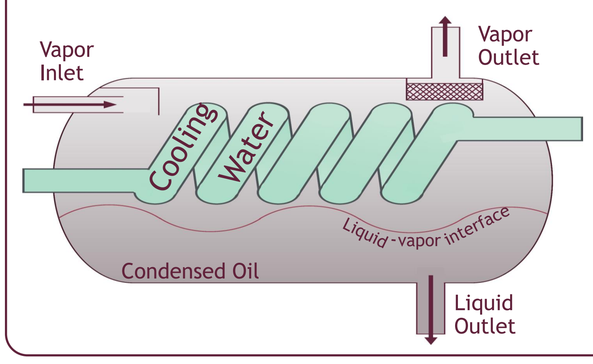
Methodology

✓ - Completed
➢ - In Progress



Simulation Details

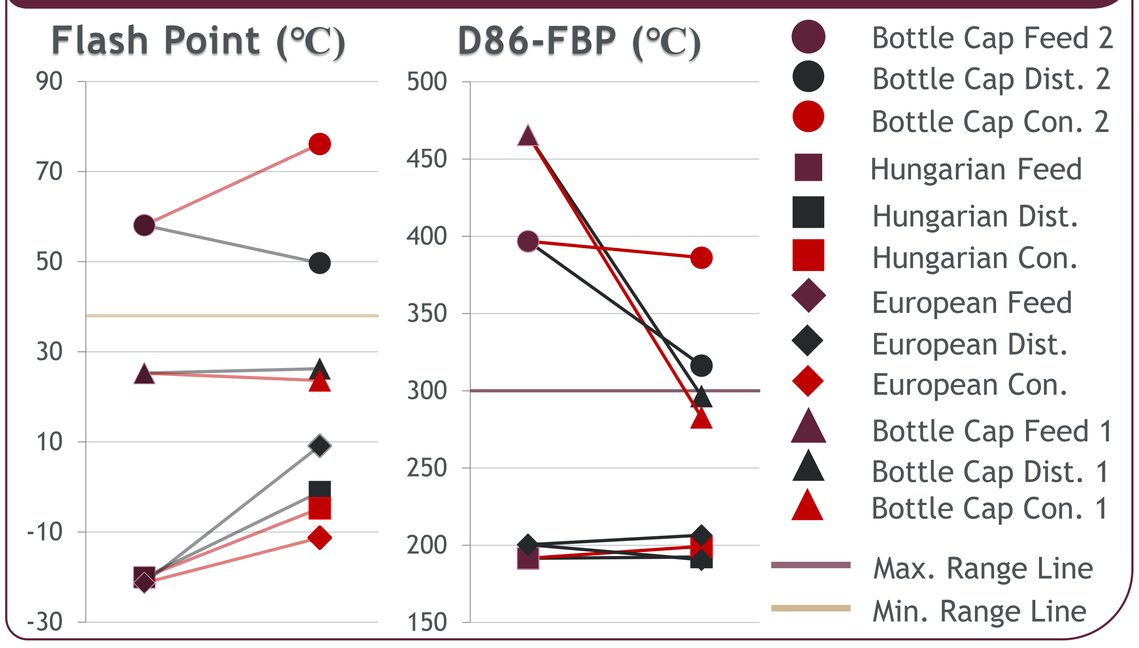
Feedstock	Euro	Hung	BC 1	BC 2
Pre-pyrolysis Composition				
LDPE	31,5%	22%	0%	0%
HDPE	21,5%	15%	100%	100%
PP	35%	49%	0%	0%
PS	12%	14%	0%	0%



Feedstock	Euro	Hung	BC 1	BC 2
Distillation Columns				
Total Trays	9	9	9	9
Feed Tray	7	7	6	5
Reflux Ratio	5	5	3	6
Distillate Flow	11%	5%	12%	55%
Mids Tray	5	5	6	9
Mids Flow	15,5%	11%	76%	15%
Mids Phase	Liquid	Liquid	Vapor	Vapor

Feedstock	Euro	Hung	BC 1	BC 2
In series Fractional Condensation				
Total Cond.	3	3	3	3
Main Cond.	2	1	3	2
Temp. 1	122	110	250	300
Temp. 2	100	105	208	240
Temp. 3	90	90	100	220

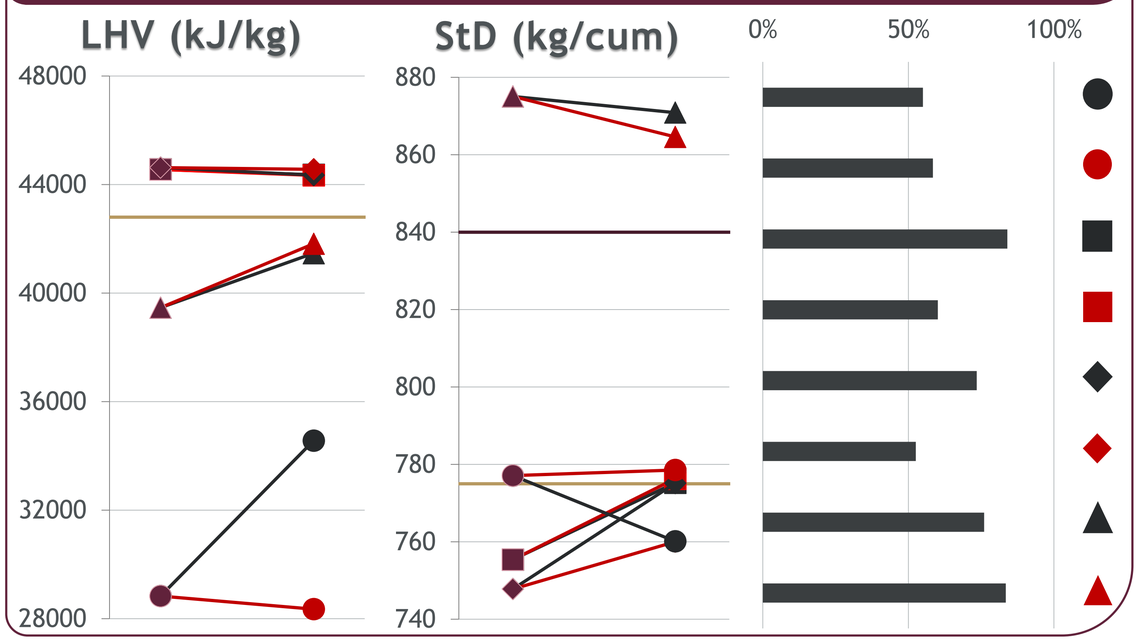
Flash- and Final Boiling Point



✓Conclusions and ➢Recommendations

- ✓ Fractional condensation and distillation can improve pyrolytic oil parameters to fall closer to SAF standards.
- ✓ Flash point and the final boiling point can be significantly adjusted via separation processing.
- ✓ There are major trade-offs between flash point and final boiling point, and LHVs and density.
- ➢ Further dynamic simulations are suggested.
- ➢ Linear mixing to improve parameters may be viable, excluding flash point and final boiling point.
- ➢ Further optimizations should be considered, such as reflux ratio, feed mixing and possibly combining distillation and condensation setups.

Fuel Energy and Density Recoveries



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