Chemical Recycling of Plastic Waste in Practice: Assessment of Technologies and Economics

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Introduction
- Low recycling rates of plastic waste, combined with high volumes of plastic waste generated (see Fig. 1 for plastic production and recycling data in the US) has raised environmental concerns.
- Limitations in the mechanical recycling of some plastic (i.e., heterogenous plastics, contaminated plastics) has motivated alternative recycling methods such as chemical recycling.
- Chemical recycling encompasses the conversion of polymers into smaller molecules by chemical methods (i.e., thermochemical) in a way that smaller molecules can be subsequently reprocessed to fuels or plastic.
- Pyrolysis, the method selected for analysis in this study, is a technology used to transform plastics into fuels by reducing long polymer chains of plastics into shorter chain of hydrocarbons at high temperatures, under inert conditions, to produce oil, fuel, and syngas.

Method
Techno-Economic Feasibility Assessment of Pyrolysis Process for Plastic Conversion to Oil
- Method of analysis: Selective Design Analysis
- A published process flow diagram (PFD) of a 30 TPD pyrolysis plant with equipment details was selected for analysis; equipment prices were obtained
- Base case Capacity: 30 TPD
- Analysis Accuracy: +/- 30%
- Lang factor method was used to estimate the Total Capital Investment (TCI)
- DFC = Total plant direct cost + total plant indirect cost + contractors fees and contingency
- Total Capital Investment borrowed and repaid over 20 years with 5% annual discount rate
- The 30 TPD PFD was selected from Sahu et al. and analyzed based on the US market, and scaled up to 60 and 100 TPD for feasibility assessment

Results & Discussion
- Sensitivity analysis shows that oil price, operating hours, interest rate, and total capital investment can easily affect the plants profitability at 30TPD
- Obtained positive NPV of the base case scenario is $518,2584 or 2.84% return after 20 years, which is extremely low for this type of investments

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References