

Motivation and Background

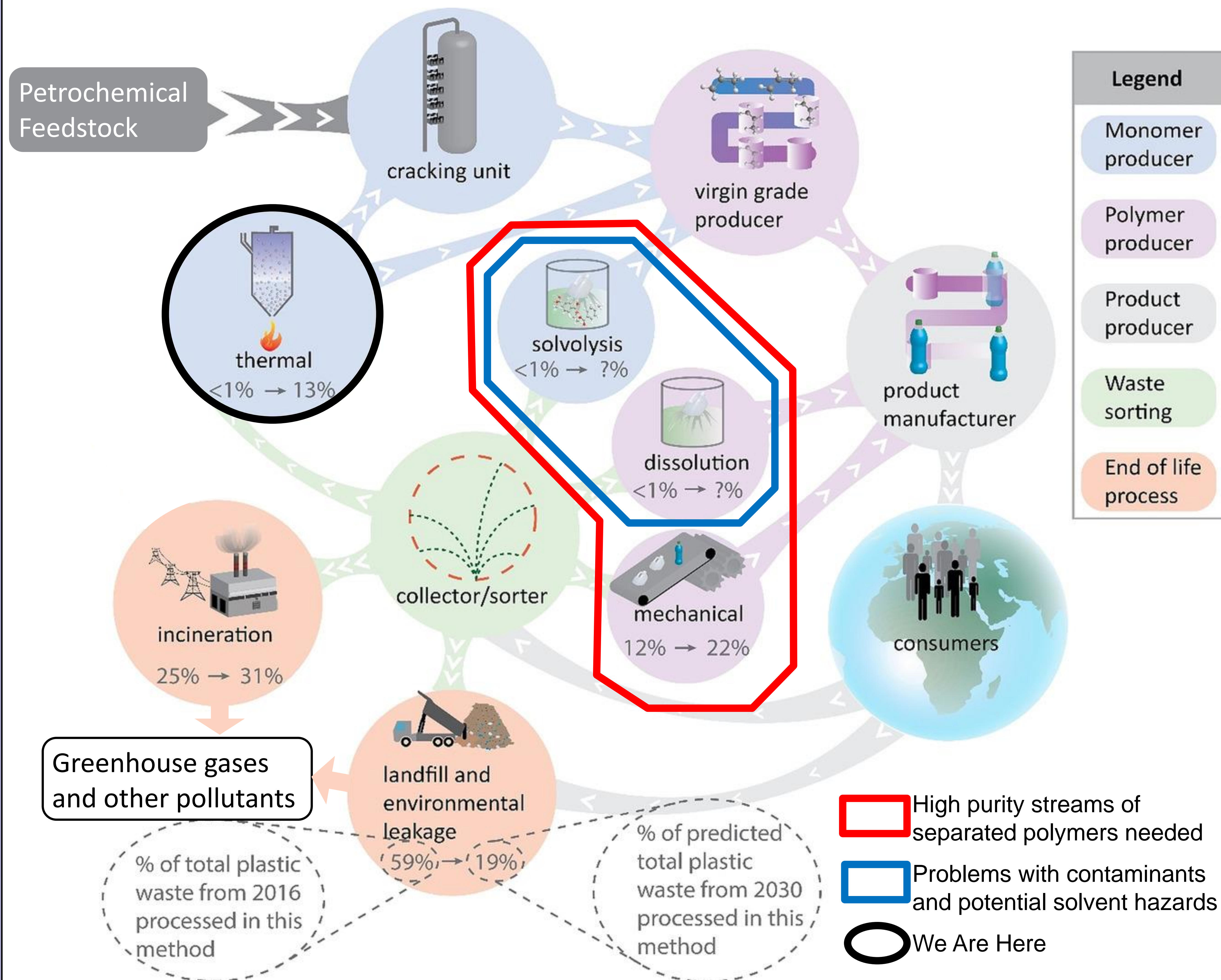


Figure 1: Plastic value chain and expected changes toward circularity (Volmer et al., 2020).

Objectives

Develop carbon-neutral technologies for plastic waste thermal recycling.

- Study pyrolysis of plastic films in Pyrolytic Shaker Reactor (PSR) at moderate temperatures (<550 °C)
- Valorize liquid and wax products
- Valorize products gases by catalyzed conversion to solid carbon and hydrogen gas.

Reference (for Figure 1)

Vollmer, I., Jenks, M. J., Roelands, M. C., White, R. J., van Harmelen, T., de Wild, P., ... & Weckhuysen, B. M. (2020). Beyond mechanical recycling: Giving new life to plastic waste. *Angewandte Chemie International Edition*, 59(36), 15402-15423.

Equipment

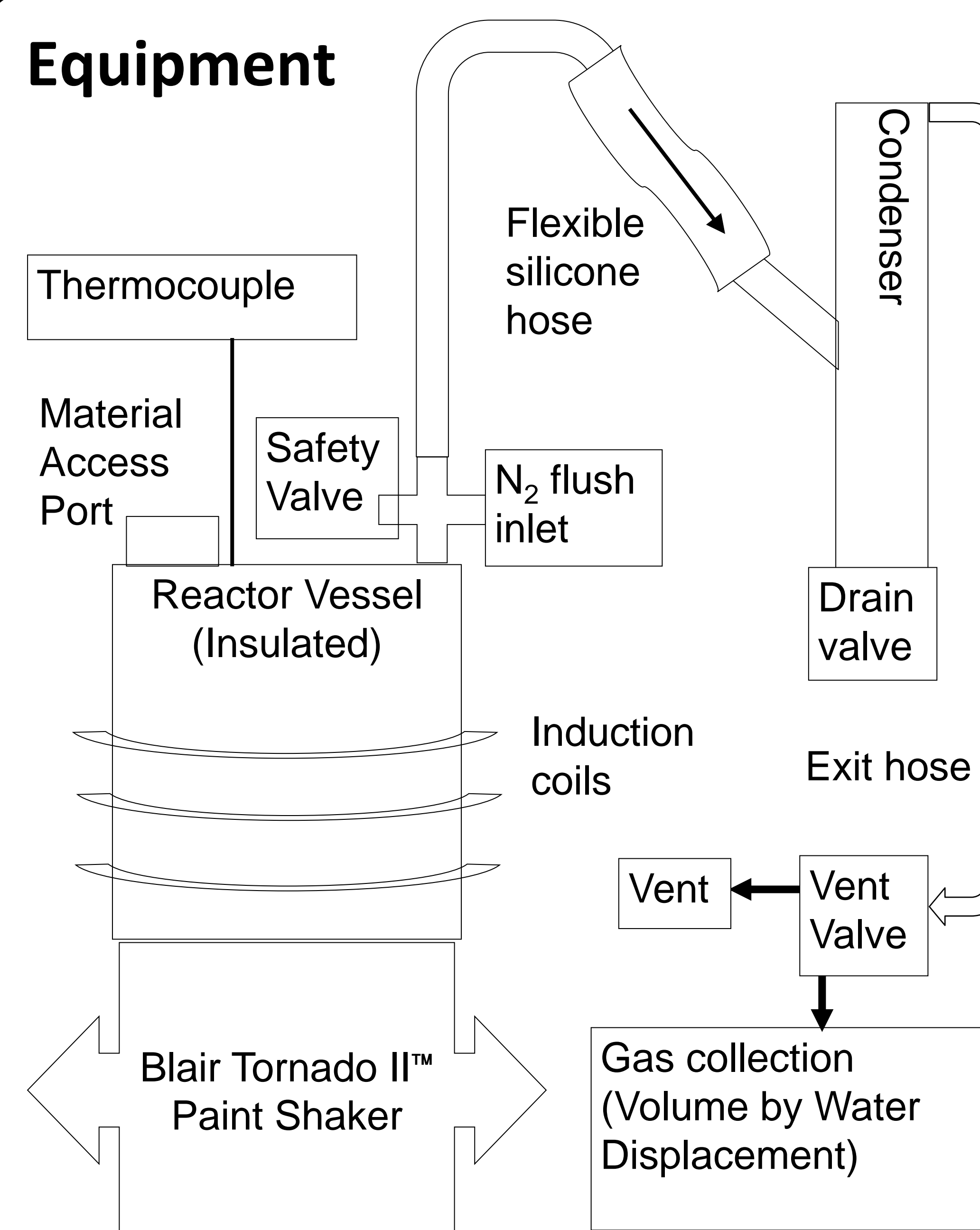


Figure 2: Pyrolytic Shaker Reactor Diagram

Methodology

- Ziploc bags as example of low-density polyethylene (LDPE) films.
- Measure yields of oil (including wax) at various temperatures
- Batch and continuous runs performed.

Enthalpy:

- Measure reactor power needed for constant temperature while injecting:
 - water, or
 - kerosene, or
 - Slurry of plastic particles in kerosene/toluene.
- Calculate Ziploc pyrolysis energy needs.

Results

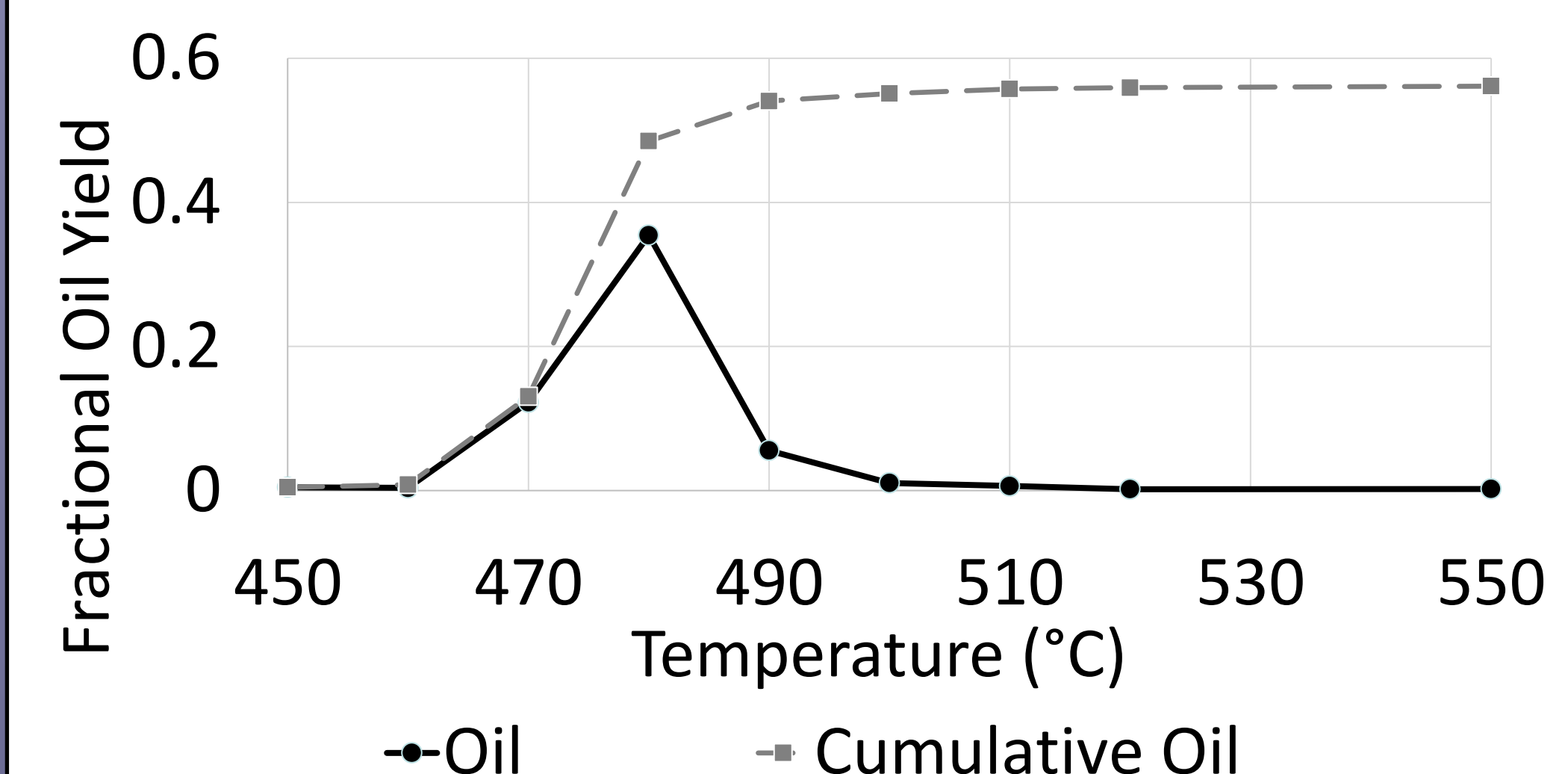


Figure 3: Batch pyrolysis oil yields. 56 wt% by 500 °C, 56.1% final.

Continuous pyrolysis at 500 °C gave 43.5 wt% oil yield.

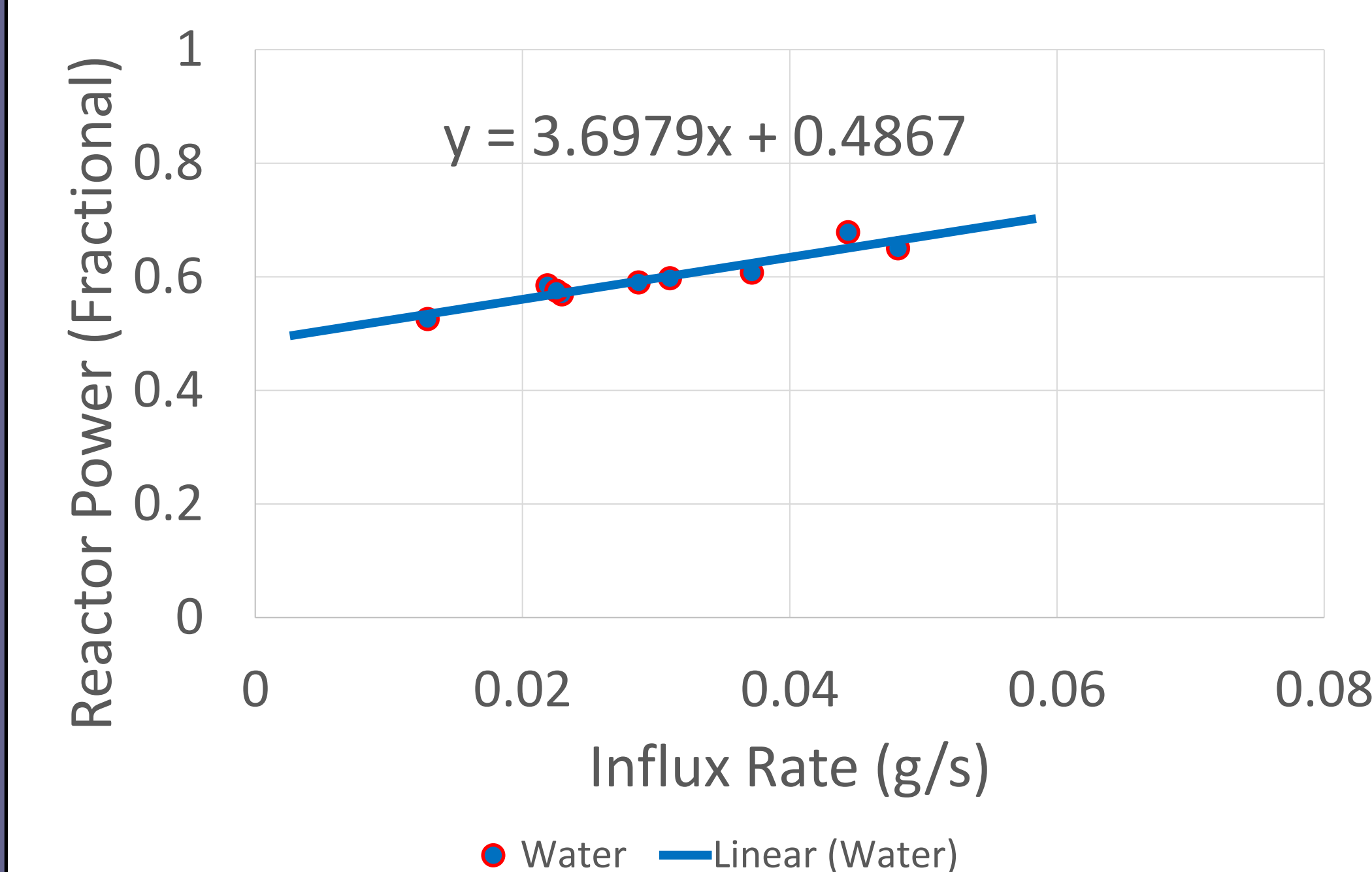


Figure 4: New calibrations at 500 °C, heat losses predominate

Conclusions

- Initial experiments calculated Ziploc bags required 590 kJ/kg to go from 16 °C to product vapors at 500 °C.
- Negligible solid residue found.
- More measurements of pyrolysis energy needs and gas yields.
- Continuous pyrolysis at different temperatures.

Acknowledgements

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