Optical Fiber Coating Raw Material Synthesis Reactor Design and Scale-Up

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CORNING

1. Background

- Urethane Acrylate oligomer is formed by an exothermic reaction between polyol diisocyanate and acrylate
- UA is used to coat fiber optic cables to protect them from damage once they are installed
- Last year's Corning senior design team created the "build a batch" model in order to scale lab data to production size

2. Goals

- Use last year's model to upscale the production of UA from lab scale
- Generate kinetics data from lab scale reaction data
- Conduct an economic analysis of the process of creating UA including all production costs
- Analyze how different reactor conditions affect the viability of the reactor

3. Economic Analysis

- Functionality was added into the model to calculate cost of utilities
- A calculation for operator cost was incorporated into the model assuming two operators would be necessary to process the batch
- The driving cost of the process was found to be utility cost, specifically the cost to run the agitator in such a large batch quickly increased as the product has a high viscosity

4. Process Design

Step 1
2 P + D → → DPD + 2A

ADPDA ← ←

Step 2
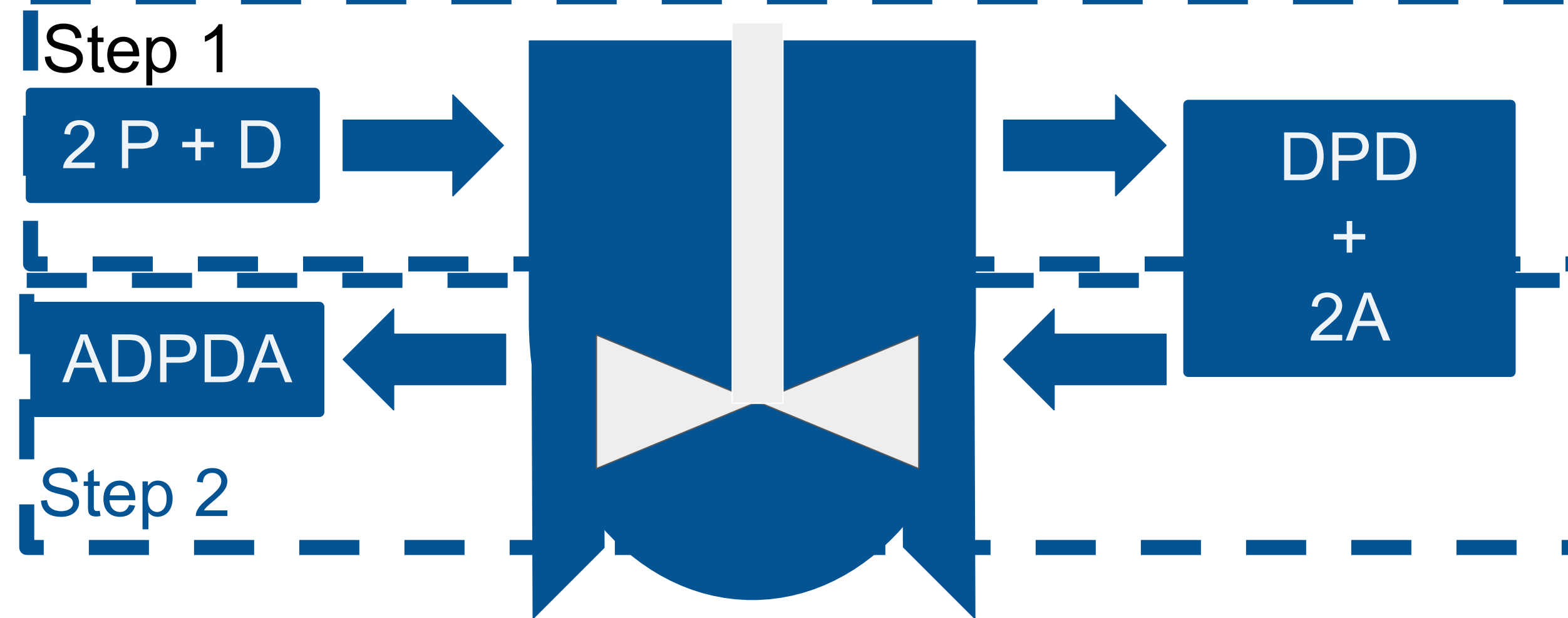
- A 2 Step, jacketed batch reaction with a highly exothermic 2nd step.
- The reaction is completed in the same batch reactor as direct addition of A occurs after step 1.

5. Kinetics

1st step - 1st order analysis
$R^2 = 0.999$

2nd Step Second Order Analysis
$R^2 = 0.9089$
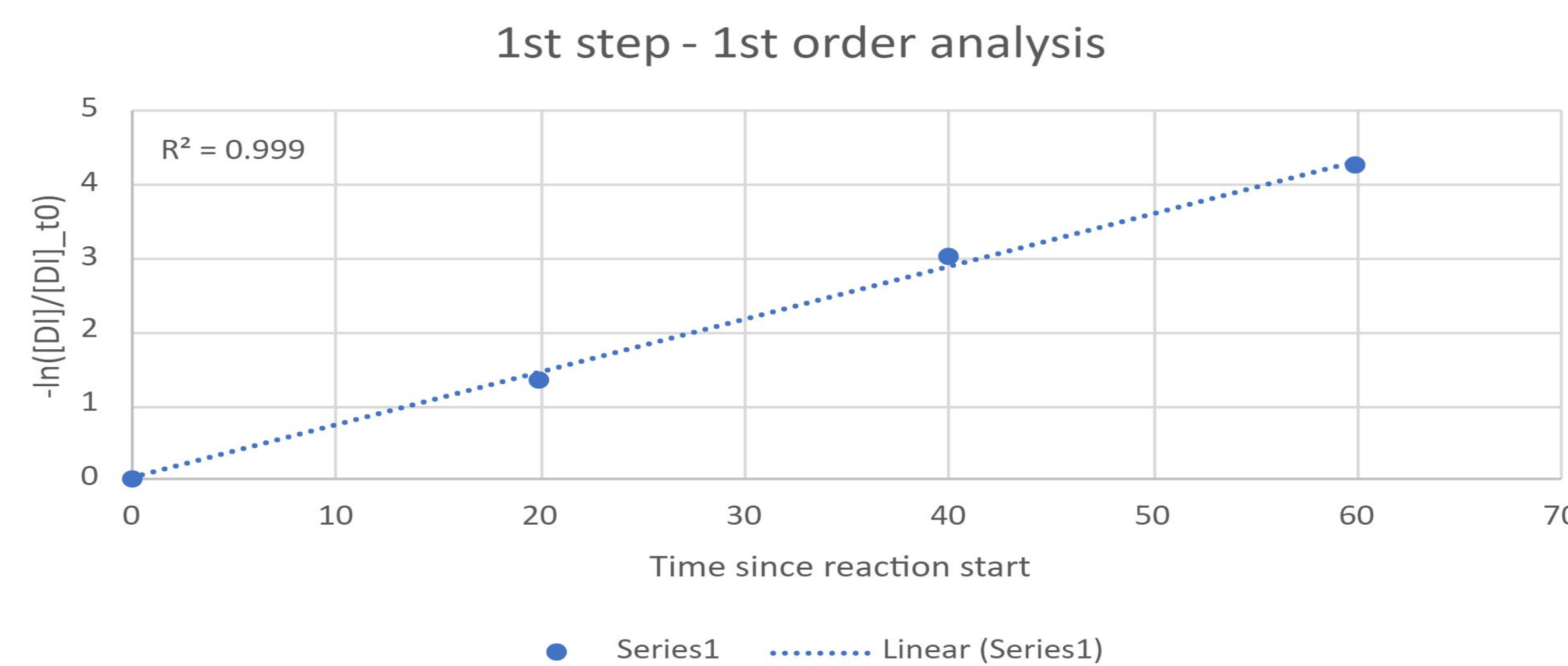
6. Results

- Jacket without Baffling resulted in slightly reduced max reaction temperature
- Impeller selection did not have significant influence on reactor volume
- Batch sizes below 10 metric tons proved to be most effective as the required heat exchange surface area wasn't an extreme value.
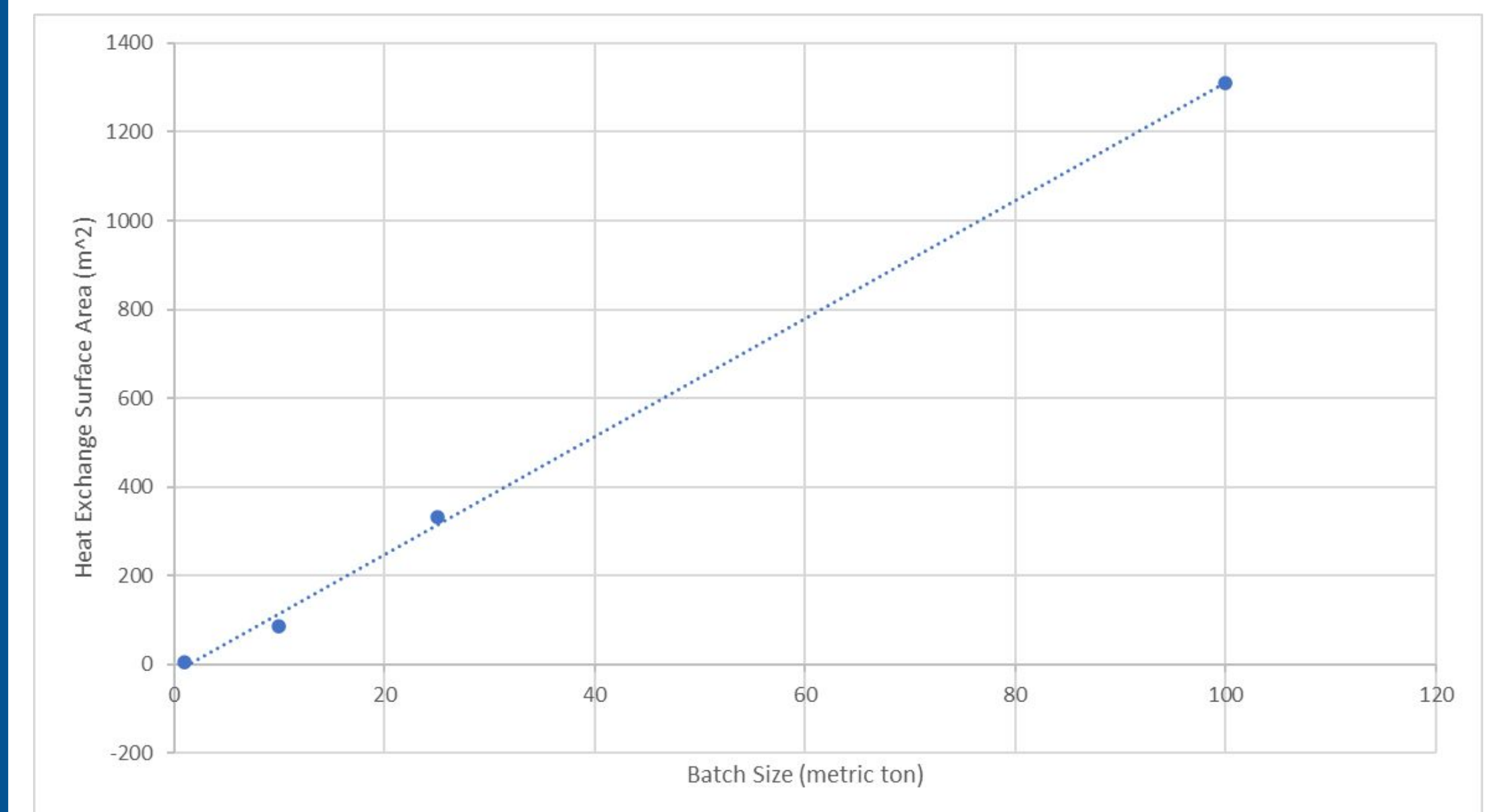
7. Recommendations

- Adjust model:
  - Allow variable cooling water flow
  - Specify cooling fluid inlet temperature rather than flow rate
  - Add practical constraints for reactor size
  - Add an internal reactor cooling element
- Max batch size is limited by the required surface area for cooling and the availability of a high-surface area internal cooling element

8. Acknowledgements