In-Line Cooling of Polyimide Fluids

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Mentor

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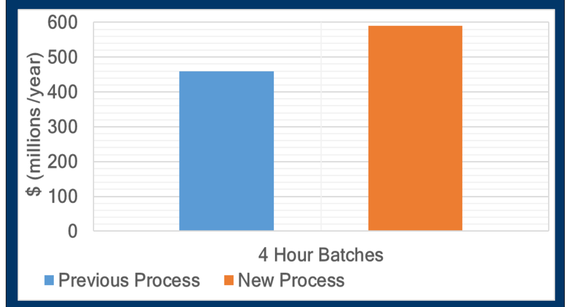
Mission Statement:

Design cooling system that will lower the polymer temperature from 53 to 40 degrees Celsius in-line, cutting down on the cooling time required for each batch while minimizing heat exchanger size.

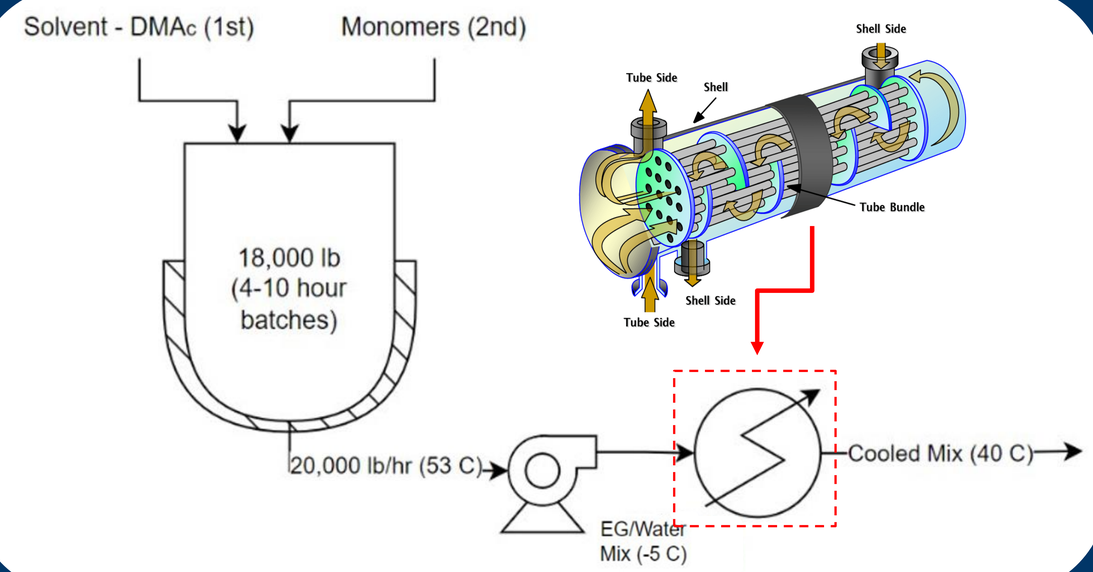
Profit: $130 Million/Year



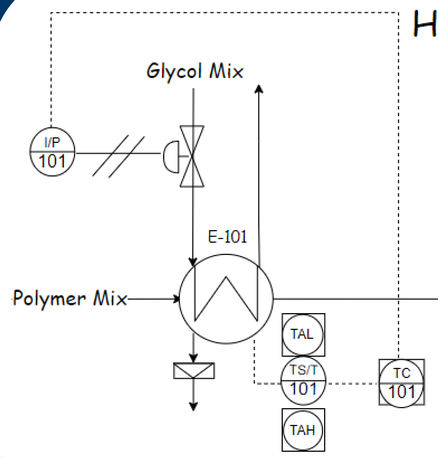
Economics

- Heat exchanger bare - module Cost: $241K
- Two batches to break even
- Enables about 280 more batches/year

Process Flow Diagram:



P & ID control scheme



Heat Exchanger Specifications

Exhanger Type: Shell and Tube
Size (Surface Area) : 125 ft^2
Heat Duty: 120,000 BTU/hr
Tube Orientation: Square
Number of Tubes: 19
Tube Length: 13 ft

Shell Inside Diameter: 2.73 ft
Shell Side: Polymer Mixture
Tube Side: 50/50 Ethylene Glycol and Water Mix
Material: Stainless Steel 317
Overall Transfer Coefficient: 20 BTU/(hr * ft^2 F)

Other areas explored:

Ideas Explored	Rejection Reasoning
Plate & Frame	High pressure drop, low heat transfer coefficient, and high maintenance.
Double Pipe	Low heat exchange, large pressure drop, too large of an area and number of bends.
Larger Jacket	Polymer is emptying so larger jacket would not excel cooling to a high enough degree.
Recycle	Unsteady state and would have to close & purge the recycle line..

Final recommendation:

- AEM TEMA specification Shell and tube heat exchanger
- Stainless Steel shell & tubes
- Maximum Pressures:
  - Shell side: 4 bar
  - Tube side: 6 bar
- Reduces cooling time from 2-3 hours to 1 hour