LyondellBasell Identifes and Addresses Slurry Deposition in Polymer Cooling System

AFT FATHOM™ CASE STUDY

Chemical and Petrochemical

Applied Flow Technology

PROBLEM

LyondellBasell engineer, Rajitha Papagari, performed a reliability study on a polymer slurry cooling system used to maintain a stable temperature in a reactor, critical to maintaining product quality.

This system had several reliability issues leading to downtime and associated maintenance costs to clean the piping. The existing system was unable to meet design requirements, potentially due to solids deposition not considered in the initial design.

ANALYSIS

Papagari approached this problem with AFT Fathom's Settling Slurry (SSL) add-on module to consider the additional hydraulic effects of slurry flow, including identifying if any areas had deposition concerns.

A model was built and validated against plant data by adjusting pipe resistances. Non-standard frictional losses, such as those through heat exchangers, were modeled using resistance curves from Pressure Loss vs. Flowrate information. The model also accommodated temperature-dependent fluid properties as the fluid was heated and cooled through heat exchangers (Figure 1).

"The original design relied on simplifying assumptions in another hydraulic modeling tool, the limitations of which were proven after an analysis with AFT Fathom's SSL module"

- Rajitha Papagari, LyondellBasell

SOLUTION

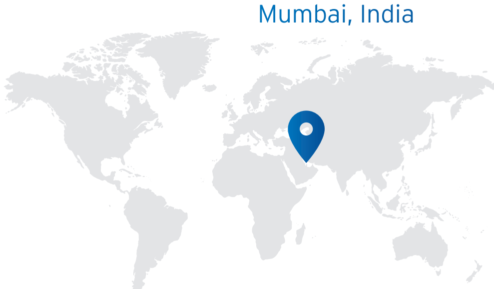
The model identified several slurry deposition areas (Figure 2) which were later confirmed by observation during a system turnaround. This deposition caused higher system losses which reduced the slurry recirculation rate and caused reliability issues.

Papagari suggested replacing a problematic 8-inch pipe with a reducer tee to maintain high fluid velocity. Along with this, other modifications on pump suction and discharge piping were suggested to reduce friction and increase circulation through pump.

These changes increased reliability by avoiding deposition and simultaneously increased recirculation rate by 15%.

The piping changes were so effective that an up-sized replacement pump to further drive flow was canceled, a capital cost savings of $435K. The improved reliability and reduced shutdowns further added approximately $247K in savings per year.

Mumbai, India



lyondellbasell
Advancing Possible

Platinum Pipe Award Winner: Most Interesting Model

ELEMENTS OF SUCCESS

The uniqueness of the polymer cooling loop application, the validation of solids deposition, and the savings from reliability improvements earned Papagari this Platinum Pipe Award.

FIGURE 1

Workspace view of the slurry cooling system, highlighting the problematic piping and the recommended replacement reducer tee to address deposition concerns.

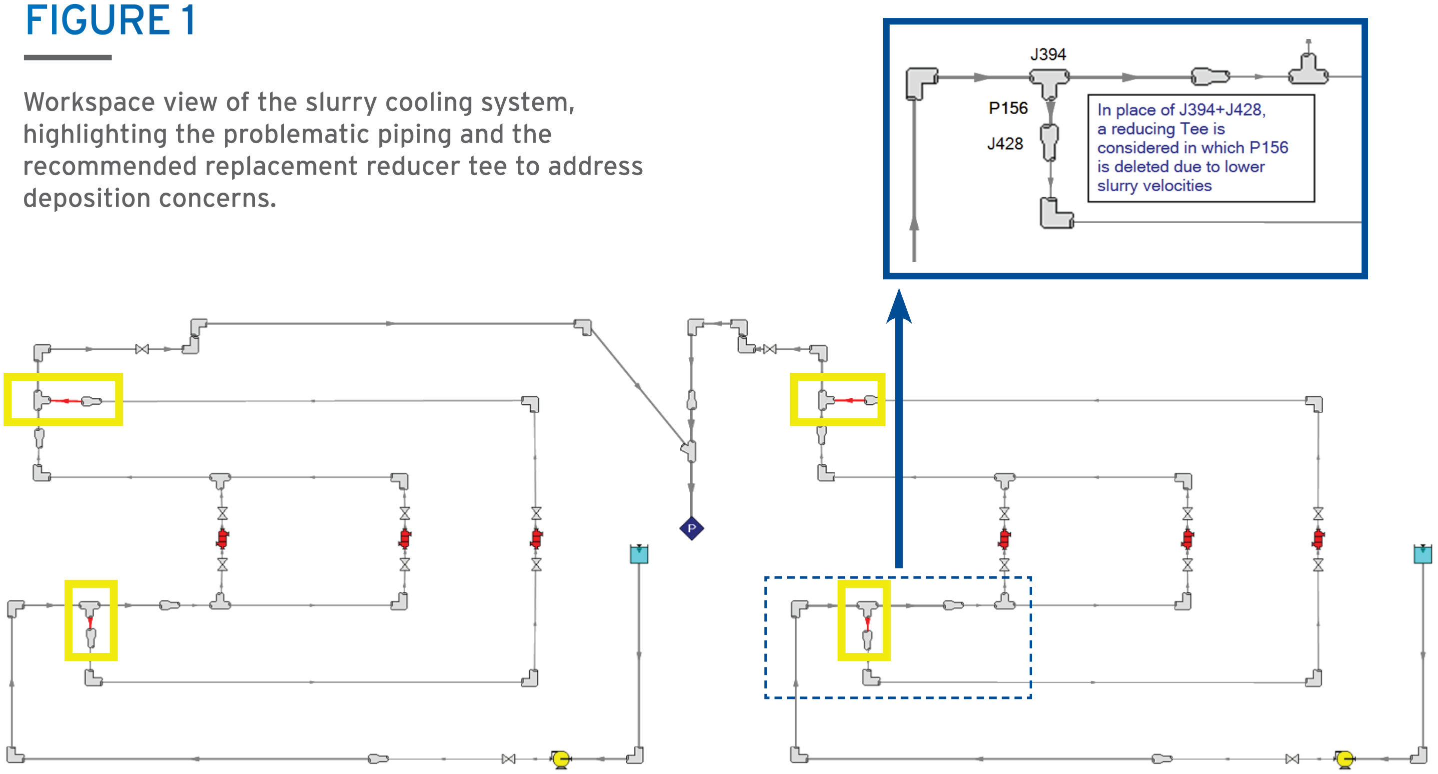


FIGURE 2

View of the deposition velocity warning provided by AFT Fathom's Settling Slurry (SSL) add-on module and settling slurry-related Output.

General | Warnings | Design Alerts | Pump Summary | Valve Summary | Heat Exchanger Summary | Reservoir Summary

Messages

For an explanation of Warnings, click an item in this list and press F1 or search for 'Warnings' in the Help system.

CAUTION

- Velocity in pipe 114 is less than the deposition velocity (Velocity: 1.113 meters/sec, Vsm: 1.901 meters/sec).
- Velocity in pipe 119 is less than the deposition velocity (Velocity: 1.113 meters/sec, Vsm: 1.901 meters/sec).
- Velocity in pipe 156 is less than the deposition velocity (Velocity: 1.138 meters/sec, Vsm: 1.902 meters/sec).
- Velocity in pipe 157 is less than the deposition velocity (Velocity: 1.138 meters/sec, Vsm: 1.902 meters/sec).

Pipes | Slurry

Pipe	Name	Im (m/100 m)	Jm (m/100 m)	Velocity (meters/sec)	Settling Velocity Maximum (meters/sec)	Vm/Vsm	dH Slurry (meters)	dP (bar)	Mass Flow Rate (kg/sec)	Vol Flow Slurry (m3/hr)	(Im - If) / (Sm - Sf)
114	Pipe	16.933	258.23	1.113	1.90081	0.5854	0.07871	0.00001915	22.14	129.3	5.8841
119	Pipe	16.933	258.23	1.113	1.90081	0.5854	0.07871	0.11775314	22.14	129.3	5.8841
156	Pipe	16.413	250.31	1.138	1.90193	0.5982	0.07630	0.00001856	22.64	132.2	5.6877
157	Pipe	16.413	250.31	1.138	1.90193	0.5982	0.07630	0.11772847	22.64	132.2	5.6877