IPST’S EVAPORATOR PERFORMANCE AUDITS HELP CHEMICAL PULP MILLS

In the kraft pulping process, evaporators routinely foul with inorganic and/or organic scale on heat transfer surfaces. This is a widespread problem that results in lost capacity and lost time for scale removal. It can also increase the overall evaporation and/or environmental load, limit pulp mill production, and reduce the steam supplied by the recovery boiler. These impacts can be immediate if the mill’s evaporation capacity is limited.

One common type of scale is soluble scale which consists of water-soluble Na$_2$SO$_4$ and Na$_2$CO$_3$ in the form of burkeite (2Na$_2$SO$_4$ · Na$_2$CO$_3$) and mixtures of burkeite and Na$_2$CO$_3$. The other common types of scale are insoluble or “hard” scale (CaCO$_3$), and mixtures of soluble scale, hard scale, and fiber. Soluble-scale fouling occurs when Na$_2$SO$_4$ and Na$_2$CO$_3$ precipitate from solution and can be described in terms of specific fouling regions, as illustrated in Figure 1. The relative composition of Na$_2$SO$_4$ and Na$_2$CO$_3$ in the black liquor determines the locations of the first and second critical solids points. These can be moved, as illustrated in Figure 2.

IPST’s Evaporator Performance Audit uses IPST’s expertise and understanding of solubility and scaling phenomena to help identify whether evaporator fouling is due to fiber, soluble scale (burkeite and/or Na$_2$CO$_3$), or insoluble or hard scale (CaCO$_3$). This diagnostic service helps mills evaluate the extent of fouling and recommends a strategy to minimize it.

![Figure 1. Simulated solubility behavior of Na$_2$SO$_4$ + Na$_2$CO$_3$ in black liquor.](image)

Project Description

To conduct an audit, IPST requires process information showing chemical stream addition points and operating conditions, plus liquor and scale samples or analyses. IPST uses this information to predict the sodium salt solubilities using proprietary software. IPST then evaluates process alternatives to increase or decrease critical solids points as shown in Figure 2.

Recommendations to control soluble scale deposition are in the form of changes in
operating guidelines, e.g., maintaining low salt levels in black liquor, keeping the Na$_2$CO$_3$ to Na$_2$SO$_4$ ratio less than three, and/or adding recycled streams after the first critical solids point where Burkeite starts to precipitate. For other types of scale, recommendations include maintaining fiber filters and soap skimmers in good working order and minimizing the input of calcium to the black liquor.

Benefits

Elimination or reduction in evaporator scaling can increase mill profitability by two hundred thousand dollars to several million dollars per year, depending on the extent of the problem and on whether the mill is evaporator limited.

Applications

Kraft evaporators.

Progress and Milestones

IPST has conducted evaporator audits at 12 mills since January 1999.

For additional information, please contact:

Chris Verrill
chris.verrill@ipst.edu
Institute of Paper Science and Technology
500 10th St., NW
Atlanta, GA 30318-5794
Phone: 404 894-5700
Fax: 404 894-IPST

Creation date: May 2001,
Updated December 2002