EFFECTS OF DECREASED WATER USE ON ENERGY USE

Scaling of Heat Transfer Surfaces

Decreased water use may increase concentrations of chemicals that exacerbate scaling problems. If increased scaling occurs on heat transfer surfaces, energy requirements may increase, although these problems are usually addressed via chemical additives.

Aluminum and silicon

In sufficient concentrations, silicon and aluminum can form sodium aluminosilicates ($NaAlSiO_4 \cdot 1/3\,Na_2X(s)$ where $X = CO_3^{2-}, SO_4^{2-}, 2OH^-$, etc.) in the evaporator area. Na-Al-Silicates form hard, glassy scales in the evaporators that reduce the heat transfer rate and are the most difficult evaporator scales to remove in kraft pulp mills. The solubility of Na-Al-Silicates in the black liquor is dependent upon the hydroxide concentration, lignin content, and the concentration of sodium and potassium ions (Ulmgren 1982, 1987).

Calcium carbonate

Deposition of calcium carbonate is a major problem in many areas of the mill that operate under alkaline conditions. Calcium carbonate exhibits an inverse solubility with temperature (i.e., the solubility of calcium carbonate decreases with increasing temperature), so scaling problems are typically encountered on heat transfer surfaces. In the bleach plant, calcium carbonate scaling can be found in alkaline stages (pH range 8-12) such as Extraction (E) and Peroxide (P) stages, on “hot” areas such as heat transfer surfaces (Berglin et al. 2002). Calcium carbonate is a persistent scaling problem in pulp digesters, typically forming in the upper heating zone and circulation heaters (Markham and Bryce 1980; Hartler and Libert 1972). Scale formation on heat transfer surfaces leads to increased steam usage in the digester. Calcium carbonate is known to form scales in the evaporation area (Grace 1977; Frederick and Grace 1979a), but can be effectively mitigated via black liquor heat treatment (Frederick and Grace 1979b).

Chlorides

Chlorides can form sticky deposits in the upper heat transfer section of the kraft recovery boiler. The chloride deposits reduce heat transfer from the hot flue gas to the water tubes, reducing net steam generation from the recovery boiler.

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