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BLACK LIQUOR EVAPORATOR / CRYSTALLIZER CONTROL PHILOSOPHY

The general control philosophy for the overall train is presented hereafter:

Primary Controls

Primary control loops are those that govern the operating rate of the system. The evaporator/concentrator system proposed has three primary control loops:

- 80%TS product liquor flow to boiler
- Steam Pressure to the REX 80 and REX 1A Heaters

Product liquor flow to the boiler will be set by the operator (based on mill objectives) and controlled automatically. The operator will also adjust the steam pressure to the REX 80 heaters as necessary to maintain the desired 80%TS liquor concentration from the system. The steam pressure controller can be selected to cascade from the product liquor density meter or the measured BPR – both measurements of liquor solids.

The operator will also adjust the steam pressure to the REX 1A heaters as necessary to maintain the desired 71%TS liquor concentration from this unit. Here again, the steam pressure controller can be selected to cascade from the liquor density meter or the measured BPR – both measurements of liquor solids.

Secondary Controls

Secondary controls are those that adjust system levels, pressures, and flows to maintain stable operation. Secondary control loops for the evaporator / crystallizer system proposed include the following:

- Liquor tanks and vapor bodies levels
- Condensate tanks levels
- REX's vapor bodies pressures
- Cooling Water Flow
- 80%TS and 72%TS liquor temperatures
- Liquor flow to ash sluicing

All four REX units in effect 1, all falling film evaporators (effects 2-6) and liquor tanks operate on "level-in" control. Process liquors are flowing to the vessels at a rate ultimately controlled by the boiler liquor firing rate (set by the operator). The "level-in" control modulates the flow from the vapor bodies or tanks to maintain the proper level.

All four REX vapor body pressures are controlled to maintain constant operating pressure and liquor temperature within the vapor bodies. This allows stable operation of these units independently of fluctuations within the rest of the train.

The 80%TS and 72%TS product liquor temperature controllers will modulate a valve in the respective flash tank vapor lines. By adjusting the amount of flash, the liquor can be controlled at the desired firing / storage temperature.

Intermediate liquor flow to the mix tank(s) is controlled at a sufficient quantity to effectively pick up and return the boiler ash.

Cooling water flow is regulated to provide the required heat sink for the evaporation system and the desired water return temperature.

Process Monitoring

Finally, instrumentation and controls are provided to monitor the system, obtain feedback on control changes, initiate alarms and interlocks, and make operating decisions. This instrumentation includes:

- Temperature Monitoring
    - Crystallizer and evaporator vapor bodies liquor
    - Crystallizer heaters liquor inlet / outlet
    - Weak liquor feed, 50%S liquor, 72%TS liquor and 80%TS product liquor
    - Crystallizer heater shells
    - Cooling water inlet/outlet
- Pressure Measurement
    - Crystallizer heater shells
    - Vapor Bodies
- Density Measurement
    - Weak liquor feed liquor
    - 50%TS and 71%TS intermediate liquors
    - 80%TS product liquor
- Conductivity Measurement
    - Steam condensate
    - Contaminated and foul process condensate

Measurement of various temperatures and pressures allows for calculation and trending of the heat transfer coefficients. The heat transfer coefficients provide a means by which to monitor the condition of the heat transfer surfaces. The boiling point rise of the liquor can also be calculated and trended from measured pressures and temperatures. The BPR provides another reliable measurement of liquor solids.