LUNDBERG

13201 Bel-Red Road
Bellevue, Washington 98005
tel: 425.283.5070
fax: 425.283.5081

COST EFFECTIVE BLACK LIQUOR OXIDATION

In recent years, Black Liquor Oxidation systems installed in the 1960's and early 1970's have begun to deteriorate due to corrosion. This is particularly true for the vessel internals and trays, etc. Concurrently, in recent years energy costs for oxidation have increased dramatically.

Based upon these two items, a new oxidation scheme offering the same oxidation efficiency, using as much existing equipment as possible, and minimizing energy consumption is desirable.

It has been found from kinetic studies of black liquor oxidation that for concentrations of Na_2S above 2 gpl, the oxidation reaction of the Na_2S is a zero order reaction. This means that the reaction rate is only dependent upon this rate of diffusion of the oxygen from the air to the Na_2S in solution. This reaction is not dependent upon the concentration of Na_2S above 2 gpl. Below 2 gpl the reaction rate becomes dependent upon the concentration of the Na_2S, i.e. a first order reaction in Na_2S.

Systems installed in the 1960's and 1970's were designed for oxidation in a well-mixed tank with the Na_2S composition approximately that of the desired residual oxidized liquor. The residual content is about 0.1 to 0.2 gpl. At this low Na_2S content, the reaction time is quite long to oxidize the sulfide in the incoming liquor and further, considerable excess air is required.

Since the reaction rate is independent of sulfide content above 2 gpl and the rate is quite fast, it is logical to approach oxidation as a two-stage system. The first stage is a completely mixed tank with the residual sulfide content of 2.0 gpl. The oxidation air for mixing ensures uniform composition throughout the first stage tank.

In the second stage, where oxidation of the sulfide reduces its concentration from 2.0 to 0.1, the reaction rate is quite dependent upon the concentration of the sulfide in the black liquor. Therefore a slug (plug) flow, non-mixing second stage unit will optimize reaction rate and minimize reaction time.

The above discussed theory is put into practice by installing a two-stage system. Typically, if the existing tank is mechanically sound, a second tank is installed concentrically around the first. The first tank then acts as a completely sparged mixed reactor and the annular region between the two tanks acts as the sparged plug (slug) flow region.

Benefits of the Modified Two-Stage System

1. Reduced energy consumption since large excess air requirements are not needed.
2. Utilization of existing tankage foundations since reaction rates are increased.
3. Increased capacity of existing equipment because of high reaction rates.