

CARRIER, DANIEL J., The Amalgamated Sugar Company LLC, Nyssa Plant, 105 East Main St., Nyssa, OR 97913. **Flue gas scrubber water de-calcification.**

ABSTRACT

The Nyssa Oregon facility, in compliance with a *Mutual Agreement and Order* with the Oregon Department of Environmental Quality and due to operational restrictions of the factory was required to build a segregated scrubber water loop consisting of a 5 million gallon lined (HDPE 80 mil) settling lagoon and pumping system. The scrubber water was used to scrub particulate and sulphur dioxide emissions from three coal fired pulp dryer stacks and one coal fired boiler stack. The fly ash scrubbed and settled in the lagoon has a calcium constituent which is soluble and dissolves into the scrubber water as the fly ash soaks in the settling lagoon. Sulphur dioxide scrubbed from the flue gas oxidizes and combines with the calcium leaching from the settled fly ash in the lagoon to form calcium sulfate in solution. The process of volumetric reduction of the water by evaporation ash accumulation and the addition of calcium and sulphur dioxide from scrubbing caused the solubility point of the calcium sulfate in the scrubber water system to reach saturation in 22 days of operation. The reverse solubility properties of calcium sulfate caused the precipitation of calcium sulfate (gypsum) scale on the surface of the dryer and boiler wet scrubbers due to the heat of flue gas. This accumulation of calcium sulfate scale caused significant operational difficulties and related down time for maintenance. Another concern was the additional loading to the structural steel supporting the dryer scrubbers. The density of the scale was 120 to 140 lbs./cu-ft. With scale formation reaching thicknesses of 2 to 3 inches, 10 to 20 tons of additional weight could potentially be added to the structure. Through experimental and empirical determination, a process called *Lime Soda Softening* was found to be the most efficient and economical method to de-calcify the scrubber water. A 35,000 gallon batch reactor tank and agitator is used to receive 30,000 gallons of scrubber water. A 1,000 gallon batch lime slurry system is used to raise the scrubber water batch to approximately 10.3 pH, this is pH point at which calcium carbonate in solution will precipitate. A 1,000 gallon batch soda ash dilution system is used to add the carbonate needed for the calcium to break free from the sulfate and form calcium carbonate and precipitate. A anionic polymer flocking aid was used to enhance settling of the precipitate. The sulfate is tied up with the sodium and is highly soluble and will remain in solution to very heavy concentrations ($\text{CaSO}_4 + \text{Na}_2\text{CO}_3 = \text{CaCO}_3\downarrow + \text{Na}_2\text{SO}_4$). Free calcium also forms calcium carbonate and is precipitated ($\text{Ca}^{2+} + \text{Na}_2\text{CO}_3 = \text{CaCO}_3\downarrow + 2\text{Na}^+$). 80 to 140 grains per gallon (343 to 600 pounds per batch) of calcium hardness are removed. The softened water at a hardness of 5 to 20 grains per gallons is decanted and returned to the scrubber water loop. A CO_2 gassing tank was installed to polish the water or adjust pH if required. The calcium carbonate mud is slurried and pumped to the flume mud pond and the process is started again. Six batches a day was required to maintain the system at a 140 to 160 grain per gallon hardness.