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ClO_2 (chlorine dioxide) Scrubber Repack with Q-PAC

$80,000+ per Year Power Cost Reduction
Packing Proves to be Anti-Fouling / Self Cleaning
Major CO_2 Emission Reduction Achieved
Two Year Repacking Eliminated
ClO_2 Emissions Below Detectable Level

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Introduction

Chlorine dioxide, ClO_2, is widely used to bleach wood pulps at kraft pulp mills. Papers produced from such pulps have the high whiteness demanded by paper consumers. ClO_2 achieves high whiteness at reasonable costs. Additionally, wood fibers bleached using ClO_2 have superior physical properties of burst, tear, tensile strength and viscosity compared to wood fibers bleached with alternate chemicals [1]. The USA EPA has therefore designated ClO_2 bleaching as a BAT (Best Available Technology) [2]. Chlorine dioxide bleaching is also widely accepted by European pulp mills as the best method to produce strong, white paper and remain environmentally friendly [3] by allowing for 'elemental chlorine free' (ECF) bleaching of the wood fibers.

The primary alternate bleaching technology available to a kraft pulp mill is 'total chlorine free' (TCF) bleaching. This alternate bleaching technology is known to produce inferior papers of poor tensile strength. If adopted by the entire wood pulping industry in North America, it is estimated TCF bleaching would require additional harvest of 100 million trees per year to compensate for inferior strength papers that would result [2]. TCF pulping vs. chlorine dioxide bleaching therefore means more scenes such as Figure 1.

Figure 1. A log truck leaving the Dixie National Forest [4].

Chlorine dioxide yields high brightness pulps of good strength due to the fact that it is an extremely powerful oxidizing agent. ClO_2 is always produced on site for immediate use in the bleaching process [5]. The threshold limit value (TLV) for exposure to ClO_2 is 0.1 ppm_v [6]. The short term exposure limit (STEL) of ClO_2 is 0.3 ppm_v [7]. Therefore emissions of chlorine dioxide to atmosphere must be prevented. Most pulp mills prevent these emissions by using a packed bed wet scrubber. In this unit operation the ClO_2 is absorbed into white liquor as gas containing chlorine dioxide passes up through the packed bed and the liquor passes down through the packing.

The packing choice in a scrubber is a critical for optimal tower performance. The absorption (removal) efficiency of the ClO_2 is directly proportional to the ability of the packing to support efficient gas / liquid contact.

The ClO_2 Wet Bed Packed Scrubber

The packed tower at the pulp mill is 12.5 ft diameter. It treats 45,000 cfm of air containing trace levels of ClO_2. The chlorine dioxide is absorbed by a 2400 gpm flow of white liquor passing the tower. The tower has two, 30 ft packed beds. The original packing in the tower was 2” Kynar saddles in the lower 30 ft packed bed and 3” CVPC saddles in the upper 30 ft packed bed.

Historically, this scrubber operated at a pressure drop of 30 inches Water Column. White liquor does contain a variable amount of suspended solids, so over time the saddles would plug. On average, as a result of this constant fouling of the saddles, the ClO_2 scrubber was repacked with new saddles every two years. The two year schedule was adhered to because the pressure drop of the saddles constantly rose during the two years of service. The mill reported that 38 in WC pressure drop was not uncommon for two year old saddles.

Q-PAC Supplied by Lantec Products

Introduced to industry in 1996, Q-PAC achieves far superior gas / liquid contact than is possible with old, traditional packings such as saddles. Note that in Figure 2 that the design of Q-PAC is all rounded surfaces, with many needles to force the scrubbing liquor to break into a torrential shower of droplets as the liquor passes the packed bed.

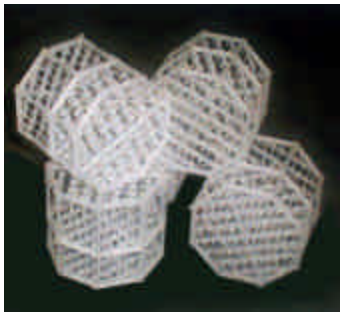

Figure 2. Q-PAC tower packing supplied by Lantec Products.

Pulp Mill Replaces Saddles with Q-PAC in October of 2001

Tired of the cost and effort required to replace fouled saddles every two years, in October of 2001 the mill took out their two year old saddles during their normal maintenance shutdown. But rather than a simple repack with new saddles, the mill loaded the tower with Q-PAC made from Kynar.

The result was, without exaggeration, spectacular:

Chlorine Dioxide Scrubber Tower

	With Saddles	**With Q-PAC**
Air Flow	45,000 cfm	45,000 cfm
Packed Depth	60 ft	60 ft
ΔP	30 in WC*	**4 in WC**
Fan hp	570	**300**
ClO_2 Emissions	Within Permit	**Non-detectable**

*Pressure drop observed with new, clean saddles, note previous discussion noting that after two years normal service pressure drop routinely rose to 38 in WC.

Power Savings

Every hp represents a fixed electric power cost power cost per year. Using data published by the Electric Power Research Institute [8] the direct result of eliminating 270 hp at the SAPPI mill has been a

power savings of $80,000+ per year.

Carbon Emissions Reduction

Additionally, each kWh generated in the USA results in the release of 1.341 pounds of CO_2 [9] to the atmosphere. This means that the mill has helped to reduce greenhouse gas emissions:

270 hp (0.746 hp/kWh) (24 hours/day) (340 operating days/year) (1.341 # CO_2/kWh) =
2.205 million pounds per year CO_2 GHG emission reduction

Two Year Project Update

The passing of the two year anniversary of Q-PAC in service in the ClO_2 scrubber was uneventful. No increase in pressure drop has been observed, no fouling of the packing is evident. The mill continues to enjoy the lowered power cost, lowered carbon emissions of Q-PAC on a daily basis. **No need to repack the scrubber will likely exist for many years to come**. The total $225,000 + cost of the project has easily been returned to the mill and continued savings are assured.

References

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