Greif uses a full-system boilout at its zero-discharge Massillon, Ohio, mill to control biological and other deposits, with the added benefit of increased production

Unique Cleaning Process Solves Biological Control Problem for Greif

By JOHN SCHWAMBERGER and LEE WORMSBAKER

Greif Inc. is a leader in industrial packaging products and services. The company manufactures steel, plastic, fiber, corrugated and multi-wall containers as well as and protective packaging for various industries. Greif has more than 160 operating locations in more than 40 countries.

Greif's containerboard mills in Amherst, Vir., and Massillon, Ohio, manufacture semi-chemical and recycled medium and recycled linerboard. The Massillon mill manufactures 140,000 tpy of 100% recycled No. 21, 23, 26 and 33 medium. The mill operates two fourdrinier top former paper machines with width of 110 and 150 in., respectively. The stock prep area is a modern OCC recycling facility that was rebuilt in 2003.

In spring 2005, the mill's two paper machines had to shut down every couple of days to wash up because of slime breaks. Biocide use was increased, but it still had minimal effectiveness.

The mill had no wastewater discharge to any body of water or wastewater treatment facility. The only means of water removal was atmospheric evaporation.

A complete boilout and wet end cleaning of the machine was the obvious solution. However, because the mill had no means of discharge, such a solution had not been viable historically.

Greif worked in conjunction with JohnsonDiversey, which focuses on mill cleaning and deposit control. A method was needed that would remove biological and other deposits from the machine system. JohnsonDiversey worked with Greif to develop a plan for a zero-discharge, full-system boilout, a unique procedure for a paper mill.

To successfully complete a boilout where the spent cleaning solution remained in the system after startup, the cleaning chemistry had to be selected carefully. It would have to be invisible to the paper making process parameters after restart of the machine. A product was proposed for the boilout that would meet such parameters and also be an effective cleaner. It was built around a stabilized hydrogen peroxide system. The peroxide along with detergent and co-solvent provided the ideal combination to break down the soils encountered without leaving cleaner residues with a high pH.

One of the benefits of hydrogen peroxide is that it breaks down organic soils. Also, it converts into oxygen and water during chemical reaction. After reaction with organic soils in the system, the spent boilout solution will be near neutral pH. Another benefit is that this cleaning product is effective against the products of biofouling, eliminating them from the system without the use of harsh or legally-restricted chemistry.

The safety profile of the product allowed mill personnel to work in the area of the boilout with no personal protective equipment other than gloves, conventional safety glasses and ear protection.

To successfully implement the complex boilout, a team was formed including people with an understanding of the Greif processes, experience with complex boilouts, and sound understanding of the chemistry involved. Greif's most experienced operations personnel, mill production managers along with JohnsonDiversey's sales and technical support personnel worked together to consider various ideas until a final plan was developed.

Both Machines Included

Given the complexity of the system, project leaders decided to include both machines in a total system boilout. It would incorporate the entire system except for the high-density stock chest. It would be done in three stages, which would eventually blend together into a single full-mill recirculation.

The first stage was initiated by circulating through the whitewater recovery system, which recovers the raw whitewater and clarifies a portion of it using a Sweco screen and Krofta flotation clarifier. The second stage circulated through the repulping and stock preparation area, which includes the hydrapulper, fiber screening, thickening, and the associated stock and whitewater chests. The final loop circulated from the unrefined stock chest, through the refiners, and to both paper machine thin stock systems. The three separate circulation loops were then allowed to merge to result in a boilout encompassing the full system with the exception of the high-density stock chest and the whitewater surge chest. During the boilout, the whitewater surge chest served as a location where liquid could be sent to or from to adjust chest levels.

The peroxide residual, pH and temperature were monitored throughout. The pH was initially elevated with a small amount of sodium hydroxide to accelerate the cleaning product's release of hydrogen peroxide. As expected, the pH had returned to the machine's near-normal operating pH by the end of the boilout.

Near the conclusion of the boilout, the mill's defoamer pumps were turned on to help break the remaining foam. Finally, the spent solution was pumped to the whitewater surge chest to conclude the boilout.

In addition to the boilout, deposits and biological growth were removed from the surfaces of the wet end of the machine, including the forming tables, the top wire formers and the

FIGURE 1.

The three-stage boilout process

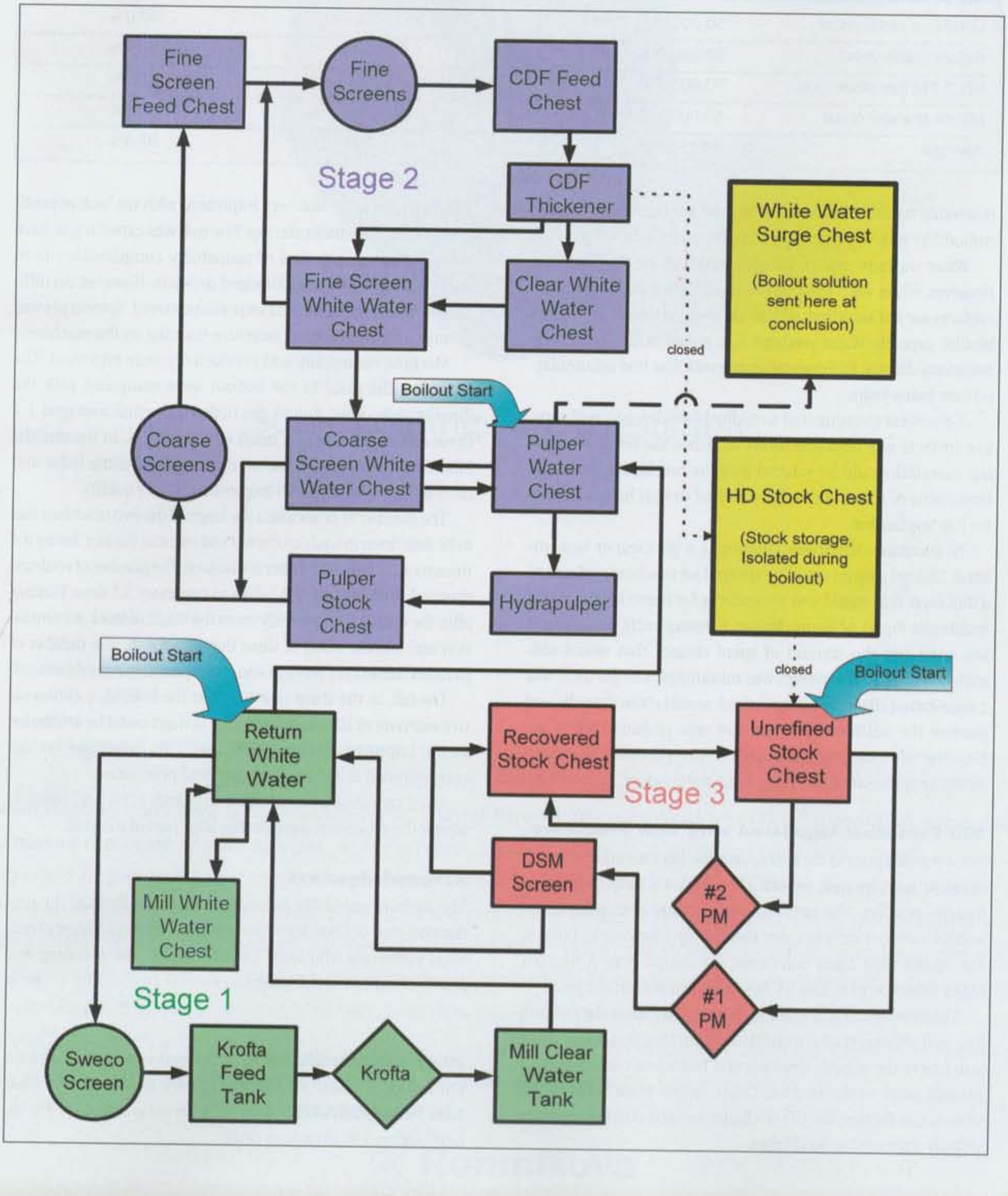

TABLE 1.

Comparison of aerobic bacteria counts before and after the boilout
3M Aerobic Pertifilm, incubation of 48-hours at 98° F

Sample Location	Bacteria Counts Three Days Prior to Boilout	Bacteria Counts 24-hours After Startup Following the Boilout	% Reduction
Unrefined stock chest	50,000,000	500,000	99.0%
Return water chest	38,000,000	1,000,000	97.4%
No. 2 PM thin stock loop	70,000,000	3,000,000	95.7%
Mill clear water chest	53,000,000	1,000,000	98.1%
Average	52,750,000	1,375,000	97.4%

machines' frames. If this deposition had not been removed, the runnability improvement may have been limited.

Water washups were a common practice on the machine. However, while such cleanups remove visible deposition, the surfaces are not sanitized, which can lead to faster re-growth of biofilm deposits. Water washups also would not remove more tenacious organic and inorganic deposits that had accumulated over many years.

A chemical cleaning that would remove deposits and sanitize surfaces was desirable. However, since the residual cleaning chemical would be washed into the machine system, the limitations of a zero discharge mill had to also be considered for this application.

To accommodate these limitations a gel cleaner was utilized. This gel cleaner could be sprayed on machine surfaces as a thin layer that would stay on surfaces for much longer than a traditional liquid or foam cleaner. Consequently, less cleaner was used and the amount of spent cleaner that would ultimately end up in the system was minimized. The gel used was a chlorinated alkaline product, which would clean the soils and sanitize the surfaces. The wet end was isolated during gel cleaning with caution tape, and proper personal protective equipment was worn when applying the product.

Mill Personnel Impressed with New Procedure

In the months prior to the boilout, aerobic bacteria enumerations of system samples were periodically completed using 3M aerobic bacteria Petrifilm. The last test date was three days prior to the boilout. Twenty-four hours after the start-up following the boilout, the counts were again completed for comparison. A bacteria count reduction of at least 95.7% was shown at each test point.

The headbox of one machine was opened after the boilout. The mill personnel who inspected it indicated that it was clean and free of the organic deposits and biological contamination present prior to the boilout. Other visible areas such as the whitewater flumes, the CD thickener screens and the repulper visually appeared to be cleaner.

Mill supervision was very impressed with the lack of problems at the subsequent startup. The mill was expecting to have to work through a period of runnability complications from water quality issues and dislodged deposits. However, no difficulties related to the boilout were encountered. System pH was normal, and there was no excessive foaming on the machines.

Machine runnability and productivity were improved. The three months prior to the boilout were compared with the three months after. Before the boilout, the mill averaged 1-2 sheet splices per day as a result of slime holes. In the months following the boilout, there were no reported slime holes and no resulting splices, which improved product quality.

The number of times when the larger of the two machines had to be shut down to wash up the wet end was also tracked during the three months before and after the boilout. The number of washups dropped from one every 3.1 days to one every 5.3 days. Washup after the outage was generally more the result of stock accumulation and less the result of slime deposit growth. The number of minutes needed per washup was also reported to have decreased.

Overall, in the three months after the boilout, a conservative estimate of 10 hours downtime savings could be attributed to the improved system cleanliness. This downtime savings corresponded to 150 tons of additional production.

Greif repeated the procedure in March 2006, and plans to repeat the procedure again in the later part of the year.

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JOHN SCHWAMBERGER *is the paper chemicals division marketing manager for JohnsonDiversey in Sharonville, Ohio.* **LEE WORMSBAKER** *is paper mill superintendent for the Greif Inc. mill in Massillon, Ohio.*