Reducing Culled Paper by Improving Upstream Dirt Inspection Methods

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Abstract

Domtar Industries mill in Port Edwards, Wisconsin targeted dirt reduction in their premium white paper grades as a priority for quality improvement. In the spring of 2003, key customers demanded a significantly lower dirt specification. It was quickly discovered that the existing method to inspect pulp for dirt and shives was not sensitive enough to predict dirt problems at the new specification level, resulting in a cull rate of around 200 tons per year of high value paper grades. The existing inspection method was difficult for bleach plant operators to consistently detect small particles that were now considered unacceptable in the brighter grades.

In order to address this problem, pulp mill operations staff initiated an appropriation request for a new dirt testing system that promised to consistently and accurately identify dirt at a level that predicted final dirt count when running premium white paper grades. The basic idea of this system is to filter dirt from a pulp sample and then use electronic scanning to provide an accurate and repeatable measurement of the dirt in each sample. Only a couple of minutes is required on the part of operators for each test, so tests can be performed at several stages in the pulping process, which aids in pinpointing the cause of problems. Since the new system was implemented, the Port Edwards mill has not lost a single reel of paper due to dirt attributable to the pulpmill.

Demanding quality standards

The Port Edwards mill has four paper machines, 720 employees, and a capacity of 550 tons per day. It produces uncoated freesheet paper, uncoated

premium, specialty, and technical business papers. The integrated Sulfite pulp mill maintains very high environmental standards by using a three-stage totally chlorine free (TCF) bleaching process. Because this process is not as aggressive as chlorine-based bleaching, it's very sensitive to bark carryover from the chipping process. The cleanliness requirements for Domtar's' premium text, cover and opaques are very stringent, especially the Carrara White line, an exceptionally high brightness white paper that is used for annual reports and other high profile publications. Domtar's demanding quality control inspectors will cull paper of this grade with even very small specks of dirt.

The previous inspection process began when operators made a pulp pad and counted the specks using the TAPPI measurement standards. The type of dirt that is seen most often is a light yellow speck that comes from the inner bark. These specks are easy to see on a finished white sheet but difficult to detect in a pulp pad. There were several occasions where the pulp pad showed a low dirt count but the paper mill rejected paper because of visible dirt in the sheet. If the problem was identified earlier then the pulp could have been diverted to storage supporting colored paper or a textured white grade where it would easily meet the dirt specification. We started looking for a more sensitive and repeatable method to detect dirt in the pulp so we could avoid surprises on the paper machines.

We considered several options. We knew of other mills that use an electronic scanner to inspect a pulp hand sheet but we were not comfortable with the results they were getting. Variations on the sample size, sheet mould, and testing frequency were also ineffective. Concurrently, we were also trying to optimize the screening and cleaning system to reduce dirt carryover to the bleach plant. An older Pulmac Shive Analyzer was being used for this study. We had the idea to try the bleached pulp samples on the shive analyzer and found we were able to effectively separate the dirt from the bleached pulp and make a repeatable dirt count test. We then approached Cowan Technologies about purchasing a system for dirt testing and found they had made several improvements to the analyzer and had already developed the scanner technology for recycle pulp applications. Cowan Technologies then ran tests with our sulfite pulp on a Pulmac MasterScreen and DirtScan100 instruments to determine the best screen slot size, analyzer sequence timing and scanner settings. We found that they demonstrated a substantially higher sensitivity to dirt than any other procedure we have tried. We initiated an appropriation request and obtained

management approval to purchase the testing system. The new system was installed in December of 2003.

Preparing the sample

The new inspection process works as follows. Operators collect a sample of approximately 50 grams of oven dried equivalent pulp stock then push the start button on the analyzer to initiate the testing sequence. The instrument automatically provides water into the feed tank. When the water reaches a specified level, an air mixer kicks in, and the operator pours the stock into the MasterScreen instrument. At this point they can leave the instrument unattended and go on to another task. When the water level reaches the top of the feed tank, it triggers another sensor that stops the inflow of water and the screening cycle begins. A valve opens and a charge of pulp is metered into the screening chamber for 4 seconds followed by 15 seconds of screening.

Fibers are carried through a screen plate while debris is retained in the screening chamber. A backflow though a hydrorotor prevents plugging of the screen plate. The metering and screening cycles continue until the slurry level reaches the bottom level control probes. The MasterScreen then enters the final screening cycle that ensures all the fiber has been accepted through the screen plate. The .004” slotted screen plate easily passes the sulfite hardwood fibers, but captures larger dirt particles. When the screening is completed, a discharge valve opens and contaminants are discharged on to an 8-inch diameter filter pad. A vacuum system then removes the excess water. The operator removes the filter pad and places it on a blotter to damp dry for two minutes.

Performing the dirt count

The operator brings the damp dry pad to the DirtScan 100 and places it dirt side down on the scanner bed. A dedicated personal computer handles the scanning sequence, imaging analysis and data reporting functions. The operator selects the sample identification tag from a drop-down list and then clicks on a button to start the scan. The software analyzes the scan and displays several parameters such as total dirt count, total area of dirt particles, and average particle size. A reference test sheet is also available to verify the calibration of the scanner. Data from all tests is presented to the operator via the monitor and stored on the hard drive. Operators take pulp

samples every other hour at the first stage of the bleaching process and every hour at the last stage of the bleaching process and from the high-density storage tank. Taking samples at these different stages of the pulping process is designed to provide early warning of the presence of dirt, and to help troubleshoot the process.

Implementation of the new analyzer system

There were a few initial operational issues to resolve with the MasterScreen and DirtScan100 Analyzer. The sensitivity of the image analysis was tuned to focus on the yellowish inner bark that caused most of the problems and ignore the environmental dust and shadows from wrinkles of the damp filter pad. Cowan Technologies also "hardened" the off-the-shelf office scanner by sealing the glass bed to prevent moisture from entering the scanner. Since the startup bugs were worked out, the system has operated reliably for nearly two years of continuous service with only a couple of minor valve and gasket type repairs.

Advantages of new inspection method

Reliable changes in the dirt count test and visual inspection of the dirt have led to improved troubleshooting of process problems and more consistent pulp quality. Because the analyzer physically separates the dirt from the pulp sample, it is much easier to analyze for troubleshooting the process. Experience from visual inspection of dirt pads has led to quick identification of process problems. Characteristic types of dirt can point to problems in the chip plant, brownstock cleaning and screening areas, or within the bleachplant. The ability of the analyzer to handle larger sample sizes has also improved the reliability of the test.

The MasterScreen separates out all of the dirt in a 50 O.D. gram pulp sample. This gives a more representative sample than looking at just the surface of a 10 gram pad. From the first tests it was clear that we were able to do a much better job of detecting dirt. Our comparison showed that, on average, the operator was able to identify 40% more dirt by looking at the filter pad prepared by the MasterScreen (on the same size pulp sample) than by looking at the hand sheet pad. The new system also identified several dirt problems during the initial testing period that did not show up in the hand sheets.

The information provided by the dirt analyzer has also helped the mill to make substantial improvements by identifying problems that had been difficult to isolate in the past. For example, improved testing helped to confirm that a particular wood species was responsible for most of the bark carryover issue. This provided justification to change our wood purchase specification. Intermittent bark carryover issues are spotted sooner, allowing improved communication to the chip plant operators. Issues in the screenroom have been detected earlier by seeing the characteristic dirt on the pads in the first bleaching stage.

Most importantly, the new inspection method has demonstrated the ability to reliably reduce papermaking problems. Since we began using the new analyzer as our primary dirt inspection tool, we have not culled any paper for dirt from our pulping process. Savings attributed to avoiding culled paper are on the order of $100,000/yr. By being able to detect dirt at much finer levels, we have made major strides towards eliminating it from our chipping and pulping processes.