WEYERHAEUSER REBUILD OF BARK FEED SYSTEM CUTS POWER BOILER DOWNTIME

Solving problems such as pitch variance, product variance, and stress corrosion cracking in screw feeder system reduces maintenance costs

By JOHN ALMAREZ

Weyerhaeuser Paper Co.'s Valliant, Okla., mill generates approximately 50% of its own power and purchases the remainder as needed. Obviously, one of the lowest-cost fuels for the mill's power boiler is bark from the woodyard operations, which means that reliability of the bark feed system is vital if the Valliant operation is to remain cost-competitive.

In the past, downtime due to screw failures in the 16-screw, live-bottom bark bin feeding the boiler was very costly. To help solve this intolerable problem, Weyerhaeuser contracted the Conveyor Div. of Martin Sprocket & Gear Inc. After a thorough analysis of the failures, modifications were made to the bark bin feed system to eliminate system malfunctions and breakdowns.

The bark bin feeds 50 tons/hour of 4-in. hogged bark directly into the bark boiler. The bark originates from ground storage and is conveyed into the powerhouse via a belt conveyor system.

PITCH VARIANCE. The live bottom was comprised of four sets of screws, with each set having four screws. Each set had a 10-hp drive at 6 rpm. Two sets had right-hand screws and two had left-hand screws. The screws were originally furnished with conventional variable-pitch design. These were 13-in.-dia screws with pitches starting at approximately 4 in. and increasing to 8.5 in. or 11.5 in. at the discharge area. Inconsistent pitches of 8.5 in. to 11.5 in. inside the bin caused variable capacities in screws directly connected to one another via the roller-chain sprockets. Some screws were performing more work than others, which caused excessive torque and thrust on the longer-pitch screws. Variable thrust caused misalignment in the sprocket drivetrain and caused roller-chain and sprocket failures. And variable torque caused premature fatigue and increased torque requirements on one or two screws instead of distributing the required torque over the four screws equally.

Solution. The variable-pitch design has been used for years to obtain uniform withdrawal from a bin. Problems occur when an attempt is made to convey particles that can bridge over the smaller pitches. This application requires that manufacturers hold closer-than-standard pitch tolerances. To eliminate the pitch variance problem, the screws were remade with a consistent 11.5-in. pitch and a tolerance of ±¼ in. To draw the material across the bin uniformly, the "cone screw" design is used. The cone screw has many advantages other than just eliminating the bridging. It helps distribute the work evenly among all four screws in each drivetrain. This additionally helps to eliminate variable thrust, which helps reduce premature roller-chain and sprocket failures.

RIGHT-HAND/LEFT-HAND SCREWS. The original design using right-hand and left-hand screws caused confusion when replacements were needed. It is somewhat difficult to tell the difference between a right-hand and left-hand variable-pitch screw visually, especially in the middle of the night when a failure might occur. If a right-hand screw was installed where a left-hand screw should be, or vice versa, the product would flow in the opposite direction and cause pipe, flight, or shaft failure. Use of right-hand and left-hand screws also doubled the necessary inventory costs because the mill had to carry both hands in stock.

Solution. In handling bark or woodchips, the use of right-hand and left-hand screws is not necessary. Replacement screws were all changed to right-hand screws to eliminate double inventories and visual confusion by maintenance personnel.

PRODUCT VARIANCE. Bark was fed directly from ground storage. Bark density weighed 20 lb to 25 lb/ft^3 dry but would weigh as much as 40 lb to 50 lb/ft^3 wet. During the rainy season, wet conditions created added torque requirements and assisted the bark in bridging over the narrow 4-in. variable-pitch flights. This again caused uneven torque and thrust distribution. Obviously, failures were more prevalent when it rained or when the bark otherwise became wet.

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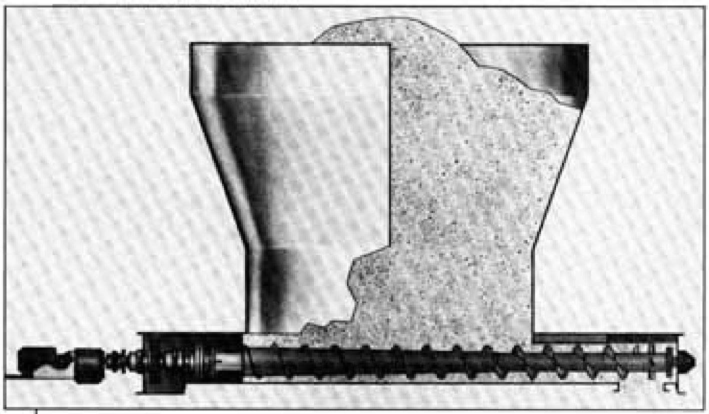
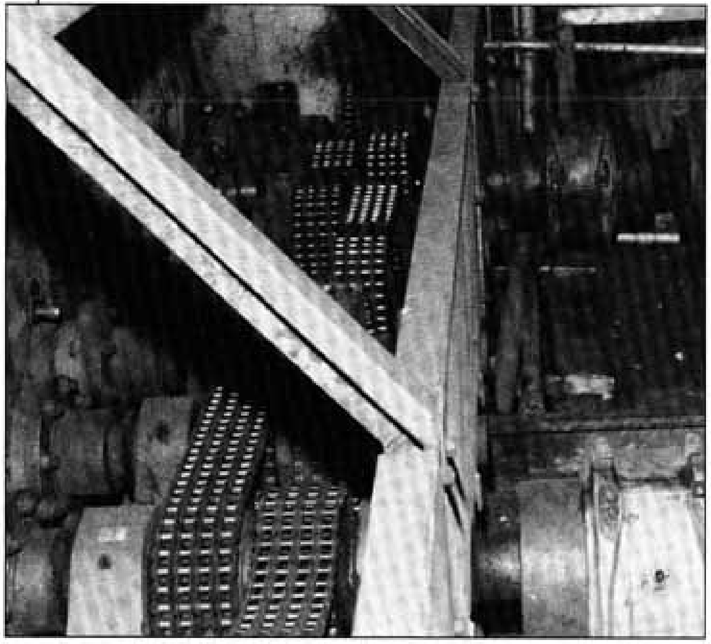
Solution. Little can be done to combat wet and dry conditions due to ground storage. Wet bark has a tendency to pack and bridge more than dry bark. But even dry bark will bridge the narrow 4-in. variable-pitch flights if a high percentage of 4-in. particles are prevalent. Therefore, pitches must be widened to 11.5-in. but must draw uniformly across the bin. This was accomplished by using the cone-screw design. "Grabber" teeth can be added to the outside diameter of the screws to help break up the bridge and allow the bark to fall into the screw to eliminate tunneling. Obviously, the horsepower requirements should be considered under the worst conditions using 40-lb to 50-lb/ft^3 density. Shaft upgrade may be necessary (i.e., consider 4140 instead of C1018, which is most commonly used).

FIGURE 1: **Martin Sprocket & Gear Inc.'s live-bottom bin arrangement eliminated system malfunctions and breakdown at the Valliant, Okla., mill.**





Variable thrust caused misalignment in the sprocket drivetrain and caused roller chain and sprocket failures. A cone screw design was used to eliminate variable thrust, which helped reduce premature roller chain and sprocket failures.

STRESS CORROSION CRACKING. The corrosive nature of the wet bark contributed to the failure of welds in the flights and especially on the pipe flanges. But many failures of equipment and components can be traced to residual surface tensile stresses that cannot, in any practical manner, be allowed for in original designs. These stresses are induced during manufacture of the equipment, regardless of the metal or alloy. Welding, drilling, threading, grinding or bending, and wrapping are examples of operations that create residual surface tensile stresses. In short, the screw pipes, flanges, and drive shafts all had manufacturing tensile stresses, and, when these components were subjected to continual weight or pressure and to cyclic loading, the stress cracking problems occurred prematurely. Pipe flanges were failing at a rate of almost every two to three weeks, particularly on the main drive screw, where torque is the greatest.

Solution. Residual surface tensile stress was converted to surface compressive stress through controlled shot-peening. This was particularly helpful in the welded areas that had failed. From a significant number of studies that have been conducted on controlled shot-peening, empirical data have proven that peened surfaces outlast unpeened surfaces by ten times or more under most conditions.

PREMATURE FLIGHT WEAR. The existing design incorporated ⅜-in.-thick carbon steel C1018 screw flights, which gave the mill approximately six months of life. This meant that regardless of other component failures, a complete set of 16 screws had to be replaced approximately every six months.

Solution. The original ⅜-in.-thick carbon steel C1018 flights were replaced with ½-in.-thick A-R steel flights for added base-metal life. Additional protection was provided by using hard-facing weld buildup on the outside edge and carrying face of the screw flights. The cones were also made of A-R steel.

RESULTS. As a result of these modifications, no pipe, shaft, flange, or premature sprocket failures have occurred for two years. The flights have shown wear, but after 24 months of continuous operation they are still operational.

The mill is now able to replace the screws on normal maintenance shutdowns approximately every 24 to 30 months. Unscheduled downtime in bark bins due to screw failures should not have to be tolerated by mills. Weyerhaeuser's Valliant mill has proved that these costly problems can be eliminated through design improvements, metal improvements through shot-peening, metallurgy upgrade, and quality manufacturing know how. ■

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