Strategies for preventive maintenance in a modern pulp and paper mill

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Adequate lubrication, performed on a regular schedule, can prevent unexpected failures and unnecessary machine downtime.

"Preventive maintenance" is a term overused to describe activities ranging from corrective maintenance tasks to predictive data-gathering. In a real sense, preventing maintenance is the most basic activity expected of a maintenance department.

Traditionally, in North America's pulp and paper industry, the chore of oiling or lubricating fell upon an army of men laboriously refilling oil containers, oiling wipes, replacing blocks of grease, and pumping grease onto chains, sprockets, and grease fittings. All of this took time and labor—three shifts a day, seven days a week (or five for some operations)—and in many cases equipment or machinery had to be shut down to perform the lubrication cycle. In fact, until recently there were places still existing in the United States where a paper machine would have to be shut down and cease production long enough for the "oilers" to check and replace backside (gear driven) dryer bearing grease blocks on a regular, routine basis.

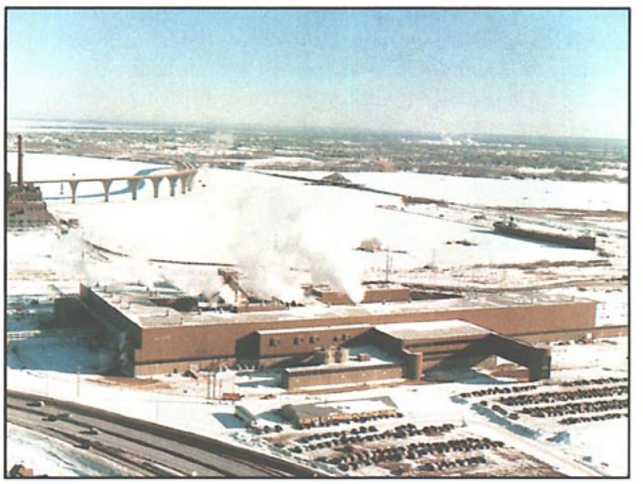
Calling this "preventive maintenance" is a misnomer. It is, in fact, prevention of unexpected failure due to lack of proper lubrication.

Adequate lubrication, properly applied, that prevents failure and unnecessary downtime is preventive maintenance. So are several other practices, such as proper alignment, cleaning and corrosion prevention, balancing, and elimination of mechanical distress, among others.

With the objective of reducing unnecessary downtime, Lake Superior Paper Industries (LSPI) set about preparing a nonconventional approach to preventive maintenance measures for its new greenfield mill being built in Duluth. Installing lubricant delivery equipment which applies the proper amount of lubricant at the proper interval was one of the strategies for accomplishing the goal.

Unique for North America was the fact that initial price, although a consideration, was not an overwhelming factor in the selection of a lubrication delivery system or the equipment upon which it was installed. Traditionally, project engineering seeks the lowest price for equipment regardless of its life cycle costs. In this case, engineering sought not only the lowest initial price but that equipment (both production and support) which would provide the maximum operating time with minimum lifetime maintenance costs (labor, materials, and maintenance-related downtime).

1. Producing 575 tons of supercalendered printing paper daily, Lake Superior Printing Industries practices preventive maintenance to reduce machine failures and downtime.



The mill

The LSPI mill is located just south of the city of Duluth on the shores of Lake Superior. The climate is northern, with temperature extremes from -30°F in the winter to +85°F in the summer.

The mill is a cooperative effort between Pentair Inc. and Minnesota Power. The paper mill site does not include the operation of the adjacent power house, which is run independently by Minnesota Power. Steam from the power generation station is piped to the mill, where it is run

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through a 9-kW turbine to produce electricity and lower pressure process steam. The mill produces 575 tons/day of supercalendered groundwood printing paper.

The pulp mill includes a wood room, pressure grinders, washers, and bleaching. The paper mill has a 317-in., 4600-ft/min twin-wire paper machine and three supercalenders and rewinders.

All this is located in an attractive, modern mill site with rail and truck facilities designed for future expansion.

The PM system

The preventive maintenance program is led by a team leader who reports to the maintenance manager. The lubricating group consists of two technicians working five days per week, with occasional overtime. Some lubrication activities are performed by operations personnel. Also reporting to the PM team leader are two "planned maintenance" (versus "predictive maintenance") technicians. The technicians with lubrication responsibilities all have journeyman skills acquired from the mill's and outside training programs.

The maintenance department operates under a team concept, with multiple skills divided along mechanical, electrical and instrumentation lines. There are approximately 30 mechanical and fewer than 20 E & I personnel. Some outside contracting is used for supplementing pipefitting and carpentry workload.

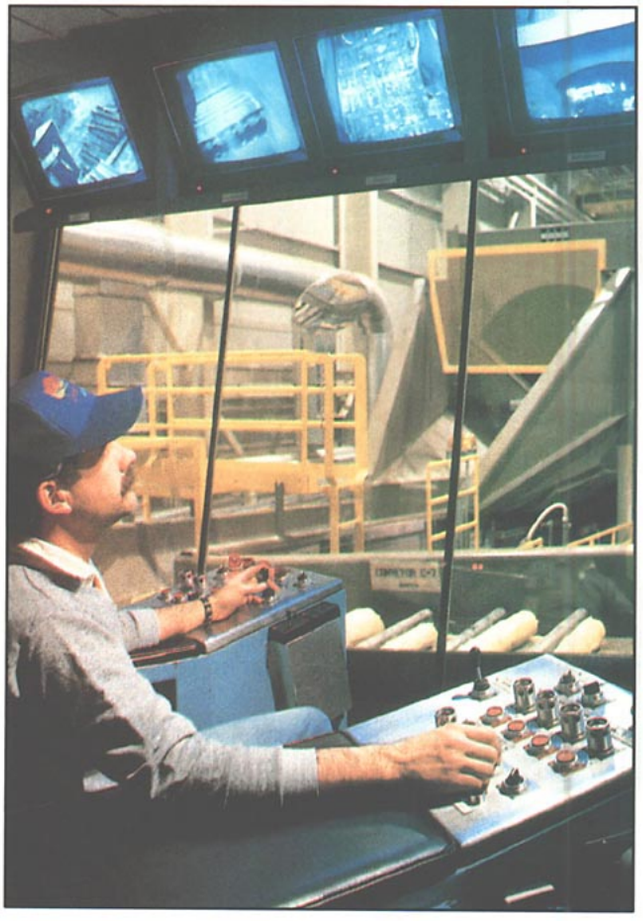
The mill has 16,526 lube points. These are identified on a proprietary software program used to administer the PM schedule.

When we were determining which points automatically to lubricate, part of the initial analysis assigned values to various criteria. Among the criteria were:

- What is the frequency of lubrication? Obviously it is cost effective to automate points that require frequent injection of lubricant such as the sliding surfaces on the supercalenders or the trunnions on the barking drums.
- What is the location? Again, inaccessible lubrication points require more man-hours than easily accessed points. Examples are the upper lube points on the supercalenders, the backside wet-end locations, or the points inside the enclosed dryer sections.
- What safety precautions are required? Climbing around the pressurized groundwood grinders, the barking drums, or the wet end of a paper machine is hazardous and noisy.
- What are the expectations for cleanliness? The presence of excess grease or oil is becoming an important issue, not only from a product point of view but more and more as an environmental concern.
- What is the criticality of the lube point? Critical equipment requires assurances of functionality. Among the concerns are how easy—or difficult—it would be to repair a failure of this equipment. A trunnion on a barking drum, for example, may not be considered critical from a cost of repair material standpoint, but it is extremely critical from the standpoint of time and effort to make repairs.

These criteria were used to establish which pieces of equipment required automation. The result of this analysis, quite simply performed with simple logic, indicated a need for automating roughly 10% of the total lubrication points within the mill complex. This constitutes a variation of the 80/20 rule, i.e., it was determined that these 10% of the lube points represented 90% of the potential trouble (or savings), both in downtime and maintenance effort.

2. In the wood room at LSPI, two automatic dual-line grease systems deliver measured dosages of grease to specified lube points at prescribed intervals.



The lubricant delivery systems

A variety of delivery systems are used, from simple manual grease injection to oil bath bottles to complex, fully automatic multipoint oil and grease systems with alarms.

Wood room

The wood room is equipped with two automatic dual-line grease systems. Each is supplied from one central lube barrel, which is equipped with a low-level alarm to alert personnel that the barrel needs to be replaced. Each lube point has been engineered to receive the proper amount (dosage) of grease on a prescribed interval (a manual override button allows manual greasing of each point at the discretion of the lube technician). The interval timing can be changed to suit the need.

Each dosing module has finite adjustment settings to make slight adjustments to each dose sent to the lube point. Each is equipped with an indicator that displays

3. LSPI's wet end system experiences a high incidence of moisture in the oil, and requires closer monitering than the dry end system.

movement of the dosing piston, indicating the piston has cycled. A pressure sensor located at the end of the system senses system pressure. It gives an alarm if system pressure is not reached, indicating a problem in the system. The dual-line system is capable of pumping No. 2 grease in the coldest climates, making this suitable for the most difficult applications. One system greases the trunnion wheel bearings (14 points), and the other sprays grease on the drive gear and trunnion surfaces (8 points).

The reasons for automating this lubrication system are noise, wet location, the safety factor, and the cost of repairs should failure occur.

The lubrication technician services the wood room on Mondays. This service includes looking for problems, changing filters, checking for low levels, and making adjustments as needed. The technician generates work orders for any observed problems too large for his immediate attention.

Grinder room/pulp mill

Each of the six grinder lines is equipped with dosing modules operating off a dual-line system. This system is supplied from one central lube barrel quite similar to that used in the wood room. A microprocessor controls the dosing interval, and the system is equipped with alarm capabilities for a variety of system problems, including low barrel level.

A total of 152 points are greased including log charging, conveyors, shredders, bearings, and the grinder slides. These points were selected because of their critical nature, the noisy conditions, and the safety considerations. There is also a central oil lubrication system for the grinder area. Most of the pumps are equipped with bottle oilers, and a number of discrete grease points are manually lubricated. The refiners are equipped with self-contained mini-oiling systems.

The lubrication technician devotes Thursday to the grinder room/pulp mill area, again performing the duties outlined above.

Machine room

The paper machine room operating floor receives lubrication attention on Tuesday, while the ground floor level is serviced on Wednesday.

The machine is equipped with two recirculating oil systems, complete with separate reservoirs, filters, pumps, and water removal apparatus. Each lube point is controlled by an oil flowmeter which is enclosed in panels and lighted. It has individual alarms for low flow. A central alarm panel is located in the basement (ground floor) near the dry end circulating oil system reservoir.

The wet-end system is monitored more closely than the dry-end system because of the high incidence of moisture in the oil. A dedicated water removal apparatus is used

regularly on the wet-end system.

The dry-end oil circulating system is, of course, much larger than the wet-end system. Part of the routine for weekly service involves taking oil samples, which are tested on-site and regularly sent out for trend analysis by a major oil supplier. This routine has proven beneficial. Changing filter cartridges on the tank breather and the oil circulating dual filter housings is a regular task. The centrifuge is used approximately twice per month.

Each circulating system is equipped with a tank settling glass with an alarm. This serves to monitor the amount of water in the tank. Automatic dumping of this water is a feature. Drop legs from the lube points are also fitted with magnets for predictive analysis should metal fatigue occur.

The machine is also provided with three dual-line automatic centralized grease systems, all controlled from one point. A wet-end system lubricates pivot points, oscillating showers and doctors, slide and screw mechanisms, and bearings subject to movement.

The dry-end system uses the same technology on a different cycle, due to the changes in the environment from the wet end. Again, the system is used to lubricate sliding surfaces, adjustments, pivot points, etc., plus those roll bearings that are subject to linear movement and rope sheaves.

A separate system is used to lubricate the rotary dryer joints. As with the system in the wood room and the grinder area, the systems are equipped with alarm capabilities to warn of problems in the system. The dual-line feature allows the heaviest grease to be used in any of the machine environments.

Most of the pumps in the machine room are provided with bottle oilers. The turbine-generator, located in the machine room wet end, has its own self-contained lubrication oil circulating system.

There are 1020 points being automatically lubricated in the machine room. The criteria for including these points in an automatic system include safety considerations, accessibility, the critical nature of the points, and cleanliness.

Finishing, stock prep, roll handling

These areas are serviced on Friday. The supercalenders are furnished with a grease system for the sliding surfaces, and the rewinders have a single-point grease injection manifold. The routine in these areas again involves filter changes, inspection of equipment in general, and checking for low levels of lubricant.

Machine downs

During scheduled machine downtimes, the lubrication technicians are supplemented by operating personnel and outside contractors to perform a variety of duties, including the preventive measures of checking couplings, gear box oil changes, inspection of lube lines in unaccessible areas, and so forth.

The mill does not have a policy of taking regular, routine outages on a set schedule but has evolved to the point where planned outages are taken based upon clothing or roll change needs, combined with increasing maintenance backlog or times when "unexpected" anticipated failures are predicted. Although clothing or process changes typically govern the timing of planned outages, operations will combine early clothing changes with necessary planned maintenance outages. Operations will typically plan their clothing or process changes (rolls) during daylight hours so that maintenance forces can be maximized and fully prepared for the outage.

Conclusion

Using the strategy of employing available lubrication delivery systems technology, combined with dedication to the prevention of maintenance, Lake Superior Paper Industries is able to lubricate all of its equipment—some 16,500 points—with a work force consisting of just two technicians (occasionally supplemented by others). During the last three years of operation, this mill has not experienced a documented case of downtime due to lubrication failure. The strategy paid off; the objective has been reached. The mill is not now, nor should it ever be, automatically lubricated everywhere. Nevertheless, in those areas where it makes sense for the personnel, the equipment, or the product, the latest technology is being applied with considerable cost savings over the lifetime of the investment.□

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