Developing a Total Productive Maintenance System

Stopping trouble on the line before it starts is the goal of this gear set maintenance system.

Delos Hudson

There's a reason they call it catastrophic gear failure: For example, if the line goes down at a large aluminum rolling mill because a gear set goes bad, the costs can run up to a whopping $200,000 *a week*. Even in smaller operations, the numbers alone (not to mention all the other problems) can be a plant manager's worst nightmare.

The situation is no different at Haynes International. We manufacture high-performance, nickel-cobalt alloys and fabricate them in plates, sheets, wire, coils and strips. Production is mostly in small lots. Consequently, quality and productivity are critical, particularly as the products are very sensitive to upsets in the manufacturing process.

Gear sets are vital to our operation. Our strategy for keeping them and the rest of our equipment in top shape had always been a preventive maintenance program. But over the years we became dissatisfied with our approach. In spite of our best efforts, one or two pieces of equipment went down every week, a costly situation from both maintenance and production standpoints; production downtime was costing us as much as several thousand dollars an hour, depending on which line or mill was affected. We simply had to do better.

As a solution, we decided to upgrade to a Total Productive Maintenance (TPM) system, one in which both maintenance and production people work together to cut downtime. This system is based on four components:

1. Moving into predictive maintenance through equipment monitoring. This allows us to predict when maintenance will be necessary, as opposed to when it is scheduled.

2. Standardizing if necessary day-to-day maintenance into a computerized maintenance management system.

3. Instituting a Management Planning Group composed of people from both management and the factory floor.

4. Opening a management training center to train maintenance people.

In implementing this system, which is under the direction of maintenance supervisor Larry Peacock, we are using both our own resources and those on the outside. Our principal outside source is our supplier of lubricants for gear systems and other equipment, Mobil Oil Corporation. In addition, the company, like many other lubricant suppliers, provides engineering services that track lubricant and system conditions in our gear reduction sets and in our hydraulic systems. We also use outside infrared thermography and vibration analysis services to give us a better picture of overall machine performance and conditions.

Once a year Mobil engineers sample the gear oils in our 41 gear sets. Samples are sent to the company's customer service laboratory for analysis of viscosity, color, water, sediment, oxidation and the levels of dirt (measured as silicon) and wear metals in the oil. On the basis of these reports, the oil in each system is rated satisfactory or unsatisfactory for further use.

When they sample gear oil, the engineers inspect each gear reduction set, looking for signs of wear, such as pitting, spalling and peening. Using premium heavy-duty industrial gear oils is

Above: High-quality alloy strip is slowly wound onto rolls for shipping. Plastic interleafing protects surface finish.

Right: Delos Hudson, manager of maintenance at Haynes, and Larry Peacock, maintenance supervisor, look over finished coil of alloy ready for shipping.

not enough to prevent all wear. Contamination, misalignment or improper loading could also be culprits, so Mobil provides us with equipment monitoring services, which are key elements in our Total Productive Maintenance system.

This kind of regular inspection provides crucial information that enables us to intelligently plan our maintenance. For example, the latest gear inspection and oil sampling revealed the following:

• On the first gear reduction set on the Schloemann mill, a unit critical to our production, gear wear was totally uneven. Of the two pinion gears mounted on a common shaft, one was taking all the wear. The lubrication engineers suggested adjusting the gear shaft for proper loading. We are working to correct this imbalance.

• The gears in the 10-inch bar still were in poor condition and would need replacement if the mill is to continue in production. However, these are only operated infrequently. So we have decided against replacement right now and are depending on the regular reports to show us they aren't getting worse.

• Gears in the 3-high pinion stand were replaced a year ago because of excessive wear reported in a previous inspection. However, heavy shock loads continue to cause excessive wear. The engineers recommended more frequent observance of the gears to track additional wear and plan replacement.

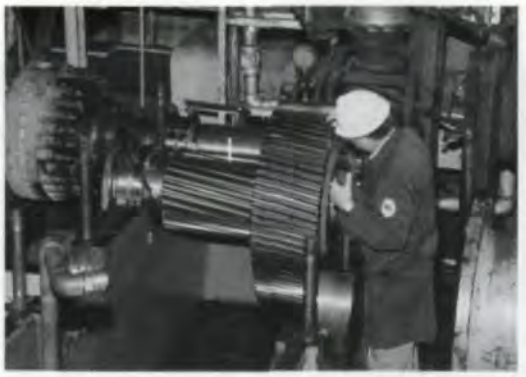
• The gear oil in the 4-high mill was rated borderline because of oxidation and iron contamination. The lubrication engineers recommended a shorter resampling period to determine when it should be changed.

• Rust was observed on the gear set in the argon-oxygen decarburization vessel. The engineers pointed out that the rust was due to condensation and recommended installing an air breather. Unattended, further rusting could only lead to gear deterioration.

These annual gear inspection reports help us both spot problems requiring immediate attention and track wear from year to year, a great help to our planning. For example, one set of gears has severe wear, but its condition has stabilized, remaining unchanged for the past seven years. So we consider this set of gears satisfactory for continued service as long as there is no further wear. Another set, however, has deteriorated steadily from one year to the next to the point where it needs replacement.

This is how we use the 15-year history of each gear set to forecast major equipment repair and replacement, which is especially important to us on the main mills. The combination of load, speeds, heat and constant operation on some mills, not to mention the ever-present contamination, will cause gears to eventually wear out. We want to maximize production from them and then schedule their replacement when it will hurt us the least. Forecasting on the basis of the annual gear inspection reports allows enough lead time to schedule downtime and order replacement parts. Some of the main gears, for example, have a minimum order lead time of six months for replacement sets, and a replacement set may cost as much as $100,000. However, our main concern is not so much the cost of replacement units, which we can budget for, as the cost of unscheduled downtime, which we can't.

By overhauling our maintenance program, we have greatly reduced unscheduled downtime, with a resulting increase in production and more consistent product quality. Our maintenance costs have likewise dropped. Our Total Productive Maintenance system, including the use of a full range of services from our lubricant supplier, has been a major contributor to this turnaround. ✪



Upper Left:
Mobil lubrication engineer Jay Ford performs the yearly gear inspection at Haynes.

Lower Left:
Mobil senior lubrication specialist Jay Ford (left) and maintenance manager Delos Hudson go over equipment inspection and lubrication analysis reports.

Below:
Max Unger (left) and Larry Peacock of Haynes do a quick check on lubricant inventory.

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Delos Hudson
is the manager of maintenance, Haynes International, Inc., Kokomo, IN, a manufacturer of high-performance alloys.