

A Picture is Worth a Thousand Words - J.R. Simplot Applies Straightforward Proactive Oil Analysis to Remain Competitive

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Over the last decade no industry has been immune to the demands of an increasingly competitive business environment. To compete globally, companies have had to boost product quality and reduced delivery costs. J.R. Simplot is an example of a company that has applied these quality practices to equipment maintenance and lubrication management using oil analysis.



J.R. Simplot is a private food processing and agricultural company, 12,000 employees strong. The J.R. Simplot phosphate mine, located near Jackson Hole, WY, is thought to be the largest high-grade phosphate mine in the western USA.



Phosphate, a primary constituent of fertilizer, is mixed into a slurry after it is mined and pumped at 3300 psi (about 225 Bar) for 87 miles to the processing plant where it is used to make fertilizer. Due to the competitive nature of the fertilizer market, the mining of phosphate is particularly sensitive to production economics. Phosphate ore represents as much as 20-30% of the cost of

fertilizer. Therefore, the costs to extract and deliver the ore represent a major portion of the total cost to produce fertilizer.

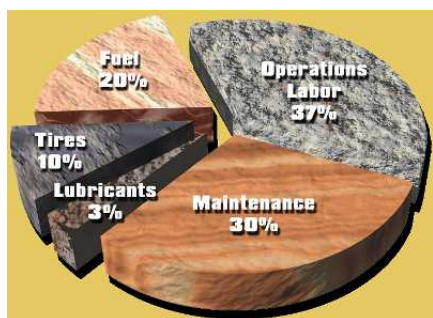


Figure 1

Equipment maintenance represents 30-40% of the mine's total operating costs. The mining industry has historically accepted these high maintenance costs as normal, but the team at J.R. Simplot believed that they can be managed, adding substantial profits to the bottom line. The mining industry has a saying: "Good deposits make poor miners," so "Poor deposits make good miners."

And while J.R. Simplot's Wyoming mine is considered high-grade, the maintenance team decided to not be complacent regarding maintenance.

Benchmarking Shows the Way

Mobile equipment forms the core of the phosphate mining operations. The fleet consumes 70% of the company's total maintenance budget. Of this budget, a large portion is consumed by haul-trucks that receive



ore from a shovel and transport it for unloading, processing and pumping. New haul-trucks cost about \$1.5 million and about \$100 per hour to operate, 50% of which is maintenance, particularly engine maintenance (an engine rebuild costs between \$130,000 and \$160,000).

Benchmarking the mine's maintenance costs against other phosphate open pit mines alarmed the maintenance team. They found sizable gaps between the mine's performance and the industry's best practice. Numerous improvement opportunities were discovered. Increasing the life of the haul truck diesel engines was one of those discoveries.

The original equipment manufacturers (OEM) conservatively suggests that the engines be rebuilt every 15,000 operating hours. Prior to the new maintenance initiatives, Simplot decided to reduce the OEM's recommended interval to 14,000 hours to avoid the risk of catastrophic failures. With a focused effort, the team believed they could substantially increase the mean-time-between-rebuild on the diesel engines and put a sizable amount of profit into the company coffers.

A Common-Sense Approach to Lubrication Excellence

The team recognized that poor lubrication management is a primary root cause of engine failure. They created a strategy to make lubrication management changes called the "senior engine program," to help extend engine life.

Lubricant Upgrade. The team upgraded to API Service Classification CH4 lubricant, which is formulated using Group II base-oils and a premium additive package. Lubricants had been purchased from the lowest bidder, with a casual position on lubricant quality. By specifying the enhanced quality product, drain intervals were extended from 250 to 350 hours and filters began to last longer. While the cost of the lubricant is 30% higher on a per-gallon basis, the total cost to lubricate the engines decreased. In addition to the benefits derived from extended drain intervals and longer filter life, secondary benefits have also contributed to the profitability of the change. For example, labor costs have been reduced.

Filtration Upgrade. Machines with clean oil last longer. Engines are no exception. The maintenance team decided to upgrade to higher quality filters. They examined the Beta Ratings (particle capture effectiveness) of several available offerings in the market and selected the one most suited for their requirements. Contamination control was achieved by upgrading full-flow filtration and adding sidestream filters. Contaminant exclusion was improved with upgraded air filters.

Oil Analysis. In 1992, the mine started performing oil analysis. In the early days, oil analysis was performed because they "felt it should be done," not because they believed that measurable benefits would be generated. At that time, the program was typical; samples were drawn and submitted for analysis and the results were filed away. When a new fuel and lubricant contract was issued, the mine received an oil analysis trending software program and they became more serious about oil analysis. Samples were then drawn and analyzed at each oil change, which occurs every 350 hours, or about twice a month.

The team soon discovered that their ability to predict engine failures with elemental spectroscopy trend analysis was limited. Abnormal conditions produce wear too large to detect with conventional atomic emission elemental spectroscopy. They supplemented the technique by back-washing filters and then analyzed the debris with elemental spectroscopy whenever a sharp increase in wear metal (iron, copper, aluminum, chromium, lead) appeared. ...

... For “senior engines,” those that reached 15,000 hours, elemental spectroscopy is supplemented with large particle oriented test. Particle count is performed to quantify the large particles in the oil. Also, at the time of an oil and filter change, the debris that is collected in the filter is back-washed, deposited on a patch, viewed under a microscope and digitally photographed. The particles are evaluated based upon size and shape. If an engine is generating great numbers of large wear particles, its life is assumed to be limited and it is scheduled for over haul.

Other system improvements included keep-full systems, variable speed fans, long-life coolant and upgraded fuel filters. In addition to oil analysis, regular inspections were made to assess the condition of the machine.

The Results Are In

The senior engine program has proven effective and very profitable for the J.R. Simplot company. Previously, the engines were rebuilt at an average life of 13,075 hours. They have increased the average number of hours between engine rebuilds to over 18,000 hours , a 37% increase! The amortized rebuild costs for the engines have dropped from \$8.26 to \$5.68 per operating hour (Figure 4); that equates to an annualized cost reduction of over \$15,000. Because this is a maintenance cost, the money saved goes directly to the operating profit line. All the engines in the senior engine program have shown life extension except for engine number 1393, which failed due to human error. The team’s goal is to achieve a mean-time-between-rebuild of 25,000 hours. Nearly doubling engine life will cut the annualized rebuild cost in half to about \$25,000.

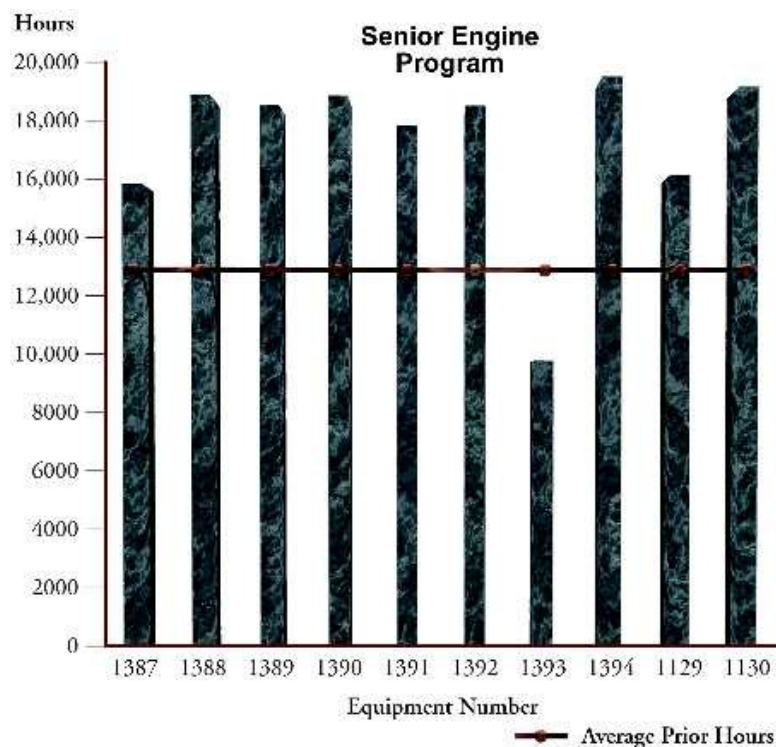


Figure 3

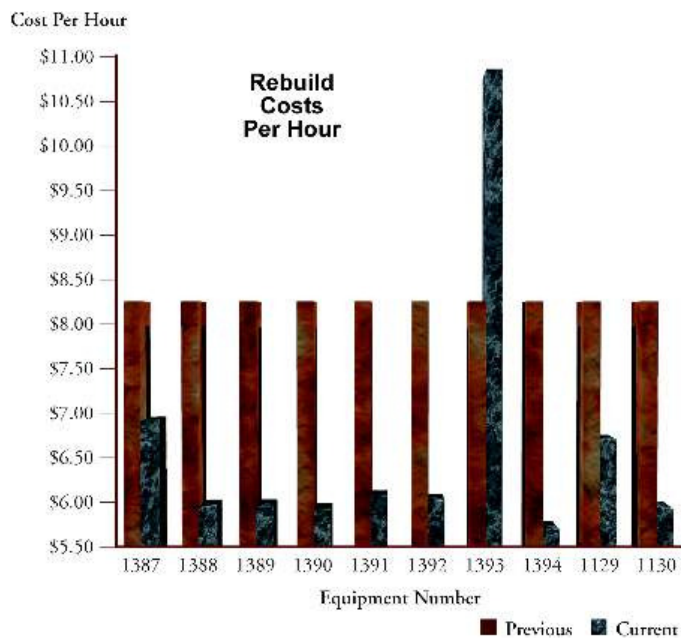
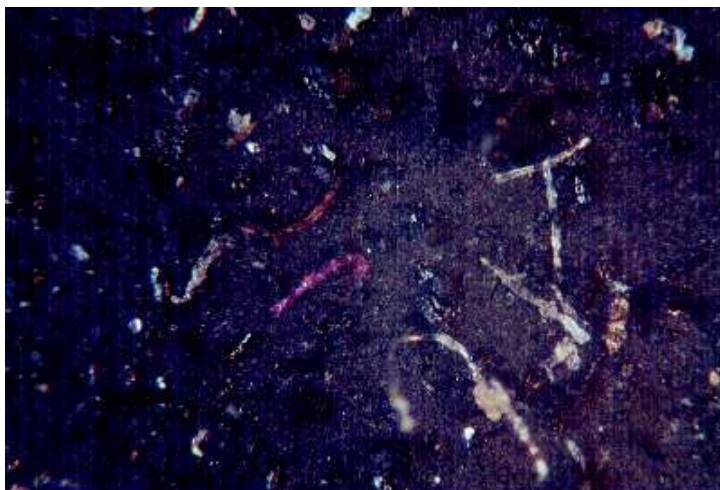


Figure 4

The team’s unique approach to oil analysis has enabled them to rebuild engines on condition, through the application of patch microscopy analysis. In addition to getting all the life the engine has to offer, the advance warning provided by oil analysis allows for smart maintenance scheduling. The photomicrograph pictured in Figure 2 show a quadrupling in wear particles from the previous sample. The team knew when this engine was a candidate for rebuild.



Photomicrograph Showing Very Large Metal Particles

Figure 2

The team photographed components from the tear-down of an engine that was rebuilt at 18,000 hours because oil analysis signaled excessive wear. As predicted, several components showed evidence of excessive wear. The bearing in Figure 5, for example, indicated severe spalling. As one might expect, not all components were worn out, but sufficient damage was visible to confirm that the right decision had been made. Proactive measures to manage engine life delivered an extra 5,000 hours of operating life, while oil analysis indicated the engine had hit the end of the line.



This Bearing Showed Evidence of Spalling on the Bearing After 18,000 Hours

Figure 5

Conclusions

The maintenance team at J.R. Simplot's phosphate mine near Jackson Hole, WY has proven that smart equipment maintenance can put money on the bottom line, and that good lubrication management with oil analysis plays a vital role. The team's senior engine program is the epitome of simplicity. When machines are pushed beyond proven time limits, they receive more detailed health monitoring using oil analysis. When the machine provides a visual indication that it is shelling out wear debris, action is promptly taken. The team's efforts increased the value of J.R. Simplot's competitive position, improved profits and shareholder wealth and gave the maintenance team much to celebrate.