fleet-management and training systems – would greatly improve the preventative maintenance process."

Fournier adds: "Health-monitoring systems could be enhanced by communicating real-time critical events, and trending data to maintenance management for immediate action or follow-up and scheduling. Some of this is being done today, but there is still room for improvement."

MAINTENANCE STRATEGIES

Although uses of new technology and more sophisticated sensing capabilities offer great potential, predictive maintenance offers immediate opportunities for any mine site ready to adopt its basic concepts.

Smith says: "Hitachi provides a recommended maintenance schedule and bases the component intervals on historical data and experience accumulated over time. Of course, the equipment owners are the ones in the best position to understand how best to maximise the equipment relative to their application, so the strategies do vary."

Fournier suggests: "We recommend following the manufacturer's guidelines for service intervals and lubrication, especially when a new fleet or product is introduced to an existing operation. Then, based on the application and environment, service intervals, component change-out intervals and lubrication can be adjusted based on site condition and trend analysis, in order to maximise maintenance intervals and component--replacement intervals on a scheduled basis."

Eller says: "Using our recommended inspection intervals and monitoring techniques, Liebherr Mining Equipment offers a maintenance programme that supports a predictive maintenance strategy. Several of our haul-truck customers have achieved higher service lives for major components and reduced maintenance costs while seeing fleet performance improve."

Modular Mining Systems used its MineCare asset health-monitoring system for a customer that wanted to reduce maintenance costs and downtime by predicting haul-truck component failure. By proactively identifying degradation in equipment performance and avoiding costly catastrophic failures, the customer reported impressive maintenance cost savings in excess of US$1.25 million per year. Modular states that these savings are directly attributable to the use of the MineCare system as part of an overall commitment to a proactive maintenance philosophy.

Filtration systems: One Eye Industries

One Eye Industries (OEI), based in Calgary, Canada, designs and manufactures magnetic filtration systems for a number of industries, including mining. Its filtration systems filter to submicron levels, which the company states can extend component, lubrication oil and hydraulic fluid life by 2-3 times. The filters are reusable and last up to 10 years.

OEI states that the most damaging and constant contaminant in hydraulic and lubrication systems that causes the majority of premature wear and equipment failure is ferrous metal under 10 microns to sub-micron in size. The metal contamination, which is left over from manufacturing processes, is present in new hydraulic and lubrication fluids and is the main cause of soft metal and non-metal component wear.

Maintenance and downtime costs can range anywhere from 20% to 50% of the cost of production, and unplanned downtime costs three times as much as scheduled downtime. Preventive maintenance and hydrocarbon management using efficient and effective filtration is the key to increased uptime and profitability allowing for growth and a stronger position in the market place.

Proactive maintenance measures are key to reducing unscheduled downtime. By reducing maintenance costs and downtime, a mining company will be in a better position to compete in the international marketplace.

ENGINES

In January 2008, a Caterpillar haul truck at the BHP Billiton Mitsubishi Alliance (BMA) Blackwater coal mine in Queensland, Australia, was diagnosed through oil analysis at 13,000 hours as needing to be rebuilt. This was due to the high levels of contamination (particle quantifier (PQ) of 12ppm).

Prior to scheduling the rebuild of the engine, Tim Rantin, maintenance manager at BMA, installed one OEI ADD-Vantage 9000 filter (200 Beta efficiency rating) with two traditional Cat filters (no efficiency rating). The oil analysis on the next planned maintenance period identified a PQ of less than 1ppm.

Rantin retained the haul truck in service and the engine lasted 17,200 hours before a glycol leak contaminated the oil and the engine failed. The one ADD-Vantage 9000 filter with the capability to remove all the ferrous and non-ferrous contamination to sub-micron levels allowed the maintenance intervals to be extended to 350-hour and then to 500-hour intervals, realising significant operational savings.

FINAL DRIVES

Another example took place at an open-pit mine in Australia, where the company wanted to extend the maintenance intervals from every 250 hours to every 330 hours on its Cat D10 and D11 dozer final drives, without risking the availability of its fleet. This would allow the company savings in transport costs from the pit to the maintenance facility and replacement hire fleets during service intervals.

An OEI ADD-Vantage 9000 filter (right) installed with two Cat filters on a Caterpillar haul truck

The extension was achieved for all components but the final drives, which were still experiencing unscheduled failures due to ferrous metal contamination generated from the gears. Through a test period, it was designated that the entire fleet should be refitted with OEI magnetic filter plug rods, and since their installation there have been no unscheduled failures. The maintenance interval of 330 hours has been achieved, and the company has saved a significant sum of money (in excess of US$1 million) per year in transportation costs alone.

NEW FUELS

OEI says that liquefied natural gas (LNG) and natural gas are quickly becoming the fuels of the future. Caterpillar and other OEMs are designing new off-road equipment with dual diesel and natural gas drive systems to stay ahead of the curve, but with this comes further complications.

Natural gas is being distributed with the same contamination inherent in diesel fuel – black powder contamination. This black powder is the result of bacterial and chemical corrosion of the carbon-steel pipeline wall, and is primarily made up of iron sulphides and iron oxides. It is extremely hard, causing damage to the fuel system components and reducing fuel quality. The black powder in diesel and natural gas will impede the burning efficiency and result in increased emissions.

OEI has designed and manufactures magnetic separators that solve this problem by removing the black powder contamination from mobile equipment down to submicron levels without flow restriction. The company's new natural-gas dispenser filter also removes this contamination before fuelling engines for mobile and stationary equipment. Both units are easily cleaned and returned to service only requiring a yearly maintenance check, with a life expectancy of 10+ years and minimal consumables.