IMPROVING COST, RELIABILITY, AND SAFETY.

INNOVATIVE SOLUTIONS FOR HYDRAULIC FLUID LEAK DETECTION.
EFFICIENCY, DURABILITY AND MOST OF ALL, SAFETY. Today’s mining industry must cope with a wide variety of priorities, ranging from safety to effectiveness and cost-efficiency. Solutions must work anywhere, in various different situations and conditions. Most of all, these solutions must be reliable and adaptable to your operations – not someone else’s.

That’s where the Quaker Chemical Corporation (“Quaker”) worldwide network of technical experts come in. Our team of technical sales, laboratory development, and manufacturing associates bring unique value to the mining industry. Having locations across the globe is important to us, but where our global reach is a true benefit is our unique advantage of having each location connected, working together to supply mining operations worldwide.

Some major issues that can sometimes seem at odds are worker safety, equipment reliability and business profitability. According to the Ventyx 2012 Mining Executives Insights Study (on page 3), ensuring employee safety was identified as the highest priority for mining companies. However, brutally honest mining executives will tell you:

“When money is tight it can also feel like you need to choose between safety and reliability. Leading edge companies know that excellence in both safety and reliability provides the best performance – and the highest profitability. In the 2012 survey, however, equipment reliability only received 8% of the survey votes as being a top priority for global mining companies.

Perhaps those surveyed did not realize that proper maintenance of mining equipment not only increases the safety of employees, but also saves the company money.

Using poorly maintained equipment not only puts employees in danger, but also puts the operation at risk for costly breakdowns. Several factors contribute to the wear and tear of equipment, including vibrations, hose flexing, high or low temperatures, pressure cycling, weather, bumping into rock walls, abrasion and internal chemical-based degradation. Breakdowns lead to downtime, which lead to money lost.

As seen in the bar graph below, hydraulic system failures can be a leading cause of breakdowns in some mines.
IMPROVING RELIABILITY. Mechanical equipment inevitably fails with time and use, as do related subsystems. Different subsystems fail at different rates. Improving reliability does not mean the equipment will never fail, rather it means optimizing equipment life and avoiding unplanned downtime. Maintenance is critical to ensuring optimal life, but world class asset management also means optimizing maintenance expenses. The best returns on investment comes from optimizing your asset’s total lifecycle cost and performance.

Assets (and subsystem assets) eventually reach a point where they are unable to perform as required and need to be replaced. As this point approaches, early symptoms become apparent. Maintenance costs tend to increase and various signals emerge (such as leaks from fluid power systems). Early identification of those signals provides a prediction for upcoming failures and an opportunity to prolong life through remediation or component replacement.

Identifying a leaking hydraulic hose early and replacing it, for example, can avoid an unplanned field failure and ensure the equipment remains productive for an extended period.

TOP PRIORITIES FOR GLOBAL MINING COMPANIES.

- Ensuring Employee and Workforce Safety: 31%
- Managing Capital Projects: 25%
- Maximizing Production Effectiveness: 21%
- Ensuring Equipment Reliability: 8%
- Teamwork and Communication: 4%
FLUID POWER SYSTEMS. These systems are ubiquitous in mining and many other industries – such as oil & gas, forestry, construction, agriculture and manufacturing. Fluid power systems operate drills, excavators, front end loaders, haul trucks and more.

Fluid power systems are becoming more powerful, using higher pressures to move greater volumes and achieve higher productivity. With increased pressure comes ever increasing levels of stored energy. Stored energy that, if released in an uncontrolled fashion, can cause harm to people and property.

Fluid power systems are composed of hard pipe, flexible hoses, pumps, valves and actuators. They are filled with hydraulic fluid to transmit power to where needed to perform work. Over time and use, fittings can loosen, component performance diminishes, and hoses wear and tear.

In hostile environments, such as mining, hydraulic hoses can fail in as little as 2 years according to Deutsche Gesetzliche Unfallversicherung (DGUV), the German Statutory Accident Insurance Association.

Unexpected failure of a fluid power system costs money. These costs include: loss of hydraulic fluid, environmental cleanup costs, emergency field breakdown costs, lost production and, sometimes, injuries to workers.

FINDING AND FIXING HYDRAULIC LEAKS SAVES MONEY. A study done by Exxon Mobil found that the average U.S. manufacturing operation uses four times more hydraulic fluid than their equipment reservoirs actually hold. In North America alone, it is estimated that over 100 million gallons (380 million liters) of hydraulic fluid could be saved every year if leakage was eliminated - worth over $500,000,000.

A hydraulic fluid leak of just one drop per second translates into 420 U.S. gallons (1,600L) lost per year. At $5 per gallon, this is worth $2,100 per year. Larger leaks can be even more financially devastating. For instance, a 1/6 inch (1.6 mm) hole in a hydraulic hose can leak 5 U.S. gallons (19 L) per minute – the equivalent of 7,200 gallons (27,000 L) at a cost of $36,000 in just one day. Fortunately, only a few reservoirs hold this much.

Furthermore, in today’s environmentally conscious world, leakage is an environmental liability that must be cleaned up. It can cost at least $2,000 to clean up an oil spill, in accordance with state environmental laws. Failure to have stringent requirements in place could cost you. Hydraulic leaks can also degrade equipment productivity and, if it sprays onto a hot engine, may even cause a fire.
FLUID RELEASE INCIDENTS HAPPEN MORE OFTEN THAN YOU THINK. Fluid injection injuries are caused by a release of pressurized hydraulic fluid penetrating the skin. A pinhole sized leak in a hydraulic hose under high pressure can release fluid at more than 600 feet (183 m) per second, approaching the velocity of a bullet. If this hits a worker, the results are frequently devastating.

In 2010 alone, the Australian Sydney Hand and Eye Hospital in Australia reported 2,460 cases involving hydraulic fluid release.

In that same year, a survey of just half of the New South Wales (NSW) mines identified 1,186 fluid releases and 152 direct fluid contact incidents - three times as many as electric shock incidents!

HOW DO FLUID INJECTION INJURIES HAPPEN?
Fluid power systems typically look non-threatening, as the danger lies with the pressure built up inside. Commonly systems hold 3,000 to 5,000, and even as much as 10,000 psi. Turning a system off does not necessarily relieve it of its pressure. Fluid injection injuries can occur at pressures as low as 100 psi.

Typically, mining maintenance workers have the greatest risk of injection. The most common situation for the chance of injection is when an employee feels along the hydraulic hose for leaks.

Of surprise to many, high pressure injection injuries can actually be difficult to view. Wounded workers initially may not even realize they have such an injury. They may think they were just pricked by a sharp edge or loose wire. They may initially not even experience substantial pain. Doctors as well, are frequently unable to tell whether an injection injury has occurred without cutting open the affected area; and when treating an injection injury, surgeons customarily act more prudently by removing more, not less, tissue to be sure they have extracted the entire affected area. It is difficult even for the surgeons to see where the wound boundaries extend. Without immediate treatment, amputation is often the only solution.

FINANCIAL CONSEQUENCES OF AN INJECTION INJURY. Costs of an injection injury can easily exceed $750,000 between worker’s medical bills and lost production costs, and this does not factor in lawsuits or government fines. The actual costs can vary by jurisdiction depending upon the circumstances.

The human cost can often be worse. It is fairly typical for an injured worker to lose fingers, a hand, an arm and/or their livelihood and sometimes their life. And, even with insurance or legal payouts, families can be devastated.

Photographs show the results of an invasive procedure caused by a fluid injection injury where FluidSafe® was not present in the system and surgeons were unable to see where the injection was located.
1. IF IT AIN'T BROKE DON'T FIX IT. Many mines simply wait until the equipment breaks down, wherever and whenever. According to the 2014 Plant Engineering Maintenance survey 57% of respondents still resort to this type of reactive maintenance. Based on Caterpillar’s experience, they estimate, breakdowns can cost 3 to 10 times more than catching the problem early. This does not include costs from associated production losses.

2. PREVENTATIVE MAINTENANCE. Some mines simply replace components on a regular time schedule, regardless of whether such replacement is necessary. Studies have shown that this approach prematurely discards assets that have further life and return on investment is needlessly reduced.

3. PREDICTIVE OR CONDITION-BASED MAINTENANCE. Mines should be aware of early signals of impending failure as tools used to predict the timing of the failure and to set maintenance schedules. Early leak detection is one such signal. This data can be used to schedule repairs during a regular maintenance cycle, which helps optimize system life.
HOW CAN WE BETTER CATCH THESE EARLY SIGNALS OF IMPENDING FLUID POWER SYSTEM FAILURE MORE EASILY AND EFFECTIVELY? By formulating a routine maintenance check program, including leak detection, early maintenance signals can be identified. FluidSafe® is a safety-formulated, fluorescent dye that is added at very low concentrations – 0.062% - to hydraulic fluids at initial fill or at normal replacement time. FluidSafe® enhances the ability to locate leaks quickly and easily using a blue light detection lamp.

Users say they use 5-7% less hydraulic fluid simply by finding and fixing leaks early, resulting in an annual savings of more than the cost associated with adding FluidSafe®.

However, customers also praise the bigger prize – the noticeable decrease in equipment field breakdowns. Early identification of hydraulic system failure signals allows breakdown processes to be identified and corrected during regularly scheduled maintenance cycles. Fewer field breakdowns translates into major money from greater equipment availability and higher productivity.

Should a fluid injection injury be suspected at any point in time, the SafetyBlu™ light can be used to illuminate the penetration point under the skin, right at the mine site. If penetration has occurred, the blue light kit, along with the enclosed instruction sheet, can then be sent along with the wounded worker and used by the surgeon to determine wound boundaries to minimize tissue removal.

Fluid power system safety and reliability can both be enhanced with FluidSafe®, and improving both contributes to greater mine profitability. In today’s tough environment, this is a true win-win.

Photograph shows the detection of a hydraulic leak after fluorescent dye was added.
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