Machinery fires start somewhere

Fires need certain elements to start and spread, and don't just happen in a vacuum. On rare occasions, fires start in machinery and then spread underground. **MIENTJIE KLEINHANS** looks at the possible causes and preventions of fires in mining machinery.

FIRE CAN BE hazardous when it is out of control. Underground fires can be life-threatening, as there is limited space to escape from the fire, and rapidly consumed oxygen is limited. Therefore, it is fundamental that mines do everything in their power to prevent fires.

One of the causes of fires in mines, although rare, yet a definite occurrence, relates to machinery. Fires need three elements to start or spread: heat, oxygen, and fuel. Obviously, when there is a spark in the right environment, enough heat and fuel, a fire could spread as fast as the fuel can carry it.

Some of the ideal fuels for fires in mines are coal or coal dust, wood, diesel, mineral oils and grease, plastics and rubber, and other waste products.

Alexis Basson is a mechanical failure and fire investigator at Alexis Basson Consulting and, as a mechanical engineer and investigator, he has to investigate fires in mines on behalf of insurance companies.

According to Basson, there are a number of reasons why fires start in mining machinery. "Some of the fires are caused by poor maintenance, component failure, operator abuse, poor fitment of after-market equipment, and poor housekeeping."

Jaco Strydom, HSE lead: Africa at Cummins, explains that machinery fires are mostly commonly caused when diesel or hydraulic oil sprays on to hot components, and when pipes and hoses are worn through or burst. "If the engine is turned off, the hydraulic fluid or diesel oil flow generally stops and the fire goes out. But, in many cases, oil-soaked dirt and dust, or deposits of grease on the equipment, provide enough fuel to keep the fire burning."

> **"It is sometimes unsafe to fight a fire and better to rather evacuate straight away."**

Strydom continues that diesel and oil do not ignite on their own, but need to be sprayed on to a hot exhaust manifold or turbocharger, or on to a worn-out and arcing electrical wire, for example.

"Underground machinery fire is a very serious topic for mines and much effort and procedures are daily put in place to reduce these risks," says Andro Gibhard, head: Fire Division at I-CAT. "It is not the fact that underground mining operations are more prone to fires, it is the fact that the impact of a fire underground is that much greater. The fire can cause a lot more damage in a very short time."

"What makes an underground fire especially hazardous is the confined space; the lack of infrastructure could sometimes contribute to a difficult situation if a fire does start. The fire can then be flared by different gases that could be present at the time," explains Strydom.

Basson agrees with Strydom. "Hot, toxic combustion gases (smoke) are circulated through the forced ventilation system and will affect all personnel downwind from the fire," asserts Basson. The ventilation cannot be turned off, as it provides breathing air for personnel underground and also provides cooling.

The fire also consumes oxygen, making the atmosphere underground less breathable. Confined spaces allow for very limited (if any) escape routes. The high heat of combustion is likely to damage a tunnel roof and can cause localised collapses, due to the thermal strain of the roof structure. "This is an immediate threat, as well, as that it can block exit routes and ventilation," adds Basson.

Underground fire prevention

Both Basson and Strydom agree that the most important tip is to ensure good housekeeping. A fuel or oil leak can cause a fire, and the build-up of coal dust, grease, and oil in a machine adds to the combustible materials and the fire load.

"Check critical components with every machine service," emphasises Basson. "Critical components include fuel systems, hydraulic hoses and couplings routed in engine bays, and high-current electrical cables – such as battery cables, starter cables, and alternator charge cables." He adds that one should ensure that firewalls are fitted between engine compartments and hydraulic pumps. Also ensure that hot components, such as exhaust manifolds, turbine housings, and exhaust ducts are shielded or insulated to prevent the ignition of sprayed fluids.

Other factors to be aware of include crimping on hydraulic hoses – worn or inadequately sized dies can cause failure

of crimped couplings. Finally, and importantly, Basson recommends that the fire suppression system is charged and in working order.

Strydom adds that the implementation of maintenance programmes is incredibly important. "Also, one needs to develop preventative maintenance programmes for critical or at-risk equipment." Further, introduce a rigid housekeeping programme that focuses on cleanliness – making it easier to find and fix problems or potential risks. And, of course, risk management and daily activity or equipment risk assessment programmes will assist in fire prevention.

Gibhard elaborates that daily pre-start-up checklists should be completed by the operator. This can reduce the risk by picking up any irregularities before the operator actually starts the machine. An automatic detection system is advised wit the option of manually activating the system as well.

Firefighting materials

Basson continues that there are no ideal firefighting materials. "Some materials are more suited for certain fires than others." For example, water is not recommended for fuel and oil fires, as it can spread the fire and the burning fuel simply floats on top of the water. Foam, sand, dry chemical powder, and fine water mist are more suitable for such fires.

Inert gases and dry chemical powders are more suited for electrical fires in confined spaces. Basson explains that water is deemed unsuitable for high-voltage/-current electrical fires, as the water may conduct electricity. "However, this risk is overestimated. Salt water is a good conductor of electricity, fresh water isn't." Fine water mist can also be used in such applications.

He further explains that dry chemical powder is unsuitable for fires where a lot heat (thermal inertia) is present, such as tyre fires, overheated components, conveyor belt fires, fuel spray fires, and fires caused by frictional overheating. The dry chemical powder does not adequately dissipate heat. Foam, water mist, and water are more suitable for such applications.

"One must also consider which fire suppression agents are safe if personnel are in the area. People cannot breathe in inert gases or foam – water mist and water are safer.

"All fire suppression agents are ineffective in electrical fires if the energising circuit (either as ignitor or heat source) is not switched off or isolated. All fire suppression agents are ineffective in fires where fuel, such as hydraulic oil or diesel, is sprayed near an ignition source. It is, therefore, critical to switch a machine off and isolate its batteries upon fire detection, for fire suppression to be effective," adds Basson.

"The type of agent used to suppress the fire should also be carefully selected, as many agents lack the cooling capabilities to prevent reignition of fires after the initial flame knockout. That is why a water or foam mist system is a good option for machine fires. It not only knocks out the flames, but it also cools down the machine to prevent any reignition," says Gibhard.

Prevention is better than cure and if the correct fire prevention plans are in place, if safety officers frequently drill workers, and if operators are adequately trained, then fires could be better managed. It is not always possible to prevent a fire but, luckily, these days, most mines are well aware of the hazards and are more safety-conscious than in previous decades. 35