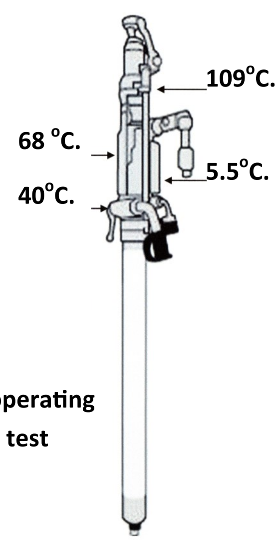
In order to determine the optimum rock drill oil, it's important to understand heat development within the tool

The lubrication requirements of a percussive pneumatic drill are different than other types of mechanical moving parts, such as bearings in transmissions.

Heat development within percussive drills is primarily affected by friction, compression and kinetic energy as a result of the energy transferred between the hammer and the drill steel. Compressed air temperature and tool design tend to dissipate heat in the tool, and thus the **external** measurable temperature around the body of the tool will be much lower than the temperature of the **internal** components of the tool, such as the rotary vane and piston.

The following examples demonstrate the rapid temperature changes within a tool. Actual measurements, using a heat sensor, indicate massive temperature fluctuations in very short distances within a percussive drill.



Stoper drill operating temperature test

These **external measurements** were taken with an infrared thermometer. Incoming air temperature was 40°C. As it entered the rotary vane section of the tool, friction and compression elevated the temperature to 68°C.

At the piston, the temperature rapidly increased to 109°C., due to the transfer of kinetic energy between the piston and the steel bit.

As the air was exhausted from the tool. the temperature at the muffler dropped to 5.5°C. This massive temperature drop is due to decompression, and explains why tools often freeze up at the muffler, even under very hot drilling conditions. **According to Boart Longyear, internal temperatures of a percussive drill can reach 570°F., (299°C.),** which is why carbonized oil is usually present around the piston, and scoring and galling occur in sections around and after the piston.

Conventional rock drill oils begin to break down (coke) at temperatures in excess of 390°F, which is why **PolarDrill high temperature polar ester RDOs** are a better choice to prolong tool life for equipment that can produce high heat. This also **includes piston motors used on mechanical raise platforms.**

If there is a breakdown in the oil supply, either through RDO starvation, or deterioration due to temperatures beyond the functional limits of the lubricating oil, frictional heating will rapidly increase the temperature of bearings and mating surfaces. This would normally lead to pronounced metal-to-metal contact, gross atomic bonding between journal and bearing, and seizure. See the impact of lubricant failure on the metal surface, photo at left.

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INDUSTRIAL DRILLING | GEOTHERMAL

New DTH Development Handles High Heat of Geothermal Drilling

By Valerie King

Atlas Copco has teamed up with Sandia National Laboratories to develop a DTH hammer capable of drilling geothermal boreholes in temperatures as high as 572 degrees Fahrenheit. *Source: Sandia National Laboratories*

US Department of Energy (DoE) funded research

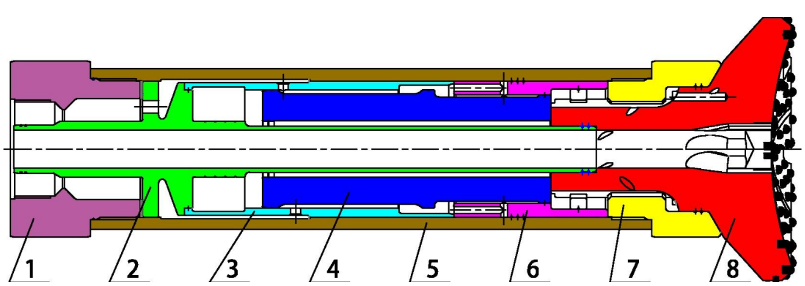
The US Department of Energy (DoE) funded a research and development project that aimed to lower the costs associated with bringing geothermal energy to consumers.

The DoE contracted Atlas Copco, which subcontracted Sandia National Laboratories, based in Albuquerque, N.M., to conduct testing to develop DTH processes to tolerate high heat.

Developing tough lubricious coatings, which help reduce friction between parts, was critical for the research project's success. DTH hammers encompass internal moving components that require lubrication, similar to a piston in a car engine. Jiann Su is a mechanical engineer with Sandia National Laboratories and principal investigator for the project. Su's team worked with Sandia's Materials Science and Engineering Center on a multilayer solid lubricant capable of operating at high temperatures. "We have tested at temperatures up to 572 degrees Fahrenheit," Source: Sandia National Laboratories . The heightened heat tolerance enhances drilling rates of penetration, a very important aspect of the geothermal energy development process. **This information is pertinent for PolairDrill high heat tolerant polar rock drill oils, which are engineered to tolerate heat up to 600°F (315°C), compared to conventional rock drill oils, that begin to break down (coke) at temperatures above 390°F (199°C).**

Percussive DTH hammers are used extensively in mining and construction, pointing out that their ability to drill very fast through hard rock makes them useful for geothermal drilling as well. "DTH are able to drill up to multiple times faster than tri-cone or rotary bits in hard rock. They efficiently transfer energy directly to the rock, which leads to higher penetration rates. They also require lower weight-on-bit and torque compared to other drilling methods."

However, he says oil mist and elastomer/plastic parts traditional DTH hammers use internally are unable to withstand the high temperatures in geothermal formations. Elastomers, which provide seals, will melt and, **"As temperatures increase, the oils essentially cook and you get this sooty mess inside. It's like running your car too long without changing your oil."**



Main parts in RC-DTH air hammer. 1: upper connection; 2: centre tube; 3: inner casing; 4: piston; 5: outer tube; 6: spacer bush; 7: splined hub; and 8: drill bit.

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These observations and tests lead to the conclusion that conventional rock drill oils, which have been used for generations in percussive drills, are limited in their ability to withstand heat that is generated within the equipment. Miners and mechanics have been accustomed to the limitations of regular RDOs, and accept their performance as normal and unavoidable.

In fact, the high temperature polar esters used in PolairDrill polar rock drill oils are formulated to tolerate both high and low temperatures typical to hard drilling.

Conclusions

The impact of high heat generation within percussive drills causes conventional rock drill oils to lose their ability to maintain a lubricious separation between moving parts. **The results of regular rock drill oil fluid degradation are:**

- Increased friction which accelerates the process of heat generation
- Development of hard carbon particles which adhere to drill parts and increase wear rates
- **Formation of mineral oil mists which are small particles that represent health hazards**
- **Formation of oil smoke as the RDO bakes onto drill parts. Oil smoke is more hazardous than oil mists.**
- Decreased service cycles - as drills wear more rapidly they must be serviced more often
- Lost productivity as equipment must be stopped for service

The cost of any rock drill oil is relatively insignificant, when compared to all the other costs involved in production drilling.

Invest in **PolairDrill** polar rock drill oils and maximize the effectiveness of your lubrication program.

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