MDEC – ROUNDTABLE FORUM – OCTOBER 8, 2010

EMISSIONS REDUCTION & ALTERNATIVE TECHNOLOGY
FACILITATOR: John Vergunst, Ontario Ministry of Labour

Some 28 people from the mines, trap suppliers, engine manufacturers and OEMs attended.

REVIEW

Several papers expanded on diesel particulate matter (DPM) control. Aleksandar Bugarski spoke on preconditioning the diesel particulate filter (DPF) so that soot filtered soot and that controlled cleaning and regeneration was important similar to that used in the air filtration technology. Vio Mosincat representing the Detroit Salt mine stated that the mine had installed Rypos flow through DPFs on their equipment. Together with using a blend of 90% soy biodiesel fuel they could now meet the 160 $\mu g/m^3$ US DPM limit. There were many other comments on the successful implementation of DPFs in the mining industry such as the Sudbury Vale experience.

The issue of increased nitrogen dioxide (NO_2) emissions and control technologies were discussed at the conference. Paul Turpin of DCL spoke of their diesel oxidation catalyst (DOC) which reduced NO_2 by 41%, whereas Domi Andre of Puritech showed reductions with their DOC of 40 – 60%. John Stekar of CEP showed results from the Canmet certification lab that showed large reductions at low exhaust temperatures but which dramatically increased when temperatures exceeded 350°C. Kevin Cassidy of the Goderich Salt Mine showed excellent NO_2 reductions using selective catalyst reduction (SCR) traps which used urea.

It appears that exhaust treatment devices are now very reliable and can control the diesel emissions. Therefore more attention is being given to maintenance of the diesel engines based on emissions. Two papers were given at the Conference on the progress of monitoring exhaust emissions from underground equipment. Peter Anyon from Australia presented a system to measure DPM in the exhaust in real-time and Doug O'Connor from Vale's Creighton mine together with Drager are working on a similar system, but one that will also monitor the gases.

However every presenter always came back to the importance of mine ventilation. Farah Kassam of the Musselwhite Mine presented occupational exposure data highlighting the importance of diesel fleet control and ventilation.

LEGISLATION & EMISSION CONTROL

It was mentioned that one presenter at the Conference stated that Canadian mines required incentives such as reductions in ventilation rates (100 cfm/bhp) before these technologies become financially feasible. Each Canadian Province and Territory has mine legislation which normally includes fuel specifications, occupational exposure limits and ventilation rates either based on name plate data or based on the maximum rated horsepower.

Dirk Dahmann of the German workers compensation board stated that the previous German air quality standards required mines to reduce exposures below the regulated occupational exposure values (OELs) and where possible to further lower concentrations as low as reasonably achievable (ALARA). In practice the mines only worked to reduce concentrations below the legislated limits although technology was available in the form of DOC, DPF or SCR to further reduce exposures. The newest German standard requires only ALARA and mines need a very good reason not to use the latest emission controls. There are guidelines available.

This is similar to legislative strategies in Australia where the mines must use a risk assessment approach and the mines must use all technical measures available. Queensland recommends a guideline limit (in accordance with MDG29) of 100 $\mu g/m^3$ elemental carbon but no prescribed ventilation rate. However there must still be sufficient quantity and quality to provide a healthy atmosphere. In Queensland most metal mines are conforming to this guideline limit of 100 $\mu g/m^3$. Companies must perform sampling audits to determine compliance. (NOTE: MDG 29 is publicly available. Refer to http://www.dpi.nsw.gov.au/minerals/safety/publications/mdg)

The incentive for US mines is MSHA's regulatory requirement for metal and non-metal mines to meet the 160 $\mu g/m^3$ total carbon limit. All the participants agreed that without legislation many of the emission technologies will not be used. MSHA recently released its error factor for DPM measurement bringing the effective limit to 190 $\mu g/m^3$ of total carbon.

One US coal mine operator stated that prior to this legislation no traps were used and now they have over 200 DPF traps. In coal mines, DPM sampling is not conducted but rather the legislation focuses on maintenance, DPFs and ventilation. Coal mines using diesel equipment must be below half the OELs plus maintain the ventilation to the MSHA certified ventilation rate.

Another mine in the US stated that because of the age of the mines, increasing ventilation was not an option. Instead they have equipped 25% of their diesel fleet (mostly scoops and trucks) with DPFs as well as using B50 biodiesel fuel. However they still have difficulties meeting the 160 µg/m^3 total carbon limit in the development ends.

Currently several US mining groups are taking legal action against the 160 µg/m^3 total carbon limit saying it is too low and causing an economic burden.

CONCERNS OVER EMISSION CONTROL DEVICES

Although the traps are now reliable, the cost of the engine will now increase because of the DPF or SCR or both. One operator stated that over the cost of a million dollar piece of equipment, the percent additional cost is small. Room on the equipment to place this technology on existing units may not be practical and new equipment may be required. On large equipment this is not a concern.

A metal mine operator stated that where possible only passive traps are being used because of the difficulty in servicing and removing active filter traps. All their mines meet the 160 µg/m^3 total carbon limit.

A coal operator stated that they have been using disposable DPF filters but now are going to the Airflow flow through DPFs with a NO_2 DOC. The mine feels this is best solution.

MAINTENANCE AND TESTING

The New South Wales prescribed tailpipe emission tests were presented in Peter Anyon's paper. According to Australian participants it does not matter where the exhaust is sampled but they are only interested into the level of contaminants that enter the workplace. (i.e. measure after the DOC, DPF, etc). Once the engine is at operating temperature, a 60-second torque stall test is taken. (20s idle, 20s full load, 20s idle). All other equipment is tested to their "free acceleration" test. (4 repeats of engine idle, instantaneous full speed, idle, etc). These tests are specified in MDG-29.

Some Canadian mines are using the ECOM system for testing the emissions. The ECOM samples oxygen, carbon monoxide (CO), carbon dioxide (CO_2), nitrogen dioxide (NO_2) and nitric oxide (NO). The sampling unit requires at least 30 seconds at torque stall conditions to take an accurate gas sample. The ECOM takes a smoke reading by drawing exhaust through a filter on the probe. (Bosch smoke test). Ontario also requires a test of the aldehydes as formaldehyde and this can only be done with a stain tube. This is an elaborate test and can only be carried out in an underground shop. For units that cannot come into the shops, stain tubes are still used to measure CO.

Because the ECOM requires 2.5 minutes of sampling at torque-stall for the Bosch smoke test the Canadian companies using this test are seeing torque problems because of the heat generation.

In US coal mines located in Pennsylvania and West Virginia, tailpipe measurements must be taken once a week. The unit's diesel is loaded by either using torque converter-stall or by pushing against the rib. The torque converter stall test is a legislated 5-minute test.

They were also seeing damage to their torque converter from the heat generated during the testing. They upgraded the transmission cooling circuits and solved the problem. The CO andCO_2 are measured in the tailpipe and compared to MSHA's published lug data for the diesel engine being tested. If the concentration is too high then that unit must be repaired.

All contractor equipment is also required to be tested, either by the mine or by the contractor.

TRAINING

In US metal mines a new miner must have 40-hours of training on mine hazards. Afterwards annual 8-hour refresher training is given of which a portion must be hazard awareness of diesel emissions. Australia also requires diesel emission awareness training.

Most mines hire heavy duty diesel mechanics but an underground mechanic does not require official certification.

In Ontario most underground mechanics are trained or have their heavy duty diesel mechanic certification through the Ministry of Colleges and Universities. For on-highway equipment there are two "restricted trades", automotive and trucking / coach. A mechanic repairing on-highway equipment must have one of these trades. Off-highway or underground mechanics generally have their "heavy duty diesel mechanics" trade but it is not a legislated requirement. All these trades require both classroom and practical experiences. An apprentice requires 9000 hrs of practical experience before being allowed to write the tests.

In the US coal mines, a mechanic must be signed off by the mine that they are competent to work on each certified engine underground. An official document for each mechanic is then issued by MSHA.

By regulation the US metal mines only require a "qualified mechanic". It is up to the mine to determine the level of qualification required.

Note: This document was kindly reviewed by, Steve (Skinner) Forbush, Kevin Hedges, JP Ouellette and Dirk Dahmann.

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