

Swedish strategy and "know how" to curtail diesel soot in mining industry

Tommy Eriksson

Health & Safety engineer, Boliden AB
Member of GRAMKO Technical committee

MDEC 2004

SveMin

THE SWEDISH MINING INDUSTRY 2004

**6 companies with a total of
13 metal mines in operation,
(4 open pit and 9 under ground)**

**All companies are organized in the trade
organization SveMin, the Swedish
Association of Mines, Mineral and Metal
Producers.**



SveMin

Co-operation in Health and Safety

There is an old tradition (since the 1940ies) of co-operation between the mining companies in the area of health and safety. Nowadays this co-operation is organized under the name of GRAMKO, an association within the SveMin organization.

GRAMKO initiates and coordinates mutual actions concerning the work environment issues and has four subcommittees:

- The Committee of Fire Prevention;
- The Medical Committee;
- The Technical Committee and;
- The Committee for Rock Mechanics.

SveMin

The GRAMKO Technical Committee

Main issues to monitoring the technical and legal development of:

- Diesel exhausts (fuel, purifiers and DPF:s)
- Noise
- Vibrations
- Electromagnetic fields
- Occupational Exposure Limit Values (OELVs); NO, NO₂, lead, silica etc.

SveMin

Exposure limits in Sweden

8 hour exposure limits (TLV-TWA)

NO ₂	2 ppm, <u>1 ppm</u> * if the source is exhaust gas.
CO	35 ppm, <u>20 ppm</u> if the source is exhaust gas.
Particles	no exposure limits

A typical situation in a Swedish mine

NO ₂	0,4 ppm
CO	4 – 5 ppm
Particles	OC: 0,18 EC: 0,08 TC: 0,27 mg/m ³

* New proposal for exposure limits from 2005: 0,5 ppm

SveMin

How to curtail diesel soot, the Swedish strategy...

In order of priority:

- Use a proper ventilation
- Use electrical engines as much as possible
- Use the best possible diesel fuel (best practice)
- Use “clean” engines, measure soot every 200 hour (legislated)
- Use diesel particle filter or other purifiers

SveMin

Proper ventilation...

Solves problems caused by both dust and exhaust gas, but:

- air requires a great deal of energy to move
- is complicated when the mine is deep
- must be heated during the winter. Direct heating with propane or natural gas is not allowed in Sweden. We have to use heat exchanger, which decrease the air flow.

SveMin

Electrical engines...

Is commonly used in:

- drilling machines;
- bolters;
- mechanical scaling machines;
- shotcrete spraying machines;
- trains

but can not be used everywhere...

SveMin

Best possible diesel fuel...

Past

Diesel fuel with high levels of sulphur (350 ppm or more) and 20 - 30% aromatics

Present

Diesel EC1 (Environmental Class 1) with low levels of sulphur (< 10 ppm) and maximum 2% aromatics

Future?

Synthetic diesel fuel with low levels of sulphur (< 5 ppm) and 1% aromatics

What you put in, is what you get out...

SveMin

Clean engines...

- The Swedish mining industry is a relatively small business, with insignificant possibilities to influence the development of the engines of the future.
- But we have the possibility to choose to buy vehicles with "clean" engines!
- As we are using mostly ordinary on-road trucks and vehicles in the small mines, the EU emission standards is one way to choose the best possible engine. The problem is that some of the manufacturer uses oxidation catalytic converters to reach the low emission levels...

SveMin

Diesel Particle Filters & Purifiers...

The history of cleaning diesel exhaust in Swedish Mines.

- 1960s Water scrubber**
Not very effective. No longer in use (?).
- 1970s Oxidation catalytic converters**
NO₂ problem, not recommended in Swedish mines
- 1980s Jetflow Fume Diluter.**
Not effective. Dilute and cool exhaust gases.
- 1990s Diesel Particle Filter and Purifiers**
Effective but not problem-free...

SveMin

Diesel Particle Filters & Purifiers...

There is a problem to evaluate the efficiency of DPF:s and purifiers. Neither the mining companies or any Swedish mining organization has the resources and knowledge to do such tests.

GRAMKO have therefore engaged an engine consultant company for validation of different DPF:s and purifiers, to make a "layabout", which will helping us to find "the best solution, on that machine, in this circumstances".

Another way of solving the problem is to work in network and take part of each others experiences. For example our good co-operation with INCO (Sudbury, Joe Stachulak)

SveMin

Problems?

- **New exposure limit for NO₂, from 1 to 0,5 ppm. Almost all of the new small diesel trucks and diesel cars has fabric mounted oxidation catalytic converters. How will that effect the air quality in the mines?**
- **How to get information of the emission values for NO₂, when the society only focus on NOx? In almost all technical documents, it´s only NOx that´s presented.**
- **Warranty. Can engine manufacturer give guarantees if we mount DPF:s and purifiers on their engines?**
- **Acceptance from users and maintenance organization?**

SveMin

Summary

We believe that the key to success is as follows:

- 1. Make sure you have a good ventilation. By that you also solve problems caused by dust etc.**
- 2. Use the best possible fuel. Demand EC1 standard or similar from the fuel supplier. They sell it everywhere in Sweden, so why not in Canada?**
- 3. Use modern engines, and keep a good maintenance standard.**
- 4. Use the “best practice” not the “best theoretical” devices and choose them in collaboration with engine manufacturers and users. It´s important to get acceptance for the devices you use.**
- 5. Avoid using oxidation catalytic converters which increase NO₂ . You solve one problem while you create another...**

SveMin