**Diesel Emissions Evaluation Program**
Project Summary

# Evaluation of Existing Diesel Particulate Matter Sampling and Analysis Methods at a High Sulphide Ore Mine

Michel Grenier, Mahe Gangal, Rolando Lastra, Shaheer Mikhail, Anne-Marie Turcotte, Kevin Butler, Eric Edwardson and Gilles Laflamme

CANMET
Mining and Mineral Sciences Laboratories
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Complete Report

## Executive Summary

This study evaluated three methods for measuring worker exposure to diesel particulate matter (dpm) in high sulphide mines. These were the Respirable Combustible Dust (RCD), the Size-Selective (SS) and the Thermal-Optical methods. Previous sampling in Canadian mines had uncovered cases where RCD samples had to be rejected because of suspected interference. This led to the suspicion that oxidation of sulphide minerals on the filter caused the sample to gain in mass during the ashing process involved in RCD analysis. The first goal of the study was to investigate the impact of the presence of respirable sulphides on the RCD sampling method. The second goal was to compare and evaluate the three sampling methods under high dpm, and mixed dpm/sulphide mineral dust conditions.

Present results show that oxidation of respirable sulphide materials on samples does not cause significant mass increases during the RCD process. Oxidation of these minerals as well as the combustion of sulphur-bearing compounds from the fuel will, however, result in the production of SO2 gas. Laboratory testing using Thermogravimetric and Differential Thermal Analysis did show the SO2 and its subsequent interaction with the silver from the filter membrane is a probable cause of mass increase. These data show that one very probable source of interference in the temperature range used in RCD analysis are organo-sulphates in the fuel. The results indicate that the performance of the RCD method can be enhanced by making use of a small pore-size silver membrane filter and using low-sulphur fuel in diesel applications underground. Smaller pore sizes help keep sulphur bearing minerals on the surface of the filter and away from the silver matrix, while lower sulphur fuel produces dpm with lower levels of organic sulphur, which can produce SO2 upon ashing during the RCD analysis.

For this work, the Total Carbon (TC) concentration as measured by the Thermal-Optical method (NIOSH #5040) was used to compare and evaluate the RCD and SS gravimetric methods. During Week 1 of the study (dpm only) the RCD method overestimated by about 12% and the SS method by 13%. During Week 2 (dpm/mineral dust) RCD underestimated by 10% and SS overestimated by 8%.

Even in a sulphide ore environment, the three methods tested performed very well. It is believed that for the present and as long as the limits of exposure are at or above 0.60 milligram per cubic metre (mg/m3 ), the gravimetric methods appear to be adequate in sulphide ore mines. Below these levels, alternatives such as the Thermal-Optical methods should be considered.

For mines where mineral interference is not a problem and/or in applications where dpm is the main source of airborne respirable dust, the RCD method could be used at even lower concentrations. This should be kept in mind in view of the fact that this method is compatible with silica analysis and as such, increases the amount of exposure data collected.

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