

to collect DPM samples for EC analysis using the NIOSH 5040 method. The laboratory results showed that the filters removed EC with efficiencies up to 99%.

Evaluation of Fuel Oxygenator System: MSHA recently completed laboratory tests on a Rentar in-line fuel catalyst. The Rentar unit was installed on a Caterpillar 3306ATAAC which was coupled to a generator. An electrical load bank was used to load the engine under various operating conditions. The engine was baselined for gaseous and DPM emissions without the Rentar; then, the Rentar was installed and operated for 100 hours of break-in. The gaseous and DPM emission measurements were repeated after the 100 hour break-in. The preliminary laboratory results showed some measurable reductions in whole DPM. Samples were also collected for EC analysis using the NIOSH 5040 method. Those results are currently being evaluated by NIOSH.

Evaluation of a Magnet System: MSHA is preparing to perform laboratory tests for Ecomax, a manufacturer of a magnet system installed on the fuel line, oil filter, air intake and radiator. A preliminary MSHA field test of this product was done at a surface aggregate operation. The magnetic device demonstrated a 30% reduction in CO levels. Subsequent laboratory testing will include DPM measurements.

Additional Testing: MSHA is also planning a lab test on a manufacturer's

fluidized bed, several types of fuel additives, and a fuel preparative. The test plans and the required test hardware are currently being discussed with the respective manufacturers of these products.

VI. Exposure Assessment and Literature Update

A. Introduction

Section VI.B summarizes new exposure data that have become available since publication, on January 19, 2001, of the existing rule limiting DPM levels in underground metal and nonmetal mines. Next, in Section VI.C, we survey the most recent scientific literature (April 2000–March 2003) pertaining to adverse health effects of DPM and fine particulates in general.

B. DPM Exposures in Underground Metal and Nonmetal Mines

In the existing risk assessment (66 FR 5752) we evaluated exposures based on 355 samples collected at 27 underground U.S. M/NM mines prior to the rule's promulgation. Mean DPM concentrations found in the production areas and haulageways at those mines ranged from about 285 $\mu\text{g}/\text{m}^3$ to about 2000 $\mu\text{g}/\text{m}^3$, with some individual measurements exceeding 3500 $\mu\text{g}/\text{m}^3$. The overall mean DPM concentration was 808 $\mu\text{g}/\text{m}^3$. All of the samples considered in the existing risk assessment were collected prior to 1999, and some were collected as long ago as 1989.

Two new bodies of DPM exposure data, collected subsequent to promulgation of the 2001 rule, have now been compiled for underground M/NM mines: (1) Data collected in 2001 from 31 mines for purposes of the 31-Mine Study (Ref. 31-Mine Study) and (2) data collected between 10/30/2002 and 3/26/2003 from 171 mines to establish a baseline for future samples (Ref. Baseline Samples, 2003). Both of these datasets have been placed into the public record, and they are summarized in the next two subsections below. Following these summaries, we discuss the relationship between EC and TC, including the ratio of EC to TC (EC:TC). This discussion will be based entirely on samples taken for the 31-Mine Study, since those samples were controlled for potential TC interferences from tobacco smoking and oil mist, whereas the baseline samples were not.

1. Data from Joint Study

As described in greater detail in MSHA's final report on the 31-Mine Study, MSHA collected 464 DPM samples in 2001 at 31 underground M/NM mines. Of these 464 samples, 106 were voided, most of them due to potential interferences resulting in invalid TC content used to evaluate DPM exposures. Table VI-1 shows how the remaining 358 valid DPM samples were distributed across four broad mine categories. All samples at one of the metal mines were voided, leaving 30 mines with valid samples indicating DPM concentrations.

TABLE VI-1.—NUMBER OF DPM SAMPLES, BY MINE CATEGORY

	Number of mines with valid samples	Number of valid samples	Average Number of valid samples per mine
Metal	11	116	10.5
Stone	9	105	11.7
Trona	3	54	18.0
Other	7	83	11.9
Total	30	358	12.5

Table VI-2 summarizes the valid DPM concentrations observed in each mine category, assuming that submicrometer TC, as measured by the SKC sampler, comprises 80 percent of all DPM. The mean concentration across all 358 valid

samples was 432 $\mu\text{g}/\text{m}^3$ (Std. error = 21.0 $\mu\text{g}/\text{m}^3$). The mean concentration was greatest at metal mines, followed by stone and "other N/M." At the three trona mines sampled, both the mean and median DPM concentration were

substantially lower than what was observed for the other categories. This was due to the increased ventilation used at these mines to control methane emissions.

TABLE VI-2.—DPM CONCENTRATIONS ($\mu\text{g}/\text{m}^3$), BY MINE CATEGORY. DPM IS ESTIMATED BY TC/0.8

	Metal	Stone	Trona	Other N/M
Number of samples	116	105	54	83
Minimum	46.	16.	20.	27.
Maximum	2581.	1845.	331.	1210.
Median	491.	331.	82.	341.