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SIMULATED WORK PLACE TESTING IN A SANDBLASTING ENVIRONMENT

E. D. BULLARD COMPANY

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Introduction

E. D. Bullard Company has conducted several base-line simulated workplace sandblasting respirator tests using one of its hard shell, hood style blasting respirators. The blasting media used is procured from a local (Lexington KY) blasting supplies distributor. A special testing chamber has been constructed from concrete blocks specifically for simulated workplace testing. The inside dimensions of the chamber are approximately 12 feet wide, 15 feet deep and 8 feet high. Standard rotating roof ventilators are employed to provide a relatively controlled exhaust path for the compressed air being released by the blasting nozzle and supplied air respirators while in use. Air sampling pumps and Milipore sample filters are used and in some cases cyclones are used to separate respirable from total dust samples. Lighting inside the test chamber comes from four large side windows and incandescent overhead spotlights. Items blasted include used auto parts, farm/tractor implements and worn machinery parts. Due to the relatively confined space within the testing chamber and high rates of air/blast media flow through the 1/2 inch blasting nozzle, the test environment is considered severe as compared to most blasting environments.

Procedures Overview

Environment

Two people enter the blasting chamber at a time, each wearing Bullard supplied air sandblast hoods. One person is fitted with two sampling pumps and he carries out the blasting activities. The other person serves as helper and observer. One of the pumps samples ambient air just outside the hood next to the lens while the other pump extracts an air sample inside the respirator hood next to the wearer's mouth. A third person serves as a helper outside the test chamber. He wears an air purifying full face piece respirator with high efficiency filters. His responsibilities include tending the sand pot and monitoring the air compressor air quality and points of attachment pressures for the two respirators inside the test chamber.

Work Simulation

When the work begins the observer turns on the sampling pumps. The blaster usually keeps the blasting nozzle trigger depressed until the visibility is reduced so much that he can no longer see to continue the blasting or until the part being blasted requires repositioning. This occurs approximately every one to two minutes. After the dust settles upon release of the trigger to a point that visibility has somewhat cleared, the blaster again depresses the trigger for the next cycle. Blasting in such poor conditions is possible since, as the abrasive sand strikes a ferrous surface, a bluish glow is given off, improving visibility. The observer is responsible for timing the operation of the sampling pumps. About every 15 minutes the doors to the chamber are opened, the pumps turned off and the floor is swept clear of debris.

Filter Procedures

Sample filters are preweighed after being desiccated using a micro balance. After exposure they are redesiccated and reweighed. In some cases we have sent the samples to the University of Kentucky for evaluation as to particle size distribution, percent silica, etc.

Results/Observations

1. About 5% of the dust created in sandblasting is respirable (below 10 microns) according to a typical particle size distribution analysis. (see Exhibit 1)

2. The bulk of respirable particles are in the 2 micron range.

3. The 50^{th} percentile concentration of respirable dust has been measured at 250 milligrams/cubic meter (See Exhibit 2). It should be noted that this concentration is significantly greater than most of those which have been reported in actual work place studies performed by others in recent years. (This may be attributed to the severe conditions imposed by our procedure.)

4. The 50^{th} percentile concentration of total dust was measured to be 3200 milligrams/cubic meter (See Exhibit 3). This concentration is likewise significantly greater than those typically reported in other studies.

5. The ratio of respirable to total dust in the sand blasting environment is then $\frac{250}{3200} = .078$, or about 8%. This value is reasonably close to the 5% value obtained in the particle size distribution analysis.

6. The measured inward leakage obtained during two, 2 hour work shifts (4 hours total) of respirable dust was in the range of .02 Mg/M^3.

7. The measured inward leakage obtained during two, 2 hour work shifts (4 hours total) of total dust was in the range of .06 Mg/M^3.

8. The ratio of respirable to total dust of the inward leakage is then $\frac{.02}{.06} = .33$ or about 30%. In contrast to the 8% value stated in Item 5 above, this would tend to indicate a higher percentage of the smaller particles seemingly penetrate the respiratory inlet covering.

9. A typical total dust sample was analyzed and found to contain 83.6% S_1O_2.

10. In order to capture enough sample inside the sandblast hood for gravimetric analysis, the sampling pump must run about 4 hours at 2 LPM. Numerous attempts have been made with durations up to one hour, none of which resulted in any detectable contaminant captured on the sampling filters.

11. On the other hand, running a sampling pump in excess of 15 to 20 minutes to capture ambient dust results in pump shutdown due to sample filter overload.

    Because of the conditions noted above, actual side by side comparisons of inside and outside concentrations (in real time) have not been possible.

12. Ambient (outside respirator) concentrations in a highly controlled simulated work place setting of respirable dust resulted in 5^{th} and 95^{th} percentile values of 5 Mg/M^3 and 1000 Mg/M^3 respectively. This amounts to a 200 fold data spread.

13. Several of the tests which have been performed were discounted due to various reasons including pump failure, questionable sample filter preweight measurement and sampling train leakage.

14. None of the results has been corrected for sampling bias.

15. While it has not yet been validated with a statistically significant quantity of accurate breathing zone samples, it appears, at this point, that inward leakage values do not seem to substantially fluctuate as do the ambient concentrations (as indicated in Exhibit 2).

16. Using the inward leakage concentrations listed above (Items 6 & 7) and the 50th percentile ambient concentrations taken from Exhibits 2 and 3 (also listed in items 3 & 4 above), the following uncorrected protection factors are reported:

	50th Percentile Ambient Concentration Mg/M^3	Inward Leakage Concentration Mg/M^3	Protection Factor
Respirable Dust	250	.02	12500
Total Dust	3200	.06	53000

Conclusions

The work carried out thus far by E.D. Bullard Company has been limited in scope. Even so, it has been expensive. Approximately 1000 man hours have gone into actual testing, preparation and analysis. At, say, $25/Hour, this amounts to approximately $25,000. Additionally, another $25,000 has been spent on facilities and equipment procurement and/or rental. As yet, the number of samples collected have been relatively few. This preliminary data indicates that ambient concentrations substantually fluctuate or vary during actual work conditions even in a simulated or controlled environment.

Particle Size Distribution

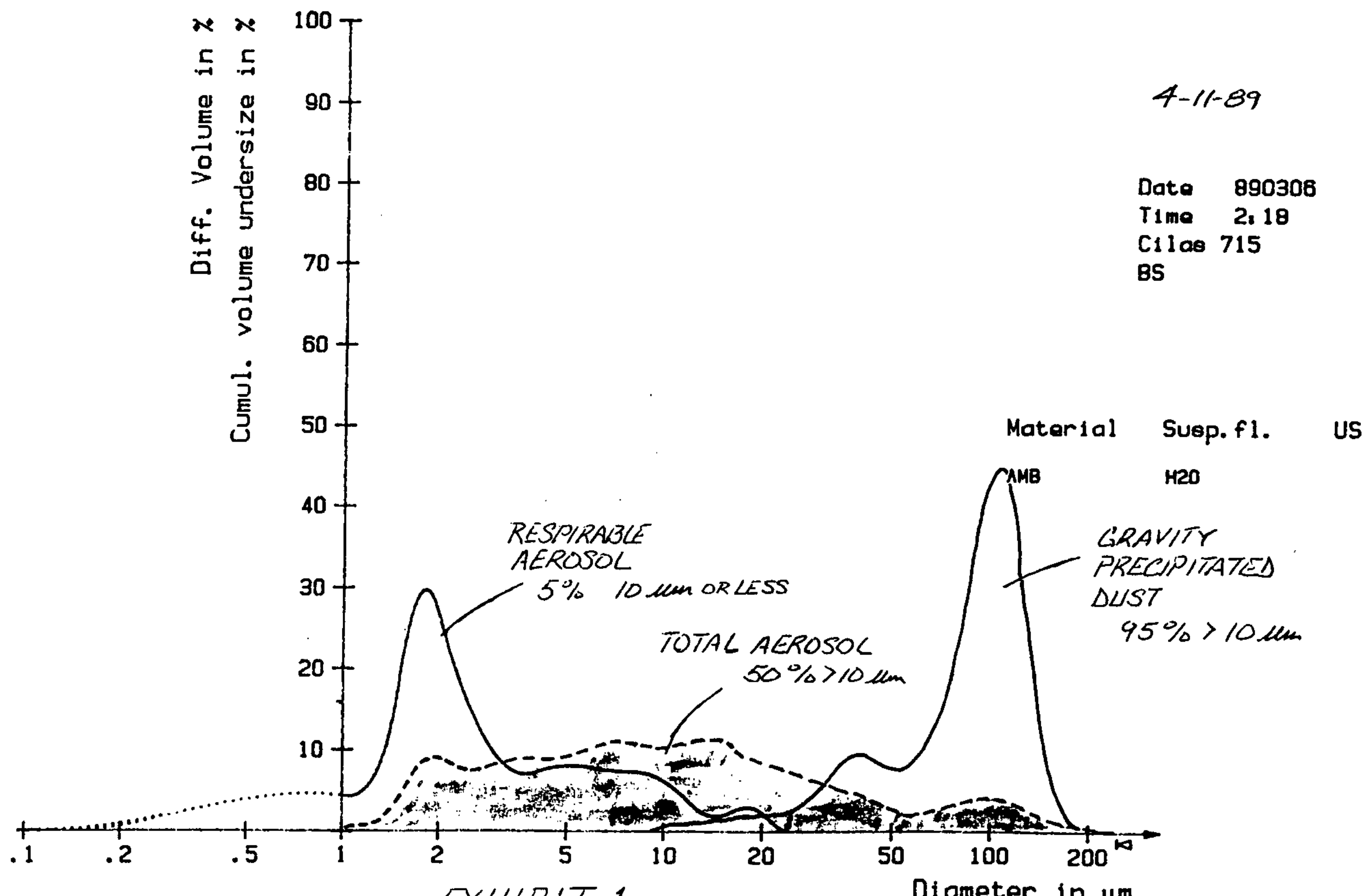

EXHIBIT 1

E.D.BULLARD CO. 11/90

SANDBLASTING RESPIRABLE DUST
CONCENTRATION MILIGRAMS/CUBIC METER

CONC.	PERCEN-TILE
5	5
250	50
1000	95

MEAN 310

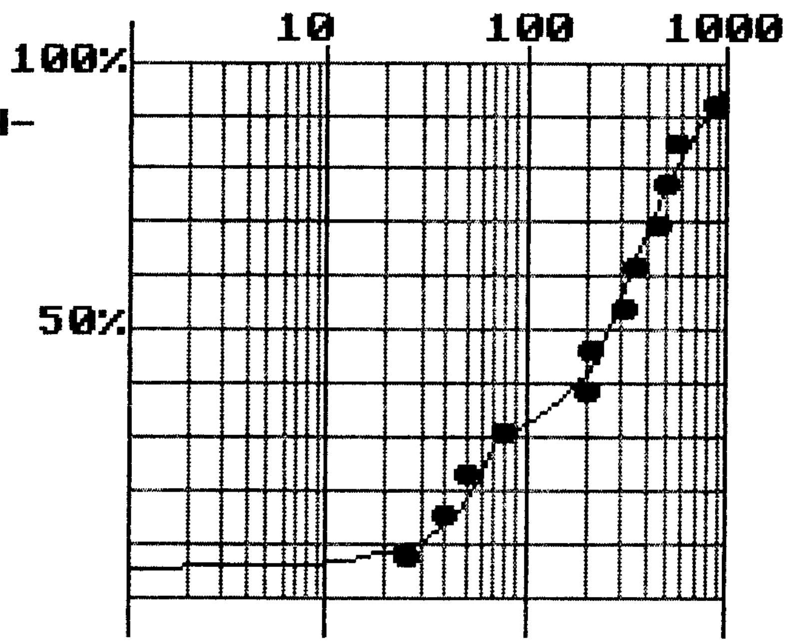

EXHIBIT 2

E.D.BULLARD CO. 11/90

SANDBLASTING TOTAL DUST CONCENTRATION
MILIGRAMS/CUBIC METER

CONC.	PERCENTILE
70	5
3200	50
33000	95

MEAN 7300

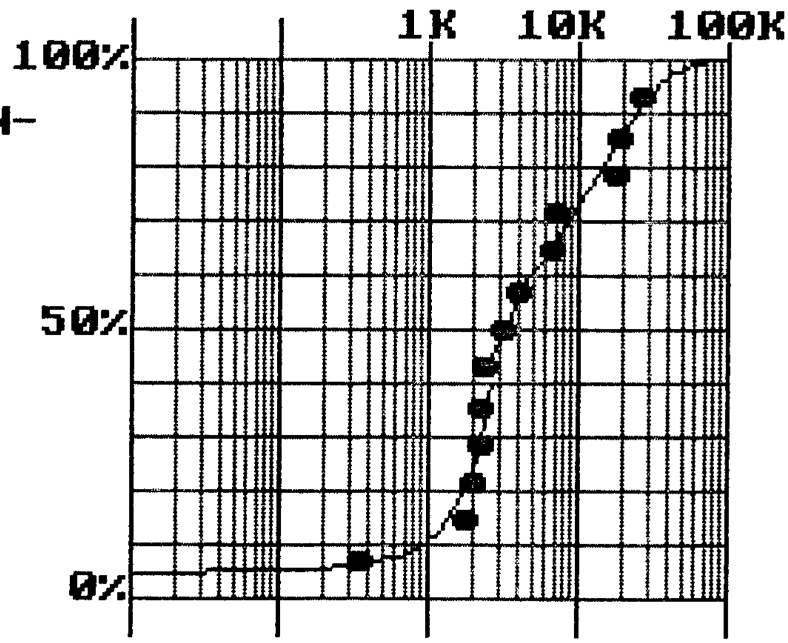

EXHIBIT 3