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EVALUATION OF THE EFFECTIVENESS OF CHEMICAL DUST SUPPRESSANTS ON UNPAVED ROADS

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16. ABSTRACT The report gives results of measurements of the long-term effectiveness of five unpaved-road chemical dust suppressants. Effectiveness at controlling total particulate emissions in three size fractions (<15, <10, and <2.5 micrometers) was determined over several cycles of chemical application, control effectiveness decay, and chemical reapplication. All five chemicals were tested on the same roa with each chemical used on separate abutting road segments. The chemicals were applied in quantities that spanned the range of common practice in the steel industry. Traffic parameters were typical of the steel industry. Over a 30-day period, control effectiveness of each chemical decreased: in some cases by as much as 50% and in others by as little as 10%. Control effectiveness for all chemicals was >95% immediately after chemical application or reapplication. The rate of decay was about the same for all particle size ranges investigated. Road surface silt loading was found to be a reliable indicator of relative effectiveness for some chemicals.

17. KEY WORDS AND DOCUMENT ANALYSIS

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Roads	Dust Suppressants	
Chemical Compounds	Unpaved Roads	07B,07C
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SUMMARY AND CONCLUSIONS

The purpose of this study was to obtain data characterizing the average control performance of dust suppressants commonly used by the iron and steel industry to mitigate particulate emissions from unpaved roads. Vehicular traffic on unpaved roads has been estimated to contribute more than half of the suspended particulate emissions from open sources in the industry.

Control efficiency values were determined not only for total particulate (TP), but also for particles less than 15 ∓m in aerodynamic diameter (inhalable particulate, IP), less than 10 ∓m in aerodynamic diameter (PM_{10}), and less than 2.5 ,∓m in aerodynamic diameter (fine particulate, FP). The study focused on PM_{10} control performance of dust suppressants in particular, because this size fraction is anticipated to form the basis of any revised National Ambient Air Quality Standard for particulate matter.

In order to make the control performance test results as useful as possible to the industry, unpaved road vehicular traffic characteristics and dust control techniques used in the industry were surveyed early in the study. Subsequently these results formed the basis for the design of the field testing program so that commonly used suppressants could be evaluated under service conditions representative of typical iron and steel industry unpaved roads.

The exposure profiling method developed by MRI was the technique utilized to measure uncontrolled and controlled emission factors for vehicular traffic on unpaved roads. Exposure profiling of roadway emissions involves direct isokinetic measurement of the total passage of open dust emissions approximately 5 m downwind of the edge of the road by means of simultaneous sampling at four points distributed vertically over the effective height of the dust plume. Downwind particle size distributions were measured using cyclone precollectors followed by parallel slot cascade impactors. Upwind particle size distributions were also determined using impaction. A total of 64 tests of controlled and uncontrolled particulate emissions from vehicular traffic on unpaved roads were conducted at two iron and steel plants.

Five chemical dust suppressants were evaluated during the study:

- Petro Tac, an emulsified asphalt
- Coherex, a petroleum resin
- Soil-Sement, an acrylic cement

- Generic 2 (QS), a generic petroleum resin product developed at the Mellon Institute
- Liquidow , a salt (calcium chloride)

All products, with the exception of Generic, have been used in iron and steel plants. In addition, industry personnel have expressed considerable interest in the use of Generic.

These suppressants were applied under the direction of MRI personnel in quantities that generally span the range of common practice in the industry, manufacturers' recommendations, and previous field evaluations. Control efficiency measurements were made over periods up to 70 days after application, although the main averaging period of interest was approximately 1 month. The latter is representative of time periods between control applications in the industry.

Average control efficiencies over the first 30 days for specific particle size ranges are presented in Figure SC-1. Note that code letters (explained in the text) have been assigned to the various dust suppressants in order to discourage selective citation of test results. It is recommended that the report taken as a whole be used as a basis for decisions regarding dust control programs rather than any one data set taken independently.

All chemicals tested exhibited average control efficiencies of approximately 50% or more over the first 30 days after application. These tests were conducted using application and traffic parameters that may be considered typical in the iron and steel industry. Note that while the control provided by some suppressants showed significant temporal decay, others exhibited a relatively constant level of control over the time period.

Statistical analyses of the data indicate that reapplication results in a significantly higher level of control and that only one suppressant exhibited significant differences in control between the various particle size fractions. Comparisons between the control efficiencies for different chemicals indicate that there were relatively few suppressant/size fraction combinations which could be considered significant at the 5% level.

Comparison of the relative cost-effectiveness reveals only a slight variation between the suppressants other than calcium chloride. In terms of cost-effectiveness, the salt did not compare favorably with the other products; however, this is at least a partial result of the abnormally high precipitation during the field exercise.

Several road surface material properties were discussed as possible indicators of control performance. While reasonably strong relationships between silt loading and control were found for some of the suppressants, the clustered nature of the entire data set precluded development of a reliable performance indicator. However, the data suggest that the industrial paved road emission factor equation may be used to conservatively overestimate emissions from controlled unpaved roads.

S = Soil Sement
G = Generic
X = Coherex
P = Petro Tac

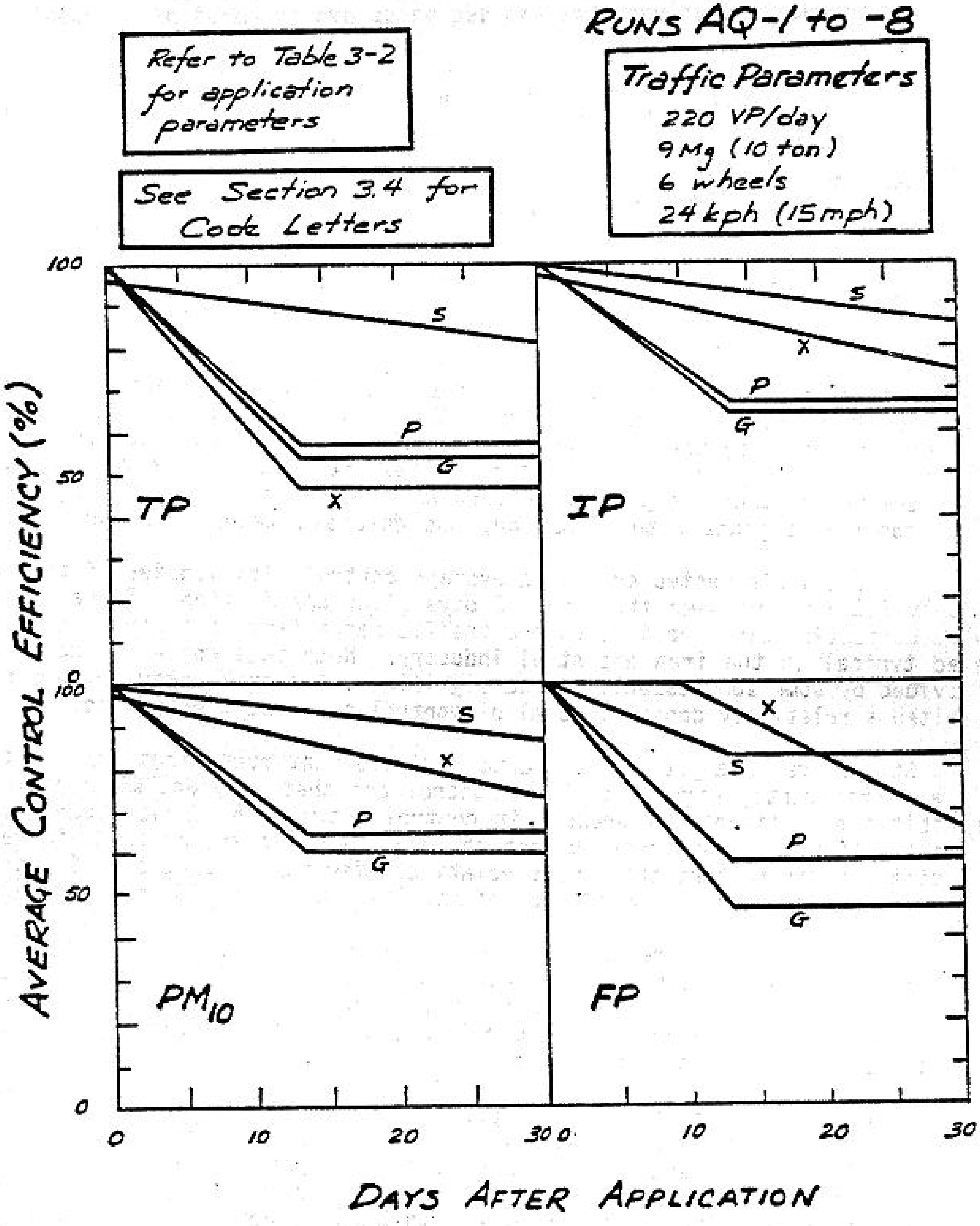

Figure SC-1. Average control efficiency as a function of time over 30 days.

Finally, results of previous tests were combined with data from the present study to develop an average control performance model for petroleum resins. The model was designed to meet typical needs in the iron and steel industry in terms of averaging periods and service environments.