United States
Environmental Protection
Agency

Research and Development

Hazardous Waste Engineering
Research Laboratory
Cincinnati OH 45268

EPA/540/S2-85/003 Mar. 1988

EPA

Project Summary

Fugitive Dust Control Techniques at Hazardous Waste Sites: Results of Three Sampling Studies to Determine Control Effectiveness

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Data is presented for several methods of controlling contaminated dust at hazardous waste sites. Commercial dust suppressant products were applied to exposed areas and soil storage piles to control wind erosion emissions. Windscreens were also used to control emissions from the storage piles. The chemical dust suppressants were effective in controlling wind erosion emissions in both applications. Windscreens were effective in reducing windspeed but did not produce commensurate reductions in particulate concentrations coming from the pile. Emissions generated by equipment movement during active cleanup were controlled by spraying the active work area with water and with a water-surfactant mixture. Emissions generated by loading soil into a truck were controlled with an array of spray nozzles mounted on the sides of the truck bed. A similar array of foam nozzles was also used to control loading emissions. All of these methods were effective in reducing emissions generated by active cleanup.

This Project Summary was developed by EPA's Hazardous Waste Engineering Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

Land surfaces contaminated with toxic chemicals can lead to subsequent human exposure through many routes. One of these routes is entrainment of contaminated soil particles and transport offsite in the air.

There are three basic mechanisms by which soil containing toxic chemicals can become entrained:

- Wind erosion
- Reentrainment by moving vehicles
- Disturbance of the soil surface during active clean-up of a hazardous waste site

The purpose of this project was to investigate control measures for these potential airborne dust sources at hazardous waste sites.

A review of previous research in this area revealed that most studies have been concerned almost exclusively with control of dust from vehicle reentrainment. Therefore, the decision was made that the present study would focus on controls for airborne emissions from wind erosion and active cleanup operations.

Three separate field studies were performed concurrently at different sites to evaluate fugitive dust control measures:

- Active cleanup emissions resulting from loading soil into a truck with a front-end loader, controlled with area spraying and with a spray curtain.

- Wind erosion of inactive surfaces, controlled with chemical dust suppressants.
- Wind erosion of an inactive soil storage pile, controlled with windscreens alone and in conjunction with other control measures.

The report contains the results of these three field studies. Another report entitled "Handbook of Dust Control at Hazardous Waste Sites" incorporates the test results into recommendations for controlling dust at contaminated sites.

Methodology

Exposed Area Testing

Twenty-one test plots were prepared by removing vegetation and topsoil from areas 50 ft. x 50 ft. Several smaller 4 ft. x 8 ft. plots were also prepared. A tracer was applied to the bare plot before the plot was treated with a specific dust suppressant. Zinc oxide and zinc sulfate were used as tracer compounds. Soil particles eroding from the exposed areas were sampled along the perimeters of the plots with saltation samplers. Samples were also taken from the treated surface of the plot with a vacuum apparatus. The presence of zinc in either sample indicated a failure of the "seal" formed by the dust suppressant.

Storage Pile Testing

The test site contained a single pile of shredded topsoil and a 75 ft. long, 8 ft. high windscreen that could be readily shifted to different positions around the pile. Particulate samplers were placed upwind and downwind of the pile/screen area to measure the particulate concentrations from wind erosion and the reduction in concentration due to the windscreen and other controls. Windspeed and wind direction sensors were also placed upwind and downwind of the pile and screen. A large number of tests were performed at different windspeeds with and without the windscreen. From the resulting values, the average reduction in net concentration (downwind minus upwind) was determined for each control alternative as a function of windspeed. Screen-to-pile distances of 5, 15, and 25 m were tested.

Active Cleanup Testing

The operation selected for testing consisted of a front-end loader (FEL) and dump truck combination. The FEL scraped material from the surface, turned and traveled to the dump truck where the load was dumped. Exposure profiling was used to sample the dust emissions downwind of the operation. The primary sampling instruments were isokinetic profiler heads utilizing a stacked filter concept. Four control measures were evaluated. Control measure 1 consisted of spraying the active working area of the FEL and dump truck with water (0.9 gal/yd^2). For control measure 2, application procedures were identical to those used in the plain water application, but a surfactant was added to the water to form a 1:1000 dilution of surfactant to water. This mixture was applied at a rate of 0.75 gal/yd^2. Control measure 3 consisted of an array of 12 spray nozzles on the sides of the dump truck emitting a continuous spray of the water/surfactant mixture. This method was used to control emissions from the dump cycle. The final method, control measure 4, utilized 4 spray nozzles at the corners of the truck bed to disperse a foam solution. The foam spray operated only during each dump. Quantities of liquid average 1.5 gal/yd^3 and 0.4 gal/yd^3 respectively for the last two control measures.

Discussion of Results

Exposed Area Testing

Surface sampler (vacuum sample) results did not appear to be reliable based on methodological problems. It is theorized that the force of the vacuum may have damaged the integrity of the "seal" formed on the soil surface by the dust suppressant products. Evaluation of the saltation sample results shows varying degrees of control among the products tested. Most of the products dropped below 100 percent effectiveness two to four weeks after application. The gradual upward trend in zinc concentration in the samples indicates that a dust controlling "seal" was initially formed but soon began to deteriorate.

Storage Pile Testing

A total of 82 tests were taken—47 with the pile surface dry, 14 with watering, and 21 with dust suppressant products applied. Hourly average windspeeds varied from 4.1 to 24.1 mph. Windspeed reductions resulting from the windscreen decreased as the screen-to-pile distance increased. These reductions were fairly independent of incoming windspeed and were consistent with reductions reported previously in the literature. The screen did reduce windspeeds by the amount anticipated, but this did not result in commensurate reductions in particulate concentrations coming from the pile. Taken in total, the results indicate that the windscreen did not produce consistent or significant reductions in wind erosion. An explanation for the windscreen's performance, developed after review of all the data from this study, is that wind erosion emission rates in the less than 10 micrometer size range are fairly constant at windspeeds above the threshold of 7 mph (hourly average). The additional emissions associated with high wind erosion losses at high windspeeds are larger particles that are not detected by the type of sampler used in this study (GCA RAM-1). The windscreen may be effective in stopping or reducing the movement of these larger particles, but many of them do not stay airborne because of their relatively large size. Thus, they present less of a threat of offsite exposure. Chemical dust suppressants, without the windscreen, were very effective in reducing wind erosion, reducing concentration by 6 to 8 $\mu g/m^3$. The tests of the windscreen in combination with watering or chemical dust suppressants inexplicably showed that the screen was counterproductive.

Active Cleanup Testing

Water spraying over the area being worked by the FEL and truck resulted in a control efficiency of 42 and 64 percent for less than 30 and less than 2.5 (TSP and FP) micrometer size particles. Surprisingly, the emissions from the dump cycle were reduced 63 and 70 percent for TSP and FP. Adding surfactant to the water increased control efficiencies slightly while allowing the quantity of water used to be reduced. TSP control efficiency for the FEL travel/scraping increased from 42 to 69 percent with the addition of the surfactant. Other control values had smaller increases.

Both the spray curtain control measures were shown to be less effective than the area spray with the water/surfactant mixture. However, a redesign of the controls used may result in higher efficiencies. Of the two, the water curtain was somewhat better for control of dust from the dump cycle than the foam curtain. If one of these controls were used in conjunction with the water/surfactant area spray, the resulting control efficiency would probably be significantly greater than for either one alone.

Drier conditions than were experienced during testing would require greater quantities of water. It is unlikely that the goal of 100 percent control efficiency can be obtained with these technologies, potentially causing subsequent human exposure impacts.

The full report was submitted in fulfillment of Contract No. 68-02-3512 by PEI Associates, Inc., under the sponsorship of the U.S. Environmental Protection Agency and the U.S. Army Toxic and Hazardous Materials Agency.

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***Stephen C. James** is the EPA Project Officer (see below).*

The complete report, entitled "Handbook: Dust Control Techniques at Hazardous Waste Sites," (Order No. PB 86-190 105/AS; Cost: $11.95, subject to change) will be available only from:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650

The EPA Project Officer can be contacted at:

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