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Edited by

J. Russell Boulding

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Chapter 3

Control of Air Emissions from Materials Handling During Remediation¹

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ABSTRACT

This bulletin presents an overview discussion on the importance of and methods for controlling emissions into the air from materials handling processes at Superfund or other hazardous waste sites. It also describes several techniques used for dust and vapor suppression that have been applied at Superfund sites.

Air emission control techniques have been utilized for Superfund cleanups at the McColl site (CA) and at the LaSalle Electric site (IL). Foam suppression has been used at Rocky Mountain Arsenal (CO), Texaco Fillmore (CA), and at a petroleum refinery (CA) site. A number of temporary vapor suppression techniques have also been applied at other sites. Additionally, the experience gained in the mining industry and at hazardous waste treatment, storage, and disposal sites will yield applicable methods for Superfund sites.

This bulletin provides information on the applicability of air emission controls for materials handling at Superfund sites, limitations of the current systems, a description of the control methods that have found application to date, site requirements, a summary of the performance experience, the status of the existing techniques and identification of future development expectations, and sources of additional information.

APPLICABILITY OF MATERIALS HANDLING CONTROLS

Estimation of the potential releases to the air and an analysis of the impacts to the air pathway are applicable to every activity in the Superfund process. Since nearly every Superfund site has a potential air emissions problem, the focus of this bulletin is to assist remedial project managers (RPMs) and on-site coordinators (OSCs) in considering the appropriate methods for material handling at Superfund sites. To do that, the first step is to estimate the potential releases using the air pathway analysis (APA) process.

The amended National Contingency Plan expands upon the requirement to conduct and fully document a regimented process called an air pathway analysis (APA). The process is defined as a "systematic approach involving a combination of modeling and monitoring methods to assess actual or potential receptor exposure to air contaminants" [1, p. 1-1].² When considering removal or remedial responses (i.e., technologies), an APA detailing emission estimate is useful for determining the potential compliance with applicable or relevant and appropriate requirements (ARARs) during

Table 3-1. Remedial Step Fractional Contribution to VCs [16, p. 39]

Remedial Activity	Overall Site
Excavation	0.0509
Bucket	0.0218
Truck Filling	0.0905
Transport	0.3051
Dumping	0.5016
Incinerator	0.0014
Exposed Soil	<u>0.0287</u>
Total	1.0000

sions was examined. Table 3-1 presents the results for each step. Although different chemical constituents and concentrations were present in two different site zones, the contribution of each remedial step to the VC emissions during the excavation process remained constant. This contribution was dependent on the parameters of the soil and the remedial activity pattern. At this site, dumping and temporary storage at the incinerator accounted for 50 percent of the VC emissions; transport from the excavation zone was the second highest contributor of emissions. All activities were assumed to be uncontrolled. The use of tarps and/or foam suppressants could substantially reduce these emissions from transport and storage.

LIMITATIONS

The control methods for dust and vapor suppression rarely remove 100 percent of the contaminants from the air. These releases have to be estimated, along with the cost estimate for application of the control method to properly assess the feasibility of implementing the remediation technology being considered. Site conditions determine the effectiveness of specific control methods.

Some methods have very limited periods of effectiveness, making multiple applications or specialized formulations necessary. The scheduling of media excavation and processing may be impacted, for example, in matching the length of effectiveness of a foam or spray suppression technique being used.

If gaseous emissions are expected to be high, or local fugitive limitations apply, costly areal containment methods may be required. If a very large site is to be excavated and the materials classified or preprocessed, portable versions will have to be designed for local air emission control. The use of such portable containment strategies will affect the overall schedule of the remediation and will mandate unique worker safety plans to ensure that the proper level of protective apparel and monitoring devices are used during the excavation process.

CONTROL METHODS

A list of the most commonly used control technologies applicable to VCs and PMs released

Table 3-2. Common Control Technologies Available for Materials Handling^a

Remedial Operation	Control Technology
Excavation	Water sprays of active areas Dust suppressants Surfactants Foam coverings Enclosures Aerodynamic considerations
Transportation	Water sprays of active areas Dust suppressants Surfactants Road carpets Road oiling Speed reduction Coverings for loads
Dumping	Water sprays of active areas Water spray curtains over bed during dumping Dust suppressants Surfactants
Storage (waste/residuals)	Windscreens Orientation of pile Slope of pile Foam covering and other coverings Dust suppressants Aerodynamic considerations Cover by structure with air displacement and control
Grading	Light water sprays Surfactants
Waste feed/preparation	Cover by structure with air displacement and control

^a Adapted from [1].

simpler windscreens, synthetic covers, and water/surfactant sprays have been used during excavation and transportation operations. The most exotic system applied to a Superfund site included a special domed structure erected over the excavation area and equipped with carbon adsorption beds through which the internal vapors were drawn [4]. The domed structure was designed to limit emissions through the structure and was capable of being transported to the next excavation site when required. A similar structure may be necessary at the point of materials processing, prior to a proposed incinerator for the site. This facility might be fixed, provided a centralized location for the incinerator can be established.

Sound engineering practices include a multitude of methods for vapor and dust suppression; these techniques are shown in Table 3-3 [5, p. vii]. More than a dozen different techniques have been

Table 3-3. Relative Effectiveness and Cost of PM/VC Suppression Technologies

Suppression Technique	Relative Effectiveness			Relative Cost
	Low	Medium	High	
Minimize waste surface area	★	★	★	1
Aerodynamic considerations	★			1
• windscreens	★			1
• wind blocks	★			1
• orientation of activities	★			1
Covers, mats, membranes, and fill materials	★	★		2-3
Water application	★	★		2-3
Water/additives	★	★		2-3
Inorganic control agents	★	★		2-3
Organic dust control		★		2-3
Foam suppressants		★	★	7-10
Enclosures			★	10

SITE REQUIREMENTS

General site conditions that dictate the estimated magnitude of air emissions are provided in Table 3-4 [7, p. 16]. The requirements for implementation of the **dust/vapor control** techniques are a function of the estimated emissions once these site conditions have been assessed. Baseline estimation techniques are available for both undisturbed and disturbed sites, as well as mathematical modeling and actual direct measurement methods to verify estimates. Consideration of the particular weather conditions relative to the proposed **remediation** schedule is critical to efficient **control** of air emissions. Tables 3-3 and 3-4 should be considered concurrently when structuring an air emissions **control** strategy for the site and the **remediation** activities.

PERFORMANCE EXPERIENCE

A study of fugitive **dust control** techniques conducted with test plots at an active cleanup area documented decreasing effectiveness of foam suppressants within 2 to 4 weeks of application. The effectiveness of water sprays on dump trucks and at the loading site was in the 40 to 60 percent range for the site and 60 to 70 percent range for the truck [8, p. 2]. Surfactants increased the effectiveness of the water sprays.

Foam suppressants have been thoroughly studied by at least two vendors: 3M and Rusmar Foam Technology [9; 10]. Laboratory data for highly volatile organics, such as benzene and trichloroethylene contaminated sand, indicated more than 99 percent suppression effectiveness for several days. Complementary data indicated better barrier performance of foams over 10-mil polyethylene film in controlling volatilization [11, pp. 7 and 8]. A burning landfill was doused and the vapors suppressed by more than 90 percent using foam at a site in Jersey City [12, p. 3]. Similarly, vapors from a

Table 3-4. Important Parameters Affecting Baseline Air Emission Levels [7]

Parameter	Qualitative Effect ^a	
	Volatiles	Particulate Matter
Site Conditions		
Size of landfill or lagoon	Affects overall magnitude of emissions, but not per area.	Affects overall magnitude of emissions, but not per area.
Amount of exposed waste	High	High
Depth of cover on landfills	Medium	High
Presence of oil layer	High	High
Compaction of cover on landfills	Medium	Low
Aeration of lagoons	High	High
Ground cover	Medium	High
Weather Conditions		
Wind speed	Medium	High
Temperature	Medium	Low
Relative humidity	Low	Low
Barometric pressure	Medium	Low
Precipitation	High	High
Solar radiation	Low	Low
Soil/Waste Characteristics		
Physical properties of waste	High	High
Adsorption/absorption properties of soil	Medium	Low
Soil moisture content	High	High
Volatile fraction of waste	High	Low
Semivolatile/nonvolatile fraction of waste	Low	High
Organic content of soil and microbial activity	High	Low

^a High, medium, and low in this table refer to the qualitative effect that the listed parameter typically has on baseline emissions.

nois). The McColl work is available as a Superfund Innovative Technology Evaluation demonstration of excavation techniques. Although the domed structure used controlled sulfur dioxide and VOC releases to the atmosphere, working conditions within the dome were difficult. High concentrations of dust and contaminants mandated use of a high level of personal protective apparel. Consequently, personnel were able to work within the dome for only short periods of time [15].

A variety of dust and vapor control techniques may be applied at Superfund sites. A systematic approach to estimate the quantities of air emissions to be controlled, the ambient impact and the selection of the most appropriate control technique requires a thorough understanding