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Sweeping Compound Application Reduces Dust From Soiled Floors Within Enclosed Operator Cabs

Objective

To reduce dust generated from soiled floors within enclosed operator cabs.

Background

Enclosed operator cabs are widely used on mobile excavation equipment in the mining and construction industries. They protect the operator from bad weather, noise, and airborne dusts. The inside cab environment usually must be kept at very low dust concentrations because of quartz dust generated from the excavation of silica-bearing rock. For cabs to be effective in controlling airborne respirable dust, they must have an efficient air filtration system, while providing a positive pressurization of the cab interior. Ideally, the recirculated and exterior makeup air filtration should provide at least 99% capture efficiency for dust particles as small as 0.3-µm aerodynamic diameters.

Many of these enclosed cabs use heating units mounted or directed along the floor (see figure 1), which can cause dust entrainment problems. Prior studies by the National Institute for Occupational Safety and Health (NIOSH) of enclosed cabs have shown that these floor heaters can generate notable amounts of dust within the cab enclosure (see *Technology News* 486). Multiple-shift dust levels measured inside a drill cab increased on average from 0.04 mg/m^3 during the summer months to 0.68 mg/m^3 during the winter months. Additional dust level measurements, made with optical particle counters during a nondrilling time period, verified that dust levels inside the cab increased from 0.03 to 0.26 mg/m^3 when the floor heater/fan was turned on. Dust levels within the cab also became greater than the ambient air dust levels outside of the cab when the floor heater was turned on during the nondrilling time period. This shows that the floor heater was a notable dust source problem.

Cab floors are commonly soiled from operators tracking dirt inside the cab upon entering from the mine or construction site. Interior cab dust levels can be increased by (1) airflow disturbance of the soiled floor or (2) operator disturbance of the soiled floor.

Approach

During prior NIOSH surveys of surface coal mine drills, several drills with very low cab dust levels (#0.1 mg/m^3) were observed to have floor sweeping compound spread out over the cab floor during the working shift. This initial observation led to a more controlled A-B study of the effect of the sweeping compound on the interior cab dust levels. This study involved dust sampling with and without sweeping compound inside the cabs of a bulldozer and two drills.

Sweeping compounds commonly use sawdust or cellulose as the main bulk material, with oil or wax added for dust adhesion purposes. Sand is sometimes added to increase bulk density. Sweeping compounds with sand are commonly used to sweep up concrete floors. Those without sand (usually referred to as "gritless") are used to sweep up smooth finished floors. Most of the oils and waxes used for the adhesive ingredient are petroleum-base and can have an irritating odor. People sensitized to petroleum distillates could have allergic reactions to these sweeping compounds. A few companies offer nonpetroleum-base sweeping compounds, using either a natural oil or chemical additive for dust adhesion.

During this study, it was decided that only the gritless sweeping compound (without sand) would be used, eliminating the addition of another potential silica source inside the cab. Since the sweeping compound would be applied on the enclosed cab floor for the duration of the shift, it was decided to use a canola oil-base sweeping compound to eliminate irritating odor from the petroleum-base sweeping compounds. The natural canola oil-base sweeping compound had a slight woody scent.

The three pieces of equipment used in this study had notably different cab layouts. The bulldozer had a small cab with vents discharging air-conditioned or heated air from adjustable louvers at operator waist level and floor level. The bulldozer also had a cloth fabric seat and a carpeted floor. Drill A had a large cab with the heat directed from adjustable louvers at operator knee level and the air-conditioned air directed from cabin ceiling louvers. This drill had a vinyl fabric seat and a steel plate floor. Drill B had a small cabin with the heat directed across the floor (see figure 1) and the air-conditioned air directed down from the ceiling. It had a vinyl fabric seat and a worn rubber mat on a steel floor.

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During the operation of each piece of equipment, airborne respirable dust sampling was done inside and outside the environmental cabs, with and without the sweeping compound applied to the floor. Three to five shifts of dust sampling were done for each test condition (baseline and sweeping compound). A 0.25- to 0.5-in-thick layer of canola oil sweeping compound was applied on the floor of the cabs (see figure 1). The average dust levels measured inside the cabs for these field tests are shown in figure 2. These average results show that the sweeping compound effectively reduced dust levels in the two drill cabs, but had no beneficial effect on the bulldozer cab dust levels. Since the outside cab dust levels could not be controlled during these field studies and varied significantly (up to two orders of magnitude), a more thorough statistical analysis was done to account for the multiple-field variable effects on the inside cab dust levels.

Figure 3 shows the proportionable effect of the multiple-field variables on interior cab dust levels. All of the field variables were found with statistical certainty to have some effect on interior cab dust levels. The sweeping compound and the interactive cab-compound effects accounted for 32% of the inside cab dust levels. The cab interior design (such as heater discharge location, floor type, and seating material) accounted for 18% of the inside cab dust levels, while the outside dust levels accounted for 16% of the interior cab dust levels. Thirty-four percent of the remaining interior cab dust level variations could not be accounted for by these variables and are unexplained.

From this analysis, it was concluded that the sweeping compound had a positive effect on suppressing dust from the soiled floor in the two drill cabs because it was able to make direct contact with and bind up the dirt on the steel and rubber mat floors. Nearly one-quarter (22%) of inside cab dust levels were accounted for by the combined effect of sweeping compound with respect to the cab interior design or floor types of the individual cabs tested. Other cab interior design factors that affect interior cab dust levels are the heating system discharge locations and the seating materials. Heating units mounted or directed along the floor can entrain dust from soiled floors, while soiled cloth seats may release dust from operator movements.

Recommendations

Application of a gritless (i.e, without sand) natural base sweeping compound is recommended on smooth enclosed cab floors to help bind up the dirt and soil tracked into the cabs. The effect of this control seems to be very beneficial when enclosed cab airflow is being directed near or at floor level. However, this control method will only be effective in reducing dust generated from within the cab. It will not control the dust from poorly designed or poorly maintained cab enclosures that allow outside dust to enter the cab through inferior filtration or cab leaks. A natural-base sweeping compound is strongly suggested for enclosed cab application to reduce any possible operator irritation or allergic reactions to odors from petroleum-base oils and wax compounds. Before any of these sweeping compounds are used, their material safety data sheets (MSDSs) should be examined for ingredients and precautions. Finally, good house-keeping is always recommended. The cab interior should be wiped down periodically, making vinyl seats and smooth surfaces easier to keep clean.

For More Information

For more information about controlling dust levels in enclosed cabs, contact John A. Organiscak, Steven J. Page, or Andrew B. Cecala, NIOSH Pittsburgh Research Laboratory, Cochrans Mill Rd., P.O. Box 18070, Pittsburgh, PA 15236-0070, phone: (412) 386-6675, (412) 386-6669, or (412) 386-6677, respectively; fax: (412) 386-4917; e-mail: **jdo3@cdc.gov**, **sep8@cdc.gov**, or **aic1@cdc.gov**, respectively.

To receive additional information about occupational safety and health problems, call **1-800-35-NIOSH (1-800-356-4674)**, or visit the NIOSH Web site at www.cdc.gov/niosh

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Figure 1.—Sweeping compound applied on drill cab floor with floor heater.

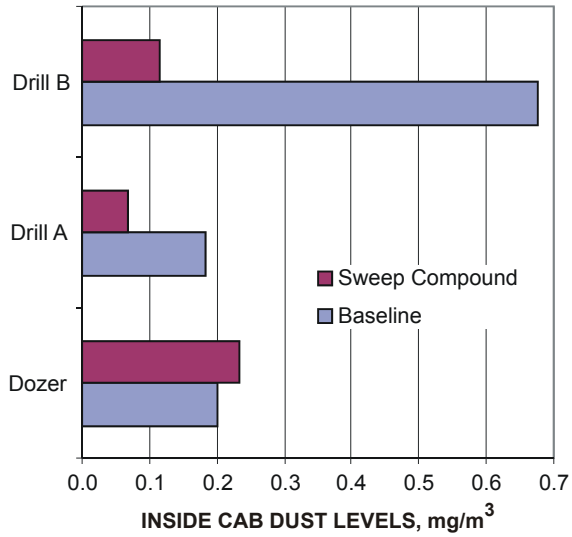

Figure 2.—Interior cab dust levels measured during sweep compound study.

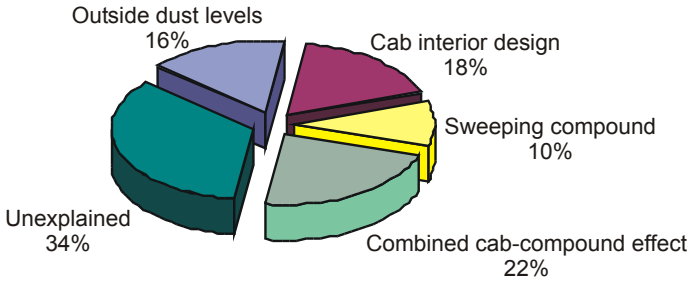

Figure 3.—The statistical effect of field variables on interior cab dust levels.