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NIOSH-developed Dustinator® Reduces Airborne Dust and Silica at Mine Sites

Summary

The Dustinator® is a commercially available compact dust collection system that reduces airborne dust and respirable crystalline silica (RCS). It was developed as part of a research collaboration between the National Institute for Occupational Safety and Health (NIOSH) and Benetech® Inc. and is designed for retrofitting onto bins, tanks, and conveyor systems. The Dustinator is one of several technologies Benetech used when creating a novel hybrid dust control system. This system was installed and tested at a mine site to reduce emissions from a pair of rock crushers and the belt conveyors that transport the crushed rock. Air quality surveys were conducted before and after the hybrid system was installed and showed that by combining dust control technologies, respirable airborne dust was reduced by 93%.

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Background

Certain jobs continue to expose workers to RCS, which is known to cause silicosis and lung cancer, among other illnesses. Worker exposures to RCS at mining sites are particularly high, likely due to the crushing, sizing, and handling of silica-bearing minerals



Figure 1. Prototype hybrid dust control system retrofitted onto a crusher-conveyor system at a mine site. Photo by NIOSH.

[Misra et al. 2023]. Active or passive dust control techniques can reduce RCS exposures; however, many current material handling systems do not incorporate dust controls. To address this problem, NIOSH is conducting research to develop and demonstrate dust control technologies, such as that shown in Figures 1 and 2, that can be installed at mines that are known to generate high amounts of dust and potential RCS.

Developing a Hybrid Dust Control System

NIOSH partnered with Benetech to create a new hybrid dust control system for use on belt conveyors and at transfer points. The work included developing three subsystems that work together: (1) passive dust control, (2) active dust filtering, and (3) spray

dust suppression. The subsystems were tested in the laboratory and then combined into a dust control system that was installed at an aggregate production site near Spokane, Washington.

The passive subsystem was designed by Benetech and is based on their existing MaxZone® technology. This technology consists of modular sections of metal shrouding mounted onto the conveyor frame. The shrouding contains interior baffles that knock dust from the air. The sealing interface between the shrouds and the belt is easily adjustable to create a good seal while still allowing the conveyor belt to move freely.

NIOSH designed the active dust control subsystem, the Dustinator, to assist the passive system by collecting and filtering any remaining dust inside the shroud. At their facilities in Spokane, Washington, NIOSH researchers designed and tested multiple prototypes [King et al. 2023; Parks et al. 2024]. The Dustinator is approximately 2'x2'x3' and powered by a 3HP blower that draws up to 1,000 ft³/min of air through four pleated filter cartridges that are 8" diameter and 21" long. Filters are cleaned by pneumatic valves that provide a burst of air. The air pulses are triggered by a controller that monitors differential pressure across the filters. The jet pulses are activated when the differential reaches a preset threshold,

releasing the dust cake from the filters. Design trade-offs included minimizing size and weight while maximizing flow rate and thus filtering capacity. The size was reduced by building the jet-pulse components into the lid, i.e., the air tank, pneumatic solenoids, and pneumatic pulse valves (Figure 2). To reduce weight, the housing, mounting flange, and lid are aluminum. To make retrofit installations easier, the design is modular, allowing for installation in four steps.

The spray dust suppression subsystem consists of a spray bar designed to reduce residual dust that might otherwise exit the enclosed system. For this application, Benetech engineers modified their current suppression system called the “MiniPak,” which contains a self-powered surfactant-metering pump that mixes a proprietary surfactant with water to feed a spray-bar. Modifications included synchronizing the spray of the water-surfactant mixture with the pulse-jet cleaning events, so that the mixture is only consumed when needed. Additionally, the enclosure was insulated and fitted with a heater to prevent freezing of the pump and surfactant tank.

Field Deployment and Evaluation

System testing demonstrated the effectiveness of enclosing the conveyors, crushers, and transfer point, while providing active filtration via the Dustinator, to remove residual dust and lower the pressure inside the enclosure, thereby preventing the escape of dust. To evaluate the effectiveness of the system, air samples were taken before and after the retrofit installation in the surrounding area (Figure 3). Testing demonstrated a 93% decrease in respirable dust concentrations in air [Parks et al. 2024]. This research shows the potential for significant dust reduction by retrofitting material handling systems with a hybrid dust control system. Stakeholders who desire to control respirable dust emissions should consider applying such retrofits to their material handling systems.

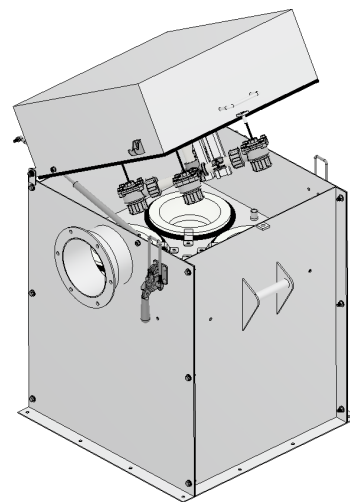


Figure 2. Prototype Dustinator with side-flange for attaching a remote blower. Image by Benetech.



Figure 3. Before and after photos show the 93% decrease in respirable dust in air. Photo by NIOSH.

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For More Information

For more information on this research or the availability of products derived from it, contact Dr. Dave Parks (DParks@cdc.gov) or the NIOSH Mining Program (mining@cdc.gov).

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