

Improved Dust Control for Bag Handlers

On-site tests lead to minor modifications to a bag-palletizing system that significantly reduce workers' dust exposure

BY ANDREW B. CECALA, JEANNE A. ZIMMER, BRAD SMITH AND STEVE VILES

A recent report evaluating silica exposure levels in the metal/nonmetal mining industry noted that bag packaging and loading are some of the occupations at the greatest risk. In addition to dust problems, the bag-stacking process is labor intensive, making lost-time injuries common due to back fatigue and strains.

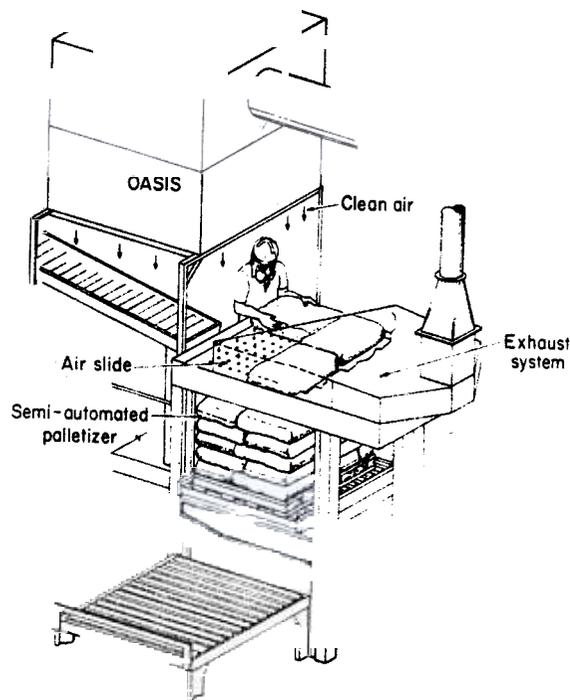
During the bag-stacking process, a significant amount of dust can be generated, mainly from product on the outside of the bags and from dust escaping the bag valve upon impact of the bag on the pallet.

In an effort to address dust-exposure and back-fatigue issues, Malvern Minerals Co., Hot Springs, Ark., made two major improvements to its ground silica stacking facility. First, the company purchased a semi-automated bag palletizing system (Figure 1). With this system, the bag staker does not lift the bags, but slides them across a metal table. Small jets of air exit through perforations in the table top (similar to an air hockey game), allowing workers to more easily slide each bag into the proper position.

After each layer of bags is completed, the table slides open, and the entire layer of bags is loaded onto an underlying pallet. The table then closes, readying it for another layer of bags. After the entire pallet is loaded, the unit delivers the pallet to a shrink wrap and forklift pick-up area.

In addition to this semi-automated palletizing unit, Malvern Minerals purchased an Overhead Air Supply Island System (OASIS) to lower the bag staker's dust exposure. The OASIS takes outside air, directs it through

Figure



Components of Malvern Minerals' semi-automated bag-palletizing system.

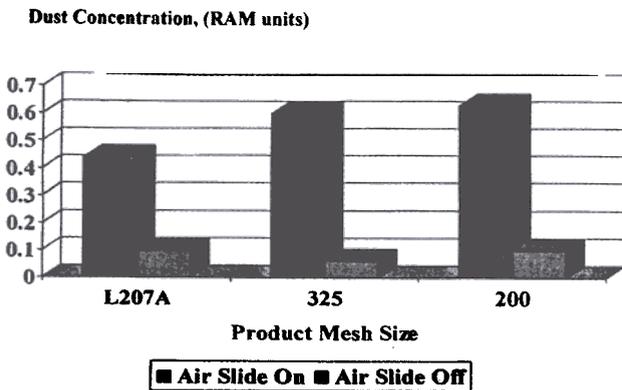
MEASURING RESPIRABLE DUST

The bag staker's respirable dust exposure was monitored using a RAM-1 instantaneous dust monitor to evaluate the impact of the various changes on the palletizing process and dust-control equipment. The bag staker wore a vest that held the 10-mm Dorr-Oliver cyclone, which classifies the respirable portion of dust. Flexible tygon tubing was used to connect the cyclone to the RAM-1 dust unit, allowing the bag staker to perform the palletizing process with minimal interference.

The RAM-1 measures respirable dust concentrations by light scattering with a sensing chamber. This device closely simulates gravimetric measurements when calibrated for a specific dust. This instrument is ideal for comparative evaluations, as was the case in this study.

Since the RAM-1 is not an MSHA-approved instrument for dust compliance sampling, the dust concentrations listed in this article should be used as a comparative value of respirable dust concentration and not to determine actual dust concentrations from a compliance standpoint.

Figure 2



Comparison of a bag stacker's average dust exposure for particular product mesh sizes—with and without the air slide operating.

two filters, then delivers clean air down over the bag stacker. During tests, approximately 1,600 cfm of filtered air exited the OASIS.

After implementing this new equipment, the bag stacker's respirable dust exposure remained at unacceptable levels. Therefore, Malvern requested the assistance of the National Institute for Occupational Safety and Health (NIOSH). Initially, NIOSH performed a three-day analysis to determine factors impacting the bag stacker's dust exposure then made recommendations to create a more effective dust-control design.

After Malvern implemented a number of these recommendations, the bag stacker's dust exposure was significantly reduced and has remained at acceptable levels during in-house and Mine Safety and Health Administration dust-compliance sampling. Five months later, a follow-up analysis was performed to determine the relative effects that the recommendations had on lowering the bag stacker's dust exposure.

Seeking the dust source

For NIOSH's initial evaluation, the pallet-loading system was operated normally for the first two days and was modified for the third day. Observing the bag stacker's work practices and monitoring his respirable dust exposure for days one and two, NIOSH found that a significant part of the bag stacker's dust exposure occurred from the air slide on the palletizing machine.

As the bag stacker leaned forward to position the back bags on the table, he sometimes placed his upper torso into the front side of the exhaust hood. The air slide on the semi-automated palletizing machine entrained dust from the bags and carried it past the worker into the exhaust hood.

In an effort to verify this occurrence, the air supply was disconnected from the slide table during testing on day three. The bag stacker's respirable dust exposure decreased 4.5 to 10.7 times with the air table turned off (Figure 2).

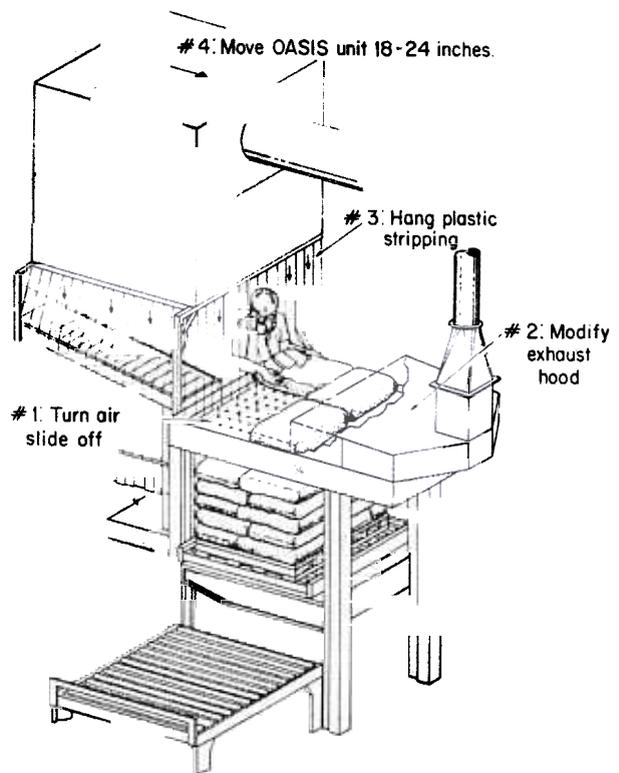
After analyzing the test results, NIOSH made four recommendations to Malvern Minerals Co. (Figure 3):

Recommendation 1—Turn off the air to the slide table. This minimized dust being entrained by the air jets and carried up over the bag stacker into the exhaust ventilation hood. However, turning off the air jets also negated the purpose of the air slide, which was to minimize the effort and stress placed on the bag stacker to slide and position a bag on the table. Therefore, a spray lubricant was used on the table top. However, this lubricant spray had a very minimal and short-term effect. This first recommendation was an interim solution.

Recommendation 2—Change the design on the exhaust hood. The exhaust hood was modified, removing the angled front and maintaining a significant distance from the worker to the hood opening across the entire front of the hood. Once modified, the bag stacker was not physically able to place his upper torso under the hood, thus lowering his dust exposure.

Recommendation 3—Hang clear plastic stripping around the discharge of the OASIS system. This helped to separate the clean air from the dust-laden air around the palletizing unit. The stripping also provided to the bag stacker a physical indication of the clean-air barrier. The worker could lean into the stripping, but once he extended to a certain point, he broke through the stripping, and

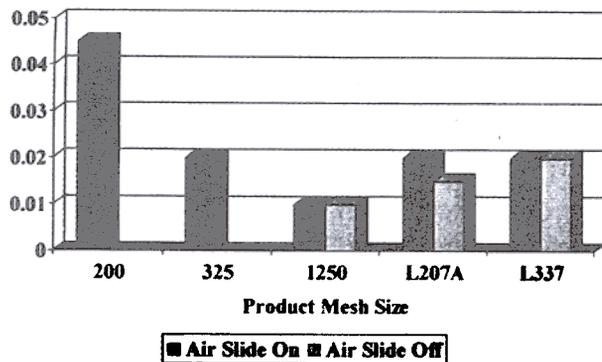
Figure 3



Modifications recommended by NIOSH to reduce the bag stacker's dust exposure.

Figure 4

Dust Concentration, (RAM units)



Comparison of a bag stacker's average dust exposure for particular product mesh sizes (with and without the air slide operating) after modifications to the palletizing system.

LOWERING DUST EXPOSURE

Based on tests and modifications of Malvern Mineral's bag-palletizing operation, the following changes may help lower bag-stacker dust exposure at operations using similar equipment:

- If semi-automated palletizing units are used with an air slide, make sure the air slide is not blowing dust up onto the worker. Using the OASIS in conjunction with the semi-automated palletizing unit is effective, but the OASIS device must be positioned to cover the entire range of motion for the worker. If the unit was properly positioned at Malvern Minerals, it probably would have eliminated most of the problems initially encountered.
- If using a semi-automated palletizing system in conjunction with an OASIS system, consider using plastic stripping around the OASIS discharge. This helps separate the clean air from the dust-laden air around the palletizing unit and gives the worker a physical indication of when he or she is extended out past the end of the clean-air zone.
- Never use an exhaust hood that creates a need for a worker to place his upper torso (breathing zone) into the hood to perform a job function. Additionally, workers should not position themselves between the dust source and the exhaust hood. This causes the dust to flow directly past the worker and significantly increases worker contamination and dust exposure.

would be aware that he was no longer protected by the clean envelope of air provided by the OASIS.

Recommendation 4—Extend the OASIS discharge 18 to 24 in. toward the palletizing unit. This would also eliminate the chances of the bag stacker leaning too far

forward. Since the OASIS is a heavy unit and includes metal duct work from the outside wall and main filtering unit, moving the discharge end would have been difficult and costly. Malvern Minerals elected to determine the impact of the other modifications before incurring this effort and expense.

Preliminary dust testing performed in-house by Malvern Minerals indicated that the first three modifications had a measurable impact. A second comprehensive evaluation performed by Malvern, NIOSH and MSHA determined the relative impact that these changes had on lowering the bag stacker's respirable dust exposure.

In the initial evaluation, the bag stacker's dust exposure increased 4.5 to almost 11 times with the air slide on versus off. During the second evaluation, dust exposure reductions ranged from 2.5 to 3.5 times the bag stacker's initial dust concentration. The primary reason for this reduction was the change in the exhaust hood. Placing plastic stripping around the discharge of the OASIS device further reduced the impact of the air slide to almost no effect.

Because these modifications were successful, it was decided that the use of air on the slide table to aid workers

in moving bags, thus reducing the likelihood of back injury, outweighed the negative consequences of the minimal increase in dust exposure. After about 14 months, dust-exposure testing by Malvern Minerals and MSHA showed that the bag stacker's respirable dust levels have remained at acceptable concentrations (Figure 4).

ANDREW B. CECALA IS A MINING ENGINEER AND **JEANNE A. ZIMMER** IS A PHYSICAL SCIENCE TECHNICIAN WITH THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH, PITTSBURGH RESEARCH LABORATORY; **BRAD SMITH** IS VICE PRESIDENT/SAFETY MANAGER FOR MALVERN MINERALS CO., HOT SPRINGS, ARK.; AND **STEVE VILES** IS A DISTRICT HEALTH SPECIALIST WITH MSHA, DALLAS, TEXAS.

REFERENCES

- Watts, W.F. and D.R. Parker, "Quartz Exposure Trends in Metal and Nonmetal Mining." *Appl. Occup. Environ. Hyg.*, 10 (12), p. 1009-1018 (1995).
- Williams, K.L. and R.J. Timko, "Performance Evaluation of a Real-Time Aerosol Monitor." USBM IC 8968, 20 p. (1984).
- Volkwein, J.C.; M.R. Engel and T.D. Raether, "Get Away from Dust with Clean Air from Overhead Air Supply Island (OASIS)." *Rock Products* (1986).