

Technology Brief

Dust Monitoring of a Polypropylene Film Densification Process at a Small-Scale Plastics Facility

This study samples indoor dust levels generated by sortation and densification operations at a small-scale plastic recycling facility. Both respirable nuisance dust and total nuisance dust levels are observed as time-weighted averages on two typical production days during which polypropylene film is being densified. The goal of the study is to gather basic information regarding dust levels, in order to assist in the evaluation and selection of adequate dust control options. Testing is performed for informational purposes only, and the results are not statistically valid for the demonstration of compliance or noncompliance with any industrial standard.

Background

For the purposes of this study, the polypropylene dust generated during the densification process is considered to be in the category of a nuisance dust, i.e., a dust that is generally innocuous and not recognized as the cause of serious pathological conditions. Because exposure to high concentrations of any dust, regardless of chemical toxicity level, can cause respiratory disruption, the United States Occupational Safety and Health Administration (OSHA), under the Code of Federal Regulations 29 CFR 1910.1000, regulates exposure to nuisance dust in the workplace. Allowable exposure is regulated via permissible exposure limits (PELs), or time-weighted averages (TWAs) that are not to be exceeded for an 8-hour workday within a 40-hour workweek. Regulatory exposure levels exist for both total nuisance dust and respirable nuisance dust.

Federal regulations require that exposure to any regulated indoor air contaminant, including nuisance dust, not exceed the documented PELs. In addition, individual states have the ability to set PELs that are more restrictive than the federal regulations.

Compliance with PELs can be achieved through



Key Words

Materials: Polypropylene film.

Technologies: Personal monitoring pumps; aluminum cyclones; NIOSH 0500; NIOSH 0600; ASTM D 4532-92.

Applications: Plastic Film Densification.

Market Goals: Enhance operational efficiency of plastics recycling processes.

Abstract: Measure respirable and total nuisance dust levels for small-scale (1,000 lb/hr) polypropylene film densification.

administrative controls (operational training, employee rotation to reduce exposure, etc.) and/or engineering controls (site ventilation, use of respirators, etc). While the results of this study cannot be used to determine compliance or noncompliance with PELs, the measurements provide estimates of the magnitude and distribution of dust levels in the facility.

A preliminary review of available research indicates that human physiological responses to polypropylene fibers appear to be similar to other "inert" types of fibers and dusts. However, evidence is not available to preclude the potential for harmful effects, particularly regarding exposures to dust concentrations near or above PELs. In high concentrations, any nuisance dust can cause respiratory disruptions by restricting respiratory air flow due to muscle stimulation or excess mucus production. Dust may also exacerbate existing chronic health conditions, such as emphysema and bronchitis. In general, it is advisable to keep the levels of any nuisance dust as low as is practical¹.

¹ National Safety Council pp. 171-200.

Test Description

Dust levels are measured to assist in the evaluation and selection of adequate dust control options. Four (4) respirable nuisance dust samples and four (4) total nuisance dust samples are collected during two (2) typical processing days. Dust measurements are taken in the densification area, which exhibits the highest level of visible dust, and also in the sorting area, which exhibits a much lower level of visible dust. During the two tests, the densification process operates at 86% and 97% of the total rated production capacity of 1000 pounds per hour.

Samples are collected using personal monitoring pumps and pre-weighed polyvinyl chloride filters. The filter pore size is five microns, in accordance with the applicable National Institute of Occupational Safety and Health (NIOSH) analytical methods. Aluminum cyclones are used to restrict the particle size collected for the respirable dust samples.

The following analytical methods are used:

- Respirable nuisance dust: NIOSH 0600
- Total nuisance dust: NIOSH 0500

Both methods involve weighing the filters after samples are collected, and comparing with the pre-sample filter weights. Time-weighted-average results are calculated in an accredited testing laboratory.

The sampling guidelines in American Society for Testing and Materials (ASTM) Standard D4532-92 are followed to the maximum extent possible.

Test Results

Respirable dust measurements in the densifier area, the sorting area, and the forklift operations area, range from 0.13 milligrams per cubic meter (mg/m^3) to $1.20 \text{ mg}/\text{m}^3$. For comparative purposes, measured respirable dust values are well below the OSHA and Washington Industrial Safety & Health Act (WISHA) PEL for respirable nuisance dust of $5 \text{ mg}/\text{m}^3$.

Total dust level measurements in the sorting area range from $0.22 \text{ mg}/\text{m}^3$ to $0.27 \text{ mg}/\text{m}^3$, and in the densifier area from $12.83 \text{ mg}/\text{m}^3$ to $18.20 \text{ mg}/\text{m}^3$. For comparative purposes, the measured total dust values in the sorting area are well below the OSHA PEL for total nuisance dust

of $15 \text{ mg}/\text{m}^3$ and the WISHA PEL of $10 \text{ mg}/\text{m}^3$; however, the measured total dust in the densifier area exceeds the PEL. Higher total dust values in the densifier area indicate that the facility could benefit substantially from dust control measures targeted toward the densification equipment.

Conclusions

This study is not a statistical sampling, and thus the measurements are invalid for the determination of compliance or noncompliance with federally-mandated or state-mandated PELs. However, test data provides information on the level, type, and location of dust in the work environment, and this information is useful for the evaluation of ventilation options.

The respirable nuisance dust measurements taken in all test areas are 76% to 97% lower than the WISHA PEL value. The total nuisance dust measurements in the sorting area are 97% to 98% lower than the WISHA PEL, while those in the densifier area are 28% to 82% higher. Comparing the respirable and total dust measurements, it appears that this facility's polypropylene film densification process generates more nonrespirable than respirable particles. These nonrespirable particles are also confined to the densifier equipment area, indicating that a localized ventilation solution, such as a vacuum hood system, may be sufficient to adequately reduce excess dust. If respirators are selected as a means of controlling dust exposure in Washington State, then the appropriate minimum requirements must be met².

Acknowledgments

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² General Occupational Health Standards, WAC 296-62-07109, Volume 1, State of Washington, Department of Labor and Industries.

For More Information

For a copy of the report, *Dust Monitoring of a Polypropylene Film Densification Process at a Small-Scale Plastics Facility (PL-97-7)*, use the CWC Publication Order Form. For more information call CWC at (206) 443-7746, email info@cw.org, or visit the CWC Internet Website at www.cw.org.

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