

Technical Data Bulletin

TDB #238 Lung Disease in Coffee Processing Industry

March 2016

The following, with the exception of the PPE Suggestions section, is a summary of Centers of Disease Control and Prevention (CDC) guidance, and National Institute for Occupational Safety and Health's (NIOSH) recommendations in the following documents:

- “Flavorings Related Lung Disease- Coffee Processing Facilities” February 1, 2016.
<http://www.cdc.gov/niosh/topics/flavorings/processing.html>
- NIOSH Publication 2015-197: Best practices: engineering controls, work practices and exposure monitoring for occupational exposures to diacetyl and 2,3-pentanedione.
<http://www.cdc.gov/niosh/docs/2015-197/pdfs/2015-197.pdf>

This brief summary was prepared by 3M PSD. It does not represent an official or legal or necessarily complete description of the publications. For complete details, the above linked documents should be reviewed.

Growing interest for the Coffee Processing Industry

On September 29, 2015, the CDC published a new report¹ on the health effects of chemicals produced during coffee processing. The CDC reported, “Roasting coffee beans naturally produces diacetyl and 2,3-pentanedione. Volatile organic compounds, including alpha-diketones (e.g, diacetyl and 2,3-pentanedione), can be released during grinding of coffee.” Exposures to these chemicals at certain levels may result in reduced lung function, severe fixed obstructive lung disease, and an irreversible, and sometimes fatal lung disease, obliterative bronchiolitis. After five cases in former workers of a coffee processing facility that roasted, ground, and flavored coffee were identified in 2012², additional studies were undertaken based on worker concerns. In August 2015, The American Journal of Industrial Medicine reported several other cases in the coffee processing industry, leading to the need for evaluation of work places beyond the microwave popcorn and flavoring industries where concerns about these chemicals first arose.

Background

Over exposures to diacetyl and 2,3-pentanedione can cause adverse health effects for workers.¹ While the hazards of artificial flavorings in microwave popcorn and flavoring manufacture have been known for some time, the impact of naturally occurring versions of these chemicals in coffee processing is now receiving more attention. Coffee processors and health care professionals should consider the possibility of flavoring

chemical-related lung disease in workers who have been exposed to diacetyl or similar flavoring chemicals (such as 2,3-pentanedione, a common substitute for diacetyl, 2,3-hexanedione and 2,3-heptanedione) and have respiratory symptoms. Workers with obliterative bronchiolitis may sometimes be initially misdiagnosed with asthma, chronic bronchitis, emphysema, or pneumonia; or their symptoms are attributed to smoking. In cases of flavoring chemical-related lung disease, respiratory symptoms do not typically improve when the worker goes home at the end of the workday, on weekends, or on vacations¹. The symptoms often have a gradual onset but can occur suddenly. The MMWR 62(16):305-307 report stated, “Additionally, a high index of suspicion is required when these potentially exposed workers have progressive shortness of breath. If obliterative bronchiolitis is suspected, immediate protection from further exposure is crucial to prevent further deterioration of lung function.” While inhalation is the primary route of exposure, diacetyl and 2,3-pentanedione have also been reported to irritate the eyes, nose, and skin³.

Workers may be exposed to diacetyl and 2,3-pentanedione during several phases of coffee processing including: grinding, roasting, flavoring, and packing. One study measured the highest exposures in the flavoring and grinding of unflavored coffee⁴. Other food processing industries with fermentation and pyrolysis products also generate diacetyl exposures, such as in the manufacture of beer, wine, and dairy products (Akiyama et al., 2003;Daglia et al., 2007;HSDB, 2007). Other flavoring exposures may occur in Flavoring Syrup and Concentrate manufacturing (NAICS Code 311930), Spice and Extract Manufacturing (NAICS 311942), and other Miscellaneous Food Manufacturing (NAICS Code 311999).

NIOSH Recommendations Include

In coffee processing facilities, NIOSH recommends air sampling for diacetyl and 2,3-pentanedione to help determine if control measures are needed to reduce airborne concentrations of alpha-diketones. Area and personal air sampling as well as air sampling during specific tasks such as roasting, grinding, and pouring and adding flavorings can help characterize exposures by area, job, and task. Detailed best practice sampling techniques are described further in the NIOSH 2015-197 publication. While no OSHA Permissible Exposure Limit currently exists, the American Conference of Governmental Industrial Hygienists (ACGIH) has established a Threshold Limit Value® (TLV) for diacetyl. Additionally, NIOSH has published its proposed recommended exposure limits (RELs) in workplace air [NIOSH 2011a]. See Table 1.

The NIOSH proposed standards do not differentiate between natural and synthetic chemical origin of diacetyl or 2,3-pentanedione. In 2010, California promulgated a regulation for occupational exposure to food flavorings containing diacetyl that requires installation of exposure controls to food flavorings to reduce exposures to the lowest feasible levels.

Table 1: Occupational Exposure Limits for Diacetyl and 2,3-Pentanedione

	8-hour Time Weighted Average (TWA)	15-minute Short-Term Exposure Limit (STEL)
Diacetyl		
ACGIH TLV	10 ppb	20 ppb
NIOSH REL	5 ppb	25 ppb
2,3-pentanedione		
NIOSH REL	9.3 ppb	31 ppb

Other recommendations for controlling exposure and protecting workers include, (see the NIOSH 2015-197 for full best practice recommendations):

- Engineering controls- such as local ventilation and properly designed room dilution ventilation systems, maintaining negative pressure in and isolating handling areas. Substitution may be challenging, as some exposures are naturally occurring. The health effects of any flavoring substitutes would need further evaluation.
- Work Practices –to minimize exposures may include covering containers, reduction of spills, closed processing (ie. avoiding open pouring), good housekeeping, providing proper work clothing, and training are recommended. Housekeeping techniques may also include using HEPA-filtered vacuums and wet cleanup techniques to remove spills. Require workers to wash hands after exposures.
- Hazard Communications - to ensure workers have access to appropriate Safety Data Sheets (SDS), hazards are labeled, and training has been conducted. Workers should be trained to immediately report eye/skin problems, cough, shortness of breath, or wheezing.
- Personal Protective Equipment (PPE) - if monitoring and hazard assessment indicate, employees may need to wear appropriate fit-tested respirators until workplace interventions can be put into place. Additionally, eye, face and skin protection should be considered based on results.
- Medical Monitoring⁵- should include both questionnaires and breathing tests (eg. spirometry) before the first exposure, and on a regular basis thereafter, to all workers at risk of hazardous exposure of diacetyl, 2,3-pentanedione, or related flavorings. Refer workers for evaluation by a physician if they have abnormal test results, an accelerated drop in test results over time, or persistent symptoms.

PPE Suggestions

Respirators Respiratory protection should be selected based on results of air monitoring and in compliance with the assigned protection factors (APFs) outlined in the OSHA Respiratory Protection Standard 29 CFR 1910.134. NIOSH suggests a full face piece respirator* with a combination organic vapor cartridge/P100 filter or a Powered Air Purifying respirator with an organic vapor cartridge/HE filter. Per OSHA regulations a site specific cartridge change-out schedule must be developed; noticeable odor cannot be

relied upon. Supplied air respirators may also be used to control inhalation exposures. Examples of air purifying respirators with appropriate organic vapor/particulate filter cartridges include:

- 3M™ Full Facepiece Respirator 6000 series* with 3M™ P100 Organic Vapor Cartridge/Filter 60921
- 3M™ Versaflo™ Powered Air Purifying Respiratory TR-600 with TR-6510N-5 Organic Vapor/HE Cartridge with head top or faceshield options including:
 - 3M™ Versaflo™ Economy Hood S-403
 - 3M™ Versaflo™ Hood with Integrated Suspension S-433
 - 3M™ Versaflo™ High Durability Hood with Integrated Head Suspension S-533
 - 3M™ Versaflo™ Respiratory Faceshield Assembly M-206 with 3M™ PELTOR™ Earmuff M-985

NIOSH-approved respirators must be used in accordance with the NIOSH cautions and limitations specified on the NIOSH approval label and comply with OSHA's respiratory protection regulations (29 CFR 1910.134). OSHA requires employers to implement a written respiratory protection program meeting all the requirements of the standard when respirators are used. The respirator manufacturer or a health and safety professional should be consulted if there is any question regarding respirator selection and use. Users must understand the respirator capabilities, as well as limitations, and follow the respirator manufacturer's user instructions in order to receive the assigned level of protection. Misuse of any respirator may result in sickness or death.

Eye Protection As noted above, eyes must be protected from any contact with diacetyl or 2,3-pentanedione, or related flavorings. Employers should consider either a full face piece respirator, hood, or helmet. If not required to wear a respirator, tight fitting goggles meeting the ANSI Z87.1 D3 Splash and D4 Dust rating are recommended (e.g. 3M™ Goggle Gear, 500-Series Clear Scotchgard™ Anti-fog Lens).

Skin Protection Skin contact must be prevented to reduce the risk of dermal exposure. Protective coveralls, lab coats, aprons, and gloves should be considered. In addition, chemical-resistant gloves should be worn to protect the hands (e.g., butyl, nitrile). Refer to coverall and glove manufacturers recommendations for specific products.

*Full face piece must be quantitatively fit tested to receive an APF of 50.

Endnotes and References:

¹"Flavorings Related Lung Disease- Coffee Processing Facilities" February 1, 2016.

<http://www.cdc.gov/niosh/topics/flavorings/processing.html>

²CDC (Centers for Disease Control and Prevention) [2013]. Obliterative bronchiolitis in workers in a coffee-processing facility - Texas, 2008-2012. MMWR Morb Mortal Wkly Rep 62(16):305-307.

³NIOSH [2011]. Draft criteria for a recommended standard: occupational exposure to diacetyl and 2,3-pentanedione. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 20XX-XXX. August 12, 2011 External Review Draft,

<http://www.cdc.gov/niosh/docket/archive/pdfs/NIOSH-245/0245-081211-draftdocument.pdf>

⁴Bailey, Cox-Ganser, Duling, LeBouf, Marting, Bledsoe, Green, and Kreiss. American Journal of Industrial Medicine. "Respiratory Morbidity in a Coffee Processing Workplace With Sentinel Obliterative Bronchiolitis Cases"
<https://www.documentcloud.org/documents/2501327-ajimtexascoffeenov2015.html>

⁵DHHS (NIOSH) Publication Number 2004-110. NIOSH Alert: Preventing Lung Disease in Workers Who Use or Make Flavorings.
<http://www.cdc.gov/niosh/docs/2004-110/>

Akiyama M, Murakami K, Ohtani N, Iwatsuki K, Sotoyama K, Wada A, Tokuno K, Iwabuchi H, Tanaka K. 2003. Analysis of volatile compounds released during the grinding of roasted coffee beans using solid-phase microextraction. J Agric Food Chem 51:1961-1969

Daglia M, Papetti A, Aceti C, Sordelli B, Spini V, Gazzani G. 2007. Isolation and determination of alpha-dicarbonyl compounds by RP-HPLC-DAD in green and roasted coffee. J Agric Food Chem 55:8877-8882.

Hazardous Substances Data Bank. 2007. Diacetyl CASRN: 431-03-8. U.S. National Library of Medicine, National Institutes of Health, U.S. Department of Health & Human Services. [Available at <http://toxnet.nlm.nih.gov/cgi-bin/sis/search2/f?/temp/~u34jo5:1> Accessed March 15, 2016]

NIOSH [2015]. Best practices: engineering controls, work practices and exposure monitoring for occupational exposures to diacetyl and 2,3-pentanedione. By Dunn KH, McKernan LT, Garcia A. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication 2015-197.

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