Analysis of Glass Dusts

Material: Recycled Glass

Issue: *All types of dust have come under increasing regulatory control in the U.S. because of the potential or perceived health hazards they pose toward workers. The Occupational Safety and Health Administration (OSHA) sets standards for worker exposure to airborne dust under Federal regulations 29CFR 1910.1000. The standards can substantially effect the cost of dust control and material handling, as well as company liability for worker safety.*

Container glass is made from over 70% silica. The term silica refers to the naturally occurring mineral silicon dioxide (SiO_2). Crystalline forms of silica, also known as "free" silica, can contribute to certain lung diseases under prolonged exposure conditions. An understanding of the difference between glass dusts and silica dusts in the crystalline form, and what the permissible exposure limits are, is necessary to ensure worker safety and to avoid liability in recycled glass processing.

Best Practice: **Glass** In considering glass dusts, it is important to evaluate both the chemical composition of glass and its physical state. Bottle glass is a silicate containing various other ingredients which have been melted and upon cooling form an amorphous, or noncrystalline structure. The majority of the raw material silica occurs as quartz, a crystalline form of SiO_2. Other crystalline forms of silica include tridymite and cristobalite. While SiO_2 is a primary ingredient in the manufacturing of bottle glass, when glass is formed, the crystalline structure is changed to an amorphous structure and the SiO_2 is no longer considered crystalline.

The permissible exposure limits (PEL) as defined in federal regulations refer to a time-weighted average (TWA) based on an 8-hour workday within a 40-hour work week. The TWA is given in total airborne dust or respirable fraction (particles less than 10 microns). OSHA classifies glass dust as a "nuisance dust" with a TWA for total dust of 15 mg/m^3, and a respirable fraction of 5 mg/m^3. Nuisance dust exposures below the PEL are not recognized to be the cause of any serious pathological conditions. However, the level of any such dust should be kept as low as is practical in the workplace (see *Dust Control Strategies for Glass Processing* Best Practice).

One of the questions raised has been whether there is any de-vitrification, or returning of glass to its crystalline state, in dust generated by processing. In a study performed by Dames & Moore Inc.[3] in 1993, samples taken of dust generated during handling of glass cullet contained less than 1% crystalline silica. A sample of the dust taken by a sampling pump worn by a Dames & Moore employee showed <2.8% crystalline silica (the accuracy limit of the abbreviated sampling time). When the 2.8% value is used to calculate the TWA, total dust is below the limit.

Silica Pure crystalline silica has several different TWA values depending on the type of crystal. The OSHA TWA for 100% quartz is 0.3 mg/m^3 total dust and 0.1 mg/m^3 respirable fraction. Because such pure crystalline forms are rarely found in industry, calculations to determine the TWA are determined based on the percentage of the most commonly found crystalline silicas in a particular type of dust.

Silicosis is a type of pneumoconiosis resulting from crystalline silica causing damage to the macrophages in the lungs. The macrophages release compounds that cause fibrosis, or scar tissue. The development of silicosis does not appear to be related to only one factor. According to the National Safety Council, the disease depends on several factors, including:

- amount and kind of dust inhaled
- percentage of free silica in the dust
- form of silica
- size of the particles inhaled
- duration of the exposure
- powers of resistance or the individual concerned
- presence or absence of a complicating process (such as infection)

Implementation: It is recommended that processors and users of recycled glass materials request Material Safety Data Sheets (MSDS) for the particular types of glass being handled. The composition of post-consumer bottle glass (see *Identifying Chemistry of Container Glass* Best Practice) as collected through recycling programs is fairly consistent, however periodic testing of both raw materials and dust levels in the workplace is recommended.

Benefits: Understanding the hazards of dusts in the workplace is important in order to achieve safe and efficient handling of recycled glass. In certain uses for recycled glass, such as industrial mineral applications, the nature of glass dusts appear to offer comparative advantage over materials containing free silica, in terms of respiratory health concerns. This may translate to economic benefits realized by suppliers of recycled glass competing with alternative fillers, abrasive grits, or other industrial minerals containing crystalline silica. Further, the benefits of understanding dust concerns and taking protective measures can be quantified by the reduced exposure to liability claims.

Application Sites: Glass processors, Material recovery facilities, Industrial users.

Contact: For more information about this Best Practice, contact CWC mailto:info@cwc.org.

References:

(1) *Fundamentals of Industrial Hygiene, Second Edition,* National Safety Council, Chapter 7, pp 171-200.
(2) *Respiratory Health Aspects of Ground Glass vs. Ground Silica,* ReTAP Fact Sheet GL-94-1, Clean Washington Center, 1995.
(3) Case Studies for the Use of Post Consumer Glass as a Construction Aggregate, Clean Washington Center Report
(4) *Code of Federal Regulations (CFR),* Occupational Safety and Health Standards, July 1, 1993 Edition.
(5) *Occupational Health Guideline for Crystalline Silica,* National Institute for Occupational Safety and Health (NIOSH), September 1978.

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