

Osha considerations for reducing pels for crystalline silica



OSHA considerations for reducing PELs for crystalline silica

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1. Introduction

Crystalline silica is known as an important constituent in some construction materials like stone, sand, concrete, and granite (1, 2). It comes from different industrial activities such as agriculture, sandblasting, mining, foundry, construction, oil and gas extraction, and hydraulic fracturing (3).

Crystalline silica is present in the form of Quartz, Cristobalite and tridymite and all of them are known as a source of exposure in the work places (1, 2).

Exposure to crystalline silica can cause silicosis, and a progressive fibrosis of the lungs (2). The National Toxicology Program (NTP) and International Agency for Research on Cancer (IARC) have found two forms of quartz and cristobalite carcinogenic (4, 5).

There is a possible mechanism that denotes how this material causes lung disease; when active oxygen species (AOS) is generated by chemicals reactions, it can interact with DNA, proteins, and lipids in macromolecules, then mutation in DNA can initiate the process of cancer or DNA damage (6).

The permissible exposure limit (PEL) for respirable crystalline silica (RCS) which is adopted by OSHA is, (RCS): $PEL = (10 \text{ mg/m}^3) / (\% \text{silica} + 2)$ which restricts both the exposure to RCS and respirable dust (7). The PEL has not updated since the agency was established in 1971.

There are many techniques to identify and quantify crystalline silica such as X-ray diffraction methods, Infrared methods, optical and electron microscopy <https://assignbuster.com/osha-considerations-for-reducing-pels-for-crystalline-silica/>

techniques, chemical and thermal analysis. However, some of these techniques have some limitations in their process (8).

The purpose of this study is reviewing the OSHA considerations for reducing PELs for crystalline silica.

2. Background

Based on the researches done to identify the reason of workers' illnesses in Vermont granite occurred in 1940 the OSHA proposed the current PEL in 1971(7). The most common symptoms among the workers in Vermont granite were shortness of breath, dry cough, and reduced pulmonary function (9). Then, a recommended exposure limit (REL) of 0.05 mg/m^3 for RCS was proposed by NIOSH in 1974 (7, 10) In 1989, NIOSH testified to OSHA that silica should be considered a " potential occupational carcinogen." And IARC attested to classify crystalline silica as a carcinogen (7, 11). As a result, the ACGIH accepted to list the silica as an " A₂ Suspected Human carcinogen" In 1999, and, in 2000, adopted a TLV of $50 \text{ }\mu\text{g/m}^3$ for RCS. In 2006, additional evidences indicated the relation between lung cancer and the inflammation caused by silica, and it led the ACGIH to reduce the TLV to $25\mu\text{g/m}^3$ (9, 12).

3. Results and discussion

The detrimental effects of silica on the workers' health such as lung cancer, kidney diseases and sometimes death necessitated OSHA proposing a new PEL for respirable crystalline silica of $50\mu\text{g/m}^3$ (9). The investigations conducted in the industries showed that workers were at the risk of illnesses

and death below the current PELs (9). The following paragraphs address the OSHA considerations for reducing the PEL for crystalline silica.

1. Possibility of Sampling and Analytical Methods

The possibility of sampling and analytical methods is between the several limitations that can affect the OSHA decision to reduce the silica PELs. There are some available and accurate personal sampling cyclones like SKC G-3, Higgins-Dowel, Dorr-Oliver, and BGI GK 2. 69 which were examined by OSHA for collecting the respirable crystalline silica. According to OSHA, all of these devices are able to collect the silica as low as $25 \mu\text{g}/\text{m}^3$ which is needed for the OSHA analytical method of ID-142 (9).

Regarding analytical methods to measure silica, two factors of sensitivity and accuracy are investigated by OSHA. The first method that OSHA concludes it has a reasonable sensitivity for measuring the silica was the X-Ray Diffraction (XRD) and Infrared Spectroscopy (IR). However, the poor inter-laboratory results indicated that the mentioned methods are lack of precision. The XRD method of ID-142 presents the precision of ± 23 for the crystalline silica of 50 to 160 μg and ± 19 percent for the sampling and analytical error. Therefore, the OSHA could not rely on such colorimetric methods to measure the low amount of silica. Finally, OSHA's analysis found the laboratories good agreement for the samples in the range of 49-70 μg . Therefore, OSHA believes that a PEL of $50 \mu\text{g}/\text{m}^3$ is more appropriate in the workplaces (9).

2. Possibility of Control Technologies

According to possibility of control technologies the OSHA has conducted an analysis for both of general industry sectors and construction industry activities that are potentially affected by the proposed silica standard.

3. 2. 1. Possibility Findings for the Proposed Permissible Exposure Limit of 50 $\mu\text{g}/\text{m}^3$

According to the results of findings, OSHA assumed that the proposed PEL of $50\mu\text{g}/\text{m}^3$ is appropriate for all affected general industries as well as construction activities (9). Thus, OSHA discerned that the PEL of $50\mu\text{g}/\text{m}^3$ will be sufficient to maintain in engineering and work practices. And for those few activities within an industry where the proposed PEL is not technologically achievable the workers can achieve the exposure levels at or below the proposed PEL by wearing the protective equipments such as respirators (9).

3. 2. 2 Feasibility Findings for an Alternative Permissible Exposure Limit of 25 $\mu\text{g}/\text{m}^3$

Regarding to the results of possibility analysis, OSHA concludes that a proposed PEL of $25\mu\text{g}/\text{m}^3$ would not be achievable for many industries, and using respiratory protection would have to be required in most operations to achieve compliance. However, there are several industries that have achieved an alternative PEL of $25\mu\text{g}/\text{m}^3$ such as asphalt paving products, dental laboratories, mineral processing, and paint and coatings manufacturing in general industry, and drywall finishers and heavy equipment operators in construction industry. In these industries, small

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amounts of silica containing materials cause to have low concentrations of airborne respirable silica (9).

The ferrous foundry industry would not be able to agree with the PEL of $25\mu\text{g}/\text{m}^3$ without using the respirators. In the ferrous foundry industry silica is used and recycled to create castings and there is a big amount of silica dust during the process of recycling. Also, the high level silica dust is generated during the shakeout process. The engineering controls determine the exposures below $50\mu\text{g}/\text{m}^3$, but the exposure above $25\mu\text{g}/\text{m}^3$ still occur. Therefore, the engineering controls in place, reported the exposure range of $13\mu\text{g}/\text{m}^3 - 53\mu\text{g}/\text{m}^3$, with many of the reported exposures above $25\mu\text{g}/\text{m}^3$ (9). The construction industry is similar to the ferrous industry with regarding the generation of dust. Thus, the engineering controls cannot comply to maintain exposures at or below the alternative PEL of $25\mu\text{g}/\text{m}^3$.

3.3. Cost of compliance

In this section the detailed assessment of the costs to establishments in all affected industry sectors was provided for supporting of the proposed silica rule of reducing worker exposures to silica to an eight-hour time-weighted average (TWA) permissible exposure limit (PEL) of $50\mu\text{g}/\text{m}^3$. Table 1 describes the annualized costs of the proposed rule by cost category for general industry, maritime, and construction. The cost is including the engineering controls, respirators, exposure assessment, medical issue, training and regulating areas or access control.

Table 1. Annualized Compliance Costs for Employers in General Industry, Maritime, and Construction Affected by OSHA's Proposed Silica Standard (2009 dollars) (13)

Industry	Engineering Controls (includes Abrasive Blasting)	Respirators	Exposure Assessments	Medical Surveillance	Training	Regulating areas or access control
General Industry	\$88,442,480	\$6,914,225	\$29,197,633	\$2,410,253	\$2,952,035	\$2,580,728
Maritime	\$12,797,027	NA	\$671,175	\$646,824	\$43,865	\$70,352
Construction	\$242,579,193	\$84,004,516	\$44,552,948	\$76,012,451	\$47,270,844	\$16,745,663
Total	\$343,818,700	\$90,918,741	\$74,421,757	\$79,069,527	\$50,266,744	\$19,396,743

Table 1 depicts the total annualized costs of the proposed rule, \$132.5 million by general industry, \$14.2 million by maritime, and \$511.2 million by construction. So, considering the economic feasibility, OSHA standards

are economically feasible so long as their costs do not threaten the existence of, or cause massive economic dislocations within, a particular industry or alter the competitive structure of that industry. For example, firms that want to have a profitable line of business may have to increase prices to stay viable. Increases in prices typically result in reduced quantity demanded, but rarely eliminate all demand for the product. This decrease in the total production of goods and services results in smaller output for each establishment within the industry or the closure of some plants within the industry, or a combination of the two, is dependent on the cost and profit structure of individual firms within the industry. So, the economic matter is the controversial subject to discuss and there are always some contradictions in companies to accept the cost of new proposed PELs.

4. Conclusion

The limitations in the characterization of the precision of the analytical method preclude the Agency from proposing a PEL of $25\mu\text{g}/\text{m}^3$. First, the measurement error increases by about 4 to 5 percent for a full-shift sample taken at $25\mu\text{g}/\text{m}^3$ compared to one taken at $50\mu\text{g}/\text{m}^3$, and the error would be expected to increase further as filter loads approach the limit of detection. Second, for an employer to be virtually certain that an exposure to quartz did not exceed $25\mu\text{g}/\text{m}^3$ as an exposure limit, the exposure would have to be below $21\mu\text{g}/\text{m}^3$ given the error of ± 16 percent calculated from the OSHA's Salt Lake Technical Center (SLTC) study. Based on the information presented in the technological feasibility analysis, the Agency believes that $50\mu\text{g}/\text{m}^3$ is the lowest feasible PEL. An alternative PEL of

25µg/m³ would not be feasible because the engineering and work practice controls identified to date will not be sufficient to consistently reduce

exposures to levels below 25µg/m³ in most operations most of the time.

OSHA believes that an alternative PEL of 25µg/m³ would not be feasible for many industries, and that the use of respiratory protection would be necessary in most operations most of the time to achieve compliance.

Additionally, the monetary matter is the controversial subject that raises many contradictions in firms to accept the new proposed PELs by OSHA.

5. References

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