INDIANA READY MIX CONCRETE INDUSTRY

Silica Objective Data

May 22, 2019

This document has been approved by the Indiana Department of Labor for use as required by the U.S. Department of Labor, Occupational Safety and Health Administration. It may be used in conjunction with your written exposure control plan.

Under 29 CFR 1926.1152(d)(2) Objective data was comprised from an industry-wide survey that reflect workplace conditions closely resembling, or with higher exposure potential, than the processes, types of material, control methods, work practices and environmental conditions present in the employers' current operations. Industrial Hygiene reports that contain the collected Silica Object Data will be kept on file with *Indiana Ready Mix Concrete Association,* and upon request, is readily available for examination.

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ABSTRACT

Background

This is a field study report evaluating respirable dust and respirable crystalline silica exposures associated with the task of ready mix concrete manufacturing. This study was conducted to collect exposure data on ready mix concrete manufacturing to comprise objective data for the ready mix industry. Crystalline silica refers to a group of minerals composed of silicon and oxygen; a crystalline structure is one in which the atoms are arranged in a repeating three-dimensional pattern [Bureau of Mines 1992]. The three major forms of crystalline silica are Quartz, Cristobalite and Tridymite; quartz is the most common form of airborne crystalline silica dust that is capable of entering the gas-exchange regions of the lungs if inhaled. Silicosis, a fibrotic disease of the lungs, is an occupational respiratory disease caused by inhalation and deposition of respirable crystalline silica dust [NIOSH 1986].

Crystalline silica is a constituent of cementitious material commonly used in manufacturing ready mix.

Assessment

Task-based personal breathing zone air samples for respirable dust and respirable crystalline silica were collected from a Loader operator, Batch operator, Truck Driver, Mechanic and Plant manager during routine work activities. Sampling was conducted in accordance with established industrial hygiene and industry best practices.

Site Surveyed:

Various sites throughout Georgia, Indiana, Kentucky, Ohio and Tennessee.

NAICS Code:

327320; READY-MIX Concrete Manufacturing

SURVEY DATES:

February 1, 2017, February 2, 2017, August 11, 2017, September 25, 2017, September 26, 2017, September 27, 2017, October 19, 2017, November 7, 2017, November 16, 2017, April 18, 2018, May 7, 2018, May 22, 2018, May 23, 2018, July 9, 2018.

SURVEYS CONDUCTED BY:

Orizon of Georgia, Industrial Hygiene Services of the BWC Division of Safety & Hygiene of Ohio, Truth Consulting and Willis Towers.

INTRODUCTION

The Ready Mix Industry comprises establishments, such as batch plants or mix plants, primarily engaged in manufacturing concrete delivered to a purchaser in a plastic and unhardened state. The industry has conducted testing to establish exposure monitoring data to be considered as “objective data” for respirable silica dust exposure (“exposure level”), associated with the use of cementitious material used in various applications of a concrete facility.   The data collected on tasks and exposure conditions required to meet OSHA’s definition of objective data is set forth in this report.

This report evaluated Industry wide companies participating in a random controlled testing environment for personal quartz exposure. The multi-dimensional involvement included Ready Mix Manufacturing companies conducting tests to determine employee’s exposure to respirable dust and respirable crystalline silica based on various job classifications.

The sampling methods follow NIOSH 7500: Silica, crystalline, by XRD method. The samples are a representative of silica exposure from one task/control combination (i.e. loader operator, batch operator, driver, mechanic, plant manager), with samples being analyzed by creditable industrial hygienist. Upon exposure assessment, the sampled occupations are expected to have the highest exposure to respirable crystalline silica (Scheduled Monitoring Option).

ISO 7708:1995 Air qualities have been taken into consideration. The fraction of airborne particles which is inhaled into a human body depends on the properties of the particles, the speed of the articles the speed and direction of the air movement near the body, the rate of breathing, and weather breathing is through the nose or mouth. There is a wide variation from one person to another in the probability of inhalation, deposition, and reaction.

The following objective data define conventions for size-selective sampling and yield a better relationship for measured concentration.

This study was conducted under real working conditions and integrated technical, organizational and behavioral factors to gain insight to an effective prevention. This is evidence based objective data.

PLANT AND PROCESS DESCRIPTION

Loader Operator –
responsible for moving raw materials to the plant for use in the production of concrete. Operation of the loader is conducted within the cab of the vehicle. Other duties include maintaining the loader and maintaining the yard. These duties both occur inside and outside the vehicle. They also conduct clean up operations throughout the batch plant site. Activities include operating heavy equipment, silo cleanup and aggregate materials during site activities. The loader operator is in a closed cab with heating and air conditioning. Loader Operators have the potential to be exposed to silica dust, cement, and other aggregate materials during all phases of the operation.

Mechanic-
are responsible for repairing and maintaining machinery such as engines, motors, pneumatic tools, conveyor systems, productions machines and other plant equipment related to batch pant operations. They also leave he site and get parts as needed. Maintenance mechanics have the potential to be exposed to silica dust, cement and other aggregate materials while working both in the shop and throughout the plant and yard.

Driver- Front Discharge Vehicle –
responsible for delivery of concrete to the jobsite. The driver enters the cab of the vehicle and drives to the loading station where concrete is loaded into the truck. The driver may stay in the cab while the truck is being loaded at the batch plant, but may also exit the cab to perform duties while loading. The driver moves from the batch plant and exits the cab for adding admixtures or water and to check the quality of slump in the drum. The driver will also rinse off the vehicle with water prior to leaving for the job site. Once ready, the load is driven to the jobsite where the driver stays in the cab, operates the controls and monitors the dispensing of product. After returning to the batch plant, the driver exits the vehicle and remains outside the cab while rinsing the vehicle. The driver is in a closed cab truck with heating and air conditioning. Drivers have the potential to be exposed to silica dust, cement, and other aggregate materials during all phases of the operation.

Facility Personnel – (Plant Manager-Batch-Dispatch)
responsible to manage employees and production at the plant, in addition to following safety and operational guidelines. The plant manager has a thorough understanding of the ready mix concrete business. The plant manager is in an office with heating and air conditioning or in the yard. Plant Managers have the potential to be exposed to silica dust, cement, and other aggregate materials during all phases of the operation. **Batch Operator**- in charge of controlling production and load out of materials produced in the batch plant, as well as for scheduling and ensuring timely delivery of supplies to the plant to perform duties in conjunction with dispatch loading instructions. The batch operator sits in an office within several feet of the driver loading area. **Dispatch**- supervises and coordinates activities of workers engaged in delivering ready-mix concrete.

METHODOLOGY

All personal air samples were collected within the worker's breathing zone. Personal air samples were collected using battery-powered, personal air-sampling pumps that drew air at a pre-determined constant flow rate through a filter that was attached to the pump with a stretch of flexible tubing. The type of filter media, flow rate and sampling duration was determined using OSHA, NIOSH and laboratory protocols. Temperature, relative humidity and dew point were evaluated and appeared proper as to not affect the collected samples. Time frames were computed as an 8-hour time weighted average (TWA).

The silica samples were collected on PVC filters using a cyclone. The cyclone is a size selective device used to separate respirable and non-respirable-sized particles. The respirable fraction of dust that passes through the cyclones is deposited onto a PVC filter. A net weight was determined by reweighing the filters using a laboratory in house zed for method and calculating the respirable dust result. Samples were analyzed for crystalline forms of Silica by X-ray Diffraction.

Upon return to the lab, the filters are re-weighed on a microbalance. The initial weight is subtracted from the final weight.

RESULTS

Beginning February 2017, continuing through September 2018, an analysis of airborne exposure to crystalline silica and respirable dust were conducted. Samples were collected following OSHA's Appendix A to § 1910.1053. Employees performing different occupational duties within the Ready Mix Industry were tested.

Results indicate that **ALL SAMPLES WERE BELOW THE OSHA PEL** as well as the exposure limits set by National Institute for Occupational Safety and Health (NIOSH) and the American Conference of Governmental Industrial Hygienists (ACGIH) for silica. All measured concentrations were detected either at or below their respective laboratory analytical limits or, if detected at measurable limits, were well below current applicable OSHA Permissible exposure Limits (PELs).

All monitored employees had exposures to resiprable dust and respirable crystalline silica **below** the reference occupational exposure limits. At the time of investigative sampling, there was no indication of airborne deficiencies for the Concrete Plant process.

Charted sample results are as follows:

Figure 1

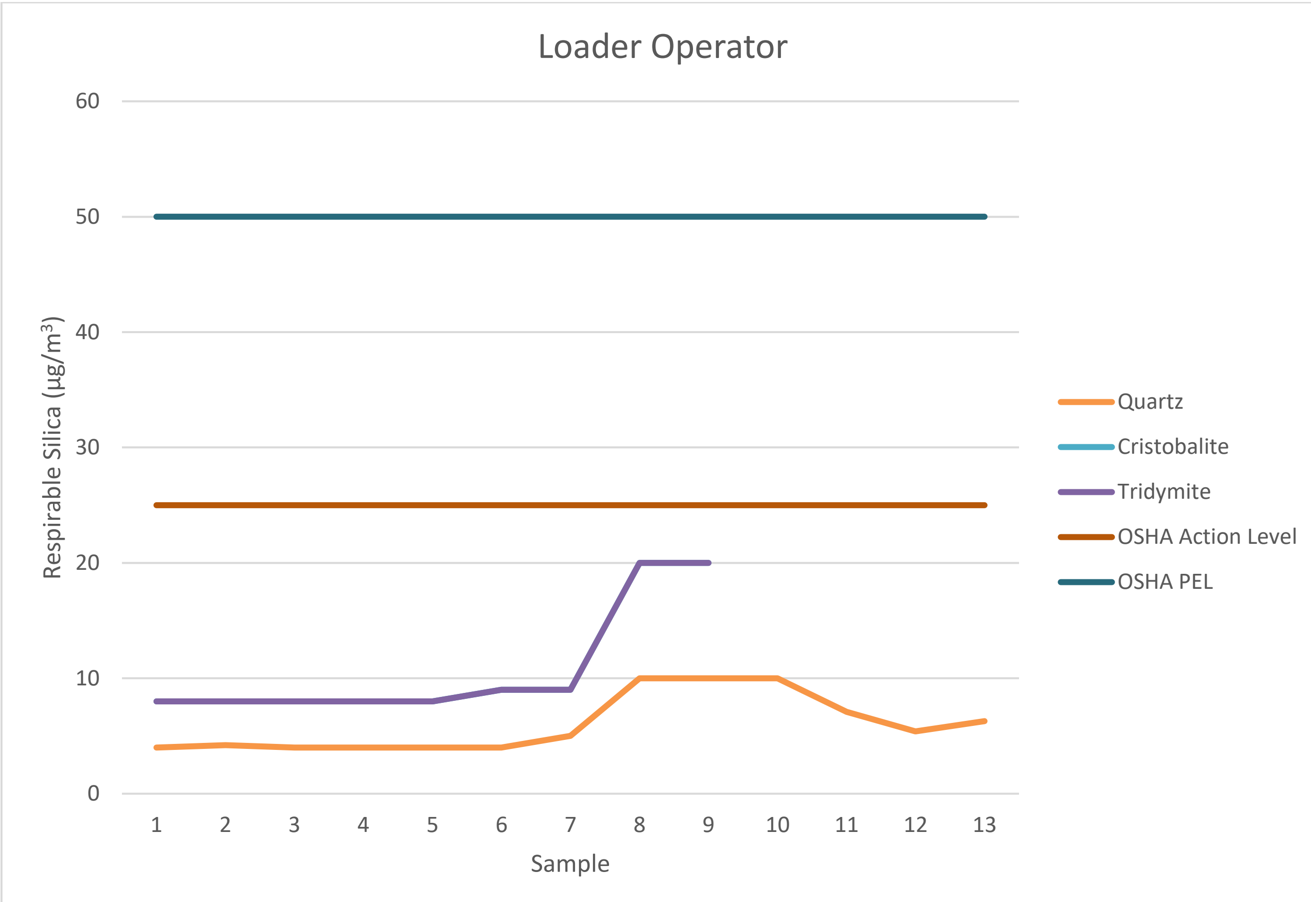

Fig. 1: The graph above shows the amount of respirable silica present in the sample. Samples obtained contained amounts of silica below the laboratory detection limit resulting in higher outcomes (i.e. sample 8 and 9 were measured at <20 µg/m^3). The cristobalite and tridymite had identical concentrations, therefore, share the same line. Samples 10-13 had no breakdown of the silica components present in the dust so there is not any cristobalite and tridymite data to graph.

FINAL DETERMINATION: All samples are below the OSHA PEL for respirable dust and silica species. Testing was conducted under normal working conditions. Data assessment subject to change outside the scope of normal working conditions.

Figure 2.

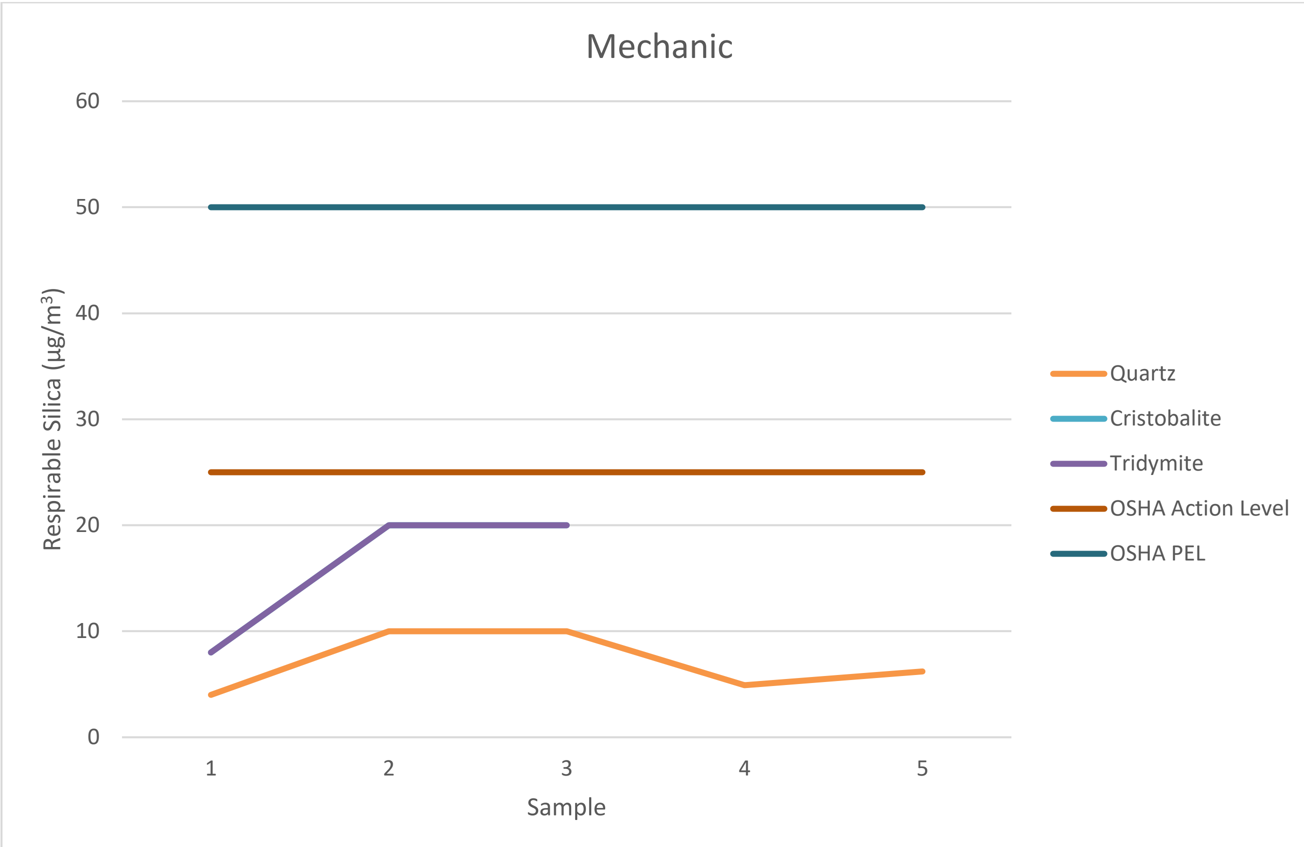

Fig. 2: The graph above shows the amount of respirable silica present in the sample. Samples obtained contained amounts of silica below the laboratory detection limit resulting in higher outcomes (i.e. sample 2 and 3 were measured at <20 µg/m^3). The cristobalite and tridymite had identical concentrations, therefore, share the same line. Samples 4 and 5 had no breakdown of the silica components present in the dust so there is not any cristobalite and tridymite data to graph.

FINAL DETERMINATION: All samples are below the OSHA PEL for respirable dust and silica species. Testing conducted under normal working conditions. Data assessment subject to change outside the scope of normal working conditions.

Figure 3

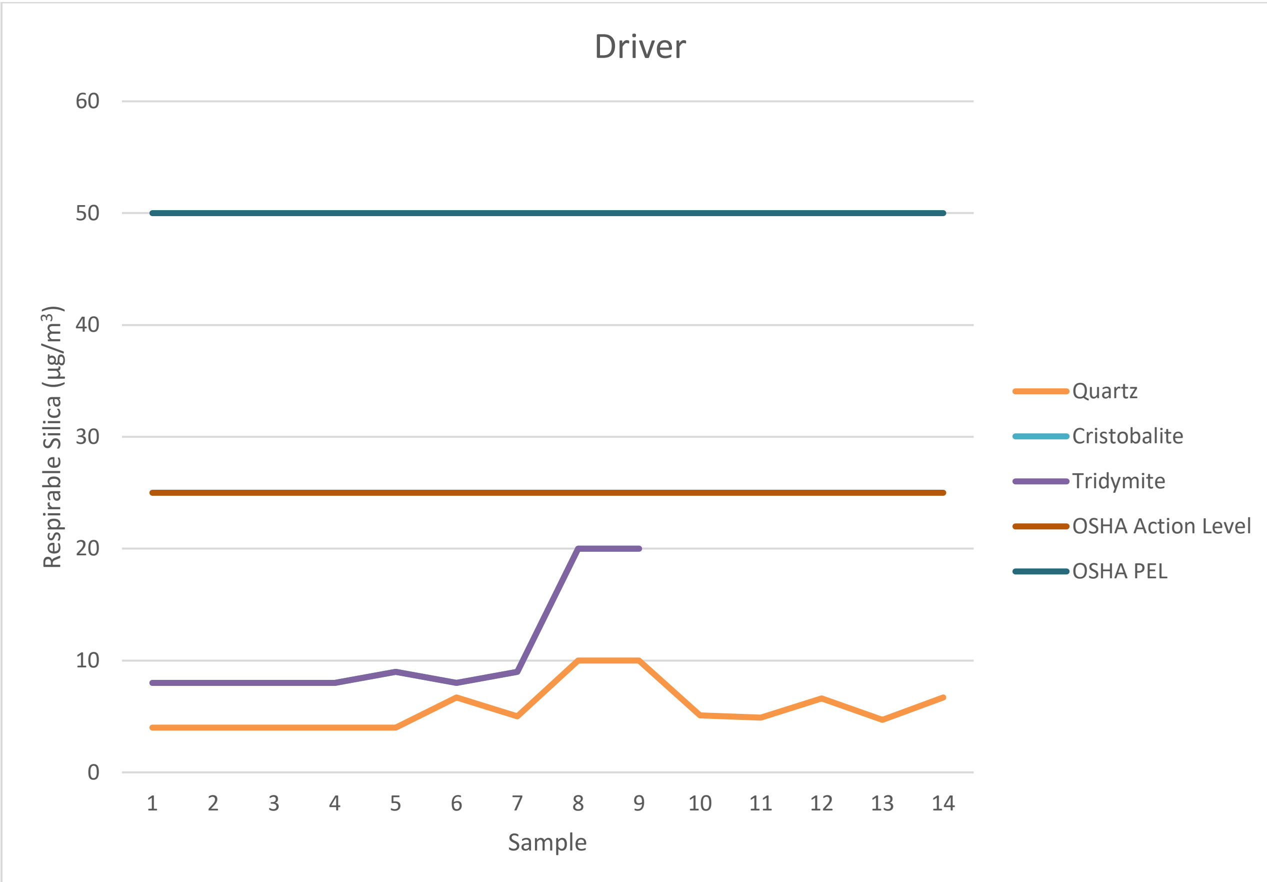

Fig. 3: The graph above shows the amount of respirable silica present in the sample. Samples obtained contained amounts of silica below the laboratory detection limit resulting in higher outcomes (i.e. sample 8 and 9 were measured at <20 µg/m^3). The cristobalite and tridymite had identical concentrations, therefore, share the same line. Samples 10-14 had no breakdown of the silica components present in the dust so there is not any cristobalite and tridymite data to graph.

FINAL DETERMINATION: All samples are below the OSHA PEL for respirable dust and silica species. Testing conducted under normal working conditions. Data assessment subject to change outside the scope of normal working conditions.

Figure 4

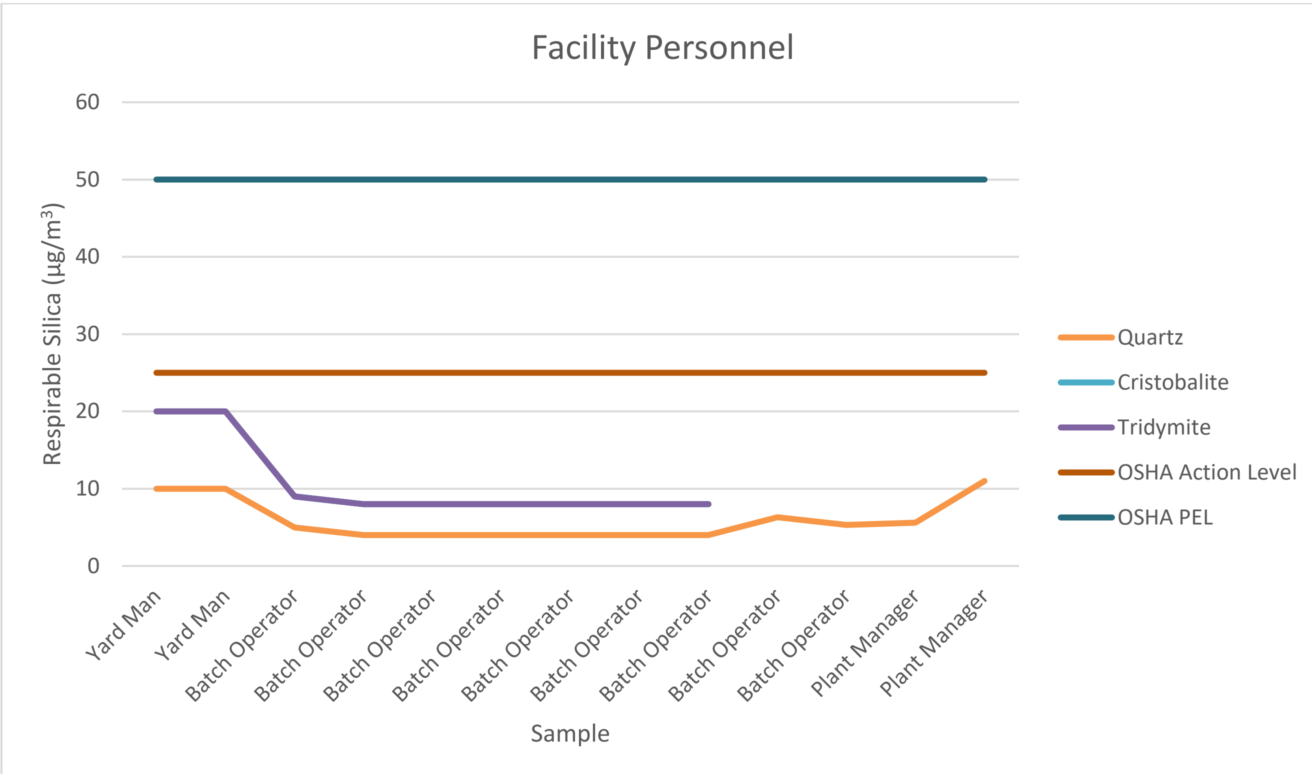

Fig. 4: The graph above shows the amount of respirable silica present in the sample. Samples obtained contained amounts of silica below the laboratory detection limit resulting in higher outcomes (i.e. sample 8 and 9 were measured at <20 μg/m^3). The cristobalite and tridymite had identical concentrations, therefore, share the same line. Two batch operator and two plant manager samples had no breakdown of the silica components present in the dust so there is not any cristobalite and tridymite data to graph.

FINAL DETERMINATION: All samples are below the OSHA PEL for respirable dust and silica species. Testing conducted under normal working conditions. Data assessment subject to change outside the scope of normal working conditions.

CONCLUSION

Based on the assessments, the following conclusions were reached:

1. Calculated 8hr TWA results of personal air samples collected for crystalline silica indicate that employee exposures are below regulatory exposure limits (OSHA PELs).
2. Current measures are sufficient in maintaining the plant personnel below current applicable exposure limits for silica and respirable dust.
3. Exposure assessment conducted has been reasonable and appropriate to meet compliance with OSHA's Appendix A to § 1910.1053.

REFERENCES

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