HAZARD EVALUATION AND TECHNICAL ASSISTANCE REPORT
HETA 89-352-L2037
SCOTT PAPER COMPANY
CHESTER. PENNSYLVANIA
APRIL 1990

Hazard Evaluations and Technical Assistance Branch
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National Institute for Occupational Safety and Health
4676 Columbia Parkway
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BACKGROUND

In September 1989, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation in the co-generation plant at Scott Paper Company, West Chester, Pennsylvania. The request addressed concerns from both management and the local union about dust exposures throughout the plant. On January 23-25, 1990, NIOSH conducted an industrial hygiene survey at the co-generation plant and this letter will summarize the activities and results of that survey.

FACILITY DESCRIPTION

The co-generation plant supplies steam and power to the adjacent Scott Paper Mill. The plant is unique in that it is currently the largest fluidized bed combustor co-generation unit of its size in the United States. Its fuel is an anthracite culm (old anthracite mine tailings supplied from northeastern Pennsylvania coal mines). Lime is added to the culm to supply the final fuel for the combustor. The system is designed to consume 200 tons of fuel per hour at full production.

The operating process for the co-generation plant begins at the point where the culm is dumped by trucks into the feeder. From there, the culm is distributed to either the on-site stock pile or fed directly to the crusher for sizing. The crushed culm is transported to silos via a belt conveyor for processing in the combustor. Prior to entering the combustor, lime is added to the culm in the boiler house. The fuel enters the combustor at a controlled rate and remains suspended in air as a result of the fluidized bed. The fine ash is filtered out at the top of the combustor with the heavier ash collecting at the bottom. The steam produced provides the energy for the turbine generator which, in turn, produces electricity for the paper plant.

METHODS

On January 24 and 25, 1990, environmental air samples were collected to assess the workers' exposures to the dust throughout the co-generation plant and the coal and ash yards. Ten air samples were collected for both respirable dust and quartz analysis. Ten air samples were also collected for trace metals analysis. In addition, bulk samples of the coal and ash were collected for trace metals identification and total percent quartz analysis.

Respirable air samples for total dust and free-silica were collected by drawing air at a rate of 1.7 liters per minute (lpm) first through a 10-mm nylon cyclone to remove the larger, non-respirable particles, then through a tared polyvinyl chloride filter connected, via tygon tubing, to a battery powered pump. The filters were analyzed gravimetrically according to NIOSH Method 0600. The total weight of each sample was determined by weighing the sample and the filter and subtracting the previously determined tare weight of the filter. The filters were then dissolved in tetrahydrofuran and further analyzed for free-silica using X-ray diffraction (XRD), according to NIOSH Method 7500. (1)

Air samples collected for trace metals were collected by drawing air at a rate of 2.0 lpm through a mixed cellulose ester filter connected via tygon tubing to a battery powered pump. The filters were digested using NIOSH Method 7300 (1) and diluted to 25 milliliters (mls) after digestion. A simultaneous scanning inductively coupled plasma emission spectrometer was used for the analysis. The spectrometer scans thirty different trace metals in the analysis.

Two of the bulk samples (one coal and one ash) were submitted for percent quartz (free silica) analysis. A two milligram portion from each bulk sample was weighed onto tared filters prior to analysis. The filters were then dissolved in tetrahydrofuran and analyzed for percent free silica using XRD according to NIOSH Method 7500.

The remaining two bulk samples were submitted for trace metal analysis. A portion of the samples were weighed and digested using NIOSH Method 7300. The samples were diluted to 50 mls after digestion and analyzed as the above filter samples.

EVALUATION CRITERIA

A. Environmental Criteria

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers are protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criteria. Also, some substances are absorbed by direct contact with skin and mucous membranes, potentially increasing the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent becomes available.

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and Recommended Exposure Limits (RELs), 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Treshold Limit Values (TLVs), and 3) the U.S. Department of Labor (OSHA) occupational health standards. Often, the NIOSH RELs and ACGIH TLVs are lower than the corresponding OSHA standards. Both NIOSH RELs and ACGIH TLVs usually are based on more recent information than are the OSHA Permissible Exposure Limits (PELs). The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agent may be used; the NIOSH RELs, by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is legally required to meet those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits (STELs) or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

B. Silica

Silicosis is a form of diffuse interstitial pulmonary fibrosis resulting from the deposition of respirable crystalline silica in the lung. Conditions of exposure may affect both the occurrence and severity of silicosis. Although, silicosis usually occurs after 15 or more years of exposure, some forms of the disease, with latent periods of only a few years, are well recognized and are associated with intense exposures to respirable dusts high in free silica. (2) In its early stages silicosis usually produces no symptoms. However, both acute and complicated silicosis (progressive massive fibrosis) are associated with shortness of breath, intolerance for exercise, and a marked reduction in measured pulmonary function. Diagnosis is most often based on a history of occupational exposure to free silica and the characteristic appearance of a chest radiograph. Respiratory failure and premature death may occur in advanced forms of the disease. Individuals with silicosis are also at increased risk for contracting tuberculosis. No specific treatment is available, and the disease may progress even after a worker is no longer exposed to silica.

NIOSH recommends that exposures to all forms of cyrstalline silica dust be reduced to the greatest degree possible. The present NIOSH REL is 50 micrograms of respirable silica per cubic meter of air (ug/m^3), which is based on the lowest reliable limit of detection for NIOSH analytical Method 7500. OSHA also enforces a PEL of 100 ug/m^3 for respirable silica as quartz. Finally, ACGIH recommends a TLV of 100 ug/m^3 for respirable silica as quartz.

RESULTS

Results of air sampling for respirable dust and silica are shown in Table 1. Respirable dust concentrations ranged from 70.0 to 7600.0 ug/m^3. Respirable quartz concentrations ranged from non-detected to 1220.0 ug/m^3. It should be noted that some of the sample results are not reported in the table since there was evidence that these samples were tampered with in the field and were not considered valid. The suspect samples contained unusually large quantities of big particles (non-respirable). Normally, the larger particles are screened out by the cyclone. The quartz content of the bulk samples averaged 18% and no cristobalite was detected in the bulk samples.

The results of the bulk samples collected for trace metals identified aluminum, calcium, iron, magnesium, and sodium as the major compounds. The airborne sampling results did not reveal any airborne levels of the aforementioned elements which would approach any established occupational health criteria. Again, two of the samples were tampered with in the field. The quantities reported on these two samples were very consistent with the bulk sample results and will not be reported as airborne concentrations.

DISCUSSION

The major concern expressed at this facility is the potential for airborne dust exposures. It should be noted that during our evaluation the dust levels were probably less than normal because the co-generation plant was operating at about 60% of production capacity and extremely wet conditions existed. However, we do feel confident that our sampling results have identified free silica as the major concern from an occupational exposure in this facility. The potential for overexposures to trace metals is probably minimal at this facility.

The samples collected for free silica in this investigation correlate very well with the most recent samples collected by the company (July 1989), which ranged in concentration from non-detected to 6600.0 ug/m^3. In fact, our lower sampling results can probably be attributed to the wet conditions existing during our investigation. The ash yard is the area identified by both sets of samples as having the highest exposure levels. Specific areas identified as the major contributors to the amount of silica present in the air are as follows:

* The open cart where the bottom ash falls out of the system.

* The ash reinjection system were a visible leak was present at the time of our survey.

* The ash unload area were the trucks transport the ash from the plant.

* The bag house area which is open to the general environment and where large quantities of ash is present on the ground.

An additional concern expressed by the employees during the investigation was the classification of the dust by the company as a nuisance dust. However, the NIOSH investigators feel that a mis-communication may exist on this issue since management is treating the dust as containing more than 5% respirable silica and comparing their exposure levels to the appropriate OSHA PEL for silica. The reference to the total respirable dust levels is used as a qualitative indicator for general information on dust levels.

A final concern expressed by the employees involved the potential hazards associated with the present location of the acid and caustic pumping systems. The employees feel that the two systems are too close together and may create the potential for a reaction in the event of a spill. We agree that the potential does exist for the two incompatible materials to come into contact.

CONCLUSION

Based on the information collected during this investigation, a health hazard does exist from airborne exposures to free silica which have been demonstrated to exceed NIOSH recommended limits.

RECOMMENDATIONS

1. An extension should be placed at the end of the pipe where the bottom ash falls freely to the open cart. The extension should completely and securely cover the top of the portable cart. A stop gate should be placed at the end of the pipe to eliminate the ash from falling to the ground whenever an full cart is being replaced. In addition, local exhaust ventilation should be added to capture the finer emissions that may leak from the enclosure.

2. It has been stated that ash leaks are a very common occurrence at the ash reinjection system due to the abrasive nature of the process. To control this problem, reinforced elbows and pipes designed specifically for abrasive processes should be used to replace the present pipes. In addition, a routine inspection and maintenance schedule needs to be established to eliminate this source of emissions.

3. A tight fitting enclosure and local exhaust ventilation system should be installed at the ash unload area. The company stated that a new system has been designed and will be installed. Following this installation, additional air samples should be collected to determine its efficiency.

4. The bottom of the bag house should be enclosed to eliminate the wide dispersion of ash which is a result of ambient air currents in the open environment. In addition, a routine housekeeping schedule should be established for this area.

5. Prior to the installation of the engineering controls, the workers should wear, as a minimum, a half-mask, air purifying respirator in those areas identified as high in silica exposure. The dust/mist respirator selected may be any air purifying type except for the single use (disposable) models.

6. The acid and caustic pumping system should be physically isolated from each other and diked to reduce the potential for a chemical reaction.

REFERENCES

1. National Institute for Occupational Safety and Health, NIOSH Manual of Analytical Methods, 3rd ed., Cincinnati, Ohio. DHHS (NIOSH) publication no. 84-100, 1984.

2. Ziskind M, Jones RN, Weill H. Silicosis, state of the art. Am Rev Respir Dis 1976:113:643.

TABLE 1

Respirable Dust and Respirable Quartz Concentrations

Scott Paper Co-Generation Plant
West Chester, Pennsylvania
HETA 89-352
January 24-25, 1990

Sample Location	Sample #	Air Vol. (liters)	Resp. Dust Conc. (ug/m^3)	Resp. Quartz Conc. (ug/m$_3$)
Coal Yard Op	5982	779	140	(20)
Coal Yard Op	5973	656	200	(30)
Coal Feeder Area	5146	710	70	ND
Coal Crush Area	5967	651	630	50
Ash Yard Op	5978	737	7600	1220Ash
Reinject Area	5980	483	1360	(40)
B. Ash Removal Area	5975	607	1250	260
Evaluation Criteria			N/A (Refer to quartz)	50 (NIOSH)

( ): (Trace value) analytical results between the LOD and LOQ
ND: none detected
Bulk samples indicate an average of 18% quartz and no cristobalite