Case Reports

Occupational Health Case Report — No. 3
Ethyl Acrylate

The Occupational Safety and Health Act of 1970 authorizes the National Institute for Occupational Safety and Health (NIOSH), on appropriate request, to investigate conditions where a potential health hazard is suspected.

JOM has arranged to review, as case studies and as teaching tools, reports of such NIOSH Health Hazard Evaluations investigations. This report (Case No. 3) and Case No. 4 on following pages should be of interest to industrial physicians and industrial hygienists.

The comments of readers concerning the problems discussed in these reports will be welcome and will be published as space permits.

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1. Introduction

The National Institute for Occupational Safety and Health (NIOSH) received a request from an authorized representative of employees regarding exposure to the dust of an acrylic emulsion polymer. The request was precipitated by the hospitalization of one worker for a respiratory "condition" that was somewhat suggestive of a jobsite hazard and this apparently caused other workers to question their own occupational safety and health.

2. Health Hazard Evaluation

A. Description of Process — Conditions of Use

This facility is engaged in the manufacture of synthetic textile products containing "fiber filler" material. The fiber filler is distributed to garment makers where it is utilized as an insulation component in robes, quilted blankets and other such items. The initial stages of the manufacturing operation involve the processing of a raw polyester fiber by a "picker machine." Once the fibers have been separated and spread, they move on a conveyor into a type of garnet called a "wadding machine." A filagree material exits from the wadding machine onto a conveyor and is carried under an open sprayer, the nozzle of which is located approximately one foot above the conveyor. The sprayer sweeps back and forth until, gradually, all of the fibers are saturated with an acrylic emulsion polymer. There is a water trough under the conveyor which is supposed to remove the oversprayed chemical, however, it is only partly effective in accomplishing this task. The material is then heat dried, baled and sent to the shipping department.

The acrylic emulsion is composed of ethyl acrylate polymer in an aqueous medium. The chemical is delivered in railroad tank cars and pumped directly into a large vat. This vat is completely enclosed and, as needed, the chemical is drawn off by gravity into a smaller stainless steel pot and diluted with equal parts of water before being pumped to the sprayer device. The worker in charge of this operation does not wear goggles or gloves when handling the chemical. In fact, the only protective gear required to be worn by the workers are safety glasses. The faint odor of the polymer is barely perceptible a few feet away from the area where it is being used.

With the exception of the vat operator, workers are stationed no closer than ten feet from the spraying operations described above. It was apparent that a fine, powdery dust was generated during the spraying procedure and there was a long standing accumulation of this substance on overhead pipes, beams and ledges in the area.

There are five to six workers per shift. The normal work shift for these individuals is twelve hours.

B. Evaluation Design

Following the preliminary observational survey which facilitated recognition of the most probable health hazard, it was necessary to return to the facility to conduct a more in-depth analysis of employee exposure to the dust and health effects if any. The procedures used to assess the validity of the alleged hazard included on-site worker interviews and discussion with management personnel, a walk-through inspection of the work place, a literature research effort on the potentially toxic agents, and the collection of ambient and breathing zone dust samples for laboratory analysis. Bulk samples of the polymer as well as the polyester fibers were also collected for laboratory analysis.

Four months elapsed from the time of the complaint before six workers were individually questioned about their occupational history and medical well-being. Seven air samples were collected, including both area and breathing zone samples.

C. Evaluation Methods

Due to the small number of people involved in this hazard evaluation, all worker responses to the medical interview were assessed empirically. Breathing zone samples were obtained with MSA Model G Vacuum Pumps. A millipore field monitor with a 0.45 μ tared filter was attached to the collar of the employee with a tygon tube. The tube was connected to the pump and suspended from a belt at the worker's waist. Area samples were taken in a similar manner. Dust levels were determined gravimetrically by the Cincinnati Laboratory (NIOSH). Infrared spectroscopy was used to identify the bulk dust samples and raw synthetic fibers. The particle size distribution of the dust was determined by phase contrast microscopic techniques.

D. Evaluation Criteria

No occupational health standard has been promulgated by

the U.S. Department of Labor for Ethyl Acrylate-Polymer.

Occupational health standards for individual substances are established at levels designed to protect workers occupationally exposed on an 8-hour per day, 40-hour per week basis over a normal working lifetime. Due to the lack of any standard for the polymer form of ethyl acrylate, bulk dust samples collected in the facility were characterized by particle size and pH to determine whether or not the inert dust standard might be applicable. It is our conclusion that the substance being investigated does not fall into the inert dust category and therefore, the interpretation of area and breathing zone dust levels are based on the physical characteristics of the material and the potential hazard of human exposure at such levels as measured in this facility.

E. Evaluation Results and Discussion

1. Bulk Sample Analysis

As previously described, the alleged toxin was determined to be an emulsion which contained ethyl acrylate (polymer) in aqueous solution. The pH of the bulk solution was 3.9. The settled dust, collected from in-plant structures, was also determined to be a polymer of ethyl acrylate. It was felt that the dust represented a dehydration residual from the emulsion. The pH of the dust following hydration was 5.7. Mean particle diameter of the dust was 0.42 microns, with 99 per cent of all particles being less than 4.5 microns in size. The raw fibers that made up the filler material were of a polyester variety (type not identified).

2. Environmental Dust Sampling

The two area dust samples were collected approximately ten feet from the spray device. The total dust concentration, reported as milligrams per cubic meter (mg/M^3), was 3.5 for the first sample and 5.19 for the second. The mean breathing zone concentration for the five samples collected was 4.10 mg/M^3, with a range of 2.89 to 5.38 mg/M^3.

3. Worker Interviews

There were no symptoms described by the workers on the day of the environmental sampling. Only one worker, the wadding machine operator, stated that the presence of excess dust was uncomfortable at times when overspray of the chemical was prominent. His discomfort was described as an itching of the skin when dust became lodged in facial creases, ears, and nose. The vat operator on the first shift, whose hospitalization was the central issue in the hazard evaluation request, denied that his condition had been caused by his work. In fact, this worker stated that his personal physician advised him that his "coughing condition"was directly related to smoking cigarettes (i.e. a 30 pack year history of tobacco abuse was elicited).

4. Discussion

The substance under discussion has been demonstrated to be an acidic emulsion of ethyl acrylate polymer and as such, the usual toxic manifestations associated with pure ethyl acrylate would not apply. Furthermore, the dust generated has been identified to be a dehydration residual of the polymer which will retain a mildly acidic character on hydration and as such, the toxic manifestations associated with an inert dust would not apply. In addition, this dust has been shown to be a highly respirable particulate. All of these factors must be considered when interpreting the environmental dust exposures.

The mean dust concentration measured in the breathing zone of the workers was determined to be 4.10 mg/M^3. If ethyl acrylate polymer was simply an inert dust of respirable nature, the U.S. Department of Labor standard for an acceptable exposure level would be approximately 3.3 mg/M^3 as adjusted for a 12-hour work shift exposure. Thus, all but one of the breathing zone dust levels would have exceeded the standard. However, ethyl acrylate polymer has been judged to be potentially more toxic than an inert dust because of its mildly acidic character and as such, the level of this particulate measured in the work atmosphere is considered to be a hazard. Although significant toxic effects of a subjective nature (i.e. described by workers) have not resulted from this dust exposure, it would not be prudent to permit the concentration of dust to remain at the current levels.

It is recommended that better engineering controls be designed to reduce the overspray of the material. It is also suggested that general housekeeping be maintained by a regularly scheduled program of sweeping and vacuum cleaning all settled dust from workroom floors, machine parts, walls, ceiling, and other structural members where such dust has accumulated. The vat operator who is responsible for handling the chemical should be adequately protected for the task. Such protection would include the use of chemical goggles, neoprene or rubber gloves, sleeves and aprons for skin protection.

In summary, the dust exposure to a polymer of ethyl acrylate is considered hazardous. It is believed that the institution of engineering improvements to control overspray, as well as a good program of general housekeeping will significantly diminish this hazard.

Acknowledgements

Field Evaluation

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Laboratory Analyses

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