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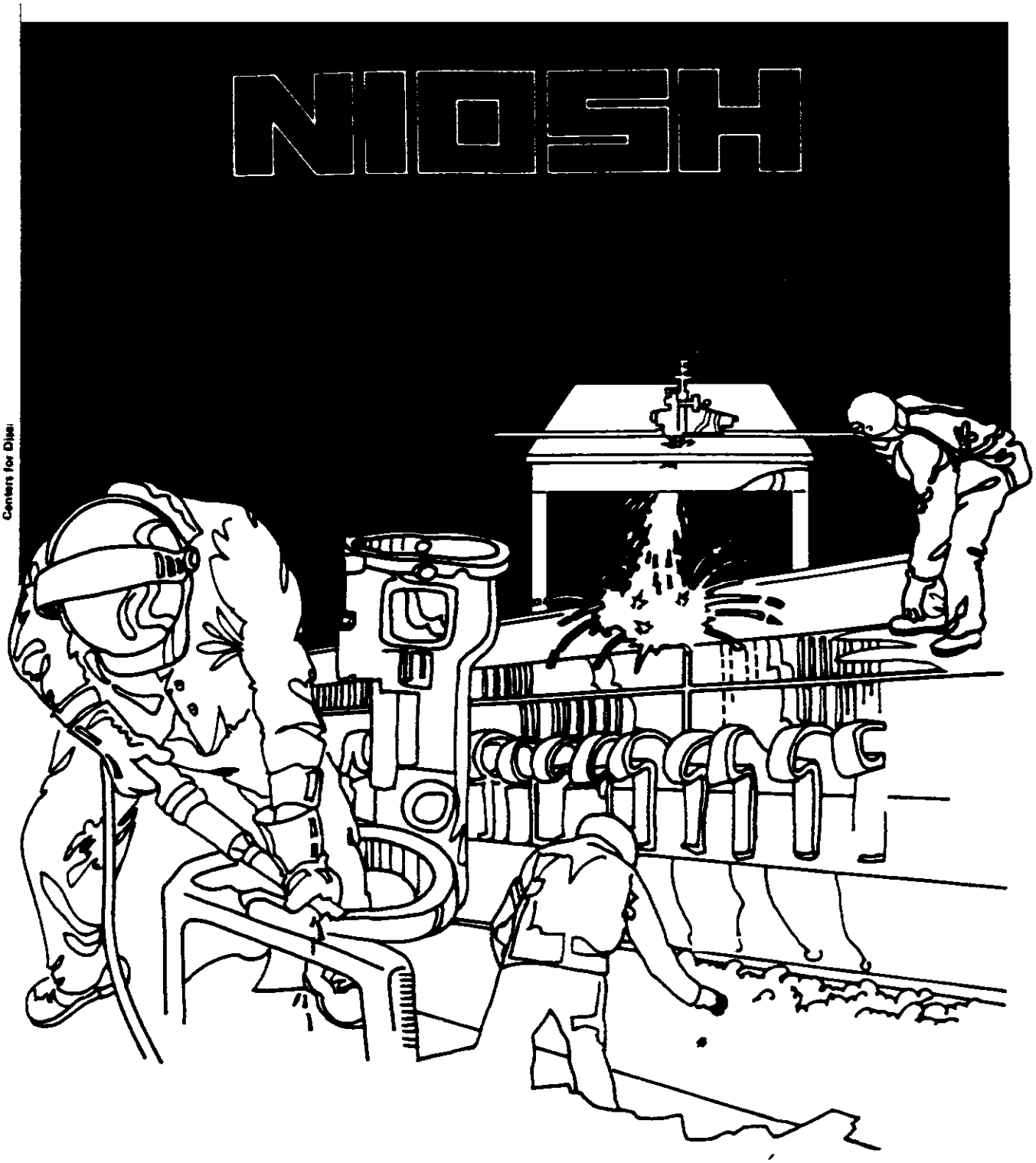

Health Hazard Evaluation Report

MHETA 87-040-1838
FREEMAN UNITED COAL MINING
FRANKFORT, IL

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

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MAY 1987

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I. SUMMARY:

On 4 November 1986, the Deputy Administrator, Occupational Health, United Mine Workers of America (UMWA) requested the Division of Respiratory Disease Studies (DRDS), National Institute for Occupational Safety and Health (NIOSH), to evaluate worker exposure to a resin (Du-Pont FASLOC) used in the roof-bolting operation at the Freeman United Coal Company Mine #6 near Waltonsville, Illinois. The request was precipitated by the fact that one employee had been diagnosed as having become sensitized to the resin and unable to work. Also, other workers had complained of headaches and sore throats after being in the areas where the resin was used.

Four workers reported to have problems were interviewed by a NIOSH physician. The symptoms (headache, sorethroat, cough) described by three of these workers are consistent with irritation but very subjective and no objective data exists substantiating an etiologic relationship between exposure to FASLOC and development of the symptoms. A fourth worker was diagnosed by two pulmonary medicine specialists as having occupationally induced asthma.

An environmental survey was conducted in March 1987 to determine worker exposure to the constituents (styrene, vinyl toluene, butyl benzyl phthalate) of the FASLOC resin. Results of the environmental samples indicated there was no exposure to the constituents of the resin when properly used.

Based on the medical histories obtained, observations made during the survey, and the negative results of the environmental sampling, it is the opinion of the investigators that a health hazard did not exist for the general work force. However, if a true hypersensitivity to the resin does exist in the one subject with asthma, further exposure to FASLOC would be hazardous to him.

Keywords: (SIC 1111), styrene, vinyl toluene, butyl benzyl phthalate, roof bolting.

II. INTRODUCTION/BACKGROUND

In November 1986, the Division of Respiratory Disease Studies, National Institute for Occupational Safety and Health (NIOSH) received a request from the Deputy Administrator, Occupational Health, United Mine Workers of America (UMWA), to evaluate worker exposure to a resin (Du-Pont FASLOC) used in the roof-bolting operation at the Freeman United Coal Company Mine #6 near Waltonsville, Illinois. The request stated that one miner had become sensitized to the resin and that other workers complained of sore throats and headaches after being in the areas where the resin was used.

In November 1986, the local UMWA Health and Safety Representative District 12, Benton, Illinois and the Safety Director for Freeman United Coal Company were contacted concerning the request. They both explained that in August 1986, a worker (mine examiner) became ill after being in an area for approximately 1-2 hours where the resin roof bolts were being installed. After the workshift, the worker saw a physician, was hospitalized, and was eventually diagnosed as being sensitized to the resin, and has not returned to work. Between August and November 1986 three other workers complained of headaches and sore throats after working in areas where the resin roof bolts were being installed.

The Mine Safety and Health Administration (MSHA) investigated and conducted environmental sampling for styrene and vinyl toluene on 11 August 1986. Their investigation did not reveal any problems and their sampling did not detect any styrene or vinyl toluene.

III. PROCESS DESCRIPTION

When a coal seam is mined using continuous mining methods such as at Freeman #6, open areas, haulageways, and rooms are created. The ceilings or roofs of the open areas are supported by pillars of coal, wooden timbers, and roof bolts.

In resin roof bolting, a two man operation at Freeman #6, a machine is used to drill a hole into the roof. The hole is usually one inch in diameter and is drilled the exact length of the bolt to be installed. After the hole is drilled, the resin is placed in the hole. The resin comes encased in plastic film cylindrical tubes that are divided into two compartments, one of which contains the resin, and the other a catalyst to make the resin harden. After the miner inserts the resin by hand, he uses the roof bolting machine to force the bolt into the hole, rupturing the resin tubes. The bolt is rotated rapidly for approximately 15 seconds to mix the resin and the catalyst. After mixing, it takes approximately 30 seconds for the resin to harden.

IV. METHODS AND MATERIALS

Material Safety Data Sheets (MSDS) for the FASLOC resin was obtained from the manufacturer. According to the MSDS, the primary ingredients are styrene, butyl benzyl phthalate, and vinyl toluene.

A survey of the operation was conducted on 12 March, 1987. At that time, environmental sampling was conducted during a typical roof bolting operation to determine the potential for exposure to the primary constituents of the resin. Fullshift area samples were obtained using constant flow samplers at a flow rate of approximately 500 cubic centimeters per minute (cc/min) for the styrene and vinyl toluene and 1 liter per minute (lpm) for the phthalate. Charcoal tubes were used as collection media for styrene and vinyl toluene and cellulose ester filters for the phthalate. Due to work conditions and the fact that some of the sampling media required changing every hour, it was impractical to place the samplers on the machine operators. Therefore, samplers were attached on each side of the machine and as close as possible, within one to two feet, of the operators breathing zone. This allowed for one sample location to be upwind of the bolting operation and one downwind. In addition to the samplers attached to the machine, the NIOSH investigator wore two samplers and positioned himself outby the machine in the direct path of air flow from the bolted area. The investigator's position was typical of the work area of the individuals that had registered complaints. Also, the airflow in and around the areas being bolted and sampled ranged from approximately 2700-3400 cubic feet per minute (CFM).

Medical

NIOSH was provided the names of four persons that had complained of symptoms which they felt were due to exposure to FASLOC resin. A NIOSH physician interviewed by telephone all four workers and reviewed the medical records of one worker.

V. EVALUATION CRITERIA

Evaluation criteria are used as guidelines to assess the potential health effects of occupational exposures to substances and conditions found in the work environment. Based on the results of accumulated experience with workers' health and of animal experiments, occupational health exposure limits for individual substances have been established and/or recommended by such agencies as NIOSH, the American Conference of Governmental Industrial Hygienists (ACGIH), and the Federal Occupational Safety and Health Administration (OSHA). The Mine Safety and Health Administration (MSHA) requires underground coal mines to adhere to the most current ACGIH threshold limit values (TLV).

Industrial limits are generally established at levels that can be tolerated by most healthy workers occupationally exposed during 8 to 10 hour workday, 40 hour workweek, without adverse effects. Because of variation in individual susceptibility, a small percentage of workers may experience health problems or discomfort at exposure levels below these existing criteria. Consequently, it is important to understand that these evaluation criteria are guidelines, not absolute limits between safe and dangerous levels of exposure.

Styrene and vinyl toluene appear to have similar toxicologic properties. At exposures of 100-200 parts per million (ppm) eye and respiratory tract irritation have been observed. At higher concentrations, 200-700 ppm, individuals may exhibit symptoms consisting of drowsiness, nausea, headache, fatigue, and dizziness. Repeated or prolonged skin contact may lead to the development of dermatitis, marked by rough, dry, and fissured skin.[1,2]

Generally speaking, it is felt that adverse effects on health would not be expected in normal workers exposed to vinyl toluene and styrene at concentrations not exceeding 100 ppm.[1] OSHA has established a permissible exposure limit for styrene and vinyl toluene of 100 ppm averaged over an 8-hour shift.[3] ACGIH has proposed a TLV of 50 ppm and a short term exposure limit (STEL) of 100 ppm.[1]

There are no published criteria for butyl benzyl phthalate and little information about health effects of exposure. Generally, the phthalate esters have demonstrated a low order of toxicity in experimental animals. They have not presented dermal problems, are not absorbed through the skin, and are not appreciably hazardous by inhalation.[4] In the absence of further toxicological information, an exposure criteria of five milligrams per cubic meter (mg/m^3), the exposure limit for dibutyl phthalate, was used in this evaluation.

VI. RESULTS

Environmental

A total of seven air samples were collected and analyzed for styrene and vinyl toluene and three for butyl benzyl phthalate. Styrene was detected in concentrations near the detection limit (approximately .05 ppm) in four of the seven samples. There were no detectable concentrations observed for vinyl toluene and butyl benzyl phthalate. The minimal detectable levels for these two substances were approximately .05 ppm and .005 mg/m^3 respectively.

Medical

All four of the workers reported to have problems due to exposure to the resin vapors were interviewed by a NIOSH physician. All were requested to provide their medical records to NIOSH for review. However, only one of the four provided his records.

The primary symptoms described by three workers were headache, sorethroat, and cough. The headaches and sorethroats tended to be mild. They usually began 1-2 hours after being in an area where the resin was used and resolved after 1-2 hours while still working or shortly after the workshift. These symptoms never prevented a worker from completing his workshift or required medical attention.

Two of these three workers also complained of cough. One of these persons, a former roof bolter, developed a non-productive cough in August 1986 while working with the resin. The cough worsened during the week while working and would improve after 2-3 days away from the resin. In September 1986, he had what appears to be an unrelated acute febrile illness which resolved following antibiotic therapy. At the time of the interview, this worker had been away from the mine approximately one month due to an injury. His cough had completely resolved.

The second worker with complaints of cough was a miner operator. His symptoms first began in June 1986 when he was working in an area where the resin was being used. The day following his first exposure, he developed a cough. The cough worsened over the next few days. The cough was not productive and there were no associated systemic symptoms. He developed paroxysms of cough associated with syncopal episodes. Because of the syncope, he was hospitalized. He remained hospitalized for three weeks. His symptoms gradually improved. His syncope was eventually labeled cough syncope. After some resolution of his symptoms, bronchoscopy was performed and he states he was told his airways "looked like raw meat". He was treated variously with antibiotics, oral theophylline preparations, and prednisone. He did state that one reason he was kept hospitalized for three weeks was an elevated "white blood count". He has developed no recurrence of his symptoms on re-exposure. No specific diagnosis was ever given to the patient and his medical records were never forwarded for review.

The fourth individual developed the onset of an asthma attack after working in an area where the FASLOC resin was used. This was the first asthma attack he had ever experienced and it was severe enough it required a two week hospitalization. His medical records were reviewed. Since his recovery, he has not been re-exposed to the resin. He has not had further attacks of the same severity but has manifested symptoms suggestive of hyper-reactive airways disease. He has been evaluated by pulmonary medicine specialists in Memphis, Tennessee and St. Louis, Missouri. Both believe his problems were triggered by an occupational exposure based on the temporal association of his exposure and the onset of his symptoms.

VII. DISCUSSION/CONCLUSION

The symptoms that persons "exposed" to FASLOC have complained of are headache, sore throat, cough, and asthma. The worker with paroxysms of cough and syncope can not be adequately explained by exposure to FASLOC. The elevated white blood cell count is suggestive of an infectious process. More importantly, if he had developed this reaction from exposure to low levels of the substances in the resin, it would be expected that similar reactions would recur on re-exposure, which it did not.

The case of asthma possibly related to FASLOC is intriguing. FASLOC does contain butyl benzyl phthalate. Asthmatic reactions have been reported following exposure to phthalic anhydride.[5] It is, therefore, conceivable that the butyl benzyl ester of phthalate might elicit a similar reaction. Currently, there is no evidence to support this supposition other than the temporal association between FASLOC exposure and development of the initial asthmatic episode. Alternatively, it is possible that he has underlying asthma and just coincidentally developed his initial attack at that time. The only method of determining if this subject's asthma is due to a sensitivity to some component of the resin would be an inhalation challenge. Due to the severity of his initial attack, this would entail some risk. We, therefore, cannot recommend such testing for the purposes of this evaluation. If there is a high likelihood that the subject will be further exposed to the resin, a controlled exposure with close medical supervision might be advisable. This is a decision best left to the subject and his physicians. If he will no longer be exposed to the resin there is little point to taking the risk of the exposure. Testing for IgE has been done in the case of phthalic anhydride and might be possible with butyl phthalate. If present it would document an immunologic response to the phthalate and make the presence of occupationally induced asthma more likely. The presence of IgE would not prove that butyl benzyl phthalate is causing asthma in this individual and its absence would not disprove asthma, however, so exposure challenge would remain the only method of truly documenting resin induced asthma.

There is a possible etiologic relationship between the FASLOC resin and the reported symptoms, headache, throat irritation, and cough. If so, these probably represent irritation phenomena and probably do not represent a serious health risk. It must be stressed that these are subjective symptoms and no objective data exists substantiating an etiologic relationship.

NIOSH environmental sampling results and the MSHA sampling results of 11 August 1986 indicate there really is not any airborne exposure to the ingredients of FASLOC resin when properly used in ventilated areas.

Based on the observations made during the survey, negative sampling results, and the medical information gathered, it is the opinion of NIOSH investigators that the use of FASLOC resin does not pose a health hazard to the general work force when properly used as was the case at Freeman #6 Mine on 12 March 1987. However, if a true hypersensitivity to the resin does exist in the one subject with asthma, further exposure to FASLOC would be hazardous to him.

VIII. REFERENCES

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1. UMWA Washington, DC Office
2. UMWA Safety and Health Representative, District 12
3. MSHA Sub District, Benton, IL
4. Safety Director, Freeman United Coal Mining Company

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