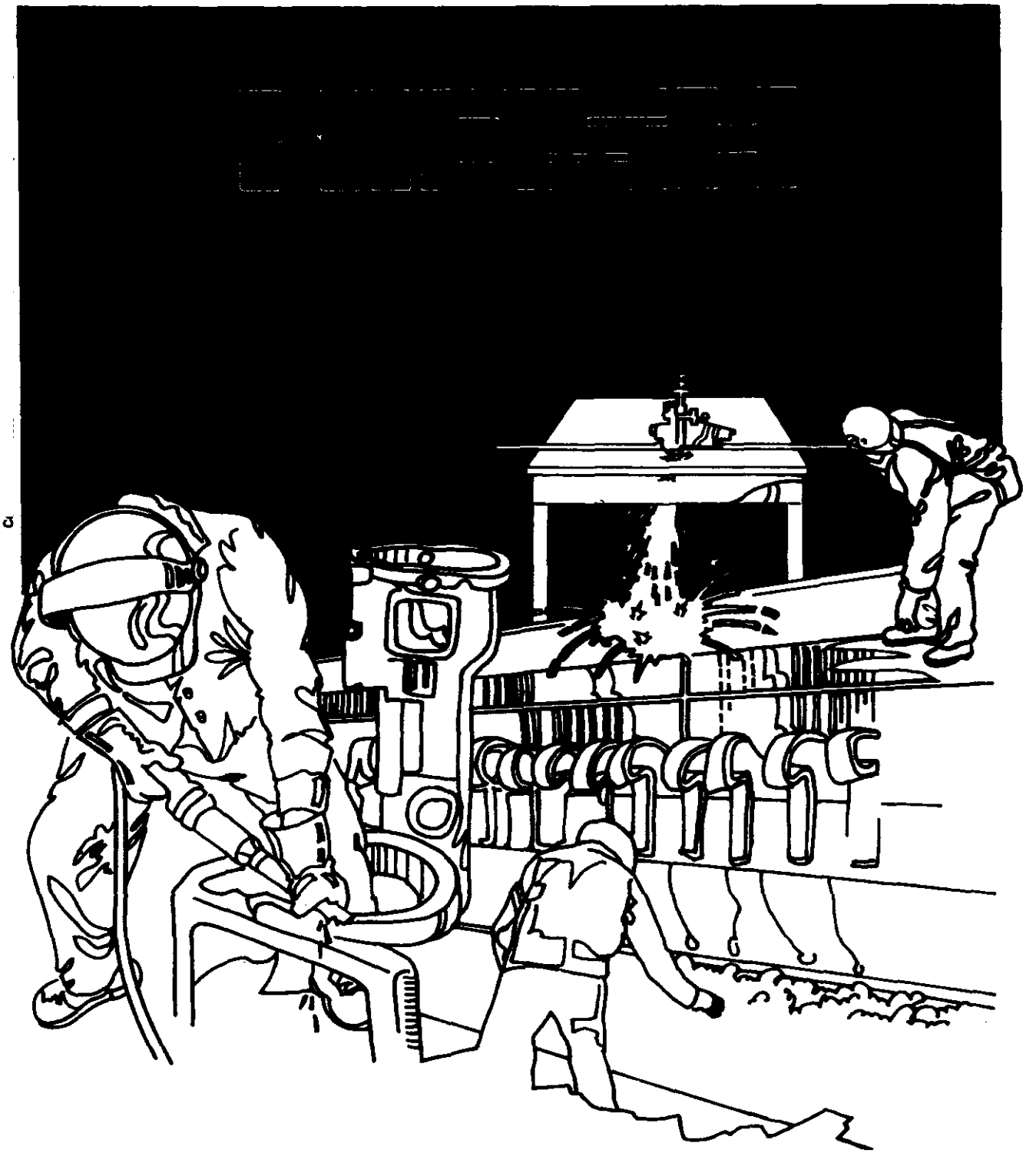

Health Hazard Evaluation Report

MHETA 87-039-1837
OLD BEN COAL COMPANY
BENTON, ILLINOIS

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.

MHETA 87-039-1837
OLD BEN COAL COMPANY
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NIOSH INVESTIGATORS
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I. SUMMARY

On 4 November 1986, the Deputy Administrator, Occupational Health, United Mine Workers of America requested the Division of Respiratory Disease Studies (DRDS), National Institute for Occupational Safety and Health (NIOSH), to evaluate worker exposure to two types of hydraulic fluid. The fluids, solcenic 3A and Solcenic 2, were used in the hydraulic supports (jacks) used on the longwall mining sections at Old Ben Coal Company Mines 24 and 25 near Benton, Illinois. The request was submitted because several individuals working with or near Solcenic 3A had complained of eye irritation, skin irritation, and/or respiratory irritation. These symptoms were not present when they worked with Solcenic 2. The symptoms described by the workers were consistent with the effects of overexposure listed on the Material Safety Data Sheets for the fluids. Also, the workers complained about the irritating odor presented by Solcenic 3A.

An environmental survey was conducted in March 1987 to determine worker exposure to the primary constituents (methyl isobutyl carbinol (MIBC) and napthenic mineral oil) of Solcenic 3A and Solcenic 2. In addition bulk samples of the fluids were collected for analysis to determine the difference between the two.

The environmental evaluation indicated that the workers were not exposed to harmful levels of the alcohol component of the fluids under normal working conditions. Minimal amounts (1.4 mg/m^3 and 3.4 mg/m^3) of MIBC were detected on 2 of the 11 samples collected. This is well below the TLV of 100 mg/m^3. Exposure to the mineral oil and its mist only occurs when there are accidents, i. e. hydraulic lines rupture, fluid spills.

Analysis of the bulk samples indicated that Solcenic 3A contained $C_6H_{14}O_3$ isomers as found in dipropylene glycol and possibly a small amount of ethanolamine. These two components are not present in Solcenic 2, and may result in a lower odor threshold for Solcenic 3A than Solcenic 2.

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 under normal working conditions.

Keywords: (SIC 1111) MIBC, napthenic mineral oil, longwall mining, hydraulic fluid.

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 the hydraulic fluid, Solcenic 3A, used in the hydraulic supports (jacks) used on the longwall mining section at Old Ben Coal Company Mine 24 located near Benton, Illinois. The request stated that spills were common and excess fluid was dumped onto the beltline and loaded out with the coal and that the employees had complained about being exposed to the fluid and its vapors.

The local UMWA Health and Safety Representative, District 12, Benton, Illinois was contacted. He stated that he was aware of the situation and that approximately 13 people had complained that after exposure to the fluid they experienced sore throat, eye irritation, and/or skin irritation.

In November 1986, the Health and Safety Superintendent, Old Ben Coal Company, Benton, Illinois informed us that they currently have four longwall operations and that the one at Mine 24 was the only one using Solcenic 3A because the warranty on the equipment required its use. Solcenic 3A had been used since approximately May 1985. The other three operations use Solcenic 2 and by the end of November 1986, Mine 24 would be using Solcenic 2 because they would be using different equipment. He also informed us that he was aware that some workers using Solcenic 3A had been complaining since approximately April 1986, and that Mine Safety and Health Administration (MSHA) representatives had investigated but did not find a problem.

In February 1987, while confirming the March dates for our survey, the UMWA Health and Safety Representative informed us that he had just been notified that Old Ben Mine 25 had recently switched from using Solcenic 2 to Solcenic 3A and a few of the workers at Mine 25 had registered the same type of complaints as the workers at Mine 24 who had been exposed to Solcenic 3A. He asked us to include Mine 25 in our survey. He also stated that since Mine 24 switched to Solcenic 2 at the end of November the workers had not been complaining.

III. PROCESS DESCRIPTION

The process is the same for both Solcenic 3A and Solcenic 2. The hydraulic fluid is shipped and handled in 55 gallon barrels which serve as feed tanks for the air operated injection pump which pumps the fluid through a mixer tank where it is mixed with water. With continuous pumping, the diluted fluid

(2-5% hydraulic fluid) is then pumped through high pressure lines to the hydraulic supports (jacks) used on the longwall mining section. The fluid which is spilled or leaks from the pumps and lines at the pumping station drains to a sump area. The liquid in the sump area is continuously pumped or pumped on demand through a pipe which discharges the liquid onto the beltline, which carries the liquid with the coal to the outside.

IV. EVALUATION DESIGN AND PROCEDURES

Environmental

Material Safety Data Sheets (MSDS) for Solcenic 3A and Solcenic 2 were obtained from the manufacturer. According to the MSDS's the primary ingredients were napthenic mineral oil and alcohol (methyl isobutyl carbinol (MIBC)). The NIOSH investigators decided to conduct environmental sampling in the work areas for these two substances and collect bulk samples of the hydraulic fluid to determine differences between the two.

Environmental sampling was conducted at Mine 24 on March 10, 1987, and at Mine 25 on March 11, 1987. Solcenic 2 was being used at Mine 24 and Solcenic 3A at Mine 25. Full shift area samples for oil mist and MIBC were obtained using constant flow samplers at a flow rate of 1.5 liters per minute (lpm) for the oil mist and 20 cubic centimeters per minute (cc/min) for MIBC. Cellulose ester filters were used as collection media for the oil mist and charcoal tubes for the MIBC.

The area samplers were located at the mixing/pumping station, and 60-80 feet out by (upwind) and inby (downwind) the point (dump station) where the fluid from the sump area was discharged onto the belt line. At Mine 24 the dump station was located on 15 west belt and at Mine 25 on longwall 2 belt. The airflow at the sampling stations in Mine 24 was approximately 22,000 cubic feet per minute (CFM) at the pumping station and less than 11,000 CFM at the stations inby and out by the dump point. At Mine 25 there was approximately 31,000 CFM at the pumping station and approximately 15,000 CFM at the stations inby and out by the dump point. Also at Mine 25 a sampling station was located four blocks inby the pump station at 4395 station where the odor of the hydraulic fluid was very prominent and no air movement could by detected. It was decided by the requester and the NIOSH investigator that these sampling locations would present a "worse case" condition.

Medical

NIOSH was provided the names of 13 persons in Mine 24 that had complained of symptoms which they felt were due to exposure to Solcenic 3A. A NIOSH physician was able to interview by phone 11 of the 13 workers.

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 worker's 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's) for harmful, noxious or poisonous gases.

These industrial limits are generally established at levels that can be tolerated by most healthy workers occupationally exposed during an 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.

For the substances monitored during this survey, the OSHA Permissible Exposure Level (PEL)[1] and the ACGIH Threshold Limit Values (TLV)[2] are 100 milligrams per cubic meter (mg/m^3) for MIBC and 5 mg/m^3 for oil mist. NIOSH does not provide any specific recommended exposure limits for these items. The PEL and TLV for MIBC also have the "skin" notation which refers to the potential contribution to the overall exposure by the cutaneous route including mucous membranes and eye, either by airborne, or more particularly, by direct contact with the substance.

The ACGIH Time-Weighted Average (TWA) of 100 mg/m^3, with a short term exposure limit of 165 mg/m^3 for MIBC is felt to be low enough to prevent eye irritation and provide a good factor of safety for systemic effects.[3] The TLV for oil mist was set at a level which contains a safety factor against minor lung changes. There is no evidence to indicate a relation between inhalation of oil mist and lung cancer. However, there are some reported cases of skin cancer from contact with certain oils.[4]

VI. RESULTS

Environmental

Bulk samples of Solcenic 2 and Solcenic 3A were analyzed for identification of organics by gas chromatography-mass spectrometry. Both bulks contained a large number of unresolved components attributed to the mineral oil portion of the samples. The major component of both bulks was MIBC. Solcenic 3A also

contained $C_6H_{14}O_3$ isomers as found in a dipropylene glycol standard and possibly a small amount of ethanolamine. These two components were not present in Solcenic 2.

Mineral oil mist analysis was attempted for the air samples collected on the mixed cellulose ester membrane filters to determine exposure to the oil portion of the water-soluble hydraulic fluid. The mineral oil mist method was developed to monitor exposure to straight mineral oils and is not applicable to water-soluble fluids, although such analysis is attempted when requested. For the water-soluble Solcenic fluids the analysis could not be performed because the bulk fluids were not soluble in the trichlorotrifluoroethane used to extract the oil from the filter samples.

It is the opinion of the NIOSH investigator that under normal operations, the workers are not exposed to mineral oil mist. Exposure to the mineral oil and its mist only occurs when there are accidents, i.e. hydraulic line ruptures, fluid spills.

A total of 11 samples were collected and analyzed for MIBC. There were no detectable concentrations observed on any of the five samples collected at Mine 24 where Solcenic 2 was used. The minimal detectable level for these samples was 0.05-1.1 mg/m^3.

At Mine 25, where Solcenic 3A was used, minimal amounts of MIBC were detected on two of the six samples collected. The sample obtained at the pumping station indicated a concentration of approximately 1.4 mg/m^3 and a concentration of 3.4 mg/m^3 on the sample collected four blocks inby the pumping station where the odor of the hydraulic fluid was very noticeable. These levels are well below the 100 mg/m^3 TLV.

The air samples collected could not be analyzed to quantify the levels of dipropylene glycol (TLV 600 mg/m^3) and ethanolamine (TLV 8 mg/m^3) which were detected in the bulk liquid sample of Solcenic 3A used in Mine 25. Because the NIOSH investigator did not have any indication that Solcenic 3A contained these two components until after the bulk sample was analyzed, the appropriate sampling media was not included in the survey. However, it is the opinion of the investigator that these two components would not have been detected in the mine air. The basis for this opinion is that MIBC with a vapor pressure of 3.8 mm at 68° F is much more volatile than dipropylene glycol (VP<1 mm) and ethanolamine (VP 0.3 mm) and since minimal amounts of MIBC were detected, it is reasonable to expect that even smaller amounts of the glycol and ethanolamine would be detected. Also according to the laboratory analysis, the bulk liquid contained a very small amount (less than 1/2%) of dipropylene glycol and ethanolamine.

Medical

Eleven of the 13 workers reported to have problems due to exposure to Solcenic 3A were interviewed by a NIOSH physician. Of these eleven, ten had some symptoms they felt were caused by the hydraulic fluid. Of these ten, half worked at the face and had been exposed to vapors as well as having some degree of direct contact with the fluid. The direct contact in most instances was relatively minor, consisting of contact of the hands with fluid leaking from hoses and connections. The other workers were exposed only to vapors from the fluid which was being transported on the belt.

Of the ten persons with symptoms, eight had symptoms of eye irritation, headache, nausea, and nonproductive cough. In each of these eight persons, their symptoms would occur following exposure to the vapors of Solcenic 3A. The symptoms began no later than 5-10 minutes after they detected the odor of the fluid and resolved after exposure ceased. The symptoms were usually gone within 10-20 minutes after exposure, but an occasional case of eye irritation or headache might take up to two hours to completely resolve. No one reported persistence of symptoms overnight.

One person had substantial direct contact with the fluid. A fitting on a hose ruptured and his clothes were soaked with Solcenic 3A. He had extensive exposure over the left side of his body. He continued to work until the end of the shift and then took a shower. He developed a severe skin rash in the areas contacted. This slowly resolved. He had no further significant exposure or recurrent symptoms.

The remaining miner had symptoms of dyspnea on exertion and skin rash which he felt initially were related to hydraulic fluid exposure. On further follow-up, however, it became clear to him that his symptoms were unrelated to the hydraulic fluid. Only this individual and the one above with severe skin rash sought medical attention for their symptoms.

In summary, nine persons had symptoms that might be caused by inhalation of the vapors of and/or direct skin contact with Solcenic 3A. None of these persons have had any symptoms since the change to Solcenic 2.

VII. DISCUSSION

Several of the workers interviewed complained about the odor imparted by the Solcenic 3A but not by Solcenic 2. Since the fluid is carried on the belt which carries the coal out of the mine, the odor is dispersed throughout several areas in the mine, especially where there is low air flow. When the workers detect the odor, they then feel they are being exposed to a harmful substance. This is not necessarily true. For example, the only place the odor of the hydraulic fluid was detected during the environmental survey was at Mine 25 four blocks inby the pumping station. The odor was very prominent, but the concentration of MIBC measured in the area was only 3.4 mg/m^3. The

odor threshold (lowest concentration perceived) for MIBC alone is approximately 2.0 mg/m^3[5] whereas the ACGIH TLV for MIBC is 100 mg/m^3. Since Solcenic 3A has dipropylene glycol and ethanolamine which Solcenic 2 does not have, these two ingredients may produce an additive effect and result in a lower odor threshold for Solcenic 3A than Solcenic 2. Therefore, the people working with Solcenic 3A may be subject to more of an odor than those working with Solcenic 2. The odor may be unpleasant to some individuals and even result in some workers experiencing nausea and headaches.

The workers also expressed concern about the fact that both Solcenic 3A and Solcenic 2 were labeled "potentially carcinogenic". The International Agency for Research on Cancer (IARC) has reviewed and evaluated data pertaining to the carcinogenicity of various petroleum lubricants. They determined on the basis of laboratory studies which applied petroleum products such as napthenic mineral oil to the skin of mice that there was sufficient evidence that they caused skin cancer in experimental animals. In view of these findings in animals, IARC concluded that it is reasonable to regard exposure to mildly hydrotreated and mildly solvent refined oils as a potential carcinogenic risk to humans.[6] Therefore, OSHA requires all manufacturers of such products to label them as potentially carcinogenic.[7] Also individuals working with such materials should use appropriate personal protection (chemically resistant gloves, eye protection, etc.) to prevent contact with the fluids which would eliminate the potential for skin irritation.

VIII. CONCLUSIONS/RECOMMENDATIONS

It is the opinion of the NIOSH investigators that the use of Solcenic 2 and Solcenic 3A does not present a health hazard when used according to the manufacturer's guidelines. "However, the MSDS specifically states that "overexposure" to these substances may cause eye irritation, skin irritation, headache, and nausea. Therefore the individuals, such as the mechanics, that work on the hydraulic jacks and lines and which are likely to have contact with the fluid should be provided safety equipment (chemically resistant gloves, goggles, or face shield) as specified in the MSDS. In case of spills, an absorbing material (vermiculite, dry sand, earth or a similar material) should be applied to the spill, collected, and transported out of the mine for disposal. Also, in cases where hydraulic lines rupture and spray fluid on an individual or the fluid is spilled on the person, the worker should be allowed to come out of the mine to shower and change clothes.

The current procedure of dumping the waste fluid on the beltline increases the potential for worker exposure and contamination of ground water by the fluid. Based on the results of the environmental sampling and the observations made

during the survey, it is the opinion of the NIOSH investigators, there was no overexposure at the time of the survey as a result of this practice. However, this method of fluid disposal is not in accordance with the manufacturer's guidelines. The manufacturer, in a letter to the NIOSH investigator which referenced disposal of the fluid stated "the standard method of disposal for used soluble oil emulsions is to first split them into discreet oil and water phases by the addition of ferric sulphate and sodium hydroxide or acid. The oil phase is then collected and, ideally, incinerated. The water phase is then neutralized and discharged." Also, the manufacturer's MSDS specifies that the material be "disposed of at appropriate waste facilities in accordance with regulations." Therefore, we recommend that the waste fluids be collected in containers and transported out of the mine and that the local, state, and federal environmental protection agencies be contacted concerning proper disposal.

As stated earlier, the proper use of Solcenic 3A does not present a health hazard. However, apparently the odor of Solcenic 3A was very annoying and irritating for some of the workers. Since the workers had no complaints when Solcenic 2 was used, and since the company representatives stated that Solcenic 2 works as well as Solcenic 3A, it would be in the best interest of all concerned to eliminate Solcenic 3A and use only Solcenic 2.

IX. REFERENCES

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X. AUTHORSHIP AND ACKNOWLEDGEMENTS

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1. UMWA Washington, DC Office
2. UMWA Safety and Health Representative, District 12
3. MSHA Sub District, Benton, IL
4. Health and Safety Superintendent, Old Ben Coal Company

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