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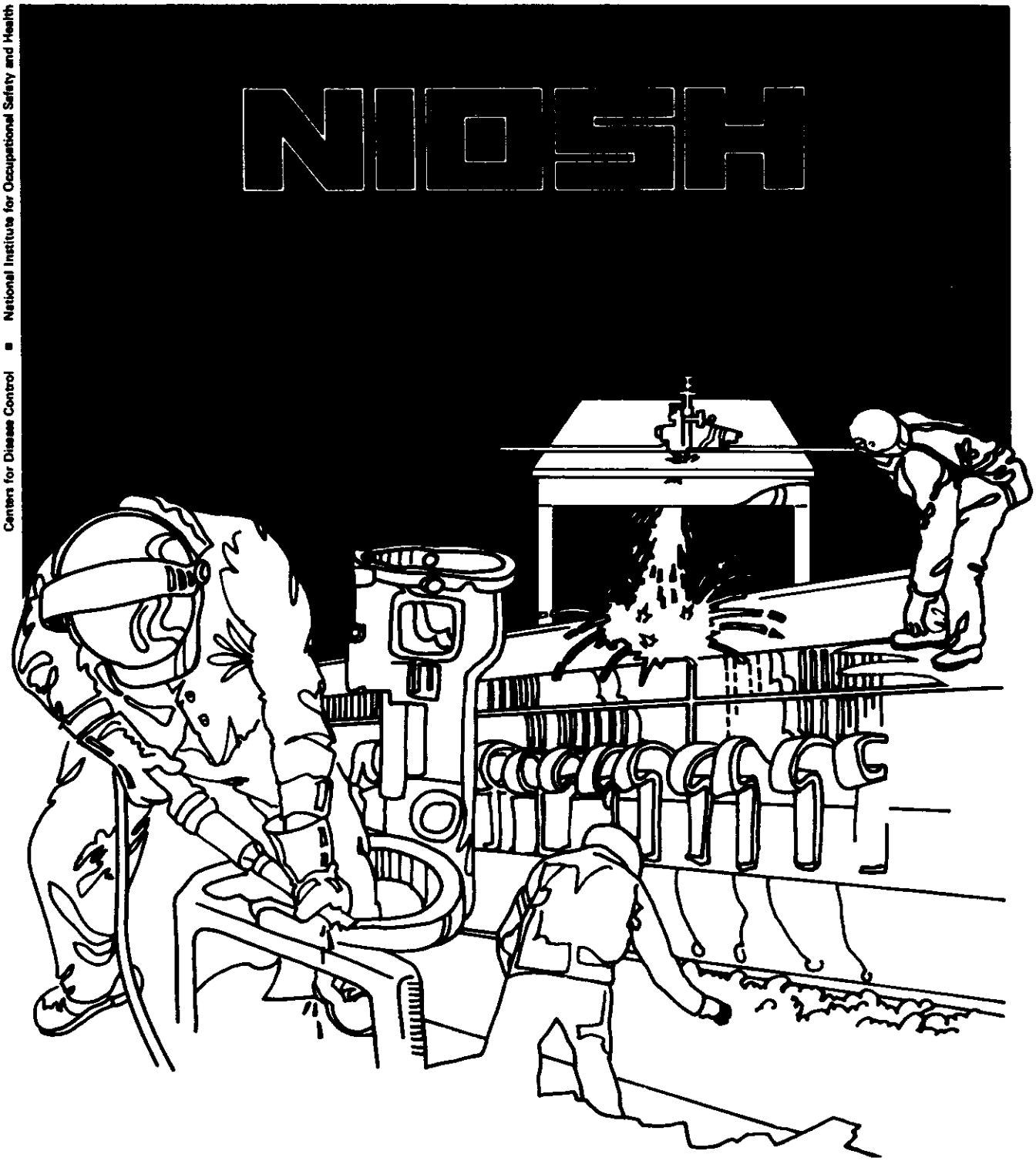

Health Hazard Evaluation Report

MHETA 89-009-1990
CONSOLIDATION COAL COMPANY
HUMPHREY #7 MINE
PENTRESS, WEST VIRGINIA

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.

MHETA 89-009-1990
SEPTEMBER 1989
CONSOLIDATION COAL COMPANY
HUMPHREY #7 MINE
PENTRESS, WEST VIRGINIA

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I. SUMMARY

In October of 1988, the United Mine Workers of America (UMWA) requested that the National Institute for Occupational Safety and Health (NIOSH) investigate complaints of headache, eye and throat irritation, congestion, and cough related to the use of a longwall mining hydraulic fluid (Solcenic 3A emulsifiable oil) at Consolidation Coal Company's Humphrey #7 Mine. This emulsion oil is used with water in the mine's hydraulic roof support system. On February 9, 1989 NIOSH investigators conducted a walk-through survey at the Humphrey #7 mine, 3 Southwest Panel. An industrial hygiene survey was done at this mine section on April 10-11, 1989.

Bulk samples of Solcenic 3A oil, analyzed for organic constituents, contained methyl isobutyl carbinol (4-methyl-2-pentanol), dipropylene glycol and paraffin hydrocarbons. Methyl isobutyl carbinol (MIBC) was the only Solcenic 3A oil constituent present at detectable concentrations in the charcoal tube samples. Personal breathing zone samples for MIBC, collected from all workers on the longwall mining operation during two days of sampling, were all below the limit of quantification (LOQ = approximately 0.6 parts per million parts air for an 8 hour sample) and well below the exposure standard/recommendations of the Mine Safety and Health Administration (MSHA) and the American Conference of Governmental Industrial Hygienists (ACGIH). Worker exposure to MIBC can also occur by skin contact with the oil through hydraulic line leaks, accidents (hydraulic line rupture or oil spills), and maintenance activity on the hydraulic equipment.

Worker exposure to Solcenic 3A oil constituents in air did not pose any health hazard at the time of this survey. Some of the workers were also exposed to Solcenic 3A oil constituents through skin contact. Recommended procedures to reduce skin contact are contained in Section VIII of this report.

Keywords: (SIC 1111) MIBC, Hydraulic Fluid, Longwall Mining

II. INTRODUCTION

In October of 1988, the Division of Respiratory Disease Studies, National Institute for Occupational Safety and Health (NIOSH) received a request from the United Mine Workers of America (UMWA), Local 1058, to evaluate worker exposure to a hydraulic fluid (Solcenic 3A emulsifiable oil) used on the longwall mining operation at Consolidation Coal Company's, Humphrey #7 Mine, 3 Southwest Panel. This request was submitted in response to miner health complaints including headaches, eye and throat irritation, congestion, and coughs.

On February 9, 1989, NIOSH investigators conducted a walk-through survey at Consolidation Coal Company's Humphrey #7 Mine accompanied by union and management personnel. Consolidation Coal Company initially refused to permit UMWA representatives to participating the walk-through survey. Following consultation with NIOSH's office of General Counsel, Consolidation Coal Company agreed to union participation during the walk-through survey.

An industrial hygiene survey was scheduled for April 4-5, 1989 at Consolidation Coal Company. During the first day of this industrial hygiene survey, mining operations were down for repair (estimated 2 hours down time). The UMWA representative accompanying the NIOSH representatives noticed that Solcenic 3A emulsifiable oil was not in use in the longwall system. The NIOSH industrial hygiene survey was canceled this day and rescheduled for April 5-6, 1989. NIOSH investigators requested that Solcenic 3A emulsion oil be added to the longwall mining system and used according to normal operating procedures. On arrival at the Humphrey #7 Mine the next day (5/5/89), the Consolidation Coal Company mine superintendent stated that UMWA representatives would not be permitted to be present during the remainder of this evaluation. The NIOSH industrial hygiene survey was again canceled pending assistance from NIOSH's office of General Counsel. Following consultation with NIOSH's office of General Counsel, Consolidation Coal Company agreed to UMWA participation during the industrial hygiene survey. The industrial hygiene survey, rescheduled on April 10-11, 1989, was completed according to plan with cooperation from both company and union officials.

III. BACKGROUND

Solcenic 3A emulsifiable oil is used as a lubricant in high pressure hydraulic lines to operate roof support shields on the coal mine working face. The emulsion oil, received in five gallon containers, is poured by hand into the concentrate holding tank in a portable pump station located near the mine working face. At this pump station, the oil concentrate and water are mixed, using a venturi meter, to achieve an oil in water concentration of approximately 2-5 percent by volume. This oil/water mixture is then pumped from the pump station, through high pressure lines, to hydraulic jacks on the roof support shields at the mine face.

IV. METHODS

A bulk sample of Solcenic 3A oil concentrate, collected during the walk-through survey, was analyzed for organic constituents including polynuclear aromatic hydrocarbons (PNAs), by gas chromatography (GC) in conjunction with mass spectrometry (MS).[1] Bulk samples of the oil/water mixture, collected during the walk-through and industrial hygiene surveys, were analyzed for the percent oil by volume using GC/MS.[1] Personal breathing zone samples were collected to assess worker exposure to organic constituents comprising Solcenic 3A oil. These samples were collected on activated charcoal media (charcoal tubes) using portable sampling pumps calibrated to 25 cubic centimeters per minute (cc/min). Bulk air samples were also collected on similar media at a flow rate of 100 cc/min. The bulk air samples were analyzed qualitatively for organic constituents using GC/MS.[1] The personal breathing zone samples were analyzed quantitatively for those organic constituents identified in the bulk samples using GC.[1]

Charcoal tube samples were collected over two consecutive day shifts; the day shift was selected for sampling because it was reported to be the high production shift. Personal breathing zone samples were collected from each worker on the 3 Southwest longwall operation during each day shift; the sampler was attached to the worker with the sampling orifice positioned in the workers breathing zone. Area samples were collected by attaching the sampler to the hydraulic shields at the mine working face or to the pump station.

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. These criteria consist of exposure levels for substances and conditions to which most workers can be exposed day after day for a working lifetime without adverse health 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.

Several sources of evaluation criteria exist and are commonly used by NIOSH investigators to assess occupational exposures. These include:

1. The U.S. Department and Labor, Mine Safety and Health Administration (MSHA), permissible exposure limits (PEL's);[2]

2. The American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit (Exposure) Values (TLV's); [3,4]

3. NIOSH recommended exposure limits (REL's).[5,6]

These criteria have been derived from industrial experience, from human and animal studies, and when possible, from a combination of the three. Consequently, due to differences in scientific interpretation of these data, there is some variability in exposure recommendations for certain substances. Additionally, MSHA considers economic feasibility in establishing occupational exposure standards; NIOSH and ACGIH do not consider economic feasibility in developing their criteria.

The exposure criteria are reported as: time-weighted average (TWA) exposure recommendations averaged over the full work shift, short term exposure limit (STEL) recommendations for a brief (10-15 minute) exposure period. Exposure criteria and standards are commonly reported as parts contaminant per million parts air (ppm). Occupational criteria for the air contaminant measured during this study are as follows:[3-6]

SUBSTANCES	NIOSH (REL)	ACGIH (TLV)	MSHA (PEL)
Methyl Isobutyl Carbinol (MIBC) (4-Methyl-2-Pentanol)	No REL	25 ppm-TWA 40 ppm - STEL	25 ppm - TWA

The primary health effects from exposure to MIBC include eye and skin irritation, and central nervous system effects (narcosis).[4,5] Chronic, systemic health effects have not been reported in humans from MIBC exposure. MIBC is not known to be a liver or kidney toxin; however, workers with impaired liver or kidney function should avoid prolonged exposure to MIBC because these organs (the liver and kidney) are involved in the metabolism/excretion of MIBC.[5] Worker exposure to MIBC can occur by several routes, including inhalation, eye or skin contact, and ingestion. MIBC is given the ACGIH skin notation, indicating that skin contact with this material can be a major route of exposure.[4,5] Considering this, and the relatively low vapor pressure of MIBC (3.8 millimeters of mercury at 20°C), skin contact may often present a greater occupational exposure risk than inhalation.[5]

VI. RESULTS/DISCUSSION

The bulk samples of Solcenic 3A oil, analyzed for the identification of organic constituents by CG/MS, contained the following ingredients:

	Approximate Percent (%)
Methyl Isobutyl Carbinol (MIBC) (4-Methyl-2-Pentanol)	12
1,1'-Dipropylene glycol	4
2,2'-Dipropylene glycol	4
Paraffin Hydrocarbons (15-30 Carbon Range)	72

Solcenic 3A oil was labeled as "potentially carcinogenic" at one time based on the presence of napthenic mineral oils. [7,8] However, due to changes in the formulation of this product, the current material safety data sheet for MIBC no longer contains a "potential carcinogen" designation. Polynuclear aromatic hydrocarbons (PNA's), potential carcinogens that can be associated with certain grades of petroleum oil, were not identified in this bulk sample of Solcenic 3A oil.

Analytical results for the three bulk samples of the oil/water mixture collected during the walk-through and industrial hygiene surveys are listed below. The oil in water concentration in the samples ranged from 0.34 to 2.5 percent by volume:

Sample	Date	Percent by Volume Oil in Water (%)
1	2/9/89 (Walk-through survey)	2.5
2	4/10/89 (Industrial hygiene survey)	0.34
3	4/10/89 (Industrial hygiene survey)	1.8

These bulk oil/water samples were collected from a bleeder line near the working face. Sample 2, with the lowest oil content, was collected prior to flushing the bleeder line contents. Sample 3 was collected immediately after flushing the bleeder line. The desired oil/water dilution was reported to be approximately 2-5 percent. These sampling results suggest that the longwall mining equipment was operated with oil in water concentrations ranging from 0.34 to 1.8 percent by volume during the period of our industrial hygiene sampling.

Workers can be exposed to concentrated Solcenic 3A oil at the pump station through maintenance activities or as the oil is manually poured into the pump station concentrate tank. Workers can also be exposed to the Solcenic 3A oil/water mixture through leaks in high pressure hydraulic lines and through maintenance activities on these lines or the mine shields they supply. Leaks in the high pressure hydraulic lines carrying the Solcenic 3A oil/water mixture were observed at several points along the longwall operation during the industrial hygiene survey. Workers, predominantly the mechanic and shield operators, were observed in contact with the Solcenic 3A oil and water mixture. As discussed earlier, skin contact with Solcenic 3A oil (specifically MIBC) can be a major route of exposure. [3] Skin contact and absorption presents a greater risk for workers handling concentrated Solcenic 3A oil. During this evaluation, we were unable to observe the handling procedures used at the pump station during the addition of oil to the concentrate tank or through maintenance activities.

During industrial hygiene sampling, odors from the Solcenic 3A oil were present. Two area, bulk air samples from the pump station, analyzed qualitatively by GC/MS, contained only MIBC. The area, bulk air sample

collected from the longwall tailgate (the end shields on the mining operation, down-wind from all mining operations) contained predominantly MIBC, along with several other chemical compounds including methyl isobutyl ketone, methyl cyclohexane, toluene, and various alkane hydrocarbons (5 to 8 carbon range). Of these, MIBC was the only chemical constituent present at detectable concentrations in the personal breathing zone samples analyzed quantitatively. Sixteen personal breathing zone samples were collected from workers operating the 3 Southwest longwall panel over the two-day survey; each worker on this longwall panel was sampled twice. Four of these samples had detectable MIBC concentrations (LOD = 0.01 milligrams/sample - mg/sample); however, none of these samples exceeded the limit of quantification. (The limit of quantification - LOQ for MIBC in these samples was 0.03 mg/sample or approximately 0.6 ppm in air for an 8 hour sample). Three of the six area samples collected at the pump station, the tailgate shield and the midsection shields (117-119) had detectable MIBC concentrations; but none of these full-shift, area samples exceeded the quantifiable levels mentioned above. The airborne MIBC personal exposures and area concentrations from this survey were all well below the MSHA-PEL and ACGIH-TLV: 25 ppm as a TWA. [2,3] (NIOSH does not have a REL for MIBC).

VII. CONCLUSIONS

1. Current formulations of Solcenic 3A oil do not have a "potential carcinogen" designation; carcinogenic PNA compounds were not detected in bulk samples of oil collected during this survey.

2. Odors from Solcenic 3A oil were noticed during this survey; however, none of the personal breathing zone measurements for MIBC in air exceeded the MSHA-PEL or ACGIH-TLV when Solcenic 3A oil was used in this operation at approximately 0.34 to 1.8 percent by volume oil in water. [2,3]

3. Skin contact with MIBC, a Solcenic 3A oil constituent, can be a major exposure route and should be avoided. [3-5] Skin contact presents a greater exposure risk among workers handling concentrated Solcenic 3A oil.

VIII. RECOMMENDATIONS

1. Repair all leaks observed in the longwall high pressure hydraulic lines promptly.

2. Workers handling concentrated Solcenic 3A oil should use chemical protective equipment including: chemically resistant gloves, face shield, apron, and rubber boots. The mechanic, or other workers, performing maintenance activities on equipment containing the Solcenic 3A oil/water mixture should use similar protective

equipment while in direct contact with this equipment/Solcenic 3A oil and water mixture. Butyl or natural rubber, and neoprene are recommended glove/protective equipment materials for MIBC.

3. Rubber boots are recommended for all workers required to walk the longwall face where Solcenic 3A oil/water leaks can pool beneath the shields. These boots should be rinsed with water following each shift to remove any Solcenic 3A oil adhering to the boots.

4. In instances where hydraulic lines rupture and saturate the miner with the Solcenic 3A oil/water mixture, the worker should immediately shower and change clothes.

5. Work clothes should be laundered frequently to prevent skin contact with any Solcenic 3A oil that may adhere to mine clothes from intermittent contact with oil-contaminated equipment/mine materials.

IX. REFERENCES

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are temporarily available upon request from NIOSH, Hazard Evaluations and Technical Assistance Branch, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. Consolidation Coal Company
2. United Mine Workers of America, Local 1058
3. NIOSH Regional Office
4. Mine Safety and Health Administration

For the purpose of informing affected employees, copies of this report should be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

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