U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
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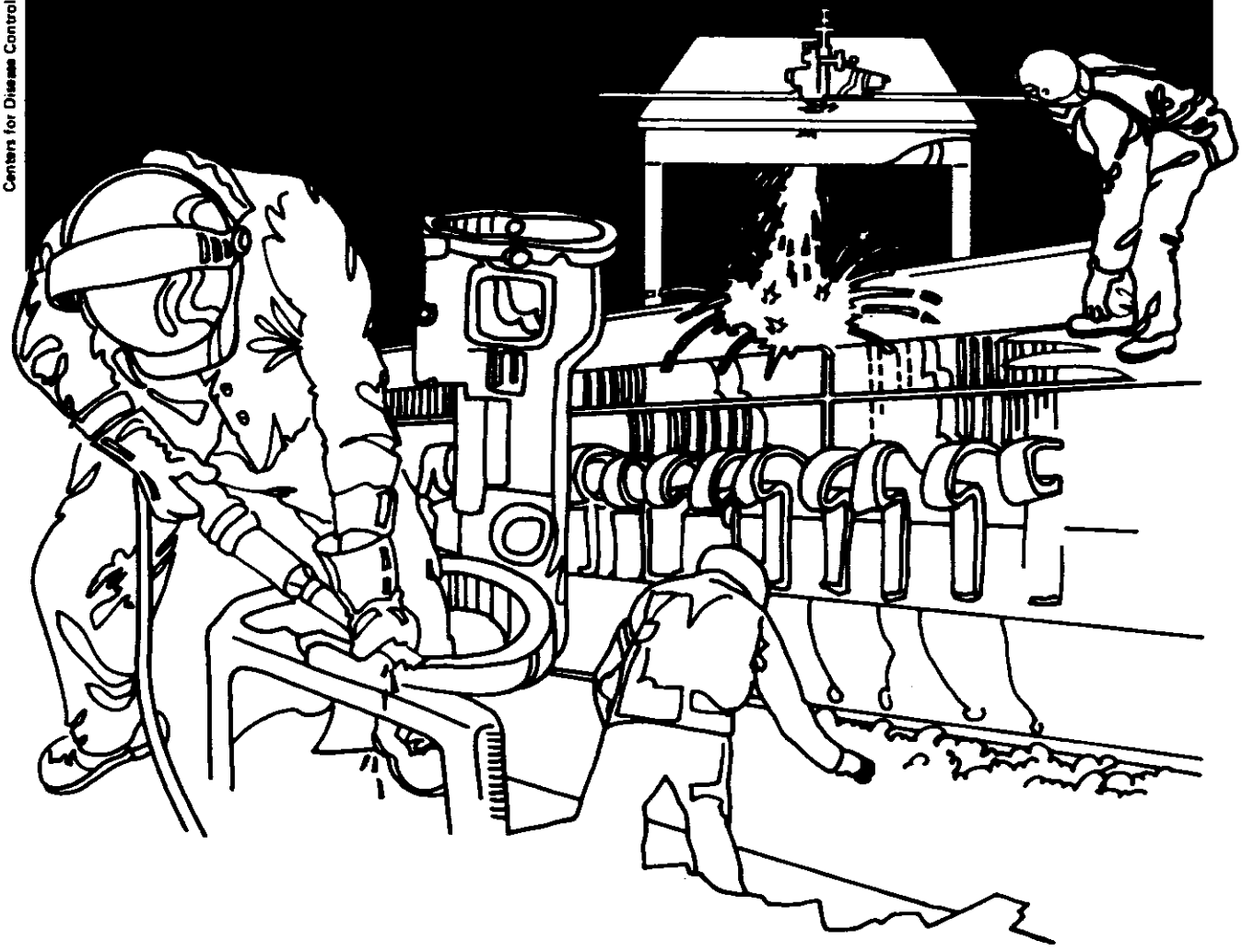
NIOSH



# Health Hazard Evaluation Report

MHETA 88-067-2059
ISLAND CREEK COAL
BAYARD, 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.

MHETA 88-067-2059
ISLAND CREEK COAL
BAYARD, WV
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## I. SUMMARY

On November 19, 1987, the National Institute for Occupational Safety and Health (NIOSH) received a request from the United Mine Workers of America, Local 8531, Cowen, West Virginia to investigate a freeze conditioning product called Enerlink FC-11301 that was being used at the Island Creek Coal Company's Bayard, West Virginia coal preparation plant. The request was prompted by several employees who had been working with the Enerlink product for three years and had reportedly developed kidney, prostate, and skin problems.

A preliminary on-site visit was conducted on January 7, 1988. On January 27, 1988, an industrial hygiene survey was conducted at the Bayard, West Virginia facility to evaluate employee exposures to the Enerlink product as it was being applied to the coal going into the rail cars. The Enerlink product is used on the coal to keep it from freezing in the rail cars. Liquid bulk samples from past and present freeze conditioning agents were collected for qualitative analysis. The results of the bulk sample analyses revealed the primary compound in the past and present conditioning agents to be diethylene glycol. Of five airborne samples collected, two had detectable levels. Both were personal breathing zone samples.

Currently, there is no federal standard for exposure to diethylene glycol. Neither NIOSH nor the American Conference of Governmental Industrial Hygienists (ACGIH) have recommended any standards for diethylene glycol. Since diethylene glycol is similar in its health effects to ethylene glycol, the 1972 ACGIH Threshold Limit Value (TLV) for ethylene glycol was used. Coal mine surface work areas fall under the 1972 TLVs adopted by ACGIH. The 1972 TLV for the ethylene glycol particulate is 10 $mg/m^3$ and 100 parts per million (ppm) or 260 $mg/m^3$ for the vapor. From the survey, only the ethylene glycol particulate was found. The sample results were: 0.22 milligrams per cubic meter ($mg/m^3$) for the car dropper and 4.8 $mg/m^3$ for the coal sampler. When compared to the 1972 ethylene glycol TLV, the results suggest minimal exposure to diethylene glycol.

It was not possible to conclude that the workers' medical diagnoses resulted from their reported occupational exposures to diethylene glycol.

Based on the environmental evaluation, NIOSH has determined that there is presently no hazardous exposure to Enerlink FC-11301 and that exposure is minimal.

Key Words: SIC 1221 (coal preparation plant), diethylene glycol, ethylene glycol.

## II. INTRODUCTION/BACKGROUND

On November 19, 1987, the National Institute for Occupational Safety and Health (NIOSH) received a request from the United Mine Workers of America, Kahn, West Virginia to investigate a product called Enerlink FC-11301 that was being used at the Island Creek Coal company's Bayard, West Virginia coal preparation plant. The request was prompted by several employees who have been working with the product for three years and have reported symptoms of kidney, prostate, and skin problems.

The Enerlink FC-11301 is used as a freeze conditioning agent which is sprayed onto the coal before it is loaded into the rail cars. The product modifies the crystalline structure of ice and reduces the adhesiveness of frozen coal. Coal comes to the rail cars from the coal preparation plant via a conveyor belt. At 50 feet from the end of the conveyor belt, a bank of sprays dispense the product onto the coal and the coal then drops into a rail car. The present spraying operation had only been in operation for about three months prior to NIOSH's survey. Previously, the product was sprayed onto the coal at the end of the conveyor belt. Since the end of the conveyor belt is located directly over the rail cars and rail area, the men who work as car droppers would get sprayed or be exposed to the spray as it drifted in the air. Prior to November 1987, the employees working around the rail cars did not have any personal protective equipment. Now the employees have face shields, rubber gloves and rain suit, goggles and dust/mist respirators.

The preparation plant operates three shifts. The workers with occupational health complaints are on the day shift and have been employed at Island Creek for 15-18 years. The workers affected have seen physicians.

On January 27, 1988, an industrial hygiene survey was conducted at the Bayard, West Virginia facility to evaluate employee exposure to the Enerlink product as it was being applied to the coal. Employee medical records were also requested by a NIOSH physician for evaluation.

## III. EVALUATION CRITERIA AND TOXICOLOGY

### A. Evaluation Criteria

Currently, there is no federal standard for exposure to diethylene glycol. Neither NIOSH or the American Conference of Governmental Industrial Hygienists (ACGIH) have recommended any exposure limit for diethylene glycol.

Since diethylene glycol is similar in its health effects to ethylene glycol,[1,2] it seemed appropriate to follow the same criteria as recommended for ethylene glycol. The 1972 ACGIH Threshold Limit Values (TLVs), which coal mine surface work areas are required to follow, has in the notice of intended changes recommended a TLV for ethylene glycol of 10 $mg/m^3$ for the particulate and 100 parts per million (PPM) (260 $mg/m^3$) for

the vapor. In Comparison to the 1981 and 1989-90 TLV's, the value for ethylene glycol vapor was lowered by ACGIH to a ceiling of 50 ppm for both mist and vapors. This TLV was recommended to minimize irritation to the respiratory passages.

B. Toxicology

Animal studies with diethylene glycol suggest that it is not a carcinogen,[1] but it does give rise to various metabolites in the body. One in particular is oxalic acid. When oxalic acid is detected in urine, it usually indicates that there has been some intake of glycols into the body, either by skin absorption or inhalation. While oxalic acid is a good biological marker for glycols, there is no biological exposure index for glycols to assess the exposures. In non-exposed workers, it is known that less than 100 milligrams of oxalic acid/gram of urinary creatinine is excreted, so this index could be assumed to be a baseline for potential exposure. However, this index is not normally used and there is not a value established. When one considers the volumes of diethylene/ethylene glycol handled in industry over the years and the lack of reports of adverse affects, diethylene glycol is considered a low degree hazard.

Skin: Diethylene glycol has not been found to be readily absorbed through the skin except where extensive and prolonged skin contact occurs.[2] Toxic amounts of diethylene glycol are reported to be absorbed through the skin in animal studies.[2,3] However, it is thought that the health hazard from skin absorption in industrial operations is quite small.[2] Diethylene glycol is not considered to be irritating to the skin.[2,4,5]

Inhalation: Hazard may exist from repeated, prolonged exposure to diethylene glycol mists when operations are carried out at high temperatures.[6] High temperatures[7] are described as greater than 197° F. At ordinary temperatures and freezing conditions, it presents little hazard.

Kidneys: Kidney damage has been reported from long term oral exposures to diethylene glycol in animal studies.[3]

## IV. METHODS AND MATERIALS

A. Environmental

Personal breathing zone air samples were collected from the loader operator, the coal sampler, and two car droppers working the day shift at the load out point. An area air sample was also collected at the load out point, 15 feet from the nearest rail car and directly below the manual hand spray which is sometimes used to deliver the freeze conditioning agent.

Two bulk samples; one of the Enerlink FC-11301 product presently being used and one from a previously used product distributed by DOW Chemical were analyzed to determine what ingredients were present in each mixture.

The personal breathing zone and area samples were collected for a full shift using NIOSH method 5500. This method utilizes a 13 millimeter glass fiber filter in-line with a 520/260 milligram silica gel tube and a battery operated pump calibrated at a flow rate of 200 cubic centimeters per minute (cc/m). After sampling, each glass fiber filter was transferred to a scintillation vial containing 1 milliliter (ml) of a desorption solution consisting of two volumes of 2-propanol in 98 volumes of distilled water. The silica gel tubes were capped and shipped to the lab to be desorbed using the same desorption solution. One control sample was also submitted for analysis.

B. Medical

A review of the literature was conducted for reported diethylene glycol-related health problems. Medical records of the workers reporting possible work-related symptoms were obtained and reviewed for diethylene glycol-related health problems.

## V. RESULTS AND DISCUSSION

A. Environmental

Two bulk liquid samples of two freeze conditioning agents used at Island Creek Coal was qualitatively analyzed. Results of the bulk liquid qualitative analysis revealed that the primary component present in both samples was diethylene glycol. However, in bulk #1, which is the freeze conditioning agent now used, traces of ethylene glycol, triethylene glycol, and tripropylene were also detected. The same ingredients were also detected in bulk #2, which was used by Island Creek five years ago.

Five air samples were collected for diethylene glycol; four were personal breathing zone samples and one was an area sample. The personal breathing zone samples were collected on the loader operator, the coal sampler and the two car droppers. Two of the five samples had a detectable level for diethylene glycol. On these two samples, only the particulate diethylene glycol was detected. The diethylene glycol vapor was not detected on the silica gel tubes. On the coal sampler, a level of 4.8 $mg/m^3$ was detected and on one of the car droppers, a level of 0.22 $mg/m^3$ was detected. Due to a lack of rail cars being available on the day of sampling, the maximum time for a sample collected was 3.5 hours. When the sample results were compared to the 1972 ACGIH TLV of 10 $mg/m^3$ for the ethylene glycol particulate, the exposure levels are minimal. One reason for the minimal exposures may be due to Island Creek Coal Company's recent modifications to the spray bar over the conveyor belt at load out. The spray bar was relocated from the end of the conveyor belt to a 50 foot distance from the

end of the conveyor belt. This change (according to employees) has greatly reduced personal exposures. Apparently, prior to the modifications, workers would get their clothes occasionally soaked or the drift in their face from the sprays. In addition to the modifications, Island Creek has provided personal protective equipment that includes: a face shield, goggles, rubber gloves and rain suit and dust/mist respirators.

Exposure at Island Creek from diethylene glycol primarily results from skin contact or by inhalation of the mist from the sprays at load out. From the literature,[1,2] diethylene glycol presents very little acute hazard during handling or from skin contact. Any skin irritation that may occur from contact is readily reversible and disappears after exposure has ended.[2]

Because of its low vapor pressure (less than 0.01 mm Hg), diethylene glycol is not likely to be a serious inhalation hazard unless heated to temperatures greater than 197° F[2]. Of course, this is not the case at Island Creek. At the low temperatures (less than 32° F) for which it is used at Island Creek, the risk of excessive exposure to diethylene glycol by inhalation is unlikely to occur.

B. Medical

Review of the medical records of those reporting possible work-related symptoms found diagnoses of Peptic Ulcer Disease, Benign Prostatic Hypertrophy/Prostatitis, Actinic Cheilitis, and Idiopathic Hematuria. Peptic Ulcer Disease and Benign Prostatic Hypertrophy/Prostatitis were not found to be diagnoses associated with exposure to diethylene glycol in the literature reviewed. Actinic Cheilitis is a sun related inflammation of the lips. As previously stated, liquid glycols do not appear to be particularly irritating to the skin.

Idiopathic Hematuria is blood in the urine of unknown origin. Renal damage of varying degrees has been reported from long-term oral exposures of animals to diethylene glycol. Toxic amounts of diethylene glycol have been reported to be absorbed through the skin in animals. It is difficult and often not useful to extrapolate the results of animal studies to humans. Continuous exposure animal studies may have very different cumulative exposures than intermittent human workplace exposures.

## VI. CONCLUSION

A. Environmental

Diethylene glycol is low in acute oral toxicity, is not significantly irritating to the eyes or skin, is not readily absorbed through the skin and its vapor pressure is so low that toxic concentrations are not normally found outdoors. Based on the sample results, literature review, and personal observation of present conditions and work practices, NIOSH investigators have determined that the health risk posed by diethylene

glycol exposures is minimal. This risk is further minimized by the personal protective equipment which the workers now have available to them.

B. Medical

Based upon review of the medical records and lack of observed exposures, it is not possible to definitely link the workers' health problems to their reported occupational exposures to diethylene glycol.

## VII. RECOMMENDATIONS

1. Island Creek should continue to provide the personal protective equipment to minimize skin exposures and follow the information provided in the material safety data sheets on the use of the product.

2. There is no special need for medical surveillance.

## VIII. REFERENCES

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## IX. AUTHORSHIP AND ACKNOWLEDGMENTS

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## X. DISTRIBUTION OF REPORT

1. Island Creek Coal Company
2. United Mine Workers of American
3. Mine Safety and Health Administration