

HEALTH STUDIES OF OIL SHALE WORKERS

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INTRODUCTION

The present difficulties associated with increased purchasing of imported crude oil coupled with environmental concerns related to the use of coal makes it necessary to look at alternative sources of energy. Shale oil is one possible energy alternative. The study of the human carcinogenic potential of this fuel has become important as the degree of oil shale activity on the Colorado Plateau increases. Up to now, the number of people who have been exposed to shale oil in occupations related to pilot scale retorting and laboratory work has been limited. Designs for facilities capable of handling up to 160,000 tons per day of oil shale are being developed. Some of them involve underground (in situ) heating of shale. Plants are expected to be operating near capacity by 1985 or 1990; four such operations are now either in production or being contemplated. Undoubtedly, if the currently planned facilities prove feasible, an increase in the number of retorting facilities may be expected. It is important, therefore, to try and determine, in advance, the health effects, if any, of occupational exposure to shale oil production.

REVIEW OF LITERATURE

A review of the literature indicates potential health problems for shale oil workers in the form of respiratory and skin diseases. Studies made in Scotland and the Soviet Union have demonstrated an association of shale oil with human skin cancer. Furthermore, emphysema, bronchitis, pneumonia, and

other respiratory illnesses have occurred more frequently among shale oil workers than in control groups. Historically, Weaver (1971) reports that skin cancers caused by shale and mineral oils rank second in number only to those caused by coal tar. He suggested that this carcinogenicity of shale oil fractions tends to be related to the 3,4-benzopyrene content, but he also recognized the presence of other types of cancer-producing chemicals.

Scott (1922, 1923) found a high prevalence of skin cancer in the paraffin workers of the Scottish shale oil industry. The carcinogenic problem became apparent soon after the establishment of the Scottish shale oil industry which produced oil for lighting, lubricating oils and kerosene (paraffin). Hueper (1957), in his study of environmental factors, found that the majority of human tumors were skin cancers caused by products of thermal treatment of mineral fuels. The shale oil industry accounted for 1907 cases out of a total of 8400 cases surveyed. With the exception of coal tar and coal tar pitch, substantially less numbers of cancer cases were noted from other products associated with thermal treatment of mineral fuels.

In the Soviet Union, Loogna and Hering (1972) reported that workers exposed to shale oil experienced occupational dermatoses such as dermatitis, eczema, folliculitis, and verruca. In addition, they reported that shale oils are sensitizers. Bogovski (1961) indicated that no cases of occupational tumors have been found (as of

1961) in the Estonian shale industry, but that this may be a result of a relatively young industry.

In the area of respiratory diseases, Feoktistov (1972) found that the leading diseases in temporarily disabled shale oil workers at the Estonian "Kava-2" mine were influenza and catarrh of the upper respiratory organs. These two diseases accounted for 85 percent of all diseases in these workers. Luts (1972) found that the greatest morbidity from grippe, acute catarrh of the upper respiratory tract, angina, bronchitis, and pneumonia occurred in workers in the mechanized oil shale mines. Lowest morbidity occurred in the above-ground pits. Maripuu (1972) showed an average chronic bronchitis rate in Estonian shale oil workers of 16.3 percent.

More recently, Purde and Rahu (1975) reported morbidity rates for stomach cancer in Estonia of 60.2 per 100,000 in males and 44.7 per 100,000 in females. They state that the highest stomach cancer morbidity is in the more developed industrial areas of northern Estonia, notably in the oil shale processing districts of the republic. They believed that this is caused by higher air pollution in this area.

THE FIRST U.S.P.H.S. MORBIDITY STUDY

In 1952, Dr. Donald Birmingham of the Division of Occupational Health, U.S. Public Health Service, initiated a medical study of workers at the Anvil Points oil shale demonstration plant of the Bureau of Mines near Rifle, Colorado. This study was principally concerned with dermatological problems that might be caused by the oil shale operations. During the three-year period, 1952-1954, 266 different men were examined.

The following types of skin lesions were considered to be of prime importance to shale oil workers because of their relation to shale oil exposure to sunlight: telangiectasia, flat warts, seborrheic and senile keratoses, and pigmentation. Dr. Birmingham found that 64 percent of the workers had telangiectasia, 42 percent had flat warts,

8 percent had seborrheic keratoses, 8 percent had senile keratoses, and 1 percent had pigmentation. Particular attention was paid to age, severity of exposure to shale oil, complexion of worker's skin, and length of residence in the Colorado plateau. The reason for considering these factors was that a higher than normal prevalence of skin cancer has been reported for residents in this area because of the high elevation.

Contact with shale oil was not found to have an effect insofar as causing skin lesions is concerned. The percentage of workers having lesions among those with no contact, light contact, and severe contact with shale oil was 75 percent, 83 percent, and 79 percent, respectively. For the first ten years, there was a gradual increase in skin lesions as length of residence on the Colorado plateau increased; after this it leveled off at approximately 85 percent. There was a statistically significant difference in the proportions of persons of dark and light complexion having skin lesions. Eighty-four percent of persons with light complexion had either telangiectasia or flat warts, while 71 percent of persons with dark complexion were similarly affected.

Because of the small numbers of workers involved in the study, Dr. Birmingham concluded (1955) that it was impossible to unequivocally assess the distinct effects and interactions between age, length of residence in the Colorado plateau, complexion of the worker's skin, and the severity of exposure to shale oil. He did conclude that contact with shale oil was not a significant factor in the production of the skin lesions, as demonstrated by the dermatological examinations.

THE PRESENT NIOSH MORTALITY AND MORBIDITY STUDY

The objective of the present study is to determine the health effects, if any, of occupational exposure to shale oil. In particular, study objectives are designed to answer questions relating to specific

health risks of people employed in a potentially large scale oil shale industry within the United States. These risks involve skin dermatoses and respiratory problems.

The study is divided into a morbidity phase and a mortality phase. The morbidity phase is designed to determine if there is increased prevalence of diseases relating to the skin or to the respiratory system compared with a control group from the same area. The mortality study will attempt to determine if shale oil workers are subjected to increased risk of early death compared to an appropriate standard group.

At the start of the present study, the universe from which the sample was drawn was estimated to be about 800 persons. However, after a very aggressive campaign to locate workers, we now have a master list of 1198 people who worked at Anvil Points during the study period - a much larger universe than originally thought.

The original sample was composed of three different employee groups: (a) 294 employees of the U.S. Bureau of Mines who worked at the Anvil Points oil shale retort from 1948 to 1956; (b) 135 employees who worked at the Anvil Points retort facility from 1966 to 1969 for the joint venture of the Colorado School of Mines Research Institute and COLONY, a six-company consortium. (This group contains all the men who worked at the facility during the three-year period.); (c) fifteen men who worked from 1956 to 1959 at the Union Oil retort facility in Grand Valley. All are included in the sample.

We are still in the process of developing our final sample. This will be a combination of the original sample with those additional workers found in our "worker location" campaign whose jobs and length of service indicate possible exposure.

The first phase of this study is an in-house mortality study which is currently well along. We are in the process of determining the vital status of the entire list of 1,198 people. This group is being divided into living, deceased, and unknown. Members of

the living group will be used in the morbidity study.

Several agencies and services are used to help determine a person's vital status. For the present study, these included: U.S. Postal Service, Internal Revenue Service, Social Security Administration, Civil Service Commission, State Motor Vehicle Bureaus, State Vital Statistics Bureaus, Geneological Society of the Church of Jesus Christ of Latter Day Saints, and a private case location service. Local newspapers have published news stories that have helped in locating people.

The following methods were used to determine vital status: first, a 3 x 5-in. card listing a cohort member's name and last known address was sent to the Postmaster in the town of last address for correction. The Postmaster returned the card to us, indicating whether or not the address is correct, the person is unknown, or the person is deceased. Secondly, the Social Security number for each cohort member was sent to the Internal Revenue Service and the Social Security Administration for checking. The Internal Revenue Service gave us the last year that the person paid income tax; the Social Security Administration indicated the last quarter which the person paid into Social Security and whether or not a death benefit claim had been paid. After this was done, a field trip was made to the Rifle, Colorado, area to check with people who might be familiar with some of the members of the cohort. A visit of several days was made to the Anvil Points oil shale demonstration plant to check our lists with long time employees. In addition, visits were made to local Registrars of Vital Statistics for leads on deceased persons and to local Postmasters for additional information. Local telephone directories were consulted for addresses of persons for whom we had no address. At a later date, a trip was made to check the records of the geneologic society of the Mormon church for leads.

One of the problems that we had with the mortality study was a large group of Bureau of Mines employees for whom there were no addresses, but for whom birth dates were available. This problem was attacked by having the Colorado State Motor Vehicle Bureau check their driver's license records by name and birthdate. A second approach, currently underway, was to ask the Civil Service Commission for permission to search the government archives at St. Louis, Missouri, for leads.

The present status of the mortality study is that we have identified 1,198 people (men and women) who have worked at Anvil Points during the study period of 1946-1958. Not all of these people are suitable for study because of short employment duration and/or type of job lacking exposure. Included in this total are 87 women. We have 194 death certificates in hand that have been coded for cause of death. We have an additional 50 people that have at least one indication of death. Four hundred seventeen (417) are known living for whom we have current addresses.

The data collection phase of the morbidity study of oil shale workers is being done as an outside contract by the Utah Biomedical Test Laboratory of Salt Lake City, Utah. Identification of the cohort and final analysis of the data will be done in-house. Sputum cytology analysis is being performed by Dr. Geno Saccamono of Grand Junction, Colorado. Three hundred twenty (320) oil shale workers and 320 controls will be examined. Priority for examination will be given to those oil shale workers in production or engineering-type jobs.

A control sample of 320 coal miners will be chosen from a group of 1,000 workers in two mines in eastern Utah and one mine in western Colorado. These control workers will be matched with the study group on the basis of age, race, smoking habits, and length of time living and working at altitudes in excess of 4,300 feet.

The morbidity study will consist of a personal and medical questionnaire, covering

both respiratory diseases and dermatological diseases, and a dermatological examination performed on each cohort member by a qualified dermatologist. Sputum samples will be taken to analyze for all changes indicative of lung cancer and urine samples will be analyzed. In cases where possible skin malignancies are found, a biopsy will be done. If any adverse results are found, the person involved will be notified and advised to see his family physician. Examinations will generally be done in regional centers. In a few cases where workers live out of the area, examinations will be done in their houses. Utah Biomedical Test Laboratory is scheduled to finish this work by the end of October, 1978.

Because most of the data collected will be of an enumerative nature and most of the "prevalence" data will not be of a normal distribution, nonparametric techniques of data analysis will most probably be used. Methods employing normal tests will be used whenever necessary and feasible. Analysis will be done on the entire study group and matched controls. Because matched controls are to be used, confounding variables such as age, number of years spent on the Colorado Plateau, smoking habits, other industrial exposure, etc., should be factored out of the analysis. However, to verify this and to examine the data for other artifacts, the control and study groups will be stratified by some or all of the variables mentioned above for further analysis. Also, the study group will be stratified by exposure and compared to controls. Analysis will determine if differences in morbidity patterns are more pronounced among the longer-exposed group. Other dichotomies like this will also be examined. In addition, an analysis of the study group alone will be done comparing those with longer duration of work with shale oil to those with a shorter duration. Also, stratifying the groups according to type of jobs held and duration within the plant will be done, assuming the other variables can be factored out without rendering the sample size inadequate.

NIOSH'S ENVIRONMENTAL COMPONENT IN OIL SHALE

In the last few years, our Environmental Investigations Branch has been active in joint work with the Environmental Protection Agency and the Institute of Experimental and Clinical Medicine, Ministry of Health of the Estonian SSR. The Chief of the Environmental Investigations Branch and others visited the Institute of Experimental and Clinical Medicine at Tallinn, Estonia. A joint oil shale workshop was set up in Denver for May 18-20, 1977, and three Soviet scientists came and participated in the Joint Workshop on Health Effects of Oil Shale Development. The Environmental Investigations Branch provided support to this workshop in helping in arrangements and in providing a person to help escort the Soviet visitors on a trip to the Paraho operation at Anvil Points, Colorado, and to the Laramie Energy Research Center.

A second trip to Estonia is planned in order to visit some of its oil shale facilities. This trip is now scheduled for May. It is hoped that a second workshop will be held in Estonia in the future.

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