PLAINTIFF'S EXHIBIT

UC-3545

JUN 2 6 1978

SUBJECT: Asbestos Cancer Hazard

FROM: Roy E. Albert, Chairman
Carcinogen Assessment Group

TO: Joseph Padgett, Director
Strategies and Air Standards Division

This is in response to your memorandum of May 3, 1978 requesting CAG assistance in determining whether EPA should regulate taconite as an asbestos cancer hazard. In our opinion the answer should be in the affirmative. The attached report by Dr. Cook summarizes the present state of knowledge. In essence, there is suggestive evidence that short fiber lengths of asbestos may not be fibrogenic or carcinogenic so far as mesothelioma is concerned but the evidence is not decisive and there is no evidence one way or the other regarding the effect of fiber length on the induction of bronchogenic cancer which is the main health hazard.

Attachment

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UCC 007438

ASSESSMENT OF POTENTIAL ENVIRONMENTAL HEALTH HAZARD ASSOCIATED WITH AIRBORNE MINERAL FIBERS EMITTED DURING TACONITE ORE PROCESSING

DRAFT REPORT

June 1, 1978

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fibers* in airborne dust derived from mining, milling, and use of asbestos are known to cause asbestosis, lung cancer, pleural and peritoneal mesotheliomas, and gastrointestinal tract cancer in man. Chrysotile and the amphiboles crocidolite and amosite are associated with all these diseases while anthophyllite mined in Finland is associated with an excess lung cancer risk and high incidence of pleural thickening and calcification (1). Non-occupational exposure to asbestos in the neighborhoods of industrial sources (2) or from household contact with asbestos workers (3) leads to increased risk for mesotheliomas.

Fibrous amphibole minerals released from rock during non-asbestos mining operations pose a less well-defined risk of disease when inhaled. Since little or no epidemiological or animal study data exists which can be applied specifically to each occurrence, risk assessment often depends on comparison of physical and chemical properties to asbestos and on comparison of airborne fiber concentrations to concentrations associated with asbestos disease.

Excess cancer and pneumoconiosis deaths have occurred for workers exposed to aerosols of talc contaminated with tremolite, anthophyllite, and chrysotile (4). A study of underground miners in a gold mine with grunerite fibers has demonstrated a three-fold excess of respiratory cancer mortality (5) but a subsequent study (6) of a larger cohort from the same mine (not limited to underground workers) indicates no excess of respiratory cancer deaths.

What basis exists for associating asbestos health hazards with mineral fibers released by taconite mining and beneficiation? Because of their unique structure, chrysotile fibers are certain to be identical morphologically, structurally, and chemically to various chrysotile fibers released by chrysotile asbestos mining and milling. Comparison of amphibole fibers to known amphibole asbestos materials is more difficult because the various amphibole minerals are formed with both fibrous (asbestiform) and non-fibrous habits. It is also probable that a gradation exists between extremely fibrous and non-fibrous amphibole occurrences.

A further complication is the propensity of amphibole minerals to cleave, or split along preferred crystal planes, when crushed and thus produce particles with length to diameter ratios in excess of 3:1. Amphibole fibers produced from amphibole asbestos such as amosite may also result from cleavage, however. No biological data exists to show different response to samples of amphibole fibers which differ only in subtle internal crystal defect structures or in crystal face orientations although these properties may be related to the asbestiform nature of the mineral sample.

*The term "fiber" in this discussion refers simply to any free particle with a length to width ratio equal or greater than 3:1.

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A current popular theory among asbestos health experts is that any long, thin durable fiber introduced into tissue will induce malignant neoplasms. Stanton (7) implanted 17 fibrous glasses of different dimensional distributions into the pleurae of rats and observed that fibers less than or equal to 1.5 μm in diameter and greater than 8 μm in length yielded the highest probability of pleural sarcoma. Extrapolation of these results to fiber carcinogenesis in man is subject to consideration of the influence of fiber dimension on aerodynamic behavior, penetrability, and clearance from the lung; i.e., none of the potentially more carcinogenic fiber sizes may have greatly diminished abilities to reach target tissue. The generally accepted greater cancer risk associated with crocidolite fiber inhalation as compared to chrysotile fiber inhalation may result primarily from greater lung retention of crocidolite fibers.

Asbestos aerosols invariably have a wide range of fiber lengths and widths. Even animal experiments can not provide absolute effect/fiber size relationships since asbestos samples of uniform fiber size have not been prepared. Rats intraperitoneally injected with short chrysotile fibers (95% less than 5 μm in one test and 99% less than 3 μm in a second test) incurred approximately a 40% incidence in tumors, in a study (8) which provides the closest association between short fibers and carcinogenesis. Pulmonary tissues of asbestos workers contain many more short fibers than long with an even shorter fiber size distribution in pleural tissue (9).

The Environmental Protection Agency's animal tests of amphibole fibers obtained from Reserve Mining Company (RMC) will not be completed until 1980. These tests involve intratracheal installation and intrapleural injection of RMC amphibole fibers and amosite fibers in rats (10). The amphibole fiber samples used are representative of fibers found in air samples from Silver Bay but not typical of all amphibole fibers present. In vitro tests of RMC amphibole, amosite, crocidolite, chrysotile, anthophyllite, tremolite, and a non-fibrous grunerite indicate that the RMC amphibole is lytic to sheep erythrocytes and depresses rabbit alveolar macrophage cellular viability similarly to the amphibole asbestos samples whereas the non-fibrous grunerite sample is not active. Cytotoxic effect in such in vitro tests has been linked to the ability to cause fibrosis but is not necessarily associated with carcinogenesis.

Mineral fibers with structures and surface properties entirely different than the asbestos minerals can be carcinogenic. Palygorskite, a fibrous clay mineral, induced as many mesotheliomas, following intraperitoneal injection in rats, as chrysotile (11). The extraordinary incidence of mesotheliomas in a Turkish village (12) is now thought to be a result of zeolite fibers released into the environment by erosion and use of volcanic tuff (13).

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Given the chemical, crystallographic, and morphological similarity of EMC amphibole fibers to erionite fibers, it is most likely that inhalation exposure to high concentrations of these fibers would produce asbestos disease. It is important to note that at this time no evidence of fibrosis in EMC employees with more than 20 years employment is found by pulmonary function studies and chest radiographs (14). These studies can not be extended to conclude that increased risk of lung cancer and mesothelioma is absent but indicate that exposures to fibers are considerably lower than those experienced by asbestos workers in the past and associated with asbestosis and cancer. MESA spot dust inspections for mineral fibers indicate time weighted average fiber concentrations in EMC working areas are far below the occupational health standards for asbestos and even further below the concentrations asbestos workers were exposed to decades ago.

The community air amphibole fiber concentrations in Silver Bay, Minnesota have now been well characterized by transmission electron microscope analysis of air samples collected on membrane filters. Amphibole fiber concentrations at three sites in residential Silver Bay were determined from continuous air monitoring to average approximately 125,000 fibers per cubic meter for the years 1974, 1975, and 1976 (15). The electron microscope analysis was performed with a technique essentially identical to the EPA provisional method published in August 1977 (16) and is in excellent agreement with results reported independently for 12 air samples by the Minnesota Department of Health and Mt. Sinai School of Medicine Environmental Sciences Laboratory. Three other laboratories participating in the interlaboratory comparison each used inferior analysis techniques and produced data which failed to correlate with any other laboratories' results (17). Air samples recently collected by Region V during and after a prolonged shutdown of Reserve Mining Company are currently being analyzed and appear to show very low amphibole fiber concentrations in the Silver Bay air during the shutdown period. Although stack emission controls being installed should greatly reduce fiber concentrations, fugitive dust from the on-land tailings basin to begin operation in 1980 pose an unknown addition to amphibole fiber concentrations in the air of the Silver Bay area.

The dose response equation for human inhaled fiber exposure is not well established and the existence of an exposure threshold, below which increased cancer risk is zero, is unknown. Amphibole fiber concentrations in the air near the taconite processing facility at Silver Bay, Minnesota are probably at least 1,000 times lower than past concentrations in the asbestos industry which led to high incidence of asbestos disease. Evaluation of the environmental hazard, however, requires consideration of factors such as 24 hour per day exposure, exposure initiation at infancy, potentially longer period of accumulated exposure, and acceptable environmental health risk versus acceptable occupational health risk. A compounding problem for assessing cancer risk at lower exposure levels is the increased lapse time between initial exposure and onset of disease (18).

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The new available monitoring, health, and mineralogical information should not change EPA's originally stated concern for the long-term health of persons living in the vicinity of taconite processing facilities which handle ore highly contaminated with amphibole or chrysotile fibers. Emissions to the environment of such fibers should be controlled with best available technology. Such controls are planned for installation at Reserve Mining Company. It should be noted that, while the 8th Circuit Court decision of March 14, 1975 stated:

> "The best that can be said is that the existence of this asbestos contaminant in air and water gives rise to a reasonable medical concern for the public health. The public's exposure to asbestos fibers in water and air creates some health risk. Such a contaminant should be removed,"

the findings of fact of the United States District Court in the Reserve Mining Trial were not reversed or modified by the 8th Circuit Court. These findings of fact included:

1. "Many of these fibers are morphologically and chemically identical to amosite asbestos and an even larger number are similar to amosite asbestos."

2. "Exposure to these fibers can produce asbestosis, mesothelioma, and cancer of the lung, gastrointestinal tract, and larynx."

3. "The discharge into the air substantially endangers the health of the people of Silver Bay and surrounding communities as far away as the eastern shore in Wisconsin."

4. "The present and future industrial standard for a safe level of asbestos fibers in the air is based on the experience related to asbestosis and not to cancer. In addition its formulation was influenced more by technological limitations than health considerations."

5. "The exposure of a non-worker populace cannot be equated with industrial exposure if for no other reason than the environmental exposure, as contrasted to a working exposure, is for every hour of every day."

6. "While there is a dose-response relationship associated with the adverse effects of asbestos exposure and may be therefore a threshold exposure value below which no increase in cancer would be found, this exposure threshold is not now known."

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