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Epidemiologic Notes and Reports

Nitrosamine Exposure in a Tire Manufacturing Plant — Maryland

Volatile N-nitrosomorpholine (NMOR), N-nitrosodimethylamine (NDMA), and N-nitrosopyrrolidine (NPYR)—3 powerful carcinogens for animals whose effects on humans are unknown—were found last year in air samples in a tire manufacturing plant in Cumberland, Maryland. Airborne NMOR was present at a maximum concentration of 250 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$), a level 10 times higher than any nitrosamine concentration previously reported in the rubber industry. Over the following 8 months, ventilation improvements and changes in chemical formulation resulted in a 100-fold reduction in NMOR levels and in elimination from air of other nitrosamines.

In June 1979, the United Rubber Workers Union, Local 26, had requested an evaluation of worker exposure to N-nitrosodiphenylamine (NDPhA) (a rubber retarding agent) at the tire production plant, located in Cumberland. As a result, 12 air samples were obtained in August 1979 in plant areas above heated rubber stock (200-230 F) to measure airborne concentrations of volatilized nitrosamines. NMOR, NDMA, and NPYR were found in the majority of the air samples. The highest concentrations (64-250 $\mu\text{g}/\text{m}^3$) were found in those areas of the plant where rubber is fed into machines, pressed, and combined with nylon fabric for bias-ply tires (the so-called feed-mill and calendaring areas). High NMOR levels were also found at the tire-tread extruding machine (32.0 $\mu\text{g}/\text{m}^3$) and in the press room (6.8 $\mu\text{g}/\text{m}^3$), where tires are cured. Personal (breathing-zone) air samples, obtained on workers in October 1979, showed feed-mill and calendaring operators to be the most heavily exposed to nitrosamines; 1 worker had a time-weighted average NMOR exposure of 25 $\mu\text{g}/\text{m}^3$. Approximately 200 workers in the plant could have potentially been exposed to nitrosamines.

Recommendations were made for immediate reduction of exposure through improved ventilation. It was established that the source of the high levels of airborne NMOR was the thermal decomposition of NDPhA and the subsequent reaction of its nitroso group with other rubber additives (performed morpholine compounds).

Follow-up environmental surveys were conducted at the plant in December 1979 and in February 1980. In December, the highest breathing-zone NMOR concentration was 18 $\mu\text{g}/\text{m}^3$; by February, the maximum concentration had decreased to 1.3 $\mu\text{g}/\text{m}^3$. NDMA levels at the latter time were 5.5 $\mu\text{g}/\text{m}^3$, and for the first time NPYR could not be detected. Before the December survey, plant management had installed local exhaust ventilation at all feed mills and tire-tread extrusion machines. By February, the company had substituted a different retarding agent for NDPhA.

In December 1979, blood, urine, and stool samples were collected from 15 workers for nitrosamine analysis. Results of all analyses were negative. In February 1980, urine samples were obtained from 9 workers for mutagenicity testing by the Ames *Salmonella* test. Methylene chloride extracts of urine showed no evidence of mutagenicity (1).

Nitrosamine – Continued

Reported by the New England Institute for Life Sciences, Boston, Massachusetts; Maryland Occupational Safety and Health, Baltimore; Washington University, St. Louis, Missouri; and the Div of Surveillance, Hazard Evaluations, and Field Studies, National Institute for Occupational Safety and Health, CDC.

Editorial Note: All nitrosamine compounds have nitroso and alkyl groups and are usually prepared from alkylamino compounds by the action of nitrous acid. There are over 130 nitrosamine compounds.

Nitrosamines as a class are considered to be among the most potent and widespread of animal carcinogens. Over 70% of tested nitrosamines, including all the nitrosamines mentioned in this report, are carcinogenic (2,3). Various nitrosamines have been found in food, cosmetics, alcoholic beverages, cigarette smoke, and many industrial processes (4). Very recently, these compounds have been reported to be present in rubber and tire factories (5,6), possibly as a result of transformation (transnitrosation) of secondary amines by NDPhA. In addition, certain chemical materials (especially amines) supplied to machines may be contaminated with preformed nitrosamines.

Nitrosamines may enter the body by inhalation, ingestion, or percutaneous absorption. *In vivo* formation of nitrosamines may also occur. As yet, there is no direct evidence that nitrosamines cause cancer in humans. However, a number of epidemiologic studies of the tire industry have reported a high incidence of cancer among workers in the areas where the National Institute for Occupational Safety and Health has found the highest nitrosamine levels (7,8).

The reduction in airborne nitrosamine levels achieved in this plant by company management, with the active support of the union, serves as an excellent example of effective risk reduction in a workplace.

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Follow-up on Mount St. Helens

From June 3-13, industrial hygienists from the National Institute for Occupational Safety and Health (NIOSH) collected personal and area samples in northern Idaho and in 5 Washington communities (Longview, Chehalis, Moses Lake, Yakima, and Spokane) that were subjected to ash from either the May 18 or 25 eruptions of Mount St. Helens. The objective of this survey was to assess occupational exposures and community breathing-