

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-

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zone concentrations of respirable dust.*

Samples of ash taken from these areas were analyzed by the NIOSH laboratories. The particles of these samples that were of respirable size (≤ 10 microns) have consistently been found to contain approximately 6% free crystalline silica (SiO_2), of which 2% is quartz and 4% is cristobalite. The sampling method consisted of using a personal sampling pump at a flow rate of 1.7 liters per minute with respirable-dust particles collected on a 37-mm polyvinyl chloride filter after passing through a 10-mm cyclone.

The NIOSH-recommended criterion for occupational exposure is $50 \mu\text{g}$ of free SiO_2 in the respirable dust per cubic meter of air ($50 \mu\text{g}/\text{m}^3$). Respirable-dust concentrations of 0.8 to $1.0 \text{ mg}/\text{m}^3$ of air and a 5% to 6% free SiO_2 content will yield approximately $50 \mu\text{g}$ free SiO_2/m^3 . Based upon available epidemiologic data, nearly all occupationally exposed workers could be exposed up to this concentration 8 hours a day, 5 days a week, for many years without being expected to develop silicosis.

Table 1 shows the workers sampled and the average respirable-dust concentrations from all locations.

TABLE 1. Types of workers, the average respirable-dose concentrations of ash to which they are exposed, and results of area samples, northern Idaho and Longview, Chehalis, Moses Lake, Yakima, and Spokane, Washington

Types of workers/ Area samples	Average concentration of respirable dust mg/m^3
Clean-up crews	
hand-shovelers and sweepers	0.46
sweeper-truck or broom-truck drivers	0.64
front-end loader operators	0.50
grader operators	0.56
water-truck drivers	0.21
truck drivers	0.19
manual hosers	0.05
Rubbish workers	0.67
Idaho forest workers	0.48
Agricultural workers	0.55
Law enforcement personnel	0.10
Area samples	
homes	0.03
schools	0.06
commercial establishments	0.09
autos	0.10

Eighty-five percent of samples that had respirable-dust concentrations of $\geq 0.8 \text{ mg}/\text{m}^3$ ($800 \mu\text{g}$) were collected in the Moses Lake and Yakima areas. Those occupations that had an average respirable-dust concentration of $\geq 0.45 \text{ mg}/\text{m}^3$ exceeded $0.8 \text{ mg}/\text{m}^3$ 15% to 31% of the time.

During the sampling period the clean-up crews (with the exception of the water-truck drivers and truck drivers), rubbish workers, and forest workers were exposed to concentrations of respirable dust that exceeded $0.8 \text{ mg}/\text{m}^3$ 15% to 31% of the time. The use of respirators or dust masks by these individuals would reduce the amount of dust being

*These samples cannot be equated with Environmental Protection Agency samples, which are collected with different instruments and at different locations.

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inhaled. Area samples suggest the general population is exposed to low concentrations of respirable-dust particles in homes, school buildings, commercial establishments, and cars (with the windows rolled up). Persons could, however, be subjected to high concentrations of both total and respirable dust while doing clean-up work outside the house or when high winds are creating visible amounts of ash in the air.

Reported by NIOSH and the Chronic Diseases Div, Bur of Epidemiology, CDC.

Editorial Note: During this period of sampling, some clean-up workers, rubbish workers, and forest workers were exposed to excessive respirable-dust levels, based on a free silica content of 5%-6%. Should there be further ashfall or sustained work in heavy ashfall which results in similar and prolonged exposures over a period of several years, these workers would be expected to be at increased risk from silicosis. Occupationally exposed workers involved in operations which have or create a visible dust cloud should wear NIOSH-approved, half-face respirators with changeable filters or single-use dust masks.

The very low levels of respirable dust measured in community settings, if representative of any future ashfalls, suggest that the general population is not likely to be at increased risk of silicosis. Individuals with asthma and chronic lung disease may have their conditions aggravated by high levels of respirable dust.

During future ashfalls, the general public should stay indoors (or, if in a car, keep the windows closed) or, when outdoors, wear NIOSH-approved, single-use dust respirators. If

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TABLE I. Summary — cases of specified notifiable diseases, United States
[Cumulative totals include revised and delayed reports through previous weeks.]

DISEASE	28th WEEK ENDING		MEDIAN 1975-1979	CUMULATIVE, FIRST 28 WEEKS		
	July 12, 1980	July 14, 1979		July 12, 1980	July 14, 1979	MEDIAN 1975-1979
Aseptic meningitis	121	144	118	1,914	1,818	1,394
Brucellosis	8	7	7	95	69	106
Chickenpox	1,527	1,219	1,219	151,000	167,472	146,885
Diphtheria	—	1	1	2	6	5
Encephalitis: Primary (arthropod-borne & unsp.)	13	24	19	319	296	350
Post-infectious	12	9	5	111	143	143
Hepatitis, Viral: Type B	310	301	301	8,970	7,549	7,937
Type A	477	594	594	14,081	15,635	16,771
Type unspecified	184	192	176	6,230	5,351	4,615
Malaria	33	18	16	949	322	253
Measles (rubeola)	201	171	477	12,092	10,978	22,160
Meningococcal infections: Total	43	42	38	1,627	1,680	1,099
Civilian	42	42	36	1,620	1,663	1,092
Military	1	—	1	7	17	17
Mumps	76	142	169	6,623	10,255	14,911
Pertussis	22	23	24	609	682	682
Rubella (German measles)	32	141	142	2,994	10,124	14,193
Tetanus	3	4	3	34	33	33
Tuberculosis	519	519	572	14,558	14,807	16,176
Tularemia	5	9	4	71	97	71
Typhoid fever	17	13	8	204	245	194
Typhus fever, tick-borne (Rky. Mt. spotted)	54	51	47	459	434	434
Veneral diseases:						
Gonorrhea: Civilian	19,355	20,850	20,554	508,962	513,741	508,137
Military	315	375	441	14,238	14,562	14,594
Syphilis, primary & secondary: Civilian	393	453	453	13,740	12,762	12,762
Military	2	8	6	166	159	166
Rabies in animals	129	97	60	3,568	2,574	1,612

TABLE II. Notifiable diseases of low frequency, United States

	CUM. 1980		CUM. 1980
Anthrax	—	Poliomyelitis: Total	7
Botulism	25	Paralytic	5
Cholera (Calif. 1)	9	Prionococcosis (La. 1, Tex. 1, Utah 1, Calif. 2)	45
Congenital rubella syndrome	37	Rabies in man	—
Leprosy (Tex. 1, Calif. 5)	103	Trichinosis (Conn. 1, La. 4)	70
Leptospirosis (Mass. 1, La. 1)	32	Typhus fever, flea-borne (endemic, murine) (Tex. 3)	35
Plague	6		

All delayed reports and corrections will be included in the following week's cumulative totals.

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these are not available or do not fit (they do not fit children), a handkerchief can be wet and fitted over the nose and mouth.

Meningitis Associated with Enteroviral Infection — Texas, Canada, 1979

Large outbreaks of aseptic meningitis associated with enteroviral infection were reported in San Antonio, Texas, and in 2 areas in Canada in 1979.

Texas: Between April 1 and October 31, 1979, 68 cases of aseptic meningitis were diagnosed in 67 pediatric patients seen at Bexar County Hospital and Wilford Hall U.S. Air Force Medical Center in San Antonio.* Most of the cases occurred between June and September. The meningitis was associated with a documented enteroviral infection in 38 (79%) of 48 cases (47 children) for which viral isolation studies were performed.

An enterovirus agent was isolated from most (71%) of the cerebrospinal fluid (CSF) specimens tested (Table 2). Except for 1 coxsackie B4 and 1 coxsackie B5 virus infection, all of the enteroviruses isolated were echoviruses; no single echovirus type predominated. Type 11 was isolated from 9 patients; type 7 (from 5); type 4 (from 4); and types 1, 17, and 25 (each from 2 patients).

TABLE 2. Enterovirus isolates from rectal, throat, and cerebrospinal fluid specimens from 48 children with aseptic meningitis, San Antonio, April-October, 1979

Type of specimen	Specimens	
	Number obtained	Number (percent positive)
Cerebrospinal fluid	38	27 (71)
Rectal	34	24 (71)
Throat	30	15 (50)

The ages of the patients with enterovirus-associated aseptic meningitis ranged from 2½ weeks to 15 years, with 79% of patients under 1 year of age. Forty-nine percent of infants were less than 3 months old. The most common clinical manifestations in this age group included irritability (100%), fever (96%), and decreased appetite (42%).

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Saskatchewan: From May through October, 80 cases of aseptic meningitis were reported to the health department in the city of Saskatoon (pop. 125,000); cases peaked in the summer months. Slightly more males than females were affected, and over half the patients were under the age of 15 years.

Among 109 aseptic meningitis patients on whom specimens were received at the Virus Laboratory at the University Hospital of Saskatoon, an etiologic enteroviral agent was identified in 54: 46 by virus isolation (ECHO 11-44; ECHO 30-2), and 8 by serology (ECHO 11-7; coxsackie B4-1). Isolations were made from the CSF in 32 (70%) of the 46 cases (ECHO 11-31; ECHO 30-1) feces in 9 (all ECHO 11), throat in 3 (ECHO 11-2; ECHO 30-1), and from the throat and feces in 2 (both ECHO 11).

*One infant developed 2 separate episodes of aseptic meningitis 2 months apart. Echovirus 11 was isolated from cerebrospinal fluid (CSF) during the first episode; echovirus 25 was isolated from the CSF during the second episode.

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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 ($64\text{-}250 \mu\text{g}/\text{m}^3$) 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).