LOCATION & MAIL CODE	NAME	FROM NAME	LOCATION
V.F. 1125/4	P. Norris	N.G.Pocock:cc	Hillsboro #257
SUBJECT: Dimethyl Formamide Sampling		DATE: July 28, 1981	

PLAINTIFF'S EXHIBIT
CT-465

cc: Mr. J. L. Anderson

I am enclosing two sample tubes and the air monitoring data sheet for the recent DMF sampling.

Enc.

NATLSCO

LABORATORY ANALYSIS REPORT

National Loss Control Service Corporation
Long Grove, Illinois 60049 (312) 540-2488

ENVIRONMENTAL SCIENCES LABORATORY, A-1

REPORT DATE: SEPTEMBER 25, 1981
SAMPLES REC'D: SEPTEMBER 21, 1981
REQUEST NUMBER: 21856

TO: PETER J. NORRIS
CERTAINTTED CORP.
P.O. BOX 860
VALLEY FORGE, PA. 19482

CORP. HEALTH & SAFETY
SEP 30 1981
RECEIVED

RESULTS

SAMPLE NUMBER	ANALYSIS REQUESTED	PPM DIMETHYLFORMAMIDE			
		FRONT	BACK		
#1	DIMETHYLFORMAMIDE	<0.01	<0.01		
BLANK	" "	NO SOLVENTS PRESENT			

COMMENTS: METHOD: GAS CHROMATOGRAPHY <-MEANS LESS THAN. NOT CORRECTED FOR THE FOLLOWING DESORPTION: DIMETHYLFORMAMIDE-82%.

RESPECTFULLY SUBMITTED,

Joan A. Wronski

JOAN A. WRONSKI, MANAGER
ENVIRONMENTAL SCIENCES LABORATORY

CTD016423

ACCREDITED BY THE AMERICAN INDUSTRIAL HYGIENE ASSOCIATION

ic than aniline, it would appear reasonable to limit the exposure to dimethylaniline to a TLV of 5 ppm and a STEL of 10 ppm.

Other recommendations: Soviet limit (1973) 0.04 ppm; Germany and Sweden (1974) 5 ppm.

References:

1. **Hamblin in Patty, F.A.:** *Industrial Hygiene & Toxicology,* p. 2108, Interscience, NY (1962).
2. **Henderson, Y., Haggard, H.W.:** *Noxious Gases,* p. 227, Reinhold Publishing Corp., NY (1943).
3. **Von Oettingen, W.F.:** *Pub. Health Bull. No. 271,* Washington, DC (1941).
4. **Mayer, R.L.:** *Arch. Gewerbepath. u. Gewerbehyg. 7:*436 (1930).
5. **Hamilton, A.:** *Monthly Labor Rev. 8:*199 (1919).
6. **Watrous, R.M.:** *Brit. J. Ind. Med. 4:*111 (1947).
7. **Fairhall, L.T.:** *Industrial Toxicology,* p. 225, Williams & Wilkins, Baltimore, MD (1957).

DIMETHYLBENZENE

See, **XYLENE**

DIMETHYL CARBAMYL CHLORIDE

DMCC

$(CH_3)_2NCOCl$

TLV, Appendix A2 — Suspected Carcinogen

Dimethyl carbamyl chloride is a liquid with a molecular weight of 108.14. It boils between 165 and 167° C, and under reduced pressure of 20 mm at 64° C. It is extremely reactive, and rapidly hydrolyzes in water to dimethylamine, CO_2 and HCl.

It is used primarily as a chemical intermediate in the manufacture of carbamate pesticides and drugs.

DMCC is carcinogenic in mice by skin application or subcutaneous or intraperitoneal injection. It produced local tumors by each of the three routes of administration.[1]

It is suggested that it is a direct-acting acylating carcinogen and its active form is the cation $(CH_3)_2NClO$.[2]

In a chronic inhalation study, squamous cell carcinomas of the nose were found in over 90% of the surviving rats after an average of 258 days, with an exposure at only 1 ppm.[3]

DMCC is also highly toxic by inhalation. 51 of 100 rats exposed 6 hours/day for 15 days at 10 ppm succumbed.[3]

An estimate of the total number of workers who have been at risk in the chemical industry, made in 1976, was about 300.[3] No cases of human cancer attributable to DMCC have been reported. Due to its high toxicity, however, exposures have apparently been well controlled.

Because of the demonstrated carcinogenesis in animals, dimethyl carbamyl chloride has been placed on the A2 listing of industrial substances suspect of carcinogenic potential for man, with no TLV assigned at this time.

References:

1. Evaluation of Carcinogenic Risk of Chemicals to Man, *IARC Monograph 12:*17 (1976).
2. **Van Duuren, B.L., Goldschmidt, B.M., Katz, C., Sidman, I.:** *J. Natl. Cancer Institute 48:*1539 (1972)-(Abstract).
3. **Stein, H.P.:** Report of *Meeting on Dimethyl Carbamyl Chloride and Diethylcarbamyl Chloride* at New York University Medical Center (October 1976).

DIMETHYL-1,2-DIBROMO-2-DICHLOROETHYL PHOSPHATE

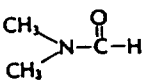
See, **DIBROM®**

DIMETHYLFORMAMIDE

DMF

Skin

$HCON(CH_3)_2$



TLV, 10 ppm (≈ 30 mg/m³)

STEL, 20 ppm (≈ 60 mg/m³)

Dimethylformamide is a colorless, high-boiling, polar liquid, with the following physiochemical properties:[1] molecular weight, 73; boiling point, 153°C; vapor pressure, 3.7 mm Hg at 25° C; concentration in saturated air, 0.48%; conversion factor, 1 mg/L = 335 ppm (1 ppm = 3 mg/m³). It is soluble in water and in numerous organic liquids and readily dissolves many resins and polymers. It has a specific gravity of 0.9445 at 25° C and a closed cup flash point of 136° F.

CTD016424

DMF finds wide use as a solvent, especially for polar polymers. It is also employed as a booster or co-solvent in applications such as protective coatings, adhesives, films and printing inks. It is a component of many paint removers, and is used in selective gas absorptions and solvent extractions.

It has been determined that single dose toxicity of DMF is in the moderate range. An LD_{50} by oral administration to rats was reported as 3500 mg/kg.[2] For man a fatal dose was estimated as 10 g.[3] It has been reported that:

> *"Single exposures of 6 hours' duration to air saturated with DMF vapor (approximately 5,000 ppm, nominal conc.) at room temperature killed rats and produced injury to lungs, liver, and kidneys. Half the saturated vapor concentration (approximately 2,500 ppm, nominal conc.) killed rats after 5 six-hour exposures. In the range of 20 parts of DMF vapor per million parts of air by volume, dogs survived more than 100 exposure periods of 6 hours each and showed no gross or microscopic pathology, but did show a functional drop in systolic blood pressure."*[4]

Massmann[2] found that repeated exposure at 100 ppm were injurious to cats but did not affect rats. Liver damage was the most prominent feature of intoxication. Hofmann,[5] however, failed to produce clinical evidence of liver or kidney damage in cats or rabbits exposed six hours daily at 300 ppm dimethylformamide (DMF) for ten months. Nor did the inhalation of 1000 ppm by rats and cats over a ten-week period result in clinical or histological evidence of liver injury.

Clayton *et al*[6] found that rats exposed at 91 ppm DMF six hours a day for ten days showed slightly enlarged livers. They exposed a number of animals five and one-half hours a day at 23 ppm, followed by a half-hour at 426 ppm. After 58 such exposures toxic effects, particularly on the liver, were noted.

No tumors have been reported in a long-term study wherein rats were orally administered 75 to 150 mg/kg until a total dose of 38 g/kg had been reached (250-500 days). Subcutaneous dosing of rats at 200-400 mg/kg per week until a total dose of 8-20 g/kg was reached likewise failed to produce tumors.[7]

Numerous studies have been carried out to determine the effect of DMF on unborn fetuses when administered to pregnant females by the oral route, by application to skin, and by inhalation. Varying results have been reported. Among the reports which have undergone examination for reproductibility, accuracy and clarity it seems that DMF does not cause fetal malformations but can produce increased embryonal deaths when doses approach the lethal level for the parent female of the species. These doses are greatly in excess of the dose that would be available by exposure to the TLV.

There are various accounts of illness and complaints of illness following exposures.[8-14] Symptoms such as stomach pain, nausea, vomiting and epigastric cramps have been reported. Because of the ability of DMF to readily penetrate intact skin, it has been difficult to relate exposures without skin contact to concentration of DMF in air in these cases of illness. In two plants in which several hundred workers handle DMF on a large scale the prevention of skin contact has been successful and air concentrations are controlled on the average to about one-half of the TLV. Regular periodic analyses of urine samples for DMF and its metabolite monomethylformamide are carried out and periodic liver function measurements are carried out. For several years there have been no complaints of illness and no abnormal liver function tests.[15]

It is concluded that a time-weighted TLV of 10 ppm and a STEL of 20 ppm are satisfactory.

The allowable concentration under the existing OSHA regulation is 10 ppm.

Other recommendations include: West Germany 20 ppm; East Germany, Sweden and Czechoslovakia 10 ppm; USSR 3 ppm.

References:

1. **Kirk-Othmer:** *Encyclopedia of Chemical Technology*, 2nd ed., Vol. 10, Interscience, NY (1966).
2. **Massmann, W.:** *Brit. J. Ind. Med. 13*:51-54 (1956).
3. **Dreisbach, R.H.:** *Handbook of Poisoning*, 8th ed. (1974).
4. **E.I. du Pont de Nemours & Co., Inc.:** *Properties and Uses of Dimethylformamide* (1976).
5. **Hofmann, T.:** *Naunyn-Schmiedeberg's Arch. Exp. Path. Pharmakol. 240*:38 (1960).
6. **Clayton, J.W. Jr., Barnes, J.R., Hood, D.B., Schepers, G.W.H.:** *Am. Ind. Hyg. Assoc. J. 24*:144 (1963).
7. **Druckrey, H.** *et al: Z. Krebsforsch* 69:103-201 (1967).
8. **Massman, W.:** *Zbl. Arbeitsmed. 6*:207-212 (1956).
9. **Potter, H.P.:** *Arch. Env. Health 27*:340-341 (1973).
10. **Reinhl W., Urban, H.J.:** *Int. Arch. Gewerbepath. Gewerbehyg. 21*:333-346 (1965).
11. **Tolot, F.** *et al: Arch. Mald. Professionelles* 19:602-606 (1957).
12. **Chary, S.:** *Lancet 2*:356 (1974).
13. **Dihorenzo, F., Grayioli, C.:** *Lav. Um. 4(24)*:97-105 (1972) (CA 78:106710).
14. **Martelli, D.:** *Ibid. 51*:123-128 (1960) (CA 54:23008).
15. **E.I. du Pont de Nemours & Co., Inc.:** Unpublished information.

2,6-DIMETHYL-4-HEPTANONE

See, DIISOBUTYL KETONE

CTD016425

NATIONAL LOSS CONTROL SERVICE CORP.

These supplies are furnished at no charge courtesy of NATLSCO when samples and unused supplies are returned within 60 days.

Item not returned within 60 days will be charged at the following rates:

Preweighed PVC Filters	$5.00
Unweighed Filters	2.50
Charcoal Tubes	2.00
Solution Bottles	5.00
Organic Solvent Diffusion Badges	8.00

This order includes:

15 silica gel tubes

For further information call:

National Loss Control Service Corporation
Environmental Sciences Laboratory
(312) 540-2488

CTD016426

CERTIFIED
INDUSTRIAL HYGIENE

A MONITORING DATA SHEET

HILLSBORO	257	N. POCOCK	7/24/81

CONTAMINANT
- ☐ FIBERGLASS
- ☐ ASBESTOS
- ☐ TOTAL DUST
- ☐ SILICA DUST
- ☐ ASPHALT FUMES
- ☐ VINYL CHLORIDE (MONOMER)
- ☐ FORMALDEHYDE
- ☐ PHENOL
- ☐ NOISE

DIMETHYL FORMAMIDE

SAMPLING METHOD
- ☐ OPEN FACE
- ☐ CLOSED FACE
- ☐ CYCLONE
- ☐ CLOSED FACE
- ☐ CHARCOAL TUBE
- ☐ IMPINGERS, TWO IN SERIES
- ☒ SILICA GEL
- ☐ AUDIODOSIMETER

SAMPLING METHOD
- ☐ 0.8μ MCEF, MILLIPORE FILTER
- ☐ 5μ PVC FILTER
- ☐ GLASS FIBER-SILVER MEM. FILTER
- ☐ 150 mg CHARCOAL
- ☐ SODIUM BISULFITE
- ☐ 300 mg SILICA GEL
- ☐ 85 dBA
- ☐ 90 dBA

EQUIPMENT
- ☐ DUPONT P4000 PUMP
- ☒ BENDIX ~~[illegible]~~ PUMP
- ☐ MSA PUMP
- ☐ DUPONT D376 AUDIODOSIMETER

EMPLOYEE NAME	PAYROLL NUMBER	DEPARTMENT / LINE
G. MILLER	596	EPOXY

JOB TITLE (IF ENVIRONMENTAL SAMPLE, DESCRIBE LOCATION)	CODE	MANUFACTURING PRODUCT
EPOXY APPLICATOR (DISPENSING STATION)		8" 150 TEST RUN. FLUSHED SYSTEM WITH DMF APPROX. 1 MINUTE.

EXHAUST CONTROL SYSTEMS ☒ FUNCTIONING NORMALLY ☐ NOT FUNCTIONING NORMALLY

REMARKS Elevation: 625'

WEATHER CONDITIONS

OUTSIDE TEMPERATURE °F 100 | WIND DIRECTION S | WIND VELOCITY MPH 15 | ☒ 1-SUNNY ○ 2-PTLY CLOUDY ○ 3-CLOUDY ○ 4-FOG ○ 5-HUMID ○ 6-SHOWERS ○ 7-RAIN ○ 8-SNOW

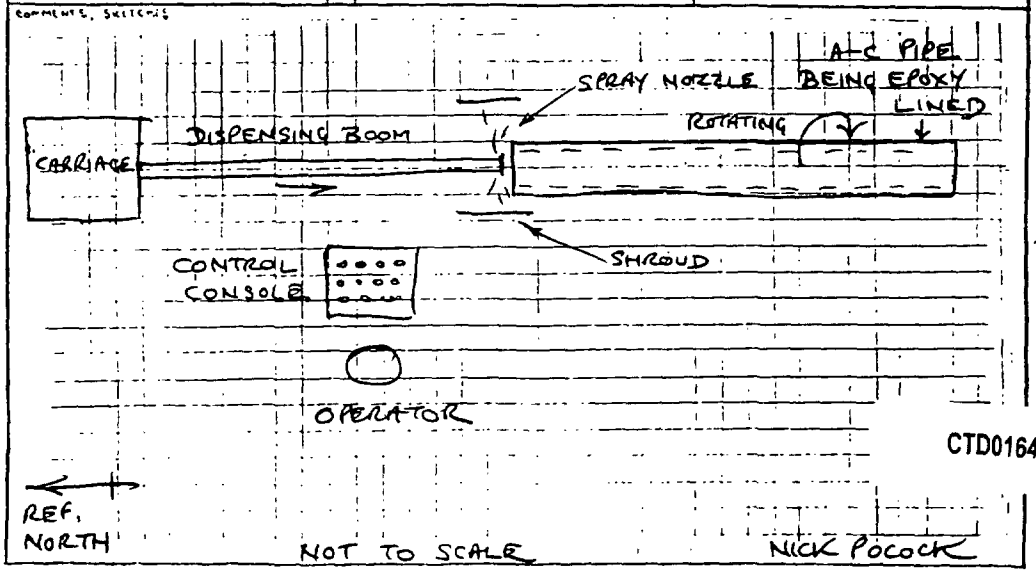
CONTROL NO.	PUMP SERIAL	SAMPLE NUMBER	TIME START	TIME STOP	TOTAL MINUTES	LPM	VOLUME LITERS	ANALYSIS RESULT	AIRBORNE CONCENTRATION
	08-78-94	1	1.44 p.m.	3.06 p.m.	82	1	82	<0.02 ppm	
	BLANK	2	—	—	BLANK				

DID EMPLOYEE WEAR RESPIRATOR? ☐ YES ☒ NO ☐ SOMETIMES | IF SOMETIMES, WHEN? | RESPIRATOR MAKE & MODEL

CONTROL NO.	DOSIMETER SERIAL	CELL NO.	TIME START	TIME STOP	TOTAL MINUTES	READOUT RESULT	8 HOUR CORRECTED EXPOSURE - %

DID EMPLOYEE WEAR HEARING PROTECTION? ☐ YES ☐ NO ☐ SOMETIMES | IF SOMETIMES, WHEN? | MAKE & MODEL

COMMENTS, SKETCHES



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