

**Industrial Hygiene Survey Report
of
TEXON USA (Russell Plant)
Turnpike Industrial Road
Westfield, Massachusetts 45233**

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DISCLAIMER

Mention of company or product name in this report does not constitute endorsement by the National Institute for Occupational Safety and Health (NIOSH).

ACKNOWLEDGEMENTS

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PURPOSE OF SURVEY: To evaluate worker exposures, personal protection equipment and engineering controls in work areas using any of four ethylene glycol ethers (2-ME, 2-MEA, 2-EE, 2-EEA) proposed for revised regulation by OSHA. This information will be used to assess the feasibility of any additional health studies of glycol ether-exposed workers.

EMPLOYER Philip A. Kyriacou, Traffic/Safety Manager
REPRESENTATIVES Gary Wenkel, Environmental Group Manager,
CONTACTED: Emhart Industries

EMPLOYEE None (Non-union)
REPRESENTATIVES
CONTACTED:

SIC Code: 2621 (Specialty Paperboard)

ABSTRACT

The National Institute for Occupational Safety and Health (NIOSH) is conducting a study entitled "An Exposure Assessment of Industries Using Ethylene Glycol Ethers" in collaboration with PEI Associates, Inc. (PEI), Cincinnati, Ohio. This work is being conducted to determine the extent of occupational exposure to these compounds to assess the feasibility of any additional health studies of glycol ether-exposed workers. In addition, the Occupational Safety and Health Administration (OSHA) is interested in this information because they are proposing to revise its current regulations for 2-methoxyethanol, 2-ethoxyethanol, and their respective acetates.

The NIOSH study involves surveying several workplaces where these glycol ethers are manufactured or used as ingredients in process materials. Each survey involves collecting industrial hygiene samples and obtaining information concerning glycol ether usage, process operations, and engineering controls, past exposure levels, the size of the potentially exposed workforce, and the corporate industrial hygiene and safety programs. This information is being compiled by PEI and reported to OSHA's Office of Regulatory Analysis for its assessment of the technical feasibility and economic impact of revising the exposure standards for the glycol ethers.

The specific results from a survey conducted at the Texon USA facility in Russell, MA are presented in this report. (Note: The Russell plant is approximately 10 miles from the Texon USA main offices located in Westfield, MA; mail correspondence is directed through the Westfield office). At this facility, a flexographic ink containing an ethylene glycol ether, 2-methoxyethanol (2-ME), is used to trademark specialty paperboard products. The potential for inhalation and dermal exposure to 2-ME exists primarily during the following periodic activities: (1) diluting ink with solvent, and (2) cleaning the ink press. The monitoring results from the survey indicate mostly nondetectable concentrations for personal samples, although higher area concentrations (0.73 and 1.06 ppm) were measured around the ink storage vats and the ink rollers. (These long-term exposures compare to the 25 ppm OSHA PEL, the 5 ppm ACGIH TLV, and the "lowest feasible level" NIOSH REL). This suggests that the process operators do not work in close proximity to these few sources of 2-ME exposure.

Texon has initiated a project to evaluate design changes to their paper machine for replacing the glycol ether-containing solvent-based ink with a water-based ink. Prior to this substitution, efforts to further minimize exposures at the Russell plant could focus on: (1) covering the ink storage vats; and (2) encouraging strict adherence to wearing respirators and impermeable gloves whenever handling the glycol ether-containing ink.

Due to the generally low exposures to 2-ME and the small number of potentially exposed workers at this facility, this work group would not appear to be suitable for future occupational health studies of glycol ether-exposed workers.

INTRODUCTION

Adverse central nervous system (encephalopathy) and hematotoxic (anemia, leukopenia) effects in workers exposed to 2-methoxyethanol (2-ME) were first noted in the late 1930s [Donley 1936; Parsons and Parsons 1938]. The hematotoxic effects of exposure to 2-ME and other ethylene glycol ethers were later confirmed in animal studies [Miller et al. 1983; Werner et al. 1943ab]. In the late 1970s, studies reported adverse reproductive effects, including testicular atrophy, infertility, fetotoxicity, and fetal malformations in laboratory animals exposed to different ethylene glycol ethers [Doe et al. 1983; Miller et al. 1982, 1984, Brown et al. 1984].

Occupational Safety and Health Administration (OSHA) permissible exposure limits (PELs) were established for eight glycol ethers (including 2-ME (25 parts per million or ppm), 2-methoxyethyl acetate or 2-MEA (25 ppm), 2-ethoxyethanol or 2-EE (200 ppm) and 2-ethoxyethyl acetate or 2-EEA (100 ppm)) in 1981 based upon the 1968 American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs[®]). The TLVs[®] were based on the hematotoxic and neurotoxic effects and on exposure concentrations reported in the early case reports of human health effects. However, more recent information from experimental animal studies indicates that adverse reproductive effects may occur at exposure concentrations below the current OSHA PELs. Therefore, because of the increased concern about their potential to cause reproductive and embryotoxic effects, OSHA is currently developing a proposal to revise its regulation of these four glycol ethers.

Under contract to OSHA's Office of Regulatory Analysis (ORA), PEI Associates, Inc. (PEI) is assessing the technical feasibility and economic impact of revising the exposure standard for ethylene glycol ethers. This work involves compiling information concerning: glycol ether usage patterns, workplace exposures, control technology, and compliance costs. Data are being collected through both mail questionnaires and site visits.

The National Institute for Occupational Safety and Health (NIOSH) is evaluating workplace exposures by cooperatively conducting industrial hygiene surveys with PEI at approximately 11 different plants representing the major usage groups (e.g., industrial coatings, jet fuel additives, commercial printing, aircraft painting, automobile refinishing, maintenance painting, and electronics manufacture) of the four regulated glycol ethers. Each survey involves industrial hygiene sampling and collecting information concerning process operations and engineering controls, glycol ether usage patterns, the size of the potentially exposed workforce, and exposure control methods. NIOSH intends to use this information to determine the feasibility of conducting any additional health studies of glycol ether-exposed workers.

This report presents the results of a site visit conducted at the Texon USA facility in Russell, MA during August 30-31, 1988.

BACKGROUND

Physical and Chemical Properties. The glycol ethers 2-methoxyethanol and 2-ethoxyethanol, and their respective acetates, are part of the family of ethylene glycol ethers; their chemical and physical properties are summarized in Table 1. The ethylene glycol ethers are manufactured by the reaction of ethylene oxide with the appropriate alcohol (e.g., ethanol, methanol); the glycol ethers are used to form acetates by their reaction with acetic acid. In general, glycol ethers and their acetates are colorless liquids with versatile solvent properties (e.g., miscible in water and most hydrocarbon solvents, low vapor pressure, slow evaporation rate) which make them useful in a wide variety of industrial applications.

Production, Use, and Exposure. The total U.S. production of the regulated ethylene glycol ethers and acetates in 1983 is listed in Table 2.

Ethylene glycol ethers and acetates have been used commercially for over 50 years, primarily as solvents in the manufacture of protective coatings such as paints, lacquers, metal coatings, baking enamels, phenolic varnishes, epoxy resin coatings, and stains [NIOSH 1983]. Ethylene glycol ethers and acetates are also used as solvents for printing inks, textile dyes and pigments, and leather finishes; as anti-icing additives in military jet fuels; and in the manufacture of printed circuit boards. Many of these uses require direct handling of the glycol ethers by workers during the formulation and/or evaporation stages, thus leading to the potential for occupational exposure via inhalation and/or skin absorption [Dugard et al. 1984]. Based on data obtained during the National Occupational Hazard Survey (NOHS) conducted by NIOSH during 1972-1974, an estimated 2.5 million men and women may be occupationally exposed to glycol ethers (NIOSH 1977). The numbers of workers potentially exposed to the regulated glycol ethers are presented in Table 3.

Toxicology. The effects of the short-chain ethylene glycol ethers (2-ME, 2-MEA, 2-EE, and 2-EEA) on reproduction and fetal development have been studied extensively in rats, rabbits, and mice. The results uniformly show developmental toxicity, including increased incidences of fetal malformations and resorptions. In general, the evidence suggests that the glycol ether acetates have the same toxicologic activity as their parent glycol ethers. Some studies have indicated that behavioral teratogenic effects may occur in the offspring of rats treated with 2-ME and 2-EE [Nelson and Brightwell 1984]. Testicular damage has also been caused in rats after acute exposures to 2-ME [Doe et al. 1983].

Changes in the blood and adverse effects on the bone marrow and thymus have been observed in rats, mice, and rabbits exposed to 2-ME. The effects of lowered red and white blood cell counts appear to be the result of bone marrow suppression. Recent studies [Miller et al. 1983a] have confirmed histologically the reported depressant effect of 2-ME on the bone marrow and thymus of rats and rabbits. Grant et al. [1985] have reported at least partial reversal of these effects in rats following short-term exposure to 2-ME. Limited information suggests that 2-EE, 2-EEA, and 2-MEA also produce adverse effects in the peripheral blood of rats [Werner et al. 1943b], mice [Nagano et al. 1979], and dogs [Werner et al. 1943a].

TABLE 1

PHYSICAL AND CHEMICAL PROPERTIES OF FOUR ETHYLENE GLYCOL ETHERS

Property	2-ME	2-MEA	2-EE	2-EEA
IUPAC Chemical Name	2-methoxyethanol	2-methoxyethyl acetate	2-ethoxyethanol	2-ethoxyethyl acetate
CAS No.	109-86-4	110-49-6	110-80-5	111-15-9
RTECS No.	KL5775000	KL5950000	KK8050000	KK8225000
Empirical formula	C ₃ H ₈ O ₂	C ₅ H ₁₀ O ₃	C ₄ H ₁₀ O ₂	C ₆ H ₁₂ O ₃
Molecular weight	76.1	118.1	90.1	132.1
Specific gravity	0.97	1.01	0.93	0.97
Density (lbs/gal)	8.04	8.37	7.75	8.10
Vapor pressure (mmHg) 25°C	9.7	2.0-3.7	5.7	2.8
20°C	6.0	2.0	4.0	2.0
Boiling point (°C)	124.5	145.0	135.0	156.0
Flash point (°F) open cup	115	140	120	138
1 ppm=mg/m ³ (25°C,760mmHg)	3.11	4.83	3.69	5.41
1 mg/m ³ =ppm (25°C,760mmHg)	0.32	0.21	0.27	0.19
Other identifiers:	methyl cellosolve ethylene glycol monomethyl ether Dowanol EM	methyl cellosolve acetate ethylene glycol monomethyl ether acetate	cellosolve ethylene glycol monoethyl ether Dowanol EE	cellosolve acetate ethylene glycol monoethyl ether acetate

Clayton and Clayton, 1982

TABLE 2

U.S. PRODUCTION OF FOUR ETHYLENE GLYCOL ETHERS

Compound	1983 Production (pounds)
2-ME	83,000,000
2-MEA	1,000,000
2-EE	187,000,000
2-EEA	153,000,000

SRI 1984

TABLE 3

ESTIMATE OF U.S. WORKERS POTENTIALLY EXPOSED TO ETHYLENE
GLYCOL ETHERS AND ACETATES

Compound	Number of Workers
2-ME	100,000
2-MEA	20,500
2-EE	407,000
2-EEA	321,000

NIOSH 1977

Methoxyacetic acid (MAA) has been isolated and identified in urine as the major metabolite of 2-ME in rats [Miller et al. 1983]. Although all of the glycol ethers are not metabolized via a single pathway, it has been suggested that the major metabolites of 2-ME and 2-EE, MAA and ethoxyacetic acid (EAA), respectively, act to cause the testicular [Miller, et al., 1982, 1984], developmental [Brown et al. 1984], and hematotoxic [Miller et al. 1982] effects observed in rats treated with 2-ME or 2-EE.

Neurologic and hematologic effects were observed in workers following inhalation and dermal exposure to 2-ME [Donley 1936; Greenburg et al. 1937; Zavon 1963; Ohi and Wegman 1978]. A cross-sectional study assessing fertility among men engaged in the production of 2-ME reported decreases in testicular size; no quantitative estimates of exposure concentrations were provided [Cook et al. 1982]. A cross-sectional evaluation of semen quality among men exposed to 2-EE (concentrations ranged from zero to 23.8 ppm 2-EE) found significantly lower sperm count per ejaculate [NIOSH 1986]. Painters exposed to both 2-EE and 2-ME (full-shift exposure concentrations of 2-EE averaged 15 ppm; the concentration of 2-ME was not mentioned) had sperm abnormalities including reduced sperm counts, and abnormalities of both red and white blood cells [Welch and Schrader 1986].

APPLICABLE STANDARDS AND RECOMMENDED LIMITS

Based on toxicological data, NIOSH recommended in Current Intelligence Bulletin (CIB) No. 39 The Glycol Ethers, with Particular Reference to 2-Methoxyethanol and 2-Ethoxyethanol: Evidence of Adverse Reproductive Effects that 2-ME, 2-EE, and structurally related glycol ethers be regarded in the workplace as having the potential to cause adverse reproductive effects in male and female workers. Also noted were and embryotoxic effects, including teratogenesis, in the offspring of the exposed pregnant females [NIOSH 1983]. The NIOSH current recommended exposure limit (REL) is therefore "reduction of workplace levels to the lowest extent possible." Since publication of

CIB No. 39, additional data on the glycol ether compounds have been published (as summarized in ECETOC 1985). These data are currently being evaluated during the development of a criteria document for the ethylene glycol ethers.

The current NIOSH RELs, OSHA PELs and ACGIH TLVs[®] established for the targeted glycol ethers are summarized in Table 4.

TABLE 4
APPLICABLE STANDARDS AND RECOMMENDED LIMITS

Compound	Exposure Limit ^a (ppm)		
	NIOSH REL	OSHA PEL	ACGIH TLV [®]
2-ME	*	25 ^S	5 ^S
2-MEA	*	25 ^S	5 ^S
2-EE	*	200 ^S	5 ^S
2-EEA	*	100 ^S	5 ^S

CFR 1984; ACGIH 1987

^a 8-hour time-weighted-average (TWA_g)

^S Skin notation

* Reduce exposure to lowest feasible level

HISTORY AND DESCRIPTION OF THE FACILITY

The Texon USA plant in Russell, Massachusetts, produces specialty paperboard material for use as insoles in footwear manufacturing. Operations at the Russell plant started in 1947. Texon also has another domestic plant nearby in Westfield, Massachusetts, where sheets and rolls of paperboard from the Russell plant are received and finished with a vinyl coating for use in the luggage industry. A large portion of Texon's products are exported. Texon also has international plants in France, West Germany, and Taiwan. Texon was purchased by Emhart Industries in 1980 and is part of Emhart's Industrial Group.

There are two machines for making paperboard at the Russell plant. While one of the machines (No. 5) uses a water-based flexographic ink for applying a trademark to the finished product, the second machine (No. 4) uses a solvent-based ink (Salmon Flexo Ink) which contains 1-20 weight percent of 2-methoxyethanol (2-ME). Previously, a black flexographic ink containing 2-ME was also used at the plant. Texon reported that the solvent-based flexographic ink was used on Machine 4 because of the incompatibility of water-based inks with the peroxide precoat finish required on the product made from this machine. Machine 4 processes 7457 tons of paperboard annually, with an associated trademarking ink consumption of 1520 gallons.

PROCESS DESCRIPTION

The pulp for the paper machines is received by rail at the Texon Westfield plant, and transferred by truck to the Russell plant. There the the pulp is processed in a pulper and machine chest before being delivered to Paper Machine 4. Machine 4 is approximately 200 feet long and produces paper 110 inches wide.

At the "wet end" of Machine 4, water is initially removed from the pulp before the pulp is pressed into a paperboard material. A latex is added to it in a press saturator before being run through a dryer system. At the "dry end", a peroxide finish is applied to the fiberboard and cured by means of an infrared heater. The trademarking ink is then applied to the wire (bottom) side of the paperboard by means of an indirect roller mechanism. The ink tray and roller span the width of the paperboard (110 inches) and are located on the bottom-side of the paper machine. (Note: Although access from either side of the machine is possible, it is generally difficult to get close to the actual ink tray-roller area). The treated paper is finally wound into rolls and removed from the paper machine. Access to any sections of the paper machine is very limited due its 12 foot width.

The paperboard is sold either in rolls or cut into sheets. The quality of the paperboard product is defined by gauge (thickness) and moisture content. Rip tests and glue tests for ensuring paper quality are performed by a chemist in the plant's quality control laboratory. Fifteen different types of products, each of three to eight different thickness, are produced by Machine 4 which operates continuously 3 shifts/day, 5 days/week. The products are shipped either to the Texon Westfield plant for further processing or to customers.

The trademarking ink is received from the supplier in 5-gallon pails and diluted at the Russell plant with an equal quantity of Carbitol[®] solvent (made by Union Carbide) before being pumped into a tray for transfer to the ink rollers. The Carbitol[®] solvent contains approximately 70 weight percent of diethylene glycol monoethyl ether. The mixing of ink and solvent is usually performed once a day. A viscosity check on the mixture is conducted at that time. The inks are stored, diluted and pumped in a chained-off area located a floor below the paper machine.

The Carbitol[®] solvent is also used for cleaning the ink application rollers; the rollers are first removed from the paper machine and ink removed using rags dipped with Carbitol[®]. This cleaning, which normally occurs at the end of the five-day work week, was not observed during our survey period. Any spills around the ink press are also cleaned at that time using a squeegee and/or paper towels. The area around the 10-gallon pail containing the ink/solvent mixture is cleaned once a month. A major overhaul on the paper machine occurs every summer and takes about three weeks.

There is very little potential for routine exposure to 2-ME for any the process operators because only a minimal quantity of the glycol ether-containing ink is handled/used and only in rather isolated locations in

the work area. These locations include the ink storage area, and the ink tray-roller section of the No. 4 paper machine. The following activities, however, were identified as having a potential for high short-term exposures:

- ° Dilution of the ink with solvent
- ° Cleaning of the ink presses
- ° Cleaning accidental spills of ink

DESCRIPTION OF THE WORKFORCE

The Texon USA Russell plant operates three 8-hour shifts per day, five days per week, 225 days per year. There are a total of 122 employees at the two Texon plants in Russell and Westfield, Massachusetts. The Russell plant has 62 employees, of which 14 are salaried personnel. There are a total of 5 workers per shift at the Russell plant who are potentially exposed to 2-ME. These employees can be grouped into the following 5 job classifications:

Backtender: Wet End - This operator monitors the press saturator and controls the rate of latex addition to the paperboard material. He is responsible for operations preceding the ink roller which is about 50 feet from his normal work area.

Backtender: Dry End - This operator monitors the thickness, moisture content, and overall appearance of the paperboard sheets. He is also responsible for diluting the ink with Carbitol[®] solvent in 10-gallon pails.

The backtenders on the wet and dry end rotate jobs every other week. Additionally, both backtenders are normally responsible for the periodic cleaning of the ink rollers.

Finisher - The finisher is responsible for rewinding the treated fiberboard material into rolls or processing them into sheets. Since his normal work area is about 30 feet from the ink roller, any 2-ME exposures would generally occur by proximity only.

Fourth Hand - This operator acts as a helper to the two backtenders and the finisher.

Machine Tender - This operator oversees the duties of the other process operators, and is responsible for overall machine operation.

CONTROL DESCRIPTION

The area around Machine 4 has general ventilation only. There is no local exhaust ventilation on the ink press.

PERSONAL PROTECTIVE EQUIPMENT

Safety glasses and neoprene gloves are worn by the process operator when diluting the ink with solvent. Arm-length rubber gloves are reportedly worn when cleaning the ink rollers although no cleaning occurred during the survey period. Respirators are also available at the plant, although they are not worn for any specific activities.

MEDICAL AND INDUSTRIAL HYGIENE PROBLEMS

Pre-employment physicals are required for all employees at the Texon plant. Periodic physicals are scheduled annually for employees over 40 years of age and bi-annually for employees under 40 years of age. The medical exams include blood tests, chest x-rays, and physical examination.

There is no formal industrial hygiene program at either the Russell or Westfield Texon plants. The Traffic/Safety Manager heads up a health and safety committee which includes representative from both plants. The parent company, Emhart Industries, also has available an Environmental Management Group which can provide industrial hygiene services to the Texon plants.

No monitoring for glycol ethers has been conducted at the Russell plant. The plant's insurance company has previously conducted monitoring for evaluating worker exposures to 1,3-butadiene and formaldehyde.

SAMPLING STRATEGY AND METHODS

A one-shift sampling survey was conducted on August 31, 1988 at the Texon Russell Plant to measure the extent of exposures associated with the typical usage of formulations containing 2-ME. Personal and area long-term (6- to 7-hour) and short-term (6- to 15-minute) samples were collected. Long-term samples are used to measure full-shift exposures whereas short-term samples are used to measure peak exposures of relatively short duration. Long-term samples were collected on the backtenders, finisher, machine tender, and fourth hand while performing routine daily duties. Short-term samples were collected in the immediate vicinity of the ink rollers and also on a backtender during a viscosity check of the ink.

OSHA Method 53 [OSHA 1985] was used for sampling and analysis of all NIOSH samples. Airborne samples were collected on charcoal, desorbed with methylene chloride/methanol and analyzed by gas chromatography using flame ionization detection (GC/FID). A brief description of the sampling and analytical procedures follows:

Long-term samples were taken with Gilian Model LFS-113DC portable low-flow air sampling pumps calibrated at a flow rate between 0.1-0.2 liters per minute (Lpm). Targeted sample volumes were generally between 30-70 liters. Short-term samples were collected with SKC Model 224 sampling pumps calibrated at approximately 1.0 Lpm; sample volumes were nominally 15 liters.

All samples were collected on SKC No. 226-01 coconut charcoal tubes (100 mg primary/50 mg backup sections) connected to sampling pumps with tygon tubing. Personal samples were attached near the breathing zone of the worker while area samples were positioned in the immediate vicinity of typical work stations. Samples were refrigerated between sample collection and analysis.

Sample analyses were performed by DataChem (Salt Lake City, UT). Charcoal tube samples were desorbed with 95/5 (v/v) methylene chloride/methanol and analyzed using a Hewlett-Packard Model 5890A gas chromatograph equipped with a flame ionization detector.

Table 5 presents the analytical limit of detection (LOD) and limit of quantitation (LOQ) for the ethylene glycol ether sampled at the DFSP terminal. The LOD is that level at which an instrument response can confidently be attributed (95% probability) to the presence of the compound being measured; the LOQ indicates the point at which an indicated response is within acceptable confidence limits. Table 5 also shows the equivalent LOD and LOQ concentrations for an 8-hr TWA sample collected at 0.2 Lpm and a 15-minute short-term sample collected at 1.0 Lpm.

TABLE 5
LIMIT OF DETECTION (LOD) AND LIMIT OF QUANTITATION (LOQ)
FOR 2-METHOXYETHANOL (2-ME)

Analytical Limits (mg/sample)		Sampling Limits (ppm/sample)			
LOD	LOQ	TWA8 ^a		Peak ^b	
		LOD	LOQ	LOD	LOQ
0.01	0.03	0.03	0.10	0.21	0.64

^a 8-hour time-weighted average sample collected at 0.2 Lpm.

^b 15-minute short-term sample collected at 1.0 Lpm.

MONITORING RESULTS

A total of 12 field samples were collected and analyzed for 2-ME. Only one personal field sample indicated the presence of 2-ME, and this result was between the limit of detection (0.01 milligram per sample) and the limit of quantitation (0.03 milligram per sample) of the analytical method. (Note that the actual sampling LODs and LODs vary according the sampling duration for each sample). The analytical results of all field samples are shown in Table 6.

TABLE 6

MONITORING RESULTS FOR 2-METHOXYETHANOL (2-ME)
 TEXON USA (Russell Plant)
 Westfield, MA

August 30-31, 1988

Date	Sample ID	Job (Activity)	Time Start-Stop	Flow (cc/min)	Duration (min)	Air volume (L)	Concentration (ppm) ^a 2-ME
08-31-88	TX-1	Finisher	7:16-13:46	203.5	390	79.4	<0.04 ^b
08-31-88	TX-2	Backtender:dry end	7:10-13:53	194.7	403	78.5	<0.04 ^b
08-31-88	TX-10	Backtender:wet end	7:11-13:51	202.0	400	80.8	0.08 ^c
08-31-88	TX-11	Fourth hand	7:15-13:46	205.2	391	80.2	<0.04 ^b
08-31-88	TX-9	Machine tender	7:07-13:48	198.7	401	79.7	<0.04 ^b
08-31-88	TX-18	Outside dock (area)	6:55-13:24	97.2	389	37.8	<0.09 ^b
08-31-88	TX-21	Ink vat pump (area)	6:56-13:32	99.8	396	39.5	0.73
08-31-88	TX-13	Dry end desk (area)	6:57-13:31	100.6	394	39.6	<0.08 ^b
08-31-88	TX-19	Ink rollers (area)	7:00-13:26	102.1	386	39.4	1.06
08-31-88	TX-14	Backtend:dry end ^d	12:56-13:02	1050.0	6	6.3	<0.51 ^b
08-31-88	TX-23	Ink roller(area) ^d	11:13-11:28	980.0	15	14.7	<0.22 ^b
08-31-88	TX-15	Ink roller(area) ^d	11:28-11:43	980.0	15	14.7	5.25

^aSamples were not time-weighted to 8-hour concentrations.

^bSample result was less than the analytical limit of detection (0.01 mg/sample).

^cSample result was less than the analytical limit of quantitation (0.03 mg/sample).

^dShort-term sample.

Long-Term Sampling Results - A total of nine long-term samples (five personal and four area) were collected during the monitored work shift. Sample results of the five personal samples ranged from nondetected to 0.08 ppm (which is below the limit of quantitation). Full-shift 2-ME area concentrations of 0.73 and 1.06 ppm were measured around the ink vat pump and ink application rollers, respectively. The low full-shift 2-ME concentrations measured for the personal samples suggest that the process operators do not work in close proximity to the ink press, the primary generation source of 2-ME vapors, during their work shift.

Short-Term Sampling Results - One short-term personal sample was obtained on the dry end backtender during a viscosity check on the ink/Carbitol[®] solvent mixture; the result showed nondetectable levels of 2-ME. Two short-term area samples were collected near (within 24 inches) of the ink application rollers; one sample (within 12 inches) showed a 2-ME concentration of 5.25 ppm. (Note: These samples were not collected in a location to which workers would be normally exposed but rather in a fairly inaccessible portion of the paper machine--chosen to measure the concentration of 2-ME nearest the generation source).

DISCUSSION

Sampling results suggest that personal exposures to 2-ME are not occurring during routine activities at the Texon USA Russell plant. Only one sample indicated any exposure to 2-ME (for a backtender at the wet)--at a full-shift concentration which was below the limit of quantitation.

A couple of long-term area samples, one collected near the storage vats from where the ink is pumped to the ink rollers, and the other in the immediate vicinity of the ink rollers, indicated that concentrations of 2-ME are being generated. The ink vats are located in a remote area of the work area where only the backtender is required to enter occasionally to perform viscosity checks and to dilute the ink as necessary. Covering these vats (which were open during our survey) would help minimize any vapor generation. The ink rollers are in a fairly inaccessible area of the paper machine and any worker exposure would be quite minimal. Dermal contact with the glycol ether-containing ink is possible, primarily when performing viscosity checks, ink dilutions and cleaning ink rollers. Neoprene gloves are provided for protection during these activities.

SUBSTITUTES

Texon personnel indicated that they have initiated a project to evaluate design changes to Machine 4 for switching to a water-based ink. This project is expected to be completed by early 1989. If the project is successful, the use of the glycol ether-based ink at the Russell plant will be eliminated.

CONCLUSIONS

The Texon USA Russell plant uses a flexographic ink containing a low percentage of 2-methoxyethanol to trademark specialty paperboard material for use as insoles in footwear. The potential for inhalation and dermal exposure to 2-ME exists primarily during the following periodic activities:

(1) dilution of ink with solvent, and (2) cleaning of the ink press.

The monitoring results from the survey indicate mostly nondetectable 2-ME concentrations for personal samples, although higher area concentrations (0.73 and 1.06 ppm) were measured around the ink storage vats and the ink rollers. This suggests that the process operators do not work in close proximity to these few sources of 2-ME exposure. The long-term exposures compare to the 25 ppm OSHA PEL, the 5 ppm ACGIH TLV, and the "lowest feasible level" NIOSH REL. The measured exposures are considerably lower than the concentrations in those few studies in which exposed workers were observed to have reproductive effects (see [Cook et al. 1982]; [NIOSH 1986]; [Welch and Schrader 1986]).

Texon has initiated a project to evaluate design changes to their paper machine for replacing the glycol ether-containing solvent-based ink with a water-based ink. Prior to this substitution, efforts to further minimize exposures at the Russell plant could focus on: (1) covering the ink storage vats; and (2) encouraging strict adherence to wearing respirators and impermeable gloves whenever handling the glycol ether-containing ink.

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