U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
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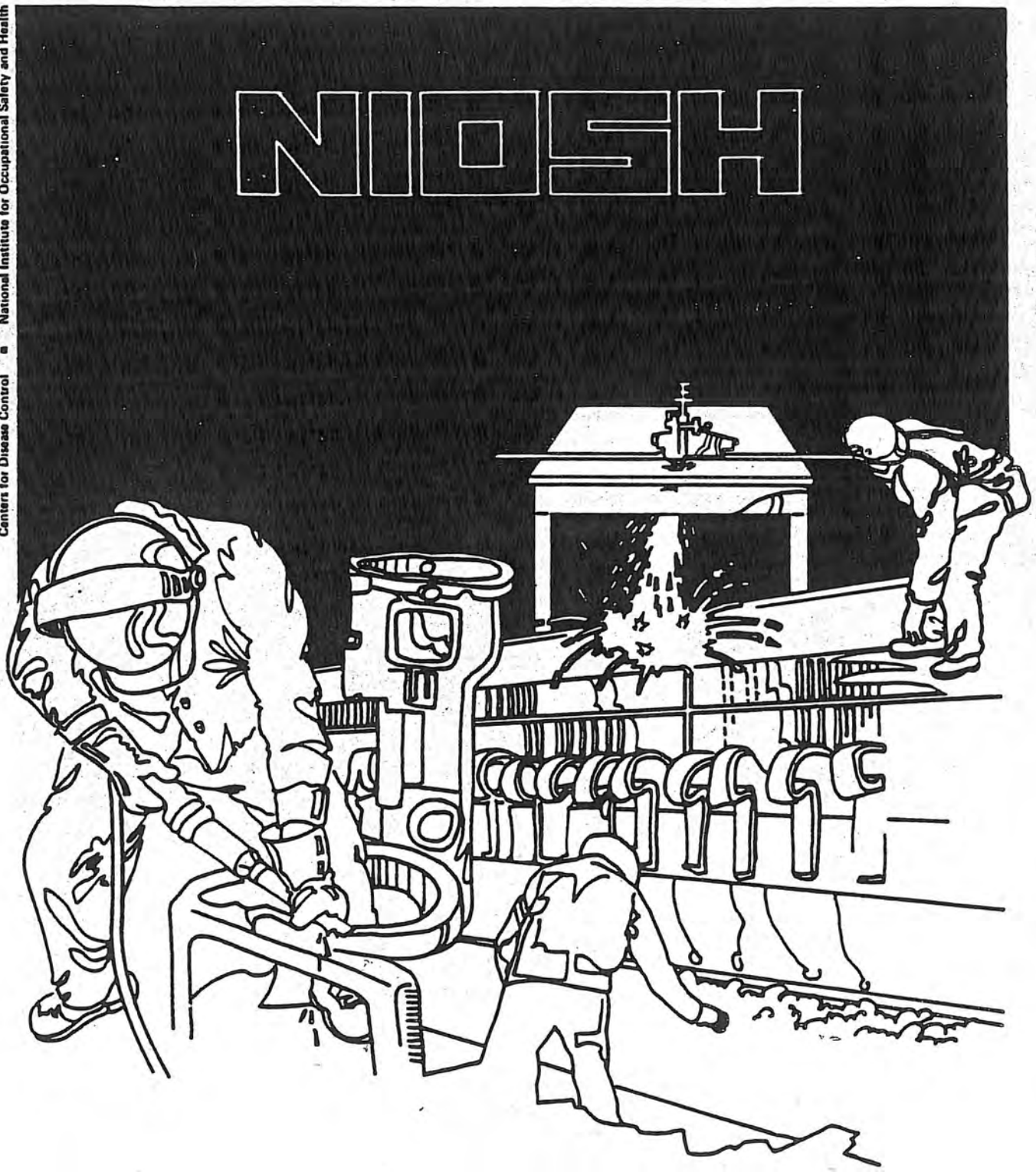
NIOSH



Health Hazard Evaluation Report

HETA 85-462-1748
BOISE CASCADE
VANCOUVER, WASHINGTON

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

HETA 85-462-1748
November 1986
BOISE CASCADE
VANCOUVER, WASHINGTON

NIOSH INVESTIGATORS:
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I SUMMARY

On July 24, 1985 the National Institute for Occupational Safety and Health (NIOSH) received a Health Hazard Evaluation request from an authorized representative of the Association of Western Pulp and Paper Workers concerning exposure to diethylene triamine (DETA), hexamethylene diisocyanate (HDI or HMDI) and other chemicals used in the production of carbonless paper. Symptoms reported as a result of exposure included: voice change, cough (sometimes productive), tightness and soreness in the chest, running sinuses, and skin rashes.

An initial survey was conducted on September 23, 1985. Due to extensive process changes, the environmental/medical evaluation was delayed until April 7-10, 1986. Personal breathing zone samples and area samples were collected to determine the coater prep operators, CF coating operators, CB coating operators, and maintenance personnel exposures to chemicals used in their jobs. The airborne concentration results were: hexamethylene diisocyanate (< 0.7 to 14.0 ug/m^3); diethylene triamine (< 0.01 to < 0.35 ppm), phenol (< 0.02 to 0.15 ppm), formaldehyde (< 0.04 to < 0.08 ppm), biphenyl (0.003 to < 0.02 ppm), butyl biphenyl (0.12 to 0.29 ppm), petroleum solvents (0.7 to 12 mg/m^3), and one total particulate sample was 2.70 mg/m^3. All the sample results were less than the evaluation criteria for these substances.

Medical interviews with 65 employees suggested that when the process is operating properly there are few health complaints associated with the coating process. CF has an odor, is dusty, and has a drying effect. CB application is associated with some irritating vapors and for some people irritation on contact. The maintenance workers have had symptoms associated with exposure to the coating equipment, with the HDI equipment reportedly being the worst offender. Four individuals reported pulmonary symptoms consistent with exposure to diisocyanates. Since the current CB process has become better established and workers are taking greater precautions to limit their exposures, the general situation has improved.

On the basis of the medical questionnaire data obtained during this investigation, we concluded that some workers may have had pulmonary problems related to past diisocyanate exposure. Recommendations to reduce skin contact with the substances and inhalation exposures through the use of personal protective clothing and engineering controls are listed in Section VIII of this report.

KEYWORDS: Sic 2641 (paper coating & glazing) Biphenyl, butyl biphenyl, diethylene triamine, hexamethylene, diisocyanate, phenol, formaldehyde, petroleum solvents, total particulates, respiratory symptoms.

II INTRODUCTION

On July 24, 1985 The National Institute for Occupational Safety and Health (NIOSH) received a Health Hazard Evaluation request from an authorized representative of the Association of Western Pulp and Paper Workers concerning exposure to diethylenetriamine (DETA), hexamethylene diisocyanate (HDI or HMDI) and other chemicals used in the production of carbonless paper. Symptoms listed as a result of exposure included: voice change, cough (sometimes productive), tightness and soreness in the chest, running sinuses, and skin rashes. An initial survey was conducted on September 23, 1985. Due to extensive process changes, the environmental/medical evaluation was delayed until April 7-10, 1986.

III BACKGROUND

This plant makes paper from pulp and makes carbonless paper by applying the appropriate coatings to the paper. The paper itself is produced in a continuous sheet from a pulp slurry. There are two types of coating applied to the paper. One is CF coating which is applied to the front of the second and subsequent sheets. The other is a CB coating which is applied to the back of the first sheet and subsequent sheets. Hence, in a three sheet form, the first sheet would have a CB coating applied to the back of the sheet. The second sheet would have a CF coating on the front and a CB coating on the back and the third sheet would have a CF coating on the front and a CB on the back.

Changes were recently made in the coating application process. The CF coating is now applied as the paper exits the paper machine. The coating is applied, it passes through a dryer and is wound on a roll. The CB is applied in a separate plant area where previously both the CF and CB were applied. The CB is applied to the paper, the paper passes through a series of dryers and is rewound on a roll.

The CF and CB coating are prepared in the coater prep area. The CF coating consists basically of a phenolic resin. It also contains water, dispersant, starch, blade lubricant, and polyvinyl alcohol. The phenolic resins had previously been cooked in the coater prep area. A recent change has been to purchase the phenolic resin already prepared. This change reduced the coater prep personnel exposure to phenol. The CB coating is composed of small urethane capsules that contain a dye, latex, starch, butyl biphenol, petroleum solvent and diethylene triamine.

Carbonless paper is such that when pressure is applied with a pencil the capsules in the CB coating break and the dye is released. The dye then reacts with the phenol in the CF coating and a color is produced.

As the plant runs continuously, the workforce is divided into four rotating shifts with three shifts working on any particular day and the fourth shift being off. Most of the Maintenance workers work a day shift on a non-rotating basis. Crew size on any particular machine varies from 3 to 5 depending on the machine.

IV EVALUATION DESIGN & METHODS

A. Environmental

Breathing zone and general area samples were collected over a three day period to determine the employees' exposures to one or more of the substances listed below:

Substance	Collection Method	Flow Rate	NIOSH Analytical Method
Biphenyl and butyl biphenyls	Charcoal Tube	50 cc/min	1500
Diethylene triamine (DETA)	Silica gel	50 cc/min	P&CAM 276
Formaldehyde	ORBO 22 Tubes	50 cc/min	P&CAM 354
Hexamethylene Diisocyanate (HDI)	Treated Filters NIOSH Method #347	1 lpm	P&CAM 326
Phenol	0.1N NaOH Impinger	1 lpm	3502
Petroleum solvents	Charcoal Tube	50 cc/min	1500
Total Particulates	Filter	1 lpm	Total Weight

B. Medical

An attempt was made to interview all production workers and maintenance workers who were involved with the coated paper and were on duty during the period of the medical site visit. This would have allowed interviewing 3 of the 4 rotating shifts. Unfortunately problems on the graveyard shift interfered with interviewing everyone on at that time. A few workers and ex-workers were interviewed off-site. A general questionnaire was utilized to gather information on current job, past work history, the workers job-related health concerns, other health problems, and smoking history.

V EVALUATION CRITERIA

A. Environmental Criteria

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours were week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the workers to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent becomes available.

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and recommendations; 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's); 3) the U. S. Department of Labor (OSHA) occupational health standards; and 4) the Washington Industrial Safety an Health Agency (WISHA) Standards. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding WISHA or OSHA standards. Both NIOSH recommendations and ACGIH TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended standards, by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendation for reducing these levels found in this report, it should be noted that industry is legally required to meet those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

Substance	NIOSH or ACGIH recommended Criteria (10 Hr TWA)	WISHA and/or OSHA Standards 8 Hr TWA
Biphenyl	0.2 ppm (ACGIH)	0.2 ppm
Butyl Biphenyl	None (Note: Manufacturer suggests 50 ppm)	None
Diethylene Triamine - Skin	1 ppm (ACGIH)	1 ppm
Hexamethylene Diisocyanate	35 ug/m^3 140 ug/m^3 ceiling	None
Phenol - Skin	5 ppm 15 ppm/15 min ceiling	5 ppm
Petroleum Solvents	350 mg/m^3	500 ppm
Total particulates	10 mg/m^3 ACGIH	10 mg/m^3

B. Toxicological

1. Hexamethylene diisocyanate (HDI or HMDI)[1,2,3]--HDI is a strong irritant of the eyes, mucous membranes and skin, and is probably a sensitizer of the respiratory tract, although it has not been studied nearly as thoroughly as the closely related toluene diisocyanate (TDI). HDI's physical properties are very similar to those of TDI and so vapor exposures could be expected to be similar under similar circumstances. Symptoms can include irritation of the eyes, nose, and throat, a choking sensation, and a productive cough.

TDI is noted for often having initial respiratory symptoms develop after a latent period of four to eight hours with night time shortness of breath or cough. TDI is also a direct irritant. Symptoms can progress to asthmatic bronchitis. After symptoms of TDI exposure subside a return to work can cause an acute and severe asthmatic attack almost immediately or within a few hours. A person who has become sensitized to TDI must avoid future exposure completely. Although similar effects have not been reported for HDI, the similarity of this compound to TDI both physically and chemically suggests that such effects are likely. It is not uncommon in applications of diisocyanates to use a partially polymerized diisocyanate, as is the case in this plant. This does reduce the toxicity, but the partially reacted diisocyanate will retain some diisocyanate toxicity, and there is usually some unreacted monomer still present. HDI is the component of most concern in the "OXA".

2. Diethylene triamine (DETA)[2,3,4,5]--DETA is a strongly alkaline skin, mucus membrane and respiratory irritant. It is a known skin sensitizer, and can probably also cause pulmonary sensitization with resultant asthma. Splashes in the eye of any but dilute solutions can cause permanent injury. The vapors are also irritating and sensitizing.

3. Butyl diphenyl (butyl biphenyl)[2,3]--Very little information is available on butyl diphenyl. Patty[2] mentions its use as a non-spreading lubricant. Diphenyl (biphenyl), the parent compound, can be absorbed through the skin as well as by mouth or breathing. It has an unpleasant odor and low volatility so it does not pose a great inhalation hazard. In the body it is metabolized in the liver and metabolites are eliminated through the kidneys. Both organs are at some risk in acute poisoning. Lesser exposure can cause eye and skin irritation. Because of the butyl group attached to the diphenyl, the volatility of butyl diphenyl is probably lower than for diphenyl itself. Heat stability probably remains. Metabolism and toxicity are probably fairly similar to that of diphenyl itself. The manufacturers of butyl diphenyl state in their Material Safety Data Sheet that they believe the TLV should be 50 ppm. This is much higher than the OSHA standard of 0.2 ppm for diphenyl.

4. Polyvinyl alcohol (PVA)[2,4,6]--PVA has low toxicity by any route normally encountered in the workplace. It is probably not absorbed when taken orally. It should probably be treated as a nuisance particulate if airborne dust is a problem.

5. Phenolic resins[2,6]--When fully reacted, phenolic resins are practically inert, although they will release phenols in addition to carbon dioxide and/or carbon monoxide if heated to decomposition (above 300°C - 572°F). However, liquid phenolic resins can give off low levels of phenol, particularly when heated in a drying oven, causing watering of the eyes and irritation of the throat and respiratory tract. Higher concentrations can cause laryngitis, bronchitis, or pulmonary problems. Skin contact can cause a dermatitis. Sensitization is possible.

6. Petroleum solvents--The airborne petroleum solvents identified by laboratory analysis were mainly C9-CH hydrocarbon. Skin contact may cause erythema and dermatitis. Inhalation may result in headache, dizziness, lightheadedness, and may cause some respiratory irritation.

VI RESULTS AND DISCUSSION

A. Environmental - The sample results are shown in Tables 1 - 5.

Coater Prep Area - In the coater prep area, both the CF and CB coating materials are formulated and prepared. There are two employees per shift that work in this area. In the preparation of the CF and CB coatings, they are potentially exposed to phenol, hexamethylene diisocyanate (HDI), diethylene triamine (DETA), butyl biphenyl, biphenyl, petroleum solvents and particulates. In the past, the phenolic resins were cooked in this area; however, a change was recently made and the phenolic resins are now purchased already prepared. Area samples were collected near the mixing tanks for phenol and were less than 0.02 ppm (evaluation criteria is 5 ppm). Bags of materials used in the coating, such as starch and calcium stearate, are placed in a hopper, cut open and dumped. The hopper has local exhaust ventilation and the worker wears a dust respirator during the dumping. His exposure was 2.70 mg/cu m. The criteria of total nuisance dust is 10 mg/cu m.

All the breathing zone and area samples for DETA in the coater prep department were less than detectable concentrations of 0.01 to 0.07 ppm (evaluation criteria for DETA is 1 ppm). Two area samples were collected by the cascade tanks in the capsule area for biphenyl, butyl biphenyl and petroleum solvents. The biphenyl was less than the detectable concentration of 0.02 ppm. The butyl biphenyl concentrations were 0.12 and 0.29 ppm. There is no established criteria for butyl biphenyl. The manufacturer suggests 50 ppm; however, since butyl biphenyl is closely related to biphenyl which has a criteria of 0.2 ppm, the manufacturer's criteria could be too

high. In any case, the workers spend only a small portion of their work shift by the cascade tanks and their actual exposure would probably be less than 10% of the area sample concentration and thus would be less than 15% of the biphenyl criteria. The petroleum solvents (C9 - C11 range) were 0.7 and 12 mg/m^3 which is less than 4% of the criteria.

The sample results for HDI are shown in Table 1. The coater prep operator's exposure for three days was < 0.7, 4.1 and 14.0 ug/m^3. The assistant coater prep operator's exposures on two days were < 0.7 and 1048 ug/m^3. (The latter result is believed by the NIOSH investigator to be in error and is further explained below.) The area samples by the cascade tank in the capsule area were all < 0.7. The criteria for HDI is 35 ug/m^3. The one high sample result is obviously not correct. The assistant coater prep operator spends only a small portion of his work shift in areas where HDI is present. The day of the high result the area sample by the cascade tank was < 0.7 ug/cu m. In order to have an 8 hour TWA exposure of 1048 ug/m^3, his short term exposure would have been much, much higher than this. It was speculated that possibly other substances that he handled that day such as color former dyes caused a positive interference. Boise Cascade launched an extensive sampling schedule to determine the worker exposure to HDI in the coater prep area. As of August 1, 1986, forty four samples were collected on 25 different shifts. All were less than 0.26 ug/m^3. They also determined by chemical analysis that there were no other substances present that would give a positive HDI interference.

Based on the additional sample results that showed exposures of less than 0.26 ug/m^3, and the minimal exposure time to HDI during a work shift, this investigator has determined that the one sample result was in error and is not using this result in the toxicity determination of this report.

There were no problems in the capsule department that required maintenance and repair work during the sampling period so work was created. The maintenance worker cleaned the heat exchange and had an airborne exposure of 1.5 ug of HDI/m^3 of air and the instrument repair man, while cleaning back pressure valves and meters, had an exposure of < 3.4 ug of HDI/m^3. The DETA airborne concentrations were < 0.13 and < 0.35 ppm, respectively. These workers came in constant contact with the liquids that contained DETA and HDI. They were not wearing protective gloves during this time period. It would appear that the maintenance and repair workers are potentially exposed to higher airborne vapor and aerosol concentrations of DETA and HDI and also to splashes and skin contact with the liquids.

Coater Department - The coater department located next to the coater prep area is currently applying the CB coating. CF coating can also be applied on this machine; however, it is currently being done following paper machine #2. The CB coating is applied to previously uncoated paper or to paper that already has the CF coating on one side.

Breathing zone samples were collected for the coater and assistant coater operator jobs and area samples were collected near the dryers to determine maximum vapor exposures. The HDI concentrations ranged from 0.7 to 4.5 ug/m^3 and the DETA results were all less than 0.06 ppm.

The exhaust fans for the two coating dyers are located on the second level. There are leaks on the pressure side of the fan and in the ductwork between the fan and the roof. Area samples near the fan showed no phenol or formaldehyde present as a result of passing previously CF coated paper through the dryer. There was 0.27 ppm of butyl biphenyl and 0.7 mg/m^3 of petroleum solvents present in the area. Any other substance present in the CB coating that can be volatilized at high temperatures would also be present. During the sample period, the doors to the coater area were open. There was a breeze through the area. A previous complaint indicated that during cooler weather the coater area would fill up with airborne contaminants which would drift into nearby areas. Sealing all the leaks on the pressure side of the fan would prevent the vapors from re-entering the coater area.

The CF coating was being applied to the paper as it exited the #2 paper machine. Breathing zone and area samples were collected for phenol and formaldehyde. All formaldehyde concentrations were less than the detectable concentrations of 0.04 to 0.7 ppm. Two phenol samples collected inside the dryer hood were 0.03 and 0.15 ppm. Only one breathing zone sample had a detectable level and that was 0.02 ppm. These are all less than 3% of the phenol criteria.

B. Medical

1) Paper machine # 2 which can apply CF. 16 workers who worked this machine from time to time were interviewed, including: 1 Machine Operator, 5 Back Tenders, 2 Windermen, 2 4th Hands, and 6 5th Hands. In general there were few health complaints although many identified the CF as giving off a distinctive odor which was somewhat irritating. It was also mentioned that the CF was somewhat dusty and had a drying effect. Once the process was operating properly and the curtains around the coater were down, the situation

improved. One worker complained that the CF bothered his asthma and another that it made his bronchitis worse. The Machine Operator identified the slimacide as causing considerable eye irritation, but noted that he had almost no exposure to the coating.

2) Coating Preparation and Coating Machine. 15 workers and one ex-worker who worked in this department were interviewed, including: 7 Coater Prep Operators, 2 Coater Operators, 1 Assistant Coater Operator, 1 Coater Winder, 4 Utility Workers, and the ex-worker. CF was identified as being dustier than CB and producing a "drying" affect on the upper respiratory system. Three workers had headaches and dizziness. Four other workers had skin problems which seemed to relate to work in the area, including one with acne not present before working here, one who got dry brownish spots on his arms and peeling on the face, one whose hands got extremely red on handling the paper fading to a grayish coloration after exposure ceased, and one who was irritated by some of the dyes. One other worker developed shortness of breath and wheezing which gradually worsened over the months while working and gradually cleared when away from the plant.

3) Maintenance Department. 30 workers who worked in this department and one ex-worker were interviewed, including: the Supervisor, 6 Millwrights, 7 Pipefitters, 2 Welders, 9 Electricians, 5 Instrument Men, and 1 Relief Oiler. Symptoms in the coating area included: a raspy sore throat with voice changes, runny nose and eyes, and chest tightness and cough. One worker reportedly had his asthma aggravated, two others apparently developed wheezing or breathing difficulties after prolonged exposure in the coating area, and one reportedly developed an obstructive decrease in pulmonary function (worse in the evening after exposure) which has improved after removal from exposure in the coating area. On the whole, the millwrights, pipefitters, and instrument men reported more problems than the other groups of workers. Concern was also expressed about a hard-to-remove residue coating the tools used in the coating area. Currently a set of tools is dedicated to coater work.

4) Others. 4 other workers were interviewed, including: 2 Starch Makers, a Boiler Tender Helper, and a Lift Truck Driver. One complained of eye irritation, dry throat, and chest tightness while working in the coater area and still notices the eye irritation when going past the open doors. Two others had problems with upper respiratory irritation when exposed to the coater area or its effluent.

5) Summary. The CF was identified as having an odor, sometimes sufficient to cause nausea, and was reportedly dusty and drying to the respiratory tract. This was sufficient to aggravate preexisting asthma or bronchitis on occasions. When the curtains were down on # 2 machine there seemed to be little problem. The coater area caused more irritative problems, particularly to those working on maintaining the equipment. Four of the workers interviewed described pulmonary symptoms consistent with exposure to diisocyanates. There were also complaints of headaches, dizziness, and feeling funny suggestive of solvent exposure. There were skin complaints as well.

Several of the components of the CB are known sensitizers. Unless precautions are taken to control exposure, one could expect health problems. Of the components of CB, the HDI could be expected to cause the most problems until it is fully reacted.

VII CONCLUSIONS

The employees of the coating prep, CB coating and CF coating department, as well as the maintenance workers who perform work in these departmens, were exposed to airborne concentrations of HDI, DETA, phenol, formaldehyde, biphenyl, butyl biphenyl, petroleum solvents and total particulates that were less than the criteria for these substances. Butyl biphenyl does not have an established criteria.

Medical interviews with 65 employees suggest that when things are running well there are few problems with the coating process. CF has an odor and is drying and dusty. CB application is associated with some irritating vapors and for some people irritation on contact. The maintenance workers have had problems with exposure to the coating equipment, with the HDI equipment being the worst offender. In four cases pulmonary problems may have been related to past diisocyanate exposure. Workers with asthma/sensitization need to be, at a minimum, medically monitored and evaluated. Since the current CB process has become better established and workers are taking greater precautions to limit their exposures, the general situation has improved.

VIII RECOMMENDATIONS

1. Personal protective equipment, gloves, clothing, etc., should be mandatory when working on the encapsulation equipment and during maintenance and clean up of the coating equipment.

2. The leaks in the exhaust side of the coating dryer exhaust fans need to be sealed to prevent the volatile materials from the coated paper from re-entering the coating area.

3. The coater area would probably benefit from increased general ventilation.

4. The opening of the hopper in the coating prep area should be reduced to increase the capture of the particulates as the bags are opened and emptied. The air velocity through the opening should be 150 - 250 ppm.

5. Workers potentially exposed to isocyanates should have pre-placement and periodic monitoring of respiratory symptoms and pulmonary function. Anyone with respiratory symptoms temporally related to isocyanate exposure, or with an unexplained decrease in pulmonary function, should be medically evaluated for hypersensitivity, which is typically manifested as asthma. Although a non-sensitized person may have isocyanate-related acute symptoms, these are usually dose-related and not likely to occur at levels below the NIOSH recommended exposure limit. Even at these levels, however, symptoms can occur in sensitized persons, so a worker with documented isocyanate hypersensitivity should not be assigned to a job where there is any exposure to isocyanates.

IX REFERENCES

1. National Institute for Occupational Safety and Health. Criteria for a Recommended Standard, Occupational Exposure to Diisocyanates. Cincinnati, Ohio: National Institute for Occupational Safety and Health, 1978. (DHEW (NIOSH) Publication No. 78-215).

2. Clayton, G.D., & Clayton, F.E., Eds. Patty's Industrial Hygiene and Toxicology. Vol II, toxicology, 3rd rev. ed. New York: John Wiley & Sons, 1982.

3. International Labour Office. Encylopaedia of Occupational Health and Safety. Vol I/a-k, 3rd (revised) ed. Geneva: International Labour Office, 1983.

4. Gosselin, R.E., Smith, R.P., & Hodge, H.C. Clinical Toxicology of Commercial Products, 5th ed. Baltimore: Williams & Wilkins, 1984.

5. American Conference of Governmental Industrial Hygienists. Documentation of the Threshold Limit Values, 4th ed. Cincinnati, Ohio: ACGIH, 1980.

6. International Labour Office. Encylopaedia of Occupational Health and Safety. Vol II/l-z, 3rd (revised) ed. Geneva: International Labour Office, 1983.

X AUTHORSHIP AND ACKNOWLEDGMENTS

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XI DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. Information regarding its availability through NITS can be obtained from NIOSH, Publications Office, at the Cincinnati address.

Copies of this report have been sent to:

1. Boise Cascade, Vancouver, Washington.
2. Washington State Department of Labor & Industries, Olympia, WA.
3. U. S. Department of Labor/OSHA - Region X.

For the purpose of informing affected employees, a copy of this report shall be posted in a prominent place accessible to the employees for a period of 30 calendar days.

Table 1
Hexamethylene Diisocyanate (HDI) Air Concentrations

Boise Cascade
Vancouver, Washington
HETA 86-462

Job Description or Area Sample Location	Date	Shift	Sample Number	Sample Time Minutes	Sample Volume Liters	HDI ug/m3
Coater Prep Opr	4-8-86	1	3	426	426	14.0
Asst Coater Prep Opr	4-8-86	1	6	420	420	1048.0*
Area Sample - Above cascade tanks in capsule area	4-8-86	1	4	412	412	< 0.7
Coater Prep Opr	4-9-86	2	10	458	458	4.1
Asst Coater Prep Opr	4-9-86	2	9	458	458	< 0.7
Area Sample - By pumps and meters capsule area	4-9-86	2	11	463	463	< 0.7
Coater Prep Opr	4-10-86	1	18	437	437	< 0.7
Area Sample - Near pumps in capsule area	4-10-86	1	17	435	435	< 0.7
Maintenance Man - Working heat exchanger & cleaning lines to curing tanks	4-10-86	1	21	202	202	1.5
Instrument Repairman - Cleaned back pressure valves & oiled meters	4-10-86	1	16	87	87	< 3.4
Coater Opr	4-8-86	1	1	432	432	< 0.7
Asst Coater Opr	4-8-86	1	2	426	426	< 0.7
Area Sample - Under hood above can dryer	4-8-86	1	5	402	402	< 0.7
Coater Opr	4-9-86	2	7	442	442	1.1
Asst Coater Opr	4-9--86	2	8	457	457	1.1
Area Sample - West end just prior to TEC dryer on mezzanine	4-9-86	2	12	437	437	< 0.7
Coater Opr	4-10-86	1	13	452	452	< 0.7
Asst Coater Opr	4-10-86	1	15	458	458	< 0.7
Area Sample - By can dryer	4-10-86	1	20	458	458	< 0.7

*Suspect sample result

Table 2
Diiethylene Triamine Air Concentrations

Boise Cascade
Vancouver, Washington
HETA 86-462

Job or Location	Date	Sample Number	Sample Time Minutes	Sample Volume Liters	Diethylene* Triamine (DETA) ppm
Winder Man Asst Opr	4-8-86	21	426	23.7	< 0.05
Coater Opr	4-8-86	22	432	19.8	< 0.06
Prep Sample - in hood above can dryer	4-8-86	25	402	35.4	< 0.04
Coater Prep Opr	4-8-86	24	426	24.2	< 0.01
Asst Coater Prep Opr	4-8-86	23	420	21.7	< 0.06
Capsule area by cascade tanks	4-8-86	26	412	20.9	< 0.06
Asst Coater Opr	4-9-86	29	457	20.1	< 0.06
Coater Opr	4-9-86	27	442	21.7	< 0.06
Coater Area - Wet end just prior to tel dryer	4-9-86	31	437	22.6	< 0.06
Coater Prep Opr	4-9-86	30	458	20.5	< 0.06
Asst Coater Prep Opr	4-9-86	28	458	17.0	< 0.07
Capsule Area by pumps on floor	4-9-86	32	463	19.3	< 0.07
Coater Opr	4-10-86	34	452	26.3	< 0.05
Asst Coater Opr	4-10-86	35	319	20.4	< 0.06
Coater Area by can dryers	4-10-86	36	458	21.0	< 0.06
Coater Prep Opr	4-10-86	38	341	17.4	< 0.07
Capsule Area by pumps	4-10-86	33	435	37.9	< 0.03
Instrument Repair Man cleaning back pressure valves & meters	4-10-86	37	87	3.5	< 0.35
Maintenancw - Clean & repaired heat exchanger	4-10-86	39	202	9.4	< 0.13

*All samples contained less than 5 ug/sample.

Table 3
Phenol Air Concentrations

Boise Cascade
Vancouver, Washington
HETA 86-462

Job Description or Area Sample Location	Date	Shift	Sample Number	Sample Time Minutes	Sample Volume Liters	Phenol ppm
#2 Paper Machine Coating CF - in hood by can dryers	4-9-86	2	81	280	280	0.15
CF Run Room by open tank of CF material	4-9-86	2	82	466	466	Sample broken in transit
Back Tender	4-9-86	2	83	454	454	0.02
Winder man #2 machine	4-9-86	2	84	439	439	< 0.02
#2 Paper machine coating CF inside dryer hood	4-10-86	1	86	415	415	0.03
#2 Paper machine - By CF coater	4-10-86	1	87	405	405	< 0.02
Back Tender #2 machine	4-10-86	1	88	420	420	< 0.02
Winder man #2 machine	4-10-86	1	89	420	420	< 0.02
CB Coater area - on 2nd level by exhaust blower fan from can dryer coating CB on uncoated paper	4-9-86	2	85	463	463	< 0.02
Coater prep - near hoppers	4-10-86	1	90	420	420	< 0.02
CB - coater area on 2nd level by exhaust blower from can dryer coating CB on CF paper	4-10-86	1	92	397	397	< 0.02
Coater Prep Area by mixing tanks	4-10-86	1	91	397	397	< 0.02

Table 4
Formaldehyde Air Concentrations

Boise Cascade
Vancouver, Washington
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Job Description or Area Sample Location	Date	Shift	Sample Number	Sample Time Minutes	Sample Volume Liters	Formaldehyde ppm
#2 Paper Machine - Coating CF - inside hood by can dryers	4-9-86	2	61	460	19.7	< 0.07
CF Run room by open tank CF material	4-9-86	2	62	466	28.0	< 0.05
Back Tender #2 paper machine	4-9-86	2	64	454	20.1	< 0.07
Winder man #2 paper machine	4-9-86	2	63	439	33.9	< 0.04
#2 Paper Machine Coating CF inside hood can dryers	4-10-86	1	65	415	20.2	< 0.07
#2 Paper Machine - by CF Coater	4-10-86	1	68	405	23.1	< 0.06
Back Tender #2 Paper Machine	4-10-86	1	69	420	21.7	< 0.06
Winder Man #2 Paper Machine	4-10-86	1	67	420	23.1	< 0.06
CB Coating Area - On by exhaust fan from can dryers	4-10-86	1	66	397	15.8	< 0.08

Table 5
Biphenyl, Butyl Biphenyl, Petroleum Solvents, & Total Particulates
Air Concentrations

Boise Cascade
Vancouver, Washington
HETA 86-462

Job or Location	Date	Sample Number	Sample Time Minutes	Sample Volume Liters	Biphenyl ppm	Butyl Biphenyl ppm	Petroleum Solvents mg/m3	Total Dust mg/m3
Coater prep general area by the cascade tanks	4-8-86	C-41	412	17.3	N.D. < 0.02	0.29	12	-
CB Coater area by wet end just prior to TEC dryer on mezzanine	4-9-86	C-42	437	23.7	N.D. < 0.2	0.12	0.7	-
On 2nd level by exhaust fan from can dryer on CB coater	4-9-86	C-43	463	463	0.003	0.27	0.7	-
Assistant coater prep operator	4-10-86	H-1281	420	420	-	-	-	2.70

*Petroleum solvents - MSDS listed composition as complete mixture of petroleum hydrocarbons.