U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45202

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 75-26-245

BABCOCK AND WILCOX COMPANY
CANTON, OHIO
DECEMBER 1975

I. TOXICITY DETERMINATION

It has been determined on the basis of environmental sampling and employee interviews that a health hazard from exposure to 1,1,1-trichloroethane, toluene, xylene, methyl isobutyl ketone, kerosene and mineral spirits did not normally exist within the worksite areas at the time of this evaluation. (May 19-20, 1975) Sample results indicate short-term potentially toxic exposures to mineral spirits in the catapult area. Such exposures are limited to the procedure where the catapults are sprayed with mineral spirits. During these brief exposures, employees should be provided with appropriate protective equipment.

The health hazard request alleged many employees were experiencing health problems, in particular heart attacks, as a result of exposure to substances used in the plant. Employee interviews and review of medical records failed to demonstrate any unusual incidence of heart disease among present or past employees. In addition, there is no evidence in the literature that the use of mineral spirits, paints, or other solvents can be linked to an increased incidence of heart disease.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are available upon request from the Hazard Evaluation Services Branch, NIOSH, U.S. Post Office Building, Room 508, 5th and Walnut Streets, Cincinnati, Ohio 45202. Copies have been sent to:

a) Babcock & Wilcox Company, Canton, Ohio
b) Authorized Representative of Employees
c) U.S. Department of Labor - Region V
d) NIOSH - Region V

For the purpose of informing the approximately 30 "affected employees", the employer shall promptly "post" the Determination Report in a prominent place(s) near where exposed employees work for a period of 30 calendar days.

III. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 20 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by 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 National Institute for Occupational Safety and Health (NIOSH) received such a request from a representative of employees through the Industrial Union Department AFL-CIO, regarding exposure of employees to Opex, toluene and other solvents. The request alleged that many employees were experiencing health problems, including heart attacks, as a result of exposure to these substances

IV. HEALTH HAZARD EVALUATION

A. Conditions of Use

The Babcock & Wilcox Company, Canton, Ohio is engaged in the manufacturing of power generation equipment and boiler fabrication. Four buildings house the above operations, with one area being used for the production of catapult cylinders.

The catapult area is under Navy contract and work consists of the boring and painting of catapult cylinders. The process is in operation approximately nine months of every year resulting in the production of about 100 cylinders. There are six to eight employees in this area during the day shift and two on the evening shift. A lubricant, basically kerosene, is used during the boring operation. Upon completion of the boring operation the cylinders are sprayed with mineral spirits, a process which takes from 15 to 20 minutes. The catapults are then placed in a trichloroethane degreaser. After removal from the degreaser and prior to painting, the cylinders are sprayed with Cosmoline. The process takes approximately three minutes. The cylinders are then brush painted twice, each coat taking approximately 30 minutes to apply.

The building designated as Fabrication involves primarily welding operations. There is however a small paint room located in this area. The painting is limited to small parts brush painted on a very sporatic schedule. Painting, if conducted at all, is limited to one hour per day. The only solvent present in the area is mineral spirits.

Some spray painting is conducted in Building A. A red oxide paint is used which has a VM&P Naphtha and mineral spirits base. Mineral spirits are used as the paint solvent in the area. Painting is performed on an irregular basis and usually confined to one or two employees.

A large layout and inspection table is located in Building B. A white paint (mineral spirits base) is used in this area to mark parts. The paint is used at various times during the shift on a daily basis. One

to two employees work in the area. A paint mixing and storage area is also located in Building B. Painting occurs daily in this area involving 6-8 employees on the day shift and 3-4 on the evening shift. Only one employee is ever continuously involved in painting operations, with the others being involved to varying degrees. Both brush and spray painting is done.

A layout and inspection table is also located in Building C. Again the white mineral spirits based paint is used in marking parts. Painting operations are performed in the North, Center and South Bays of Building C. A paint mixing and storage area is located in the North Bay. Daily painting, both brush and spray type is conducted in the area. Painting is also performed in the Center and South Bay. In all three areas, both brush and spray painting occur on an irregular basis. The number of employees involved and the time spent painting is dependent on the stage and rate of production. Two types of paint are used, Red Oxide and Red Gear Case Paint. The Red Oxide has a VM&P Naphtha and mineral spirits base and the Red Gear Case Paint is mineral spirits and xylene based. The paint pigments are titanium dioxide and iron oxide. No lead was present in any of the paints.

In all the areas described above, it should be emphasized that the operations are very irregular in nature and the number of employees involved and the duration of the painting processes are also very variable.

B. Evaluation Methods

1. Environmental

Air samples were collected using charcoal tubes in the breathing zone of the exposed workers and in various areas where it was thought the highest concentrations of solvent vapors would be produced. A total of 29 samples were collected and sent to the NIOSH laboratories in Salt Lake City for analysis. Samples were analyzed by the gas chromatographic procedures for 1,1,1-trichloroethane, toluene, xylene, methyl isobutyl ketone, kerosene, and mineral spirits. Bulk samples of mineral spirits, kerosene and an unknown solvent were also submitted for analysis.

2. Medical

The medical evaluation consisted of employee interviews and a review of the plant compensation records. Employees whose jobs entailed the use of paints and/or solvents were interviewed. The following types of personnel were interviewed: grinder/painters, layout personnel, and all persons working in the Catapult area. Interviews were conducted in a non-directed manner; and, included questions relating to the development of signs and symptoms resulting from exposure to various solvents and agents found in the workplace. The signs and symptoms resulting from a toxic exposure to the several agents found in the workplace are reported in the following section of this report.

C. Evaluation Criteria

To access the concentration of air contaminants found in the place of employment, two primary sources of criteria were used: (1) occupational health standards as promulgated by the U.S. Department of Labor (Federal Register, June 27, 1974, Title 29, Chapter XVII, Subpart G.) and (2) recommended and proposed threshold limit values (TLV's) and their supporting documentation as set forth by the American Conference of Governmental Industrial Hygienists (ACGIH) 1974. The following section summarizes the adverse effects of excessive exposure to the various substances that workers at Babcock & Wilcox Company come into contact with. Also listed with each substance is the appropriate standard.

1,1,1-trichloroethane shows low toxicity, with lack of injury to the liver or kidneys. It has little capacity to produce organic injury from either single or repeated exposure. Narcotic effects are noted at a high concentration. The current OSHA standard for human exposure to 1,1,1-trichloroethane has been established at 350 ppm.

Toluene is well known for its powerful narcotic effects. Prolonged exposure to this agent may acutely cause headache, weakness, fatigue, unconsciousness, loss of coordination, nausea, vomiting, anorexia, parestheias of the skin and irritation of skin and mucous membranes. Industrial poisoning probably results only from inhalation but toluene is slowly absorbed through the skin and is also irritating to the skin. The Amercian Conference of Governmental Industrial Hygienists (ACGIH) recommended standard for toluene is 100 ppm.

Xylene toxicity is similar to toluene although it is more pronounced with symptoms including headache, fatigue, lassitude, irritability, and gastrointestinal disturbances such as anorexia, nausea, vomiting, heartburn and flatulence. Dizziness, incoordination, and staggering gait may also occur. The absorption of xylene through the skin is not industrially significant. but skin irritation from xylene is more serious than from either benzene or toluene. The present Federal standard for xylene is 100 ppm.

Methyl isobutyl ketone is primarily an irritant but also possesses a narcotic effect. Acute intoxication may result in mucous membrane irritation and dermatitis. Chronic intoxication may produce headache, nausea, and irritation to the respiratory tract. The primary route of absorption is inhalation. It does not appear to be absorbed through the skin. In summary, it presents a low degree of hazard to health in industrial handling. The current OSHA standard for methyl isobutyl ketone is 100 ppm.

Kerosene is a hydrocarbon mixture consisting of aliphatic, olefinic, naphthenic and aromatic hydrocarbons. The principal components are aliphatic ranging from C_5 to C_{16}. Because of their relatively low vapor pressures, inhalation toxicity is unlikely under ordinary conditions

of use. Exposure to mists will cause mucous membrane irritation. Prolonged or repeated contact with skin will result in drying and dermatitis. The threshold limit for these hydrocarbon mixtures has not been established.

Mineral spirits is included in a group of related compounds known as petroleum naphthas. Effects of single acute exposure have been reported ranging from headache, nausea, inebriation and stupor to anesthesia and coma. Acute exposures to high concentrations of petroleum naphthas have been known to produce central nervous system depression. Prolonged or repeated exposure has also been associated with irritation of the skin and mucous membranes of the respiratory tract and eyes. Chronic toxicity of petroleum naphthas has not definitely been established.

Currently there is no federal standard for occupational exposure to mineral spirits. Mineral spirits are a petroleum distillate fraction composed primarily of paraffins and naphthenes. The American Conference of Governmental Industrial Hygienists has recommended an equation for computing threshold limit values for petroleum distillates for which no specific TLV's are listed.

$$TLV = \frac{100}{\frac{\%\ Al}{3.6\ (200\text{-}B.P.^{o}C) + 20} + \frac{\%\ Ar}{1.3\ (200\text{-}B.P.^{o}C) + 10}}\ ppm$$

where % Al = aliphatic components
% Ar = aromatic components
B.P. = mean boiling point in degrees centigrade

The specific brand of mineral spirits used at the Babcock & Wilcox Company contains 9.5% aromatics and represents a distillation cut from 315^{o} - 385^{o}F. Using 177^{o}C. as the mean boiling point, the calculated TLV is approximately 500 mg/M^3.

Cosmolene is a protective lubricant that shields metal surfaces from the oxidant effects of the ambient air. There are several different preparations, each with a different chemical make-up. They all have the following basic make-up: Stoddard Solvent, Mineral Oil-Petrolatum base, fatty acid esters of glycerine, various sulfonates, and other agents that make-up less than 1/2% of the final mixture. Cosmoline 1090 does not contain Stoddard Solvent. The manufacturer recommends that it be used in areas with adequate ventilation and that it should not be taken internally. It may produce skin and eye irritation. Skin contamination should be treated with soap and water. Eye contamination may produce irritation and should be treated with water and calling a physician, if needed. (This information was generously supplied by the manufacturers of Cosmoline, E. F. Houghton and Company.)

D. Evaluation Results and Discussion

1. Environmental

The breathing zone and area samples obtained at the degreaser show only low levels of 1,1,1-trichloroethane (Table 1). The concentrations of 1,1,1-trichloroethane ranged from less than 7 ppm to 18 ppm for the breathing zone samples and reached a maximum concentration of 14 ppm on the area samples. All measured values were very low compared to the present federal standard of 350 ppm and present no health hazard.

The sample results indicate only low levels of exposure to toluene and xylene. Two samples showed detectable levels of toluene with the concentrations being 2.2 ppm and 1.3 ppm. The maximum concentration of xylene measured was 68 ppm, with the average concentration being only 13 ppm. No levels of methyl isobutyl ketone were detected. All results are shown in Table 2. Therefore, based on the criteria outlined in Part C it was determined that no hazard existed from exposure to these solvents.

The analysis for mineral spirits show the concentration for all samples, with the exception of one, ranged from non-detected to 275 mg/M^3. Compared to the calculated TLV for mineral spirits of 500 mg/M^3, the concentrations are below the levels believed to cause adverse effects in workers. The one sample for mineral spirits showed a concentration of 2615 mg/M^3. The sample was a 33 minute sample obtained on an employee who sprays catapults with mineral spirits. Based on duration and frequency of exposure, the proper use of an approved organic vapor respirator during the spraying operation would be a sufficient means of controlling the potentially toxic exposure to the sprayer.

Charcoal tube samples were also collected on the Hone Operator who performs the boring operations on the catapults. A lubricant, basically kerosene, is used during the boring. Analysis was performed using mass spectrometry and gas chromatography to determine what was present in the samples and the concentrations. The results are shown in Table 3. No problem exists in relation to hexane, 2,2,4-trimethylpentane or 1,1,1-trichloroethane exposure. One of the samples was determined to contain 32 ppm benzene. As a result, on August 7 two bulk samples of kerosene were obtained to be analyzed for benzene content. One sample was collected directly from the Hone machine and a second sample from the supply barrel. No benzene was detected in either sample. The results suggest that the benzene found on the charcoal tube was possibly an artifact obtained during the analysis or a contaminant present during the time of the original sampling which has since been eliminated.

Opex was listed on the request as one of the substances whose use was causing health problems at the plant. Opex is composed of VM&P Naphtha, methyl isobutyl ketone, toluene and xylene. At the time of the initial survey, management stated that Opex was not being used and had not been used for some time. Analysis revealed that a sample of a solvent obtained from an unlabeled container in Building B was Opex. This solvent was being used at the time of the initial survey. The sample results show however, that the concentrations of naphtha, toluene, xylene and methyl isobutyl ketone are all below the levels believed to cause adverse effects and that no toxic situation exists in relation to its use.

2. Medical

The medical investigation consisted of employee interviews and a review of the plant insurance records to ascertain the number and kinds of medical disabilities that were granted since 1969 when Babcock & Wilcox took over the management of this plant. Employees whose jobs entailed the use of paints and/or solvents were interviewed; they included: grinder/painters, layout personnel, and all persons working in the catapult area.

Fifteen(15) persons were interviewed employing a non-directed approach; however, included in the interview were specific questions relating to the development of signs and symptoms possibly resulting from exposure to various solvents found in the workplace, previously enumerated above in Section "C", Evaluation Criteria. The persons interviewed during the NIOSH visit represent all persons painting or using solvents. From these interviewees it was learned that paint jobs and the use of mineral spirits and other solvents were sporadic and involved only several hours per day when done. All persons admitted that the day of the NIOSH visit was a usual work day with usual activities. None of the persons interviewed noted any symptoms suggestive of solvent intoxication on the day of the visit. Two painters noted in the past occasional and transient lightheadedness and burning of the eyes, lasting several minutes. Another person, working in the Catapult area noted that the obnoxious odor of Cosmoline aggravated his asthma, on occasion. Employee interviews, moreover, failed to elicit any signs or symptoms that were similar to those mentioned in the survey request form; namely, nosebleeds, bleeding on or into the eyes, and signs or symptoms of heart disease. Mucous membranes irritation was mentioned, as noted above.

In view of the rather "negative" data elicited from the employee interviews and the need to investigate further the allegedly excessive morbidity from heart attacks resulting from exposure to solvents, plant pension records were reviewed. Since 1969, when the Babcock & Wilcox Company took over the plant complex as well as the previous work force, 120 pensions have been granted. The following pensions have been granted for the following medical reasons:

Atherosclerotic Heart Disease	10
Atherosclerotic Cerebrovascular Disease	3
Cancer	
Bladder	1
Lung	1
Leukemia	1
Musculoskeletal Disease	6
Legal Blindness	1
Lung Disease	2

No clustering, either by job or area of employ, appears in the heart disease group or in the group as a whole.

The prevalence of heart disease (all types) is about 9 cases per 100 persons age 45-64. (Date from the National Center for Health Statistics.) Thus we would expect in a group of 120 persons around the age of 65 to find between 11 and 12 persons who have heart disease. While this group is different than the general population, it would not be unusual to find at least 10 persons with heart disease. Thus we would conclude that there is no difference between this group and the general population of similar ages with respect to the prevalence of heart disease.

E. Conclusions and Recommendations

Based on sample results and medical interviews it has been concluded that concentrations of solvent vapors normally encountered by employees are not toxic. Short-term potentially toxic exposures to mineral spirits do occur in the catapult area when mineral spirits are sprayed onto the catapult cylinders. During this intermittent operation, personal protective equipment should be provided and used. A NIOSH approved respirator for organic vapors would be suitable for this purpose.

Notwithstanding the absence of a hazard in relation to exposure to solvent vapors, it is strongly suggested that containers used for storing solvents be properly labeled as to content. Employees should be informed as to what they are using, potential hazards associated with the substance and proper handling procedures and work practices.

V. AUTHORSHIP AND ACKNOWLEDGMENTS

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Canton, Ohio

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TABLE 1

Charcoal Tube Determination
For 1,1,1 - Trichloroethane

Sample Location	Sample No.	Sampling Period	Sample Volume (liters)	1,1,1-Trichloroethane (ppm)
Area Beside Degreaser	1	6:58 - 11:22	14.3	2.4
	2	11:22 - 14:37	9.85	11.6
Degreaser Operator	7	7:25 - 11:25	10.1	6.6
	8	11:25 - 14:45	9.96	18.4

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TABLE 2

Charcoal Tube Determination For Mineral Spirits, Toluene, Xylene and Methyl Isobutyl Ketone

Sample Location	Sample Number	Sampling Period	Sample Volume (liters)	Mineral Spirits mg/M^3	Toluene (ppm)	Xylene (ppm)	Methyl Isobutyl Ketone (ppm)
Fabrication Area Paint Room	5	7:05 - 11:30	9.61	N.D.	N.D.	N.D.	N.D.*
	6	11:30 - 14:35	8.02	72.3	N.D.	N.D.	N.D.
Catapult Area Employee	9	7:27 - 8:00	1.43	2615	N.D.	N.D.	N.D.
Catapult Area Painter	35	17:15 - 17:43	1.40	142.9	N.D.	21.4	N.D.
C. Bldg North Bay Paint Room	10	7:50 - 11:38	9.82	53.9	N.D.	N.D.	N.D.
	11	11:38 - 14:45	9.81	235.4	N.D.	N.D.	N.D.
C. Bldg Center Bay Painter	12	8:05 - 11:40	9.95	66.3	N.D.	5.5	N.D.
	13	11:40 - 14:42	8.48	132.1	2.2	68.7	N.D.
C. Bldg Center Bay Painter	14	8:07 - 11:55	11.3	46.0	N.D.	5.9	N.D.
	15	11:55 - 14:42	9.92	122.9	N.D.	N.D.	N.D.
C. Bldg South Bay Painter Grinder	16	8:12 - 11:36	11.6	5.2	N.D.	N.D.	N.D.
	17	11:36 - 14:45	8.58	1.2	N.D.	2.4	N.D.
B. Bldg Painter Grinder	18	8:24 - 12:14	12.0	38.3	N.D.	0.6	N.D.
	19	12:14 - 14:41	6.43	275.3	N.D.	8.2	N.D.
B. Bldg Painter Grinder	20	8:25 - 12:06	13.2	N.D.	N.D.	N.D.	N.D.
	21	12:06 - 14:36	7.93	N.D.	1.3	8.1	N.D.
B. Bldg Paint Room	22	8:28 - 12:05	12.5	N.D.	N.D.	N.D.	N.D.
	23	12:05 - 14:36	8.46	52.0	N.D.	2.4	N.D.
B. Bldg Inspector	24	8:37 - 12:18	11.2	51.8	N.D.	N.D.	N.D.
	25	12:18 - 14:30	7.06	19.8	N.D.	N.D.	N.D.
A. Bldg Painter	26	8:45 - 12:27	11.3	133.6	N.D.	8.4	N.D.
	27	12:27 - 14:34	6.92	40.4	N.D.	10.9	N.D.
A. Bldg Paint Room	28	8:50 - 14:32	16.4	7.9	N.D.	N.D.	N.D.
C. Bldg Inspector	30	8:58 - 11:55	6.76	N.D.	N.D.	N.D.	N.D.
	31	11:55 - 14:40	6.20	46.8	N.D.	N.D.	N.D.

*N.D. - Not Detected: limit of detectability
Mineral Spirits = 1 mg/M^3
Toluene = 0.2 ppm
Xylene = 0.2 ppm
MIBK = 0.2 ppm

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Table 3

Charcoal Tube Determination for Kerosine

Sample Location	Sample Number	Sampling Period	Sample Volume (liters)	n-Hexane (ppm)	2,2,4-Trimethypentane (ppm)	1,1,1-Trichloroethane (ppm)	Benzene (ppm)
Hone Operator	3	7:20 - 11:28	13.5	1.0	0.8	13.7	N.D.
	4	11:28 - 14:35	8.84	22.4	12.1	8.3	31.9