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

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 73-151-141

ESSEX WIRE CORPORATION
KENTON, OHIO
AUGUST 1974

I. TOXICITY DETERMINATION

It has been determined that the use of trichloroethylene (TCE) in the Man-Pro automatic degreaser, the Tar-Line degreaser, a large degreasing tank, and the die-cleaning operation in the winding area is not toxic in the concentrations as used or found. However, historical accounts suggest that environmental exposure in the past to TCE may have been at toxic concentrations. This determination is based on medical interviews conducted with affected employees and on environmental measurements taken at the above locations.

It has been determined that the epoxy curing agent, dodecyl-succinic anhydride, used in the epoxy molding area is not toxic as used or found. Historical accounts also suggested that environmental exposure in the past to dodecyl-succinic anhydride may have been at toxic concentrations. This determination is based on medical interviews conducted with affected employees in light of available literature regarding epoxy curing compounds.

II. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this Determination Report are available upon request from the National Institute for Occupational Safety and Health, Hazard Evaluation Services Branch, U.S. Post Office Building, Room 508, Fifth and Walnut streets, Cincinnati, Ohio 45202.

Copies have been sent to:

a) Essex Wire Corporation, Kenton, Ohio

b) Authorized Representative of Employees

c) U.S. Department of Labor, Region V, Chicago, Illinois

d) NIOSH Regional Consultant for Occupational Safety and Health, Region V, Chicago, Illinois

For the purpose of informing the "affected employees," the employer will promptly "post" the Determination Report in a prominent place near where affected employees work for a period of 30 calendar days.

III. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29, U.S. Code 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 toxic effects in such concentrations as used or found.

The National Institute for Occupational Safety and Health (NIOSH) received such a request from an employer and an authorized representative of employees regarding exposure to trichloroethylene TCE) used as a solvent in degreasing operations and dodecyl-succinic anhydride used as an epoxy hardener in the epoxy molding area.

The request was initiated by both employer and authorized employee representative at the suggestion of the U.S. Department of Labor. This request would provide for an in-depth evaluation of cause and effect relationships associated with exposure to the aforementioned chemicals.

IV. HEALTH HAZARD EVALUATION

A. Plant/Process Conditions of Use

Essex Wire Corporation, an division of Essex International, Inc., manufactures ignition coils. Approximately 375 people are involved in the manufacture of the coils, with the majority of the workers in 2 categories: finishers (210 employees) and coil winders (101 employees). Three types of coils are manufactured--one type having an epoxy-filled core. Two employees work directly in the epoxy molding area; however, other employees--secondary and primary winders--are located adjacent to the area of the molding operations. Recently, local exhaust ventilation hoods have been installed over the epoxy casters. Dodecyl-succinic anhydride is used as a curing agent.

TCE is used as a solvent for die-cleaning in one process of coil winding. It is used in small quantities, dispensed from an open can, applied to the die with a small brush, and the die is then wiped clean with a cloth. This brief process is performed 2 to 3 times per hour, as needed. TCE is also used as a solvent in 3 degreasing tanks, one automatic and two manually

operated. One manual degreasing tank, now located in the back room, was recently moved to this location from an area near the epoxy molding operation.

B. Evaluation Design

On November 20, 1973, NIOSH representatives, including two industrial hygienists and a medical officer, conducted an observational survey of the facility. Pertinent information was obtained from the employees regarding plant processes, affected employees were interviewed by a medical officer, and work procedures were observed.

Detector tube measurements for TCE were taken at the die-cleaning operation (secondary coil winding area), at the Man-Pro degreaser, the Tar-Line degreasing tank, and the large degreasing tank in the back room.

General room air samples for dodecyl-succinic anhydride were collected in the epoxy molding area and secondary coil winding area. Personal samples were collected for the epoxy molder operator.

Smoke tube tests were also taken in the epoxy molding area, secondary coil winding area and at the degreasing operations to ascertain ventilation efficiency.

Medical interviews were conducted with 11 employees regarding adverse effects from exposure to chemicals in use.

C. Evaluation Criteria

The occupational health standard promulgated by the U.S. Department of Labor (Federal Register, October 18, 1972, Title 29, Chapter XVII, Part 1910; Subpart G, Table G-2) applicable to this evaluation is as follows:

Material	8-hour time weighted average	Acceptable ceiling concentration	Acceptable maximum peak above acceptable ceiling concentration for an 8-hour shift	
			Concentration	Maximum duration
Trichloroethylene (Z37.19-1967)	100ppm	200ppm	300ppm	5 minutes in any 2 hours

ppm = parts of vapor or gas per million parts of contaminated air by volume at 25° C and 760 mm. Hg pressure.

NIOSH has recently recommended to the Department of Labor that occupational exposure to TCE be controlled so that workers will not be exposed to concentrations in excess of 100 ppm as a time-weighted average exposure for an 8-hour day, and that no worker be exposed to peak concentration of TCE in excess of 150 ppm--both concentrations measured by a maximum sampling time of 10 minutes.[1]

No Federal standard has been established for dodecyl-succinic anhydride. Occupational health standards for individual substances are established at levels designed to protect workers' occupational exposure on an 8-hour-per-day, 40-hour-per-week basis over a normal working lifetime.

TCE, which has a sweet odor, has been noted to cause a wide variety of effects in persons exposed to its vapors. Such exposures are at levels considerably above the present Federal Standard of 100 ppm for an 8-hour time-weighted average concentration. Toxic effects include symptoms and signs such as headache, dizziness, vertigo, tremors, nausea and vomiting, sleepiness, fatigue, light headedness, and unconsciousness. Paralysis of the fifth cranial nerve has been reported in association with TCE exposure. Cardiovascular effects include cardiac arrhythmias at very high exposures. Liver and kidney function appears to be little affected by inhalation exposure, even to high concentrations of TCE. Upper respiratory irritation, eye lacrimation, and sleep intolerance have also been reported.[2-3]

Of the components to epoxy compounds, the epoxy hardeners and curing agents are more notable than the resins in their toxic manifestations. All yield a similar picture with excessive exposure, which may include skin irritation (primary irritant contact dermatitis and/or allergic contact dermatitis) as well as respiratory sensitization. The curing agent, dodecyl-succinic anhydride, is known to have less irritating properties than other curing agents used in industry.[4]

D. Evaluation Results and Discussion

1. Environmental

The following air concentrations for TCE were measured with detector tubes at operator level for the following listed locations:

Location	Air Concentration (Range)
Man-Pro Degreaser	0-40 ppm
Die-Cleaning Area	75-100 ppm
Tar-Line Degreaser	10-20 ppm
Back Room Degreaser	20-100 ppm

The above values are "grab-sample" values, taken during sporadic operation of the equipment of cleaning operations, and are much higher than 8-hour time-weighted average exposures would be. Twelve detector tube samples were taken--3 at each of the above locations.

TCE is used in the Man-Pro degreasing for washing tracks--an infrequent operation. The 40 ppm was recorded immediately after washing the track. One-half hour later, however, the reading had subsided to 0 ppm (no TCE detectable).

Values for TCE in the Die-Cleaning area had a considerable range. The high reading of 200 ppm is attributed to carelessness in the application of the TCE and from soaked rags lying near the worker. Careful application of TCE and better housekeeping would reduce the level of TCE vapors in the area.

Levels of TCE at the Tar-Line Degreaser are well under established levels of toxicity. It was noted, via smoke test, that ventilation around this degreaser was adequate.

Levels of TCE at the Back Room Degreaser reached 100 ppm. It was noticed that when the parts basket was put into the degreaser, the basket was situated at the "vapor" line--thus interrupting the vapor lock created by the cooling coils. As a result TCE vapors were able to escape into the room. When cleaning was finished and basket removed, the level of TCE subsided.

Charcoal tube samples were taken for dodecyl-succinic anhydride, but were not analyzed because laboratory techniques for evaluation of this chemical are not available.

2. Medical

Interviews of 11 women employees who had previously reported illness gave

the following characterization of illness, There was wide diversity in symptomatology among the employees who became ill, although there were a few features nearly universally present. For many, the onset of illness was heralded by smelling an odor. A number of them (8/11) then experienced nausea and/or vomiting. The sequence of symptoms beyond this point showed great variability although a large number (6/11) experienced irritability, nervousness, or crying at some time. Several described headaches, sleepiness, heaviness of extremities, and shortness of breath. Other symptoms included trouble concentrating on tasks, abdominal cramps, numbness of the lips and head, and depression. Some residual symptoms, of which a few of the individuals still complained were headache, nervousness, a tendancy to cry, and a general heaviness of the body.

There were differing opinions as to the nature of the odor which seemed to initiate the symptoms. The majority felt that the epoxy vapors were causative, but several felt that TCE was the agent. Paint thinner and soldering were also mentioned.

The majority of those who became ill were secondary winders; several finishers and primary winders were also affected.

Several of the women pointed out that co-workers in the same area experienced no symptoms and that other individuals working in much closer proximity to the TCE tank and the epoxy casters also experienced no symptoms.

Since the TCE tank had been moved into a separate enclosed room and new local exhaust ventilation had been installed over the epoxy casters, nearly all of those interviewed felt that there was an improvement in their symptoms. Some employees indicated that they still experienced symptoms when occasional odors were in their working area. However, if they left the area during these times, their symptoms subsided.

Telephone conversation was held with two local physicians. One had seen a number of the affected individuals in the local hospital emergency room. At that time he noted symptoms and signs of lethargy, malaise, fatigue, and depression. He said that physical examination of the individuals showed no abnormalities. Laboratory testing which included blood lead, chest x-ray, and complete blood count were all normal. One individual was hospitalized for further evaluation, which included liver and kidney function tests, all of which were normal. The physician had no comprehensive explanation for the clinical illness in these employees and was, therefore, concerned about the agents which initiated the problem. The other physician noted primarily upper respiratory tract irritation in the

single individual whom he treated. This person had been noted to have upper respiratory tract infection which was treated.

The wide diversity of symptoms, which in some instances did not correspond to the common toxic effects associated with TCE and epoxy compound vapors, makes any post facto analysis of the situation difficult. The agent which would seem most likely responsible for the majority of the effects noted in the employees is TCE. However, several of the symptoms (shortness of breath, numbness of the lips and head, depression, and a tendency to cry) have not been previously noted in toxicologic studies. The first two symptoms might be explained as a consequence of hyperventilation resulting from nervousness; the latter two might also be attributed to nervousness or hysteria. Further more, no similar illness had been reported during the evening shift which used TCE in the same manner as the day shift. Another question is raised because some employees in close proximity to the TCE tank remained unaffected. These factors cast doubt on the cause of employee illness being simply TCE exposure.

Another possible causative agent is the epoxy anhydride curing agent, dodecyl-succinic anhydride. As discussed above, the primary toxic effects of such agents are dermatologic and respiratory in nature. However, the vast majority of symptoms of the employees do not follow this pattern. As with trichloroethylene exposure, epoxy exposure produced no difficulty in a number of employees in as close or closer proximity to it as the affected individuals. These factors weigh against epoxy compound vapors being the sole etiologic agent.

E. Conclusions

A definite statement as to the cause of employee illness at Essex International cannot be made at this time. However, several statements can be made despite the puzzling nature of the problem. Most of the affected employees have improved subjectively since the TCE tank was moved and the new local exhaust ventilation was installed. Medical evaluation at the time of the acute illness revealed no physical exam abnormalities, and laboratory testing was normal as well; therefore, no evidence for systemic toxicity was apparent at the time of examination. Additionally, environmental measurements for TCE gave no indication that employees were exposed to toxic levels at the time of the NIOSH evaluation.

In summary, the medical histories suggest that toxic concentrations of one or both of these agents may have initiated the symptomatology in affected employees at Essex Wire Corporation. However, the wide array of unusual symptomatology in affected individuals also suggests that emotional factors may have complicated the symptom complex associated with these agents. The residual symptoms which a few of the employees have experienced appear to be related to these emotional factors rather than to toxic environmental exposure. Hence, present conditions indicate no evidence of toxic concentrations to trichloroethylene and dodecyl-succinic anhydride.

VI. AUTHORSHIP AND ACKNOWLEDGEMENTS

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VII. REFERENCES:

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2. Encyclopedia of Occupational Health and Safety, Vol. I and II, 1972, 467-470, 1433-4.

3. Patty, Industrial Hygiene and Toxicology, Vol. II, 1963, 1309-13, 1593-1644.

4. American Industrial Hygiene Association Journal, May-June, 1970, 391-4.