

FIELD SURVEY OF DIAMOND SHAMROCK CHEMICAL COMPANY
REDWOOD CITY, CALIFORNIA

I. BACKGROUND:

In the near future N.I.O.S.H. will be responsible for development of criteria and the recommendation of a standard for occupational exposures to bis(chloromethyl)ether. D.F.S.C.I. conducted on February 16, 1972 an investigative field study of the Diamond Shamrock Chemical Company in Redwood City, California following a request from the San Mateo County Health Department for an epidemiological evaluation of bis(chloromethyl)ether exposures and lung cancer incidence among employees at this plant.

The purpose of the field study was:

- (1) To determine the types of bis(chloromethyl)ether exposures and number of workers involved.
- (2) To conduct a walk-through industrial hygiene survey.
- (3) To inquire as to any known history of lung cancer in current and past employees.
- (4) To examine the suitability of personnel records for epidemiological research.

Jack Washkuhn of the San Mateo County Health Department made preliminary arrangements for our visit and contacted plant management.

II. MANAGEMENT:

Management personnel were very cooperative and helpful throughout the visit. The following company individuals were present:

Norman F. Fahnoe, Plant Manager
Harold F. Sausley, Manager, Duolite
Ion Exchange Resins, Redwood City

Bill V. Lightsey, Employee Relations Manager
Redwood City

Robert E. Frey, Director of Safety and Environmental
Engineering, Painesville, Ohio

James B. Worthington, Research Chemist
Painesville, Ohio

III. THE PLANT:

Diamond Shamrock Chemical Company is a unit of Diamond Shamrock Corporation, which was put together by combination of Diamond Alkali, Fisher Mather, Shamrock Oil, and other companies.

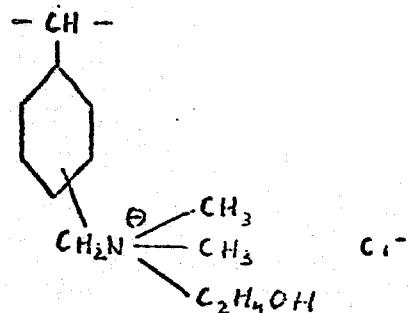
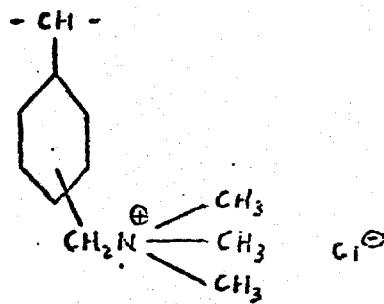
Diamond Shamrock Chemical Company is principally involved in the manufacture of ion exchange resins for use in water softening and for the removal of specific solutes: i.e. desalination of brackish water, decolorization, clarification, etc., as it applies mainly to the food, beverage, and chemical industries.

The plant which consists of three main buildings and several skeleton-type structures was built in 1945 and occupies ten acres. There are approximately 100 plant employees, 75 being blue-collar workers. Housed on the plant site, in addition to the 100 employees mentioned above, are also about 70 sales and administrative people who evidently are only connected administratively with the plant and should not be considered as being part of the plant population. The plant operates three shifts and will go on a four-shift basis shortly.

IV. PROCESS:

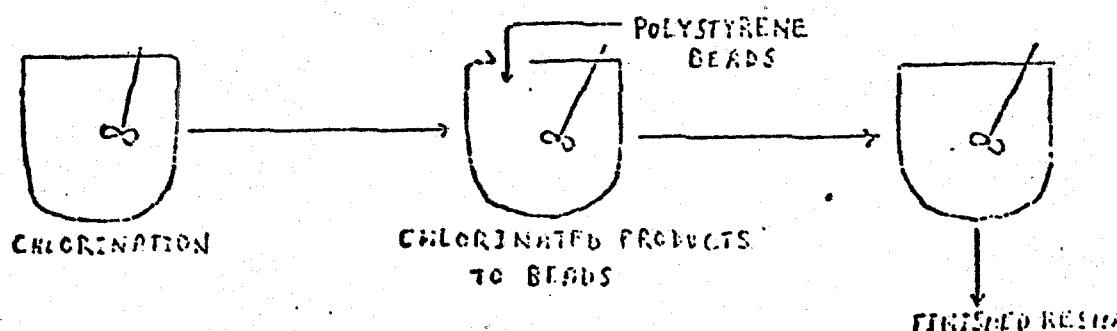
There are a series of about 40 different resins produced; however, only one series (four products) are anionic exchange strong-base resins of the Quaternary Ammonium type that are of interest in this investigation since bis(chloromethyl)ether is involved in their synthesis.

Two of these resins are aminated derivatives of chloromethylated polystyrene which are aminated with either trimethylamine or dimethylethanamine to give the following structures:



In the methylation step, both bis(chloromethyl)ether and chloromethylether form as intermediate compounds and these react to methylate the polystyrene. This chlorinated mixture is transferred by air pressure through glass pipe to the reactor containing the polystyrene beads which reacted with chlorinated product. After completion of this condensation, the mixture is transferred via glass pipe and air pressure to the amination tank where the final product results. The process is entirely enclosed except for the center tank which must be opened so beads of polystyrene can be fed in. This tank is kept under slight negative pressure. At this point, and probably only at this point, there could be some exposure of personnel to BCME.

PROCESS FLOW SHEET



After the reaction is complete, resin is washed and washwater is transferred by air pressure to the so-called water treatment tank where residual BCME or amine is hydrolysed with strong caustic before going to the city sewer.

There is also a pilot plant that runs batches of resin of this type and the same possibility exists for exposure as in the main plant, and probably with more exposure but on a less frequent basis due to the fact that the pilot plant will not always be involved in the production of chlorinated products of the BCME type.

One thing going for both the process and pilot plant equipment is that due to the mild climate, the structures are not tight and, in fact, the pilot plant had no sides, only a roof over it.

Greater exposure is possible and probably has been encountered in the laboratory in the past than is at present encountered in the plant, especially since laboratory work on BCME dates back to about 1955. It is the rule rather than the exception that the research chemists, or more usually the laboratory technicians, get greater exposures than in general do plant personnel. Research is done frequently on a temporary basis, and precautions that usually are provided for the plant worker are often omitted. The present laboratory is lacking in adequate hooding but new adequate type hooding is in the process of being installed.

V. HEALTH AND SAFETY PROGRAM:

The plant does not have a full-time nurse or physician. Dr. Richard McBurney is the full-time medical director for Diamond Shamrock Corporation in Painesville, Ohio. Dr. Paul Nordquist, a local general surgeon, is on call. Pre-employment physical examinations have been performed since approximately 1967. Minifilm chest x-rays are taken annually on a voluntary basis in a mobile trailer. Sputum cytology has been considered but never adopted.

According to management, employees have been informed of bis(chloromethyl)ether exposures and lung cancer in experimental animals. Also, employees reportedly have been told of concern about possible lung cancer risk in humans following bis(chloromethyl)ether exposures.

The plant has a general safety committee, and one employee devotes part of his time to safety. Industrial hygiene and safety consultation is available from corporate offices in Painesville, Ohio.

Safety equipment including glasses, safety shields, and shoes are provided by the company. The company pays half the cost of work clothes and pays for laundering. One shortcoming is that since the employee contributes to the cost of work clothes, he conceivably could take them home.

VI. LUNG CANCER RISK AND BIS(CHLOROMETHYL)ETHER EXPOSURES:

Bis(chloromethyl)ether exposures were first encountered in the research and development laboratories in approximately 1954, and in the pilot plant in 1956. Anion exchange resin production involving chloromethylation reactions started about 1957.

Plant management first became concerned about lung cancer risk following one lung cancer death in a 48-year-old male in 1964 and another in 35-year-old male in 1965. Both these employees had worked in chloromethylation operations.

In 1966 an attempt was made to "contain" the BCME operation, and subsequently chloromethylation reactions were handled in one small building with two operators per shift for three shifts plus occasional maintenance personnel with potential for exposure.

In 1967 a 39-year-old male chemist who had worked in both the research laboratory and pilot plant during the period 1951 to 1964 died of lung cancer.

In November, 1971, a 32-year-old male died of lung cancer; however, this worker was first employed in May, 1969. This individual reportedly had worked in only the warehouse and tank farm.

Two employees are currently alive with lung cancer. A 60-year-old male who worked at this plant during the period of 1957 to 1970 was diagnosed as lung cancer in June, 1970. He reportedly never worked in chloromethylation operations; however, he reportedly had worked in the warehouse and in the steam tube drier operation in the ion exchange department.

Another male employee who worked in the research and development laboratory reportedly underwent a recent pneumonectomy for lung cancer. The personnel file on this past employee was not available.

At least five of the six employees were considered smokers by the local management people present; however, this distribution of smokers is not too dissimilar from the general population.

RECOMMENDATIONS AND CONCLUSIONS

1. Epidemiological:

An excessive lung cancer risk is suspect in this plant population.

Death certificates and/or pathology reports will be obtained on the six cases discussed in this report.

A retrospective cohort study could examine the association between bis(chloromethyl)ether exposures and risk of site-specific cancer. The study population probably would be all plant workers employed at any time during the period 1954 to present.

Management indicated a willingness to cooperate in any NIOSH-DFSCI microfilming of the personnel records.

2. Medical:

Sputum cytology should be conducted annually on all employees with suspected current or past exposure to bis(chloromethyl)ether.

P-A and lateral 14 x 17 chest x-rays should be obtained on all individuals with any suspected history of bis(chloromethyl)ether exposures. The limitations of periodic chest x-ray examinations in lung cancer prevention and screening is recognized; however, good baseline roentgenographic data should be obtained on these workers for future reference and comparison.

Smoking should be discouraged.

3. Industrial Hygiene:

If not a current practice, respirators should be worn by operators adding polystyrene beads to reactor vessels and by maintenance personnel disassembling any equipment in the chloromethylation operations.

Contaminated clothing should not be taken home by the worker.

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16. Abstract (Limit: 200 words)		<p>Exposure to bis(chloromethyl)ether (542881) was surveyed at Diamond Shamrock Chemical Company (SIC-2821) in Redwood City, California on February 16, 1972. The company employed about 100 workers directly involved in resin manufacturing. The only medical personnel at the facility was a local general surgeon. Pre-employment physicals were given and annual chest X-rays were voluntary. Management reports informed employees about the possibility of lung cancer risk following bis(chloromethyl)ether exposure. The company provided safety glasses, shields, and shoes, paid half the cost of work clothes and paid for laundering. Four employees exposed to bis(chloromethyl)ether had died of lung cancer since 1964 and two employees were currently alive with lung cancer. Five of the six were smokers. The authors suggest that an excessive lung cancer risk exists. They recommend obtaining and examining death certificates and pathology reports for the six cases and a retrospective cohort study of the association between exposure and the risk of site-specific cancer. They also recommend annual sputum cytology, chest X-rays, and discouragement of smoking for all exposed employees. Respirators should be worn by at risk employees and contaminated clothing should not be taken home.</p>			
17. Document Analysis a. Descriptors		Field-study, Region-9, Health-surveys, Air-contaminants, Health-services, Chemical-exposure, Toxic-response, Industrial-processes, Control-methods, Occupational-health-programs, Organic-solvents, Chlorinated-hydrocarbons			
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