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Epidemiological Investigation of the Polyvinyl Chloride Industry in Reference to Occupational Acroosteolysis

by

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or elsewhere, followed by healing after removal from the job but with persistent Raynaud's phenomenon.

1. Reactor Scraping

This job appears to be the greatest single factor in the precipitation of AOL. In the overwhelming majority of cases, a history of work in this job can be found. In some few cases outside this study, AOL has been seen to occur in maintenance mechanics. The cleaning of lines from the reactor tanks may afford these workers occasional exposures qualitatively similar to that of reactor cleaners.

2. Compounding Operations

No definitive cases of AOL were found in operations involving compounding or fabrication of the finished polymer. Neither was there undue Raynaud's phenomenon occurrence in such plants. The relatively small population involved (i.e., 557 individuals) does not prove, of course, that the disease never occurs in this operation. The one questionable x-ray (Dx Cat. 4) seen in this population is not unexpected in view of the common occurrence of such borderline x-rays in the control population.

F. MATERIAL EXPOSURE AND AOL

1. Despite computer assisted comparison, no one compound or class of compounds clearly or exclusively was associated with the plants having AOL in comparison to plants without AOL.

2. As regards Raynaud's phenomenon, there is a possibility that exposure to vinyl chloride per se may precipitate a response. While it is understood that the exposure to vinyl chloride in such unique operations is minimal, nevertheless, the rather unexpected higher incidence of Raynaud's phenomenon in Plant G is noteworthy.

If this turns out to be the case, the implications for the etiology of AOL are obvious. Accordingly a close surveillance of VC monomer production population may prove valuable.

G. WORK PRACTICES AND AOL

1. Recovery Phase

The use of a short period for recovering unreacted monomer from the polymer might lead to more residual monomer in the reactor (e.g., in voids of PVC

residue on reactor walls). A study of the temperature and time characteristics of the recovery phase in several plants failed to show differences in practices between plants with AOL and those without.

2. Air Flush of Reactor Before Entry of Cleaner

While operating procedures have been established by plant supervision, it appears that these are being shortcut by hourly employees resulting in increased potential for exposure.

3. Reactor Cleaning Procedures

Hand scraping of reactors has been practiced in all plants except one that started operation in 1966 and which has always used solvent cleaning.

Among the seven plants with AOL, all hand scraped the reactors, generally after every batch, though one of these started using water jets in 1965 and another cleaned a portion of the reactors with water jets from 1962.

Among the 17 plants without AOL, only 10 hand scraped the reactors after every batch and one of these changed to solvent cleaning in 1965. Others manually cleaned reactors every 2 to 10 batches. The plant that started operation in 1966 with solvent cleaning has had no cases.

In the two plants with questionable cases, one hand scraped the reactors after every batch and one after "several" cycles. The latter utilized solvent cleaning intermittently for a portion of the reactors in 1966.

Size differences in plant populations between the "positive" and "negative" plants reduce the validity of meaningful comparisons between the two groups as related to cleaning methods.

Use of high pressure water jets and solvents for reactor cleaning greatly reduced the time that workers were inside the reactors following discharge of the batch and also their contact with materials remaining in the reactor.

H. CONTROL MEASURES IN PREVENTION OF ACROOSTEOLYSIS

In suggesting control methods, it would seem in order to reduce exposure to suspect materials even though the identification of them as the causative agents is not conclusive. Decrease in the time spent scraping reactors could be accomplished by more extensive utilization of high pressure water or solvents in cleaning procedures. The severity of exposure of reactor cleaners to vinyl chloride and also of personnel on the charging floor should be kept at a minimum, desirably below 50 parts per million as suggested by Torkelson et al.

rather than merely below the current threshold limit value of 500 parts per million.

To assure that atmospheric concentrations are below this level, air analysis instruments of adequate sensitivity should be used. The flammable vapor detector at most of the plants gives a positive reading only down to 400 to 800 parts per million of vinyl chloride. A more sensitive instrument of this type is commercially available that reads to a tenth of these levels. Also a portable gas chromatograph has recently become commercially available that has even greater sensitivity. Both of these instruments give immediate readings of the concentration present.

The current practice of venting the reactors by means of a portable blower placed on the charging floor with the vinyl chloride laden air from the reactor being discharged into the general charging room atmosphere may result in excessive vinyl chloride concentrations in this area occupied by the reactor operators and others. Since the odor threshold is 4000 parts per million, freedom from odor does not assure safe concentration. Certainly the concentration varies greatly depending on the enclosure, general ventilation, and the number of reactors being vented during the day. Air analysis using adequately sensitive methods should be conducted in these areas. If vapor concentrations at locations where personnel is exposed are above 50 parts per million for any appreciable duration, consideration should be given to provision of an exhaust system to remove residual vinyl chloride from the reactor to the outside of the building or to a vapor recovery system.

SECTION VII

RECOMMENDATIONS

1. The association between reactor cleaning and the occurrence of AOL is sufficiently clear-cut that steps should be taken to minimize the exposure of workers responsible for this operation. These steps may take the form of substituting water-jet or solvent cleaning for the present hand scraping operations. Where it is necessary for workers to enter the reactor tanks, sufficient ventilation should be provided to reduce the vinyl chloride concentration below 50 ppm.

2. Because of evidence that the disease AOL affects bony structures other than the phalanges, and because of information made available by other investigators that there may be other connective tissue involvement, recognized cases should be removed from further exposure and should be examined at intervals to determine whether there is any progression of the disease.

3. Attempts to produce the disease in experimental animals should be continued to isolate the agents responsible for the disease.

4. Plants that had no cases of the disease in the present survey should not assume that they are immune. In many instances failure to demonstrate cases may have been the result of the small number of employees exposed or limited experience rather than due to a difference in practices. Because of these factors, plants that do not now appear to have cases of AOL should perform regular periodic medical surveillances since this study cannot predict unequivocally that cases of AOL will not occur in the future. For the same reasons, it is recommended that all plants, whether or not they have had cases, adopt the practices outlined in item 1 above.

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