

## OCCUPATIONAL DERMATITIS FROM PYROLYSIS PRODUCTS OF POLYTHENE

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This study concerns occupational hazards connected with exposure to smoke which develops during cutting and sealing operations of polythene tubes at high temperatures.

Four female factory workers operating a machine for cutting and sealing of polythene bags complained of symptoms from the skin and mucuous membranes of the eyes and upper respiratory tract related to their work. The polythene tubes were made from a polythene granulate of American manufacture. The bags were cut and sealed with hot wire. During this operation a small amount of smoke developed. The complaints of the workers concerned the irritation caused by this smoke. The working place was not ventilated, and airing had to take place through the windows. These had, however, to be kept closed in cold weather. The production was organised in two shifts of 8 hours, two women operating the machine during each shift, producing about 5000 bags.

Although the amount of smoke which developed during each cutting operation was very small, the total amount during a working day appeared to be considerable. A pungent odour of the smoke filled the room when ventilation through the windows could not be done. The four women engaged with the cutting were particularly exposed to the harmful effects of the smoke. Also a fifth worker sitting near by in the draft from the cutting machine com-

plained of similar but more moderate symptoms. Occasionally also the remaining workers in the room complained of discomfort from the smoke, and occasionally the cutting operation had to be stopped.

### Histories and Findings

The four workers engaged in thermo-cutting and the fifth sitting next to the machine presented similar subjective complaints: burning sensation in the eyes, a feeling of dryness and irritation in the nose and throat, itching and irritation of the skin of the face and neck and partly of the forearms. During heavy smoke exposure, itching eruptions developed on the uncovered parts of the skin, especially in the ocular regions. In addition a certain feeling of drowsiness and headache was noted at the end of the working day. All symptoms disappeared during absences from the workplace, but recurred on resumption of the work. The workers had been engaged in thermo cutting from one half to one and a half years. They had no histories of previous skin diseases. The four women presented a mild dermatitis localized to the face, primarily in the ocular region, one also on the neck and volar aspects of the forearms. The woman working next to the cutting machine presented no clinical symptoms of dermatitis. On patch testing with formaldehyde (4 % in water) all five

workers gave positive reactions. Patch testing with acrolein was omitted because of the severe irritating effect of this substance.

It was readily stated that the smoke developing during cutting of the polythene tubes had a pungent odour, resembling that of burnt candles, and that it was irritating to the eyes and mucuous membranes of the nose.

Because of this odour the smoke was suspected of containing acrolein. In an experiment the smoke from burning the polythene used was passed through a bubbler containing water. By adding Schiff reagent and a solution of benzidin in glacial acetic acid a pink colour—respectively an intense yellow colour—was obtained, confirming the presence of acrolein and/or other aldehydes. By absorbing the smoke in "Formaldehyde-Prüfröhrchen"<sup>1</sup> a red colour developed, indicating the presence of formaldehyde.

Evidently the smoke developing during burning of this type of polythene contained acrolein as well as formaldehyde. This observation might give a reasonable explanation of the subjective and objective symptoms presented by the afflicted workers.

### Discussion

Occupational hazards due to pyrolysis products of polythene, have apparently not been described previously in the literature, as far as the author could ascertain. The chemical composition of the actual brand of polythene is not known. The manufacturer was not able to give definite answers to the possible causes for the formation of acrolein and formaldehyde by high temperature degradation. Inquiries concerning this problem had apparently not been received previously. Presumably, commercial brands of polythene do not constitute chemically uniform substances. Different synthetic methods and auxiliary substances may be used in the production. Consequently the pyrolysis products may also be different. However, in connection with the

present study, the formation of acrolein and formaldehyde by heat degradation of certain types of polythene, was confirmed (1). By heating a polythene granulate of German origin, massive amounts of acrolein was formed at 200°C, and by further heating formaldehyde developed at about 240°C.

Although acrolein and formaldehyde have been found by pyrolysis of both the American and German brand of polythene, it is not known if this applies to all other types of commercial polythene. Acrolein is intensely irritating to the eyes and upper respiratory tract. One part per million parts of air causes irritation of the eyes, nose and throat within 2–3 minutes. The maximal allowable concentration for daily exposure not exceeding 8 hours, has been set to 0.5 parts per million parts of air by volume (2). Acrolein is also characterized as a strong irritant and sensitizer to the skin (3). The irritant and sensitizing properties of formaldehyde are well known.

The symptoms presented by the four workers are beyond reasonable doubt attributable to the content of acrolein and formaldehyde in the smoke to which they were exposed. Regarding the allergy to formaldehyde demonstrated in the four workers by patch testing, it is impossible to assert if this is due to sensitization from exposure to the smoke or acquired through previous contact with formaldehyde. Anyhow, in addition to the primary irritant effects of acrolein, a combination of primary and allergic effects of formaldehyde probably have contributed to the symptoms described.

### SUMMARY

The presence of acrolein and formaldehyde has been demonstrated in the smoke from burning polythene. In special circumstances exposure to this smoke may involve occupational hazards to the skin and mucuous membranes, as found in four workers in a plastic factory.

<sup>1</sup> Drägerwerk Heinr. & Bernh. Dräger Lübeck.

## REFERENCES

1. Personal communication from Drägerwerk H. & B. Dräger, Lübeck, Germany.
2. Jacobs, M. B.: *The Analytical Chemistry of Industrial Poisons, Hazards and Solvents*. Interscience Publishers, Inc., New York 1949.
3. Schwartz, Tulipan and Birmingham: *Occupational Diseases of the skin*. Henry Kimpton, London 1957.