

absence episodes was found to be almost twice as high in the control operators as it was in the vinyl acetate group.

Overall analysis of Tables III and IV fails to yield significant evidence that vinyl acetate operators have experienced detrimental effects on health attributable to exposure to vinyl acetate.

Employee Questionnaire

Twenty-one operators from the three production units involved were given, at the time of their screening examination, a supplementary questionnaire aimed at eliciting their personal opinions regarding vinyl acetate. The questions used in the survey, along with a summary of responses, are detailed below:

1. Under normal working conditions does vinyl acetate bother you in any way? If so, please explain.

Thirteen subjects (61%) responded with a direct "no" answer. Comments from the other eight operators were:

- a. "When it is in the building it does bother."
- b. "Odor, after the hopper has been opened."
- c. "The fumes from the hoppers irritate my throat and nose and they need digging out when they plug up."
- d. "Irritates between fingers but clears up after hands are washed."
- e. "Irritant when breathed."
- f. "Skin rash? possibly caused by V.A."
- g. "Odor—at first entering the area."
- h. "Yes, it gives me a rash on liquid contact."

2. Does it irritate your eyes, nose, or throat to any significant degree?

Fifteen subjects (71%) responded with a direct "no" answer. Comments from the other 6 operators were as follows:

- a. "Some."
- b. "Some."
- c. "Yes—eyes."
- d. "It is noticeable however it is worse at times."

"Acetate irritates my eyes."

3. Have you experienced any dermatitis or skin

thirteen subjects (86%) responded with a direct "no" answer. One subject answered "yes"; the second subject cited "itchiness of hands"; and the remaining subject answered with a question mark.

4. Any other comments?

Nineteen of the subjects (90%) answered "none" or did not write an answer. Comments of the remaining two subjects were:

- a. "Sorta like the odor of it!"
- b. "When I breathe a lot of fumes it will cause hurting in chest."

How many years have you worked with or around vinyl acetate?

Sixteen of the subjects (76%) had worked with vinyl acetate for more than 15 years; six for 20 years or more. Only three of the subjects had worked with this chemical two years or less. There did not appear to be any positive relationship between length of service and type of response to the questions.

Comment: This questionnaire was answered by employees who have not been noted for their reluctance to comment on adverse conditions. The questions themselves were purposely leading in nature to elicit a maximum response. In view of these two facts, the preponderance of negative answers is strong evidence of a real lack of any significant problem with vinyl acetate under normal working conditions. This conclusion is borne out by Medical Division records which are notably free of complaints, symptoms, or findings referable to vinyl acetate exposure.

Odor Threshold

Procedure: While air sampling was being conducted, five subjects were asked to record whether or not the odor of vinyl acetate was distinctly present and if so to what degree. The subjects involved for a given sample included one of the authors, (DED), a laboratory analyst assisting in the sampling, and one chemical operator at each of the specific pro-

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TABLE V
Subjective Response to Odor and Irritant Effects of Vinyl Acetate
During Air-Sampling in Production Units

Production Unit	Concentration of Vinyl Acetate (ppm)	Odor Evaluation by Observer:			Eye Evaluation by Observer:			Cough Evaluation by Observer:			Hoarseness Evaluation by Observer:		
		X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z
C	0.4	+	+	+	-	-	-	-	-	-	-	-	-
C	0.8	-	-	+	-	-	-	-	-	-	-	-	-
B	2.7	+	+	-	-	-	-	-	-	-	-	-	-
A	4.2	-	+	+	-	-	-	-	-	-	-	-	-
B	4.2	+	+	+	-	-	-	-	-	-	+	-	-
C	5.7	+	+	-	+	-	-	-	-	-	+	-	-
A	6.8	+	+	+	+	-	-	-	-	-	-	-	-
C	7.6	+	+	-	-	-	-	-	-	-	-	-	-
A	7.6	+	+	-	-	-	-	-	-	-	-	-	-
B	9.5	+	+	+	-	-	-	-	-	-	-	-	-
A	9.9	+	+	+	-	-	-	-	-	-	-	-	-
C	21.6	M	M	M	I	I	I	+	-	+	-	+	+

Key: - = None present
+ = Slight
M = Marked
I = Intolerable for extended period

Note: Subject "X" was author (DED)
Subject "Y" was laboratory analyst
Subjects "Z" were three different chemical operators, one per each unit (A, B, C)

duction units being studied. The subjects were asked to record their impressions as follows:

- No definite odor of vinyl acetate present.
- Slight odor of vinyl acetate present.
- Moderate odor of vinyl acetate present.
- Marked odor of vinyl acetate present.

Observations were recorded as above during the collection of 13 samples in three separate production units. Recorded observations are summarized in Table V.

Results: Three of three subjects in Unit C recorded the presence of slight odor at a level of 0.4 ppm. Four of four subjects exposed to 4.2 ppm recorded the presence of slight odor at that level. Three of three subjects exposed to 21.6 ppm agreed on the presence of a marked odor at that level. The highest level at which any subject reported no odor present was 7.6 ppm.

Comment: It should be noted that the determination of an odor threshold in a chemical production unit is quite difficult due to the intermittent and unpredictable presence of odors of other assorted chemicals in the subject's environment. Another factor which may interfere with odor threshold determination under these conditions, is the possibility of olfactory fatigue among persons exposed over long periods of time to the odors of vari-

ous chemicals. Data in Table V tends to bear this out since the three chemical operators appear to have a generally higher threshold than the two subjects not chronically exposed to odors in the ambient air. From the recorded data and personal interpretation, we conclude that *in the industrial environment we have studied* concentrations slightly below 5 ppm have a discernable but not particularly objectionable odor.

Eye Irritation

Procedure: The same subjects cited above were asked to record whether or not eye irritation occurred during the sampling period. They were requested to give their response according to the following scale:

- No eye irritation noted.
- Slight eye irritation noted.
- Marked eye irritation noted.
- Irritation of such severity as to be intolerable over an extended period.

Eye irritation was defined to the subjects as any subjective awareness of burning, itching, stinging, or watering of the eyes.

Results: One of the five subjects recorded slight eye irritation at 5.7 and 6.8 ppm. No other eye irritations were recorded below 10 ppm. The three subjects who were exposed to a concentration of 21.6 ppm were in agreement that the eye irritation produced at this

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level would be intolerable over an extended period of time.

Comment: From our data and personal observations we conclude that, while the eyes of some subjects may be slightly sensitive to concentrations of about 6 ppm, concentrations up to 10 ppm are unlikely to produce eye irritation in most people.

Upper Respiratory Irritation

Procedure: Same subjects cited above were asked to record the presence or absence of cough and/or hoarseness during the sampling.

Results: One subject noted hoarseness at concentrations of 4.2 and 5.7 ppm. None of the other subjects recorded either hoarseness or cough except at a level of 21.6 ppm.

Comment: From our data and personal observation we conclude that, while one observer noted hoarseness at lower levels, concentrations up to 10 ppm are unlikely to produce similar effects in most people. None of the observers experienced cough at levels up to 10 ppm. The majority of subjects exposed to 21.6 ppm experienced cough and/or hoarseness at that level.

Review of Accidental Exposures

A search of the medical records of the 21 operators under study revealed only two episodes of acute exposure to vinyl acetate during the five-year study period. These are detailed below:

1. A chemical operator (RRY) sustained a minor chemical burn of the left eye when he was splashed with a resin slurry containing vinyl acetate, isopropanol, and acetone. The exposure produced nothing more than a slight injection of the conjunctiva which cleared with decongestant eye drops and no revisits were required.
2. A chemical operator (JAS) sustained a first degree burn of the skin of his neck and portions of his face when he was struck by a liquid spray containing vinyl acetate, vinyl chloride, acetone, and a catalyst known to be a strong skin irritant. Examination revealed slight redness of the neck and face. Treatment consisted of nothing more than washing

the involved skin. No revisits were required.

Neither of the exposures cited above resulted in any known residual permanent damage.

Summary

Tests to determine concentrations of vinyl acetate in air were carried out in a chemical plant under what were concluded to be average working conditions. Twenty-one chemical operators who have worked in vinyl acetate production for a mean period of more than 15 years have been subjected to a study of their overall health level. These operators were presumably exposed to levels of vinyl acetate in air of approximately 5 to 10 ppm for the duration of their service. From sampling data, medical records reviews, and personal observation, we believe that:

1. The described method of analysis for vinyl acetate in air has a high degree of specificity, sensitivity, and facility.
2. Vinyl acetate has a distinct odor at levels of less than 5 ppm. Some persons can identify its odor at levels of 0.4 ppm.
3. Vinyl acetate is not a significant eye irritant at levels of 10 ppm. At 21.6 ppm a significant subjective response was elicited from three of three subjects tested. (The range between 10 ppm and 21.6 ppm was not explored.)
4. Vinyl acetate is not a significant upper respiratory tract irritant at levels of 10 ppm. At 21.6 ppm a response of slight cough and/or hoarseness was experienced by observers. (Again, no observations were recorded in the range between 10 ppm and 21.6 ppm.)
5. Vinyl acetate is not a serious eye injurant provided prompt first aid, including an eye-washing procedure, is carried out.
6. Vinyl acetate is not a serious skin injurant when applied to uncovered skin. No serious skin burns due to vinyl acetate have occurred among 21 operators having 320 man-years of possible exposure in production units.
7. Vinyl acetate has presented no signifi-

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No revisits were required. As cited above residual permanent dam-

concentrations of vinyl acetate were found out in a chemical analysis concluded to be average.

Twenty-one chemists worked in vinyl acetate plant over a period of more than a year, subjected to a study level. These operators reported levels of vinyl acetate approximately 5 to 10 ppm in service. From samplings, reviews, and personal observations, we believe that:

Method of analysis for vinyl acetate has a high degree of accuracy, and facility. There is a distinct odor at 5 ppm. Some persons report odor at levels of 0.4

not a significant eye irritation at 21.6 ppm. At 21.6 ppm subjective response of three of three subjects range between 10 ppm (not explored.)

not a significant upper respiratory irritant at levels of 10 ppm. A response of slight irritation was experienced. (Again, no observed in the range below 21.6 ppm.

not a serious eye irritation. Prompt first aid, including washing procedure, is

not a serious skin irritation. No burns due to vinyl acetate among 21 operators over years of possible exposure on units.

presented no significant

problem as a producer of contact dermatitis during the same survey period mentioned above.

8. Review of medical records and recent multiphasic examinations reveals no evidence to suggest chronic effects of vinyl acetate at the determined long-term levels of 5-10 ppm.

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Honorary Membership

At the annual A.I.H.A. banquet during the 1969 meeting, honorary life membership in A.I.H.A. was bestowed on Professor Warren Cook, Department of Industrial Health, School of Public Health, The University of Michigan. In this photo, Professor Cook (right) is shown accepting from President Lewis Cralley the Certificate of Honorary Membership.



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