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16. Abstract (Limit: 200 words)

As a result of worker complaints in the Baltimore, Maryland area, potential health hazards associated with the use of polyvinyl-chloride film for wrapping meat were reviewed. Fumes generated during the meat wrapping process were causing concern among the workers as they experienced respiratory irritation and distress. It appeared that only some of the meat wrappers experienced difficulty, only some of the rolls of film produced irritations in the affected workers, and affected workers had prior histories of respiratory difficulties. Fumes were generated during hot wire film cutting. The amount of fume generated depended significantly on the care taken during the operation. If the dispensing machines were improperly adjusted, large amounts of fumes could be obtained during the cutting process. Even under these aggravated conditions, only trace amounts of hydrogen-chloride (7647010) and general hydrocarbons were generated. During an intensive study of the decomposition products of films available on the market, the following contaminants were also identified: chlorobutane (109693), benzene (71432), toluene (108883), 1-chloro-2-ethylhexane (123046), 2-ethyl-1-hexanol (104767), and benzyl-chloride (100447). The author concludes that the amounts of these chemicals released during this operation does not constitute a health hazard to the employees. It may be necessary, however, to remove persons with prior respiratory irritation from this particular job location.

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POLYVINYL CHLORIDE MEAT WRAPPING FILM STUDY

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ABSTRACT

A study was initiated as a result of complaints associated with fumes produced by hot wire cutting of film in meat wrapping operations. The meat wrapping material studied was polyvinyl chloride film. Atmospheric samples collected in the working environment indicated only trace amounts of hydrogen chloride. An analysis of the film thermal decomposition products was conducted. Trace amounts of several compounds including benzyl chloride were identified. It was determined that volatile compounds from film decomposition were not produced in sufficient quantity to exceed threshold limit values. Results indicate that polyvinyl chloride film fumes present no apparent health hazard to meat wrappers with no prior respiratory illness. Control recommendations are given for cases where workers have a peculiar sensitivity.

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FINAL REPORT

POLYVINYL CHLORIDE MEAT WRAPPING FILM STUDY

by Robert Vandervort*

This report summarizes the results of an 11-month study aimed at determining the potential health hazards associated with the wrapping of meat with polyvinyl chloride film. The study was prompted by a request from the Food and Drug Administration which referred to worker complaints filed from the Baltimore, Maryland area. An investigation of the complaint revealed that several meat wrappers in the Baltimore area were concerned about fumes generated during meat wrapping while using PVC film as the wrapping material. The fumes, they claimed, caused respiratory irritation and distress which in some cases had led to hospitalization and loss of work. We learned too, that a similar problem had arisen in Virginia in the summer of 1969. State health officials in Virginia had investigated the problem and found, through on-site environmental sampling, that trace amounts of hydrogen chloride were generated by the cutting of the meat wrapping film with a hot wire cutting element, typical of most film dispensing machines. The amount of fumes generated by the cutting process was found to depend upon the adjustment of the dispensing machine. It was concluded that no apparent potential health hazard was associated with PVC film fumes provided that machines were properly maintained. A similar conclusion was reached by the Baltimore City Health Department when they were involved in the problem late in 1969.

These conclusions did not satisfy the meat wrapper representatives, however, and they solicited federal involvement for further investigation. Our final decision to make further investigation into the meat wrapping problem was promoted by medical data uncovered during initial contacts with state and local agencies. Several cases of employee difficulty were reviewed. All cases were seen by physicians and many diagnosed to be directly related to occupational exposure to PVC film fumes.

In light of the information available concerning the problem, a meeting was arranged to assemble representatives of industry, labor, and state and local health agencies involved in the problem. The meeting was held at the Maryland State Health Department of Health facilities in Baltimore on March 19, 1970.

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Films manufactured by several film producers are used in the Baltimore area, however, all but one complaint uncovered to the date of the meeting involved the film produced by the Borden Chemical Company. The Borden film also comprised approximately 80 percent of the film market in the area. For these reasons Borden was the only film manufacturer asked to attend the initial meeting.

A discussion of the various facets of the complaint was made. On the one hand Borden stated that their film presented no known health hazard to employees. On the other hand, the meat wrappers' union presented cases of workers difficulty which they associated with exposure to film fumes. Out of this discussion came several interesting and pertinent discoveries.

1. Only a fraction of the meat wrappers were affected by the film fumes.
2. Only a fraction of the rolls of film produced irritation in the affected workers.
3. Many of the workers affected had had prior histories of respiratory difficulty.

We subsequently visited several meat wrapping operations in grocery stores in the Baltimore area. Air samples were gathered at each location under conditions of normal operation with film dispensing machines properly adjusted and maintained. Films produced by several manufacturers were being used at these locations. A bulk sample of each film was obtained for later laboratory analysis.

Samples were also gathered under conditions which produced much above normal amounts of fume generation. These conditions were produced by improperly adjusting the dispensing machines and allowing large amounts of film to burn on the cutting wires.

Laboratory analyses and subsequent air concentration calculations showed that only trace amounts of hydrogen chloride and general hydrocarbon were present in the working environment even under aggravated conditions.

In Baltimore, Dr. G. W. McCarl of the Bureau of Occupational Safety and Health contacted many of the local physicians involved in the problem and later secured medical reports from them concerning patient's symptoms and treatment. These medical data indicated that the affected employees had had prior histories of respiratory distress.

It was decided after the Baltimore meeting that a study of the thermal decomposition of the PVC films should be undertaken to assure that no harmful compounds were generated in the film cutting process. At that time our laboratory had on order the scientific instruments necessary to conduct a study of this type and it was decided that, until these instruments were received, an examination of film formulas should be made to guide the indepth analysis. Several film manufacturers were contacted and asked for film samples, formulas and information they had regarding thermal decomposition products of their films. They were also asked whether they had any complaints from meat wrappers using their films. The following companies were asked to participate and did supply the requested information:

FMC Corporation, American Viscose Division
Filmco Division of Archer Products, Inc.
Goodyear Tire and Rubber Company
Ethyl Corporation, Visqueen Division

The Borden Chemical Company had already supplied the desired information after a request was made at the Baltimore meeting. An unfortunate oversight excluded notification of the Reynolds Metal Company of Richmond, Virginia. However, a sample of their film was obtained during the Baltimore visit and later analysis showed it to be very similar to films produced by other manufacturers.

Once the necessary equipment was operating in our laboratory an intensive study of film decomposition products was undertaken. A micro furnace was used to heat the film materials for one hour and the volatiles liberated were passed through a soda lime trap to remove hydrogen chloride and then collected on activated charcoal. Collected compounds were then desorbed using carbon disulfide and injected into a gas chromatograph for identification. A unique method for trapping each compound as it left the gas chromatograph column was devised using very small glass tubes filled with activated charcoal. The compounds were then prepared and put into a time-of-flight mass spectrometer for further identification. In this way the following compounds were found to be present in the thermal decomposition products of the various films at decomposition temperatures in the range of 200-230°C.

Chloro-butane
Benzene
Toluene
1 chloro 2 ethyl hexane
2 ethyl 1 hexanol
Benzyl chloride
Hydrogen chloride

The 200-230°C temperature range brackets the normal operating temperatures of the hot cutting wires. PVC film exhibits a 1-5 percent weight loss due to volatile liberation in 10 minutes at 200°C. The compounds noted comprise the major volatiles that are generated, but are present in only several parts per million of the total volatile portion. Hydrogen chloride is the most predominant product.

Due to the fact that hydrogen chloride was a known thermal decomposition product, and that its concentration in the meat wrapping environment had been found to be very low, it was not further pursued as a possible health hazard. The other compounds discovered, with the exception of benzyl chloride, also were excluded from intensive study since they were not recognized to be toxic in very low concentration. Benzyl chloride, however, was known to be quite toxic and produce symptoms much like those the meat wrappers experienced. Therefore, it was decided that the study should concentrate on determining how much benzyl chloride was present or could be present in the meat wrapping environment. The assistance of the Baltimore City Health Department was enlisted to help assess the occupational exposure to benzyl chloride. The necessary sampling equipment was sent to them and they collected several air samples and additional film samples in Baltimore supermarkets. As before, samples were collected under normal and aggravated conditions. Analyses of these air and film samples did not indicate that any measurable amounts of benzyl chloride were present in the atmosphere, nor were they expected.

Since there was nevertheless a remote possibility of benzyl chloride generation it appeared important to determine what factors controlled the occurrence of benzyl chloride in the thermal decomposition products of the wrapping films. To assist in this investigation the Borden Chemical Company was asked to provide samples of all film ingredients and samples of film containing many combinations of the possible ingredients. They did provide a large number of samples. After it was determined which formulas produced the most benzyl chloride, Borden was asked to duplicate these samples, which they did. The analytic assay results of this second batch of film did not precisely correlate with the results of the first analysis of each of the formulas. Further investigations showed that the factors effecting benzyl chloride generation are subtle and random. Benzyl chloride appeared in approximately one out of twenty film samples tested. In all cases, however, benzyl chloride constituted only several parts per million of the total volatiles generated and its generation decreased with increasing temperature.

At the conclusion of the film study the Borden Chemical Company asked to be acquainted with the analytic procedures used by our laboratory. They wished to conduct similar studies of their films and had the necessary equipment and personnel available. We met with them and supplied the necessary information.

While Borden worked independently, we made arrangements for a second meeting in Baltimore on January 26, 1971. Prior to this meeting Borden's laboratory confirmed our findings. Since Borden was the only manufacturer deeply involved in the Baltimore problem, the other manufacturers were not asked to attend. All who attended the March 19, 1970 meeting were present at the January 26, 1971 meeting.

At this meeting it was explained that a thorough study had been conducted and that no significant levels of any known toxic agents were discovered. Furthermore, it was explained that it did not seem possible that any of the thermal decomposition products of PVC films could build up to exceed TLV limits for each respective compound in the meat wrapping environment. Even concentrations found in undiluted film fumes seemed unable to exceed TLV's. In light of these findings it was stated that fumes generated by the hot wire cutting of PVC meat wrapping films appeared to present no significant health hazard to normal healthy meat wrappers.

It should be noted that hydrogen chloride and benzyl chloride are primary irritants and that they can irritate previously injured tissue even when present at levels significantly below the TLV. Persons with a history of respiratory passage irritation may experience some difficulty working in the very low concentrations which are characteristic of the meat wrapping environment. It may be necessary to remove these people from the meat wrapping environment and place them in other jobs more suited to their particular situation. Levels of hydrogen chloride and benzyl chloride below TLV limits do not produce permanent injury in healthy persons.

Due to the fact that several of the affected workers in the Baltimore area were of the opinion that occasionally a roll of film would seem to be more offensive than others, it was decided that these offensive rolls be sent back to the manufacturer for analysis. This agreement was made with Borden Chemical Company only and with the restriction that only rolls of marked difference be returned. The actual occurrence of offensive rolls was confirmed in the laboratory where approximately one in twenty of the film samples tested displayed elevated levels of volatile production. Many of the rolls which gave increased amounts of volatiles may not be distinguishable from normal rolls in the working environment, however. This means that markedly different rolls should be very scarce.

Since the films of all manufacturers displayed similar qualities with regard to thermal decomposition products, this report will be sent to all manufacturers of PVC films. In addition, all members attending the Baltimore meetings will receive a copy. It is suggested that if any markedly offensive rolls of film are found that were manufactured by producers other than Borden, the manufacturer be notified to determine what action each may wish to take.

Again, the basic conclusion of this report is that there appears to be no apparent health hazard presented by PVC film fumes generated in meat wrapping to normal healthy persons employed as meat wrappers.

I wish to extend my sincere thanks to all those who provided assistance in the completion of this study, especially to Mr. Jeffrey Lee, Mr. Richard Kupel, and Dr. G.W. McCarl of the Bureau of Occupational Safety and Health, Mr. David T. Lewis of the Baltimore City Health Department, Mr. James A. Beegan of the Maryland State Department of Health, and to the Borden Chemical Company.

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