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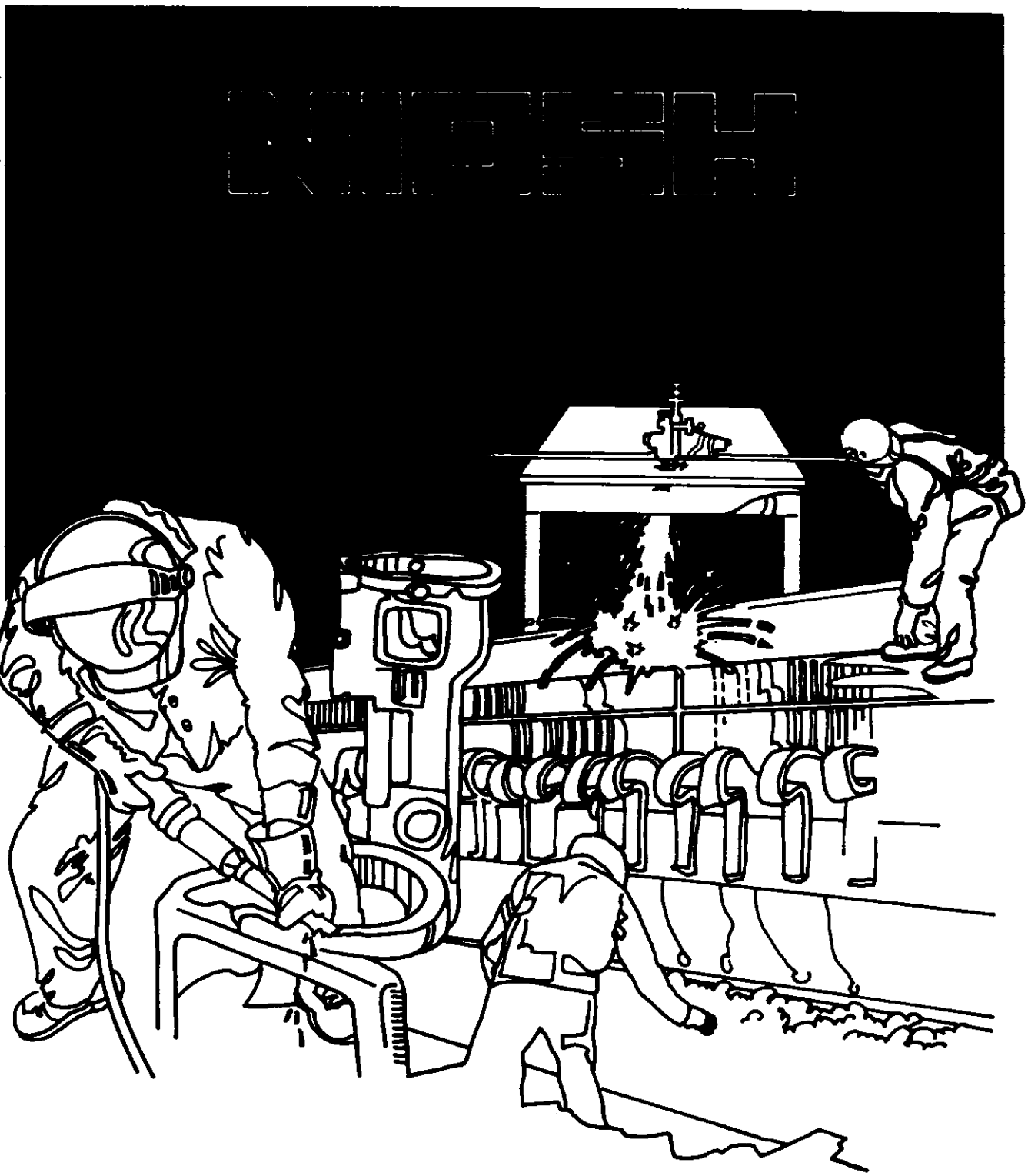

Health Hazard Evaluation Report

HETA 88-156-1984
GEORGIA GULF CORPORATION
TIPTONVILLE, TENNESSEE

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

HETA 88-156-1984
AUGUST 1989
GEORGIA GULF CORPORATION
TIPTONVILLE, TENNESSEE

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I. SUMMARY

In January, 1988, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Georgia Gulf Corporation to investigate an outbreak of dermatitis at its Tiptonville, Tennessee plant.

NIOSH investigators conducted an initial investigation February 25-26, 1988, and a follow-up medical investigation May 2-4, 1988. The medical investigation consisted of administration of a questionnaire to determine the period prevalence of dermatitis since May 1985, the characteristics of the dermatitis, and the jobs and activities at the plant associated with the dermatitis. In addition, employees with a rash at the time of the follow-up medical investigation were offered a limited dermatologic exam.

Environmental evaluation consisted of a walk-through survey by NIOSH investigators. Blender operators, material handlers and utility men were observed to be exposed to large amounts of airborne dusts and powders. These dusts and powders settled on the employees' clothes and exposed skin. Air sampling was not performed.

Twenty-two (41%) of the production workers and 3 (30%) of the clerical and management staff reported having had a rash during or after May, 1985. Seven of these 25 workers with dermatitis underwent a voluntary dermatologic examination, and all seven were found to have findings consistent with contact dermatitis.

The rashes were likely to be occupationally induced for several reasons: 1) improvement occurred when away from work; 2) there was exposure to irritating powders that potentially could cause dermatitis (pigment powders and acrylic polymer powders that contain residual monomers), and; 3) the rashes were located where powders likely came in contact with skin as judged by visual assessment of work activities (hands, lower arms, lower legs, and trunk).

Prevalence risk ratios[1] for rash were calculated for each of the job titles at high risk for exposure to dusts and powders (blender operators, material handlers and utility men). Blender operators had a significantly elevated risk of developing dermatitis since May 1985 when compared with production workers who had low exposure to dusts and powders (prevalence risk ratio [PR] = 2.81, 95% CI=1.11, 7.13). When compared with office workers, blender operators had a similar but statistically nonsignificant elevation in risk for the development of dermatitis (PR = 2.50, 95% CI=0.89, 6.99). No other job titles had a statistically significant elevation in the risk for dermatitis.

No association was found between history of rash and any of the following: history of atopy, skin response to the sun and presence of dermographism.

Based on environmental observations and medical findings, the NIOSH investigators concluded that blender operators have had an elevated risk of developing dermatitis since May, 1985. The dermatitis was likely to be of occupational origin and due to exposure to airborne dusts and powders, including pigment powders and acrylic polymers that contain residual monomers. Recommendations aimed at reducing exposures and preventing dermatitis include showering at the end of a work shift that involved exposure to dusts and powders, reduction of airborne dust levels through engineering controls, and use of protective clothing, barrier creams and skin moisturizers. Further details on these recommendations are included in Section VII.

Key Words: SIC 3079 (Miscellaneous Plastic Products), polyvinyl chloride compounding, acrylic polymers and monomers, dermatitis, calcium carbonate, titanium dioxide, carbon black, pigment powders.

II. INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH) received a request dated January 29, 1988 from the Georgia Gulf Corporation in Tiptonville, Tennessee to investigate a cluster of dermatitis that had affected eight employees. The first case was reported to management in September, 1985. The company became aware of two more cases by January 1987. Between September and December 1987, the company became aware of five additional cases. Because the company was concerned that more cases of dermatitis would arise in the future, NIOSH's assistance was requested to identify the source of the problem and recommend measures for prevention.

Three of the employees with dermatitis were referred to an outside dermatologist for patch testing on January 16, 1987. Patch testing of the skin was performed using 21 raw materials from the plant, including some of the acrylic polymers, an organotin compound and vinyl chloride resin. These patch tests were negative for all three employees, indicating that there was no development of allergic sensitivity to any of these raw materials. Around November 6, 1987, these three employees, along with one other employee that had recently developed dermatitis, were evaluated by a another dermatologist. He felt that the four employees were suffering from four different, unrelated forms of dermatitis. Because of the wide diversity of skin lesions that he observed, the dermatologist felt it was unlikely that exposures at Georgia Gulf were responsible. On December 16, 1987, one of the employees that originally underwent patch testing using raw materials from the plant, underwent standardized patch testing and was found to test positive for formaldehyde and balsam of Peru, an ingredient in many cosmetics and skin care products. The dermatologist performing this patch test felt it was unlikely that these sensitivities developed from exposures at Georgia Gulf.

On February 25, 1988, NIOSH investigators held an opening conference with union and management representatives. Following this meeting, a walk-through survey of the plant was conducted. Material safety data sheets, medical records from previous medical investigations and an inventory of raw materials was obtained. Seven of the eight workers who complained of dermatitis to management were given confidential interviews and dermatological exams. Four of these workers had contact dermatitis, one worker had either contact dermatitis or endogenous nummular eczema, one had urticaria and one had psoriasis. All five of the employees with skin lesions consistent with contact dermatitis reported having had high exposure to irritating dusts and powders when the dermatitis began. A letter reviewing our activities during the initial site visit and describing our preliminary conclusions and recommendations was sent to management and union representatives on March 21, 1988.

A follow-up medical investigation was conducted from May 2-4, 1988. A letter summarizing our findings and providing further conclusions and recommendations was sent to management and union representatives on May 26, 1988.

III. BACKGROUND

The Georgia Gulf Tiptonville plant produces polyvinyl chloride compound. The polyvinyl chloride compound is produced by blending polyvinyl chloride resin, with other various ingredients. These ingredients impart new characteristics to the polyvinyl chloride compound such as increased durability or transparency. The mixture is then flaked, milled and pelletized to produce a pellet, the final product. These pellets are then shipped to manufacturers who make molded PVC plastics according to desired specifications.

A. Process Description

This description concentrates on the chemicals and work practices used in each phase of the production process. There are few references to the job titles involved in specific phases of the process. However, the next section describes the duties for each job title.

The facility is housed in a large building built in 1969. PVC resin powder is delivered to the plant by railroad car. The powder is removed via vacuum hoses and is stored in large silos. Later the powder is emptied into hoppers via a closed system. Major additives, all of which are dry powders, are contained in large bags that are cut open and manually dumped into a hopper on the first floor. Major additives are impact modifiers consisting of various combinations of acrylonitrile, butadiene, methacrylate and styrene. The NIOSH investigators observed that large clouds of dust were generated when the major additives were dumped into the hoppers. Despite local ventilation, dust accumulated on the hands, face and clothing of the worker. The major additives are moved from the hopper to the storage chamber within a closed system. On the third floor, large bags of minor additives are cut open and emptied into hoppers. The minor additives are dry powders and include calcium stearate, titanium dioxide, magnesium stearate, aluminum stearate, acrylic polymers which contain trace amounts of monomers, alkyl amides and calcium carbonate. The dumping of minor additives was also found to generate large dust clouds. Although local ventilation was present, dust accumulated on the hands, face and clothing of the workers.

On the first floor is a master batch room where powdered pigments and powdered waxes are weighed (5-50 lb batches) and blended together to make a tumble mixture. This mixture is then taken to the third floor and manually emptied into a hopper. Also on the first floor is a large drum of liquid compounds containing organotin stabilizers. These are transferred into a hopper via hoses. Full drums of the organotin stabilizers are supplied by an outside supplier, thereby avoiding the need to refill empty drums. There is little chance of contact with the organotin stabilizers by workers.

Because the remaining operations essentially occur within a closed system, there is little chance of employee contact with the mixture. From the separate hoppers, each ingredient proceeds to a scale where they are weighed and then emptied into a common blender. At this point the common blender contains PVC resins, liquid organotin stabilizers, the tumble mixture, and the minor and major additives. After blending, the contents are transferred to a cooler. Next the mixture moves through a series of hoppers before arriving at a screen that removes large impurities. The mixture then enters a mixer. Afterwards, it enters a cooling bath before entering a pelletizer, which cuts the mixture into small pieces measuring 3-5 mm square. The pelletized pieces are cooled and then boxed or loaded directly into railroad cars. The boxes are assembled using a formaldehyde-containing glue.

B. Major Job Categories:

The eight major job categories at the Georgia Gulf Corporation are described below.

1) Blender Operator - The blender operator transfers liquid organotin stabilizers to a hopper, prepares the tumble mixture and dumps the tumble mixture into a hopper. These workers are primarily exposed to powdered pigments and waxes. Exposure to major and minor additives occurs occasionally, but only when workers are asked to fill in at a different job title. Additionally, a worker may be assigned a different job title when working overtime.

2) Material Handler - This job primarily involves cutting open bags of major and minor additives and dumping them into a hopper. These workers are exposed to minor additives, including calcium carbonate, calcium stearate, and major additives, including acrylonitrile and acrylic polymers.

3) Utility Man - This job primarily involves cutting open bags of minor and major additives and dumping them into a hopper. Exposures are similar to those for material handlers.

4) Mixer Operator - These workers observe the mixer operation and record onto a clipboard data from the mixer. These workers have little, if any, exposure to the tumble mixture or the major and minor additives.

5) Pelletizer Operator - These workers observe the pelletizing operation and record onto a clipboard from the pelletizing operation. These workers have little, if any, exposure to the tumble mixture or the major and minor additives.

6) Boxing - These workers assemble and fill boxes with the finished product. They are exposed to glues containing small amounts of formaldehyde. Exposures are minimal because the glue applicator has a long stem extending outward from the applicator grip.

7) Lab - These workers perform quality control analysis in a laboratory. These workers have little, if any, exposure to the tumble mixture or the major and minor additives.

8) Warehouse - These workers are responsible for maintaining the warehouse which contains raw materials and finished products. These workers have little, if any, exposure to the tumble mixture or the major and minor additives.

The utility man, pelletizer operator and warehouse jobs are rotating; that is, a worker stays in one area for six months, then rotates to another area for six months. This cycle repeats every 18 months.

Based on observations made during a walk-through survey at the plant, the job titles with high exposure to dusts and powders were blenders, material handlers and utility men. All other job titles had low levels of dust and powder exposure.

The plant normally employees 71 people. There are 50 production workers, 10 management or clerical workers, 6 maintenance workers and 5 foremen. At the time of our investigation, two production positions were unfilled, leaving only 69 workers employed at the plant. Since 1982 there has been a small increase in the size of the workforce. In 1982, the plant employed approximately 56 workers. Average seniority exceeds seven years for production workers and exceeds 8 years for the clerical and management staff. Each worker rotates his shift every seven days. Shifts are 7:00 A.M. - 3:00 P.M., 3:00 P.M. - 11:00 P.M. and 11:00 P.M. - 7:00 A.M.

C. Recent Process Changes

Although there are frequent alterations in the amount of specific chemicals used, the types of chemicals used rarely change. Lead stabilizer had been used for six months in 1974 and from 1981 until October 1987. Appropriate protective equipment for lead was used and medical surveillance for lead was performed. Employees were permitted to shower on company time when lead-containing batches of PVC compound were run.

Personal protective equipment provided by the company includes dust masks, gloves (cloth and rubber), aprons, safety shoes, goggles and barrier creams. Two varieties of barrier creams have been used for the last 24 months. The company makes available two types of soaps - body soap and pumice soap. In addition, the company has locker room and shower facilities available for use by their employees. However, at the time of our investigations, only those with dermatitis were permitted to shower on company time.

IV. EVALUATION DESIGN AND METHODS

A questionnaire was administered to 63 of the 69 workers working at Georgia Gulf at the time of the follow-up investigation. Six workers were unavailable because they were on vacation or off work for other reasons.

The questionnaire asked the employees whether they had had a rash during or after May, 1985. May, 1985 was chosen for three reasons: 1) from May, 1985 to the present, Georgia Gulf has complete records on the amount of raw materials used; 2) The first case of dermatitis was reported to management in 1985 (September, 1985), and; 3) To assist worker's recall, May, 1985 is exactly three years before our May, 1988 investigation. If a rash was reported, then the employee was asked to answer questions on when the rash began, its duration, what job title was held when the rash began, what body parts were affected, whether there was improvement of the rash when off work for extended periods of time, and whether the employee felt that exposures at the plant may have been responsible for development of the rash. Additional information obtained from the questionnaire included present job title, job titles held in the past three years, history of atopy and skin response after sun exposure. Atopy was defined as self-reporting any of the following conditions: 1) hay fever; 2) asthma; 3) hives; 4) skin allergies from foods; 5) atopic dermatitis; 6) chest tightness, sneezing or prolonged cough when exposed to pollens, animals or dusty, moldy places; or 7) watery, itchy eyes and nose or sneezing when exposed to pollen, animals or dusty, moldy places. In grading their skin response to sun exposure, the participant could select one of five

responses ranging from "never burn, always tan" (Grade 1), to "always burn, never tan" (Grade 5). Information on atopy and skin response to sun exposure was collected because presence of these conditions may increase the risk for dermatitis.[2,3]

All production workers who completed the questionnaire were given a skin examination to assess the presence of dermographism. Dermographism is characterized by redness and swelling (wheal) of the skin in response to firm stroking of the skin. Normally, dermographism is found in 25-50% of the population.[4] Dermographic response was graded on a scale from "1" to "4", with "1" indicating no response,"2" indicating that redness appeared but swelling was absent, "3" indicating that swelling arose in less than half of the stroked area and "4" indicating that swelling arose in greater than 50% of the stroked area. Because dermographism is considered a risk factor for dermatitis caused by fibrous glass and other irritating hard particles,[5] we hypothesized that dermographism may be a marker for the development of rash in Georgia Gulf employees.

A more complete dermatological exam was offered to all employees with a rash. The examinations were performed by a board-certified dermatologist. After obtaining a history of the nature of the rash, followed by inspection and palpation of the rash, the dermatologist made a diagnosis. In the analysis, cases were defined as those reporting onset of rash during or after May 1985. Those individuals reporting rash onset before May 1985 were eliminated from the analysis.

Job titles in the production area were categorized into two groups based on levels of exposure to dusts and powders observed during a walk-through survey. High exposure job titles were blender operators, material handlers and utility men. All other job titles in the production area (including foremen and maintenance workers) were considered low exposure job titles.

Prevalence risk ratios[1] for rash were calculated for each of the job titles having high exposure to dusts and powders (blender operators, material handlers and utility men). Level of exposure to dusts and powders was determined by NIOSH investigators based on observations made during a walk-through survey. The referent population was comprised of workers from one of two different groups: 1) clerical and management staff or 2) production workers having low exposure to dusts and powders (this excludes the clerical and management staff and also excludes those workers that ever worked as a blender operator, material handler or utility man). When calculating the prevalence risk ratio for a particular job title, the number with rash included only those employees working in the job title at the time their rash began and the number without rash included those employees who reported ever having

worked in the job title between May, 1985 and May, 1988, excluding those with a preexisting rash when they began work in that job title. Prevalence risk ratios for rash were also calculated by atopy status. The statistical significance of the prevalence risk ratios were determined by calculating 95% confidence intervals.[6] Chi-square trend analysis was used to assess the association between the development of dermatitis and dermographism, as well as the association between the development of dermatitis and skin response to sun exposure.[7] The relationship between level of powder and dust exposure and improvement of dermatitis when away from work was assessed using chi-square analysis.[8] Comparison between subsets of workers for dermatitis involvement at specific anatomic sites was performed using the Fisher exact test.[9]

V. RESULTS

1. General

Of the 69 employees working at the plant at the time of the survey, 63 (91.3%) workers participated in the survey. Fifty-three of the 59 production workers participated and all 10 of the clerical and management staff participated. Eleven production workers and none of the office workers had onset of rash before May 1985; these workers were removed from further analysis. The mean age of the 42 production workers included in our analysis was 38 years (range 19-55); the mean age of clerical and management workers was 47 years (range 34-56). Forty (96%) of the 42 production workers were male and two (4%) were female. Five (50%) of the 10 office workers were female and 5 (50%) were male. Twenty-two (52%) of the 42 production workers and 3 of the 10 (30%) office workers reported having a rash after May, 1985. Fourteen of the workers with rash were working in high exposure job titles when their rash began. Seven denied ever having worked in a high exposure job title, three of whom were office workers. Three workers were working in low exposure job titles when their rash began but had worked in high exposure job titles before rash onset. One worker had a preexisting rash when he began working in a high exposure job title (utility man). His rash began while working in a low exposure job title.

Figure 1 depicts the date of onset of all rashes. Although cases began to appear in the second quarter of 1985, there is a clustering of cases beginning in the second quarter of 1987.

2. Risk of Dermatitis by Job Title

The employee who had a preexisting rash when he began employment as a utility man was excluded from the risk of dermatitis analysis for utility men. In addition, one worker who had developed a persistent rash while working as a blender operator but who worked for one month as a material handler after his rash began was excluded from the risk of dermatitis analysis for material handlers. This employee was included in the risk of dermatitis analysis for blender operators.

Blender operators were the only single job title with a statistically significant elevation in risk for dermatitis when compared with production workers having low exposure to dusts and powders (PR = 2.81, 95% CI=1.11, 7.13)(Table 1). When compared with office workers, blender operators had a similar but statistically nonsignificant elevation in risk for the development of dermatitis (PR = 2.50, 95% CI=0.89, 6.99). No other job title had a significantly elevated risk for dermatitis. When workers in the three job titles suspected to have the highest dust exposures (blender operators, material handlers and utility) were grouped into one category (high-exposure group), they were found to have a statistically nonsignificant elevation in risk for the development of dermatitis when compared with either of the referent groups.

3. Other Risk Factors for Rash

Those employees with a history of atopy had a non-significant elevation in risk for the development of dermatitis when compared to employees with no history of atopy (PR=2.63, 95% CI=0.64, 11.17). For all atopic employees reporting rash, onset of atopy preceded the onset of rash.

During our follow-up visit all production workers completing the questionnaire were examined for the presence of dermographism. The association between prevalence risk ratio for dermatitis and increasing grade of dermographism was not significant for trend (Grade 1, PR=1.0; Grade 2, PR=1.8; Grade 3, PR=3.75; Grade 4, PR=0.75, chi-square=0.511, p=0.237). Participants were asked how their skin reacts after a half-hour of sun exposure in the summer. The participant could select one of five responses ranging from "never burn, always tan" (Grade 1) to "always burn, never tan" (Grade 5). The association between the risk for dermatitis and an increasing skin susceptibility to burning was not significant for trend (Grade 1, PR=1.00; Grade 2, PR=4.80; Grade 3, PR=2.77; Grade 4, PR=3.00; Grade 5, PR=3.00, chi square=0.261, p=0.305).

4. Sites of Involvement

The most common site of rash involvement was the upper extremity (68%) (Table 2). Most employees reported rash involvement at more than one site. Among employees working in high exposure job titles when their rash began, the most common site of rash involvement was also the upper extremity (79%). Among employees who denied ever having worked in high exposure job titles, the most common sites of involvement were the upper extremity (57%) and the lower extremity (57%). Among blenders, the most common sites of involvement were the upper extremity (67%) and the lower extremity (67%). There were no significant differences in the distribution of the site of rash involvement between those working in high exposure job titles when their rash began and those who denied ever having worked in high exposure job titles. Likewise, no difference was found between blenders and those who denied ever having worked in high exposure job titles.

5. Chemicals Attributed by Production Employees to Be the Cause of Their Dermatitis

Among the 22 production employees with onset of rash after May, 1985, ten employees felt that their rash was caused by an exposure at Georgia Gulf. Nine of these workers were working in high exposure job titles when their rash began; the remaining worker was employed in the lab when his rash began but had experience as a utility man at an unknown time in the past. Three of the 10 employees that attributed their rash to exposures at Georgia Gulf were working as blenders when their rash began. The other fifteen employees with rash did not know if their rash was caused by an exposure at Georgia Gulf.

Six workers suggested that several chemicals at the plant were the cause of their dermatitis. The most commonly cited chemicals were calcium carbonate (30%), titanium dioxide (30%), and acrylic polymers and monomers (30-40%) (Table 3).

Organotin stabilizers are also used at Georgia Gulf. These compounds are known potent skin irritants.[10] However, since these compounds remain within a closed system, there is little chance of employee exposure. None of the employees blamed these compounds.

6. Improvement When Away From Work

Employees with a rash were asked if there was clinical improvement of the rash when off work for extended periods of time, such as on weekends, vacations, lay-offs or sick leave (Table 4). Using

chi-square analysis, there was a statistically significant difference in the responses of employees working in high exposure job titles when their rash had begun when compared to the responses of employees that denied ever having worked in high exposure job titles (p=0.030). No significant difference in responses was found between blenders and employees that denied ever having worked in high exposure job titles. Failure to find a difference was probably due to small numbers.

7. Dermatological Exams

Seven of the 25 employees who reported onset of rash during or after May, 1985 volunteered for a dermatologic exam from the NIOSH dermatologist who was blinded to the exposure status (job title) of workers. Four of the employees were working in high exposure job titles when their rash began: the other three were working in low exposure job titles when their rash began. Among the three employees with a rash onset during employment in low exposure job titles, one denied ever working in a high exposure job title, another reported working in a high exposure job title at an unspecified time before rash onset and the third employee reported working in a high exposure job at an unspecified time after rash onset. All seven employees had dermatologic findings consistent with contact dermatitis. Six employees had contact dermatitis and one employee had findings consistent with either contact dermatitis or dyshidrotic eczema.

VI. DISCUSSION/CONCLUSIONS

An apparently high 3-year period prevalence of dermatitis was observed at the Georgia Gulf Corporation in Tiptonville, Tennessee. Twenty-two of 53 (42%) production workers and 3 of the 10 (30%) office workers reported having had a rash at some time after May 1985. Expected numbers are difficult to obtain since no extensive population-based surveys measuring the 3-year period prevalence of dermatitis exist. Because we asked only about dermatitis having an onset during or after May, 1985, we cannot determine if a high prevalence of dermatitis existed before May, 1985.

Blender operator was the only job title associated with a significantly elevated risk of dermatitis. The elevation in risk among blenders was statistically significant in the comparison with production workers who had low exposure to dusts and powders but not in the comparison with office workers. The low number of office workers may have been responsible for the failure to reach statistical significance since the prevalence risk ratios were similar. During our walk-through survey, we observed that blender operators were exposed to a large amount of airborne dusts and powders. We found that the dusts and powders settled on the clothing and exposed skin of these workers.

Workers in two other production job titles, utility men and material handler, were also exposed to large amounts of airborne dusts and powders. Statistically nonsignificant elevations in the risk of dermatitis were observed for these two job titles (Table 1). Statistical significance may not have been reached due to low numbers of observations. The statistical power of our study to detect a 40% difference in the proportion with dermatitis was only 65%.[11]

One utility man and one material handler were excluded from the risk of dermatitis analysis because they had a preexisting rash when they began working in those job titles. We did not collect the data needed to determine if the rash affecting these two employees was exacerbated by employment in those high exposure job titles.

When we were calculating the prevalence risk ratio for rash, to contribute to the prevalence of rash for a particular job title, an individual had to have been working in that job title at the time his/her rash began. By using this definition, our prevalence risk ratios may not be accurate. This is because we do not know the latency period between exposure and onset of the rash. Some chemically-induced rashes may have a latency period of hours, whereas others may have a latency period of two days or longer.[12] Thus, if an employee moved to a new job title during the latency period, the rash may have been attributed to the wrong job title. Incorrect attribution of a job title responsible for a rash may also have occurred among employees temporarily assigned to a different job title, such as when working overtime or when substituting for a vacationing employee. Because the latency period may have exceeded the length of the temporary assignment, the employee may not have suspected the temporary assignment as the cause for the rash. Therefore, both permanently and temporarily reassigned employees may have incorrectly identified the job title responsible for their dermatitis. If the rash was an acute condition with very short latency, including only individuals working in the job title of interest at the time their rash began may have resulted in a more accurate determination of the prevalence risk ratio for that job title. It may have been less accurate if the rash had longer latency.

Some of the powders used at the plant and to which the employees are exposed are known skin irritants. Acrylic polymers containing trace amounts of monomers (K-120, K-175, Durastrength) are known to produce skin irritation and were blamed by some employees for their rash.[13] Types of acrylic polymers used at the plant include methyl methacrylate, butyl acrylate and ethyl acrylate. Although calcium carbonate, titanium dioxide, carbon black, alkyl amides and amber toner were blamed by some as the cause of their rash, there are no reports in the literature associating these agents with skin irritation or allergic sensitization. It is possible that contact dermatitis can be

caused by exposure to either calcium carbonate (due to its drying ability) or by exposure to titanium dioxide and carbon black (because of their hardness, which can lead to friction and irritation of the skin).

One case-report identified 14 cases of acne-like rashes among employees working in a Singapore factory that manufactured and compounded polyvinyl chloride.[14] Five of the 14 employees worked in the compounding section, where PVC powder was mixed with various plasticizers including organic lead compound, barium-cadmium-zinc complex, and/or calcium carbonate. The investigators felt that irritation from the PVC powder was one factor responsible for the dermatitis at the Singapore plant. The other factors cited were excessive heat and high humidity.

Although the Georgia Gulf Tiptonville plant also compounds PVC, the extent of PVC dust exposure at the plant is probably much lower than at the Singapore plant. At the Singapore plant, PVC powder is manually poured into a mixer, whereas at the Georgia Gulf plant, the PVC powders remain in a closed system throughout the production process thereby preventing employee contact with the powders. Another difference between the two plants was the type of dermatitis observed. At the Singapore plant acne-like lesions were observed, whereas at the Georgia Gulf plant contact dermatitis was observed.

Most of the rashes observed at Georgia Gulf were felt to be occupationally induced. Characteristics of the rashes that lead to this conclusion were:

1. Improvement when away from work. Forty-eight percent of all workers reporting the onset of rash after May 1985 noted improvement of their rashes on weekends, vacations, lay-offs or sick leave and 32% were not sure if improvement occurred at these times. Only 20% reported no improvement when away from work. Among employees with high airborne dust and powder exposure, 57% noted improvement when off work for extended periods and 36% were not sure.

2. Presence of irritating powders. Acrylic polymers and residual monomers are known to irritate the skin.[13] There are several types of acrylics used at Georgia Gulf including methyl methacrylate, butyl acrylate and ethyl acrylate.

   Small amounts of acrylic powders containing styrene are also used at Georgia Gulf. Styrene is reported to cause rash by defatting and dehydrating the skin.[15]

In our study, the common sites of rash involvement were the hands, lower arms, lower legs and trunk (Table 3). Dermatitis caused by airborne agents commonly is found at these sites.[16] Rash can appear even at sites covered by clothing as a result of dust gaining access through shirt and pant cuffs which may explain the high frequency of trunk and lower extremity involvement that we observed. However, we did not find a difference in the anatomic distribution of dermatitis between employees working in high exposure job titles and those working in low exposure job titles. Another common site for contact dermatitis caused by airborne agents is the head and neck. We cannot explain why involvement at these sites was not frequently reported in our study.

Most acute industrial illness or injury clusters can be explained by one of three changes: 1) a large increase of new employees; 2) introduction of new chemicals into the workplace; or 3) a change in the manufacturing process.[17] There is no evidence of a change in the workforce or in the chemicals used at Georgia Gulf. The workforce is stable with an average seniority of over 7 years for production workers and over 8 years for clerical and management staff. Management denied any recent change in the types of chemicals used. However, there was a change in procedures. When the company used lead stabilizers, employees were permitted to shower at the end of the shift on company time. When use of lead stabilizer ended in October, 1987, employees were no longer permitted to shower on company time. This change in policy may have resulted in prolonged skin contact with irritating dusts and powders if workers delayed their showers until returning home or deferred them altogether. However, we cannot explain why the substantial increase in rashes began in the second quarter of 1987, approximately six months before the change in shower policy. Although this six month difference may be due to faulty memory, this cannot be verified since the accuracy of recall for the date of onset cannot be validated.

VII. RECOMMENDATIONS

The following recommendations were included in a letter sent on May, 26, 1988 to union and management representatives.

1. Provide engineering controls to reduce exposure to dust generated by the dumping of bags containing powders. NIOSH's Engineering Control Technology Branch, Division of Physical Sciences and Engineering may be able to provide assistance. (Contact Dr. Jim Gideon at (513) 841-4221.)

2. Provide protective clothing to prevent powders and pigments from gaining contact with exposed skin. These should include gloves, aprons, placing elastic material at the ends of shirt sleeves to fit over the ends of gloves and use of elastic gators to fit over the collar of boots.

3. Permit employees to shower after exposure to powders and pigments has ceased for the day. After the shower, the employee should change into clean clothes. Pumice soap should only be used to clean the palms of the hands. This soap is too abrasive to be used on other body areas. It can irritate the skin, and drive the powders and pigments deeper into the skin.

4. Before working with powders, apply a skin moisturizer (such as Aquaphor or Eucerin) to exposed skin surfaces, including the face and neck. This will prevent the powder from making contact with the skin and should facilitate the cleansing of body surfaces. The skin should be washed soon after powder or pigment exposure has ceased. After cleansing, a skin moisturizer should be applied to the skin. Skin moisturizers should be available in the washrooms.

5. It must be stressed that moisturizing creams will help eliminate the onset of new rashes but are not effective for treating already existing rashes. For the latter purpose, hydrocortisone 0.5% cream should be made available to employees with early, mild rashes. This cream can be applied to the rash two to four times daily. If the rash worsens or persists for more than one week, the employee should consult his personal physician or a dermatologist. The hydrocortisone should be needed only infrequently once the preceding recommendations are implemented, since new rashes should be largely prevented.

6. Since many factors may contribute to the persistence of dermatitis once it has arisen, those individuals already affected should remain under the care of their personal physician or be referred to a dermatologist.

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X. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. Georgia Gulf Corporation, Tiptonville, Tennessee.
2. United Rubber Workers, Local 1008, Tiptonville, Tennessee.
3. The Occupational Safety and Health Administration (OSHA) Region IV.

Table 1
Risk of rash by job title using two different referent groups.

Georgia Gulf Corporation
Tiptonville, Tennessee
HETA 88-156

job title	rash*		Referent Group 1 rash among low exposure production workers+		PR	95% CI	Referent Group 2 rash among office workers		PR	95% CI
	yes	no	yes	no			yes	no		
Blender Operator	6	2	4	11	2.81	1.11, 7.13	3	7	2.50	0.89, 6.99
Material Handler	5	5	4	11	1.88	0.66, 5.32	3	7	1.67	0.54, 5.17
Utility man	4	7	4	11	1.36	0.43, 4.29	3	7	1.21	0.36, 4.14
High Risk (blender, utility man, material handler)	14	12	4	11	2.02	0.81, 5.02	3	7	1.79	0.65, 4.94

Notes for Table 1

* For a particular job title, the number with rash includes only those employees working in the job title at the time their rash began. The number without rash includes the remaining employees who ever worked in the job title between May, 1985 and May, 1988 and excludes those with a preexisting rash when they began working in the job title. The total number of workers in the high exposure group is less than the sum of the individual job titles because one worker reported working as both a utility man and a material handler at the time his rash began and two workers without rash had worked as both a blender operator and a material handler.

+low exposure production workers are those workers who never worked as a blender, material handler or utility man.

PR = prevalence risk ratio.

95% CI= 95% confidence interval.

Table 2
Site of rash in 25 employees with onset of rash after May, 1985+

Georgia Gulf Corporation
Tiptonville, Tennessee
HETA 88-156

Site	All employees (n = 25)		High Exposure Employees* (n = 14)		Blenders (n=6)		Low Exposure Employees* (n=7)	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Head and neck	6	(12%)	4	(29%)	2	(33%)	2	(29%)
Upper arms	6	(24%)	5	(36%)	2	(33%)	0	(0%)
Lower arms, wrist	12	(48%)	7	(50%)	3	(50%)	3	(43%)
Hands	12	(48%)	7	(50%)	2	(33%)	3	(43%)
Upper legs	7	(28%)	4	(29%)	2	(33%)	3	(43%)
Lower legs, ankles	12	(48%)	7	(50%)	4	(67%)	3	(43%)
Feet	1	(4%)	0	(0%)	0	(0%)	1	(14%)
Upper extremity (inc. upper arms, lower arms, wrists and hands)	17	(68%)	11	(79%)	4	(67%)	4	(57%)
Trunk (inc. chest, back, stomach, and waist)	12	(48%)	8	(57%)	3	(50%)	3	(43%)
Lower extremity (inc. upper and lower legs, ankles and feet)	14	(56%)	8	(57%)	4	(67%)	4	(57%)

+ because many workers complained of dermatitis at more than one site, the sum of the employees complaining of dermatitis at each of the individual sites exceeds the total number of employees complaining of dermatitis.

* High exposure employees are those employees that reported ever having worked as either a blender, utility man or material handler when their rash began. Low exposure employees are those employees that denied ever having worked as blenders, utility men or material handlers.

Table 3
Chemicals attributed by 10 production employees* to be a cause of their rash

Georgia Gulf Corporation
Tiptonville, Tennessee
HETA 88-156

Chemical (trade name)	Number of production employees that blamed the chemical
calcium carbonate (ultraplex)	3
alkyl amide (Acrawax C))	1
titanium dioxide (CR-800)	3
acrylic polymer (K-120)	2
acrylic polymer and monomer (K-175)	3
acrylic polymer (Durastrength)	4
amber toner	1
carbon black (Raven Black)	2
don't know	4

*only those employees whose rash began during or after May, 1985

Because many workers blamed more than one chemical, the total number of chemicals blamed is larger than the total number of workers with dermatitis.

Table 4
Proportion reporting improvement of rash when removed from exposure for extended periods of time

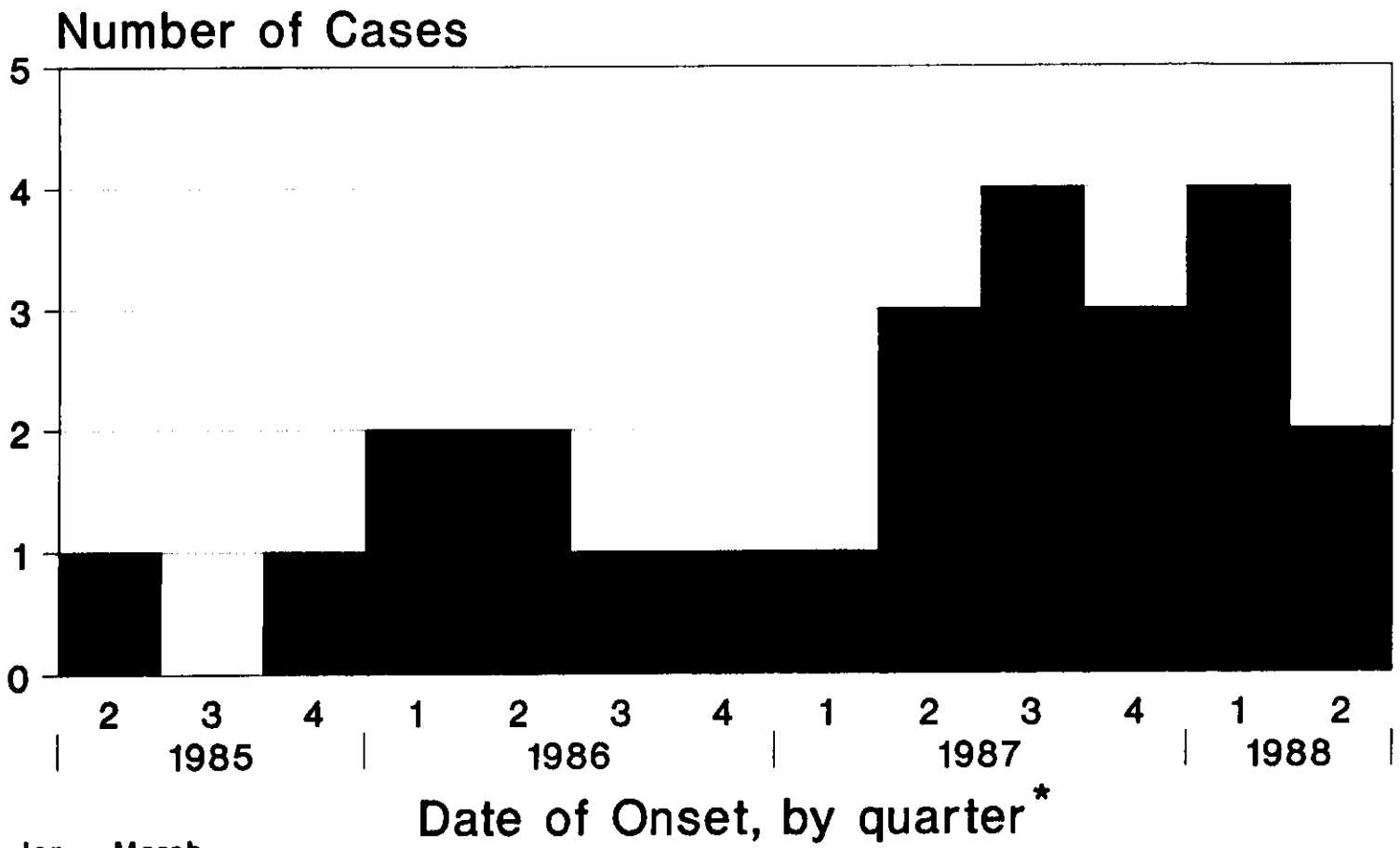
Georgia Gulf Corporation
Tiptonville, Tennessee
HETA 88-156

	Improvement of Rash						
	N	Yes	(%)	No	(%)	Don't Know	(%)
All Employees With Rash	25	12	(48)	5	(20)	8	(32)
High Exposure Employees * +	14	8	(57)	1	(07)	5	(36)
Blenders Only+	6	3	(50)	0		3	(50)
Low Exposure Employees *	7	1	(14)	4	(57)	2	(29)

* High exposure employees are those employees that reported ever having worked as either a blender, utility man or material handler when their rash began. Low exposure employees are those employees that denied ever having worked as blenders, utility men or material handlers.

+ There was a statistically significant difference in responses of high exposure employees when compared with low exposure employees ($p = 0.030$). There was no statistically significant difference in responses of blenders when compared with low exposure employees.

Figure 1: DATE OF ONSET OF RASH
Georgia Gulf Corporation
Tiptonville, TN HETA 88-156



*
1 = Jan. - March
2 = April - June
3 = July - Sept.
4 = Oct. - Dec.