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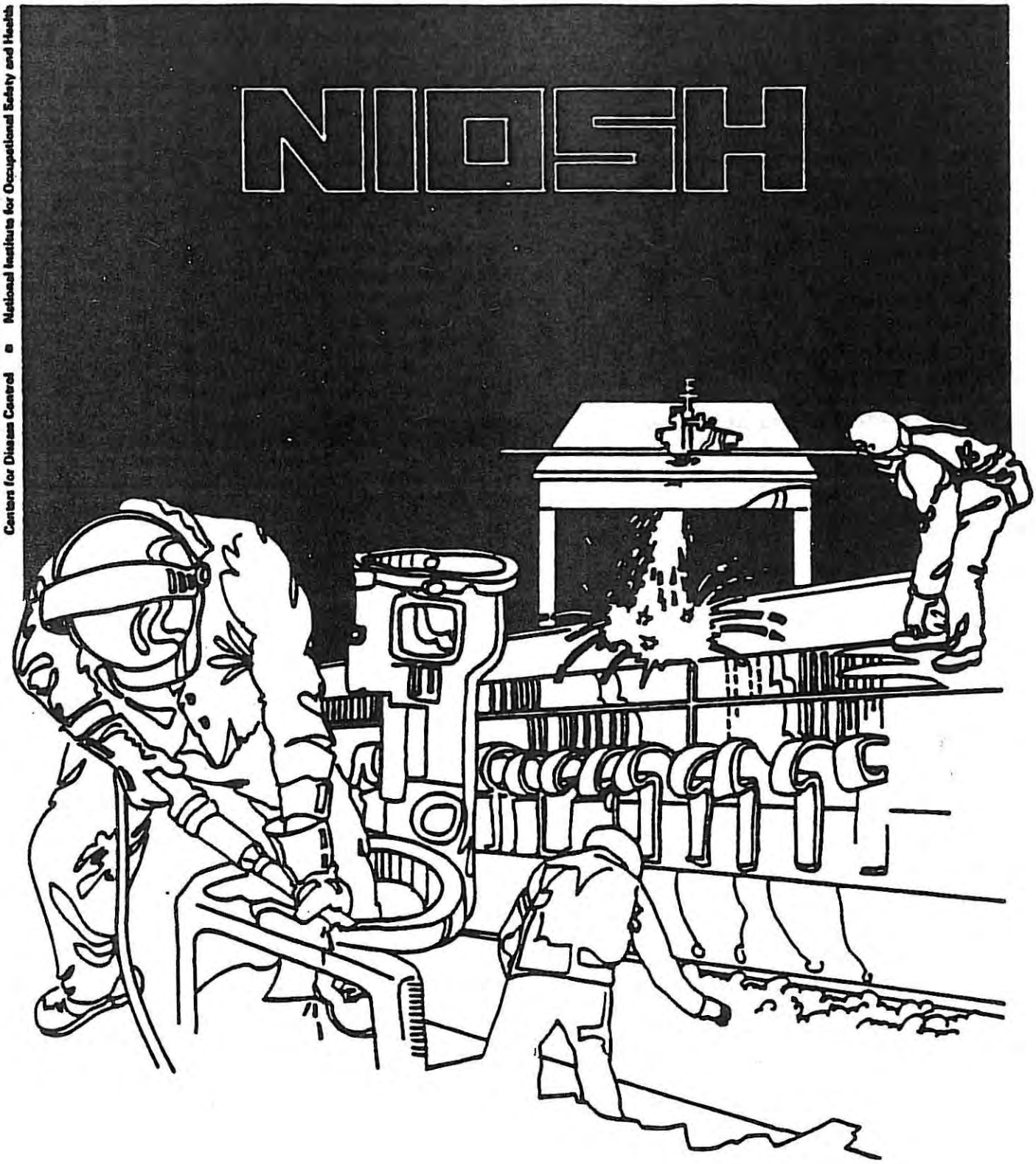

Health Hazard Evaluation Report

HETA 83-196-1492
GOODYEAR TIRE AND RUBBER COMPANY
GADSDEN, ALABAMA

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.

HETA 83-196-1492
JULY 1984
GOODYEAR TIRE AND RUBBER COMPANY
GADSDEN, ALABAMA

NIOSH INVESTIGATORS:
T.M. Williams, M.S.P.H.
J.L.S. Hickey, Ph.D.,P.E.,C.I.H.
C.C. Bishop, M.S.P.H.

I. SUMMARY

On March 14, 1983, the National Institute for Occupational Safety and Health (NIOSH) was requested to evaluate the chemicals used in the manufacture of tires, tubes, flaps and bladders at the Goodyear Tire and Rubber Company at Gadsden Alabama. Workers were experiencing severe skin rash which caused itching and sores as a result of exposures to these chemicals. A survey of the plant was conducted August 30-31, 1983 by three industrial hygienists.

Dermatitis among the workers at the Gadsden Goodyear Plant has been observed for many years. This plant has been the focus of several surveys of its occupational environment, some of which included dermatitis studies. Some of the groups which conducted studies are the University of North Carolina, the National Institute for Occupational Safety and Health, and the University of Cincinnati.

The University of North Carolina was assigned this health hazard evaluation (HHE) with the intention that our approach would be to review industrial hygiene reports of the Goodyear Gadsden Plant from which some dermatitis data were generated by the Occupational Health Studies Group personnel, then reevaluate the plant conditions with the current industrial hygiene data obtained during this survey. It was anticipated that an evaluation could be made to determine if conditions were more or less conducive for skin exposure to chemical dusts now than in the past. Medical surveillance of workers at the Gadsden Plant was not included in this HHE due to time restraints and the extensive previous medical studies.

Airborne total particulate concentrations of from 0.5 to 21.2 mg/m^3 (mean of 5.4 mg/m^3) were found in the banbury and milling areas and from 0.16 to 1.8 mg/m^3 (mean of 0.69 mg/m^3) in the pigment blending areas. Settled dust was observed in these areas. Airborne total dust concentrations in the banbury area were about twice those observed in a 1979 NIOSH survey. The cause of this difference could not be determined. Concentrations in air of 22 organic vapors were assayed and found to be very low.

Chemicals used in the plant include some known to cause dermatitis in sensitive persons. Control appears to be dependent on avoidance of skin contact. Several recommendations are made, aimed at improving control of chemical dusts in air, increasing surveillance of dermatitis, expanding training and education of workers, encouraging increased worker awareness of potential effects of chemicals used, improved personal hygiene, provision of clothing for use at plant, stock liner cleaning, and relocation of sensitive employees.

KEYWORDS: SIC 3011, dermatitis

II. INTRODUCTION

On March 14, 1983, the United Rubber, Cork, Linoleum and Plastic Workers of America, Local Union No. 12 requested a health hazard evaluation of the Goodyear Tire and Rubber Company at Gadsden, Alabama. The request stated that workers were experiencing severe skin rash which caused itching and sores as a result of exposures to the chemicals used in the manufacture of tires, tubes, flaps and bladders.

The University of North Carolina under a cooperative agreement with NIOSH was assigned the health hazard evaluation, May 12, 1983. A survey of the plant was conducted August 30-31, 1983 by three industrial hygienists. The goals of the survey were to evaluate the environmental conditions for possible excess skin exposure to chemicals, and to develop appropriate recommendations to management and/or union to alleviate any problems found.

III. BACKGROUND

The manufacture of tires, tubes, flaps and bladders involves a series of operations which have the potential for exposing workers to a variety of chemicals. Chemicals used in manufacturing these products are added to rubber either to shorten the time of vulcanization or to gain certain desired properties in the rubber. Some of these chemicals are among the major sources of rubber dermatitis, or so-called "rubber itch," in rubber workers.

Areas of the plant where skin contact to chemical dusts appears most likely are in the beginning stages of manufacturing; i.e., receiving, pigment blending, mixing, milling and extrusion. However, direct skin contact with uncured and cured products which contain additive chemicals is most likely in the middle and latter stages of manufacturing. Curing fumes are likely around the curing presses and areas of the plant adjacent to the presses. Throughout the plant all production workers are likely to have some skin contact with the products, waste material, and/or equipment and supplies. All these materials have the potential for containing, or having on their surfaces, chemicals which may cause dermatitis.

Some personal protection equipment is available but its use generally has been left to the discretion of individual employees.

Dermatitis among the workers at the Gadsden Goodyear Plant has been observed for many years. This plant has been the focus of several surveys of its occupational environment, some of which included dermatitis studies. The University of North Carolina, the National Institute for Occupational Safety and Health, and the University of Cincinnati have produced reports on the plant (11, 15, 16).

Dermatitis Problem at the Gadsden Goodyear Plant

The dermatitis problem among workers at the Gadsden Goodyear tire manufacturing plant has been considered and is judged by the Occupational Health Studies Group (OHSG) to be excessive (11). The findings of the initial OHSG study, which took place from 1971-1974, include the following:

(1) The incidence rate of dermatitis for workers under 20 years of age is almost three times that of the rate for the overall population of workers, which suggests that young workers experience a skin reaction to certain chemicals shortly after beginning work.

(2) The incidence of dermatitis by length of service increases with seniority, with the exception of the young workers' experience mentioned above.

(3) Workers with dermatitis complaints seem to come from all sections of the plant. However, the areas of the manufacturing process which have the greatest likelihood of a worker developing a dermatitis problem are the pigment blending and banbury areas for tires, tubes, flaps and industrial products.

(4) The areas of the body affected vary from generalized to specific regions; however, the hands and arms are the most often mentioned affected areas. The trunk, legs and feet are the next most affected areas.

(5) Among a sample of dermatitis-disability retirees from 1973, one basic pattern leading to disability retirement stands out. After a substanital period of employment, 20-25 years, a few isolated visits to the dispensary for skin problems rapidly moves to referral to a dermatologist, sick leave, and inability to return to work after being relieved of the discomforts of the problem and clearing of the skin rash. A return to work usually results in another outbreak.

The findings indicate that rubber processing chemicals handled at the begining stages of the process may be more significant than other agents in causing skin diseases in the plant. These chemicals may also be responsible for dermatitis in other work areas where workers handle rubber stock and come in contact with unreacted compounds in the rubber. Furthermore, the increasing rate of dermatitis with seniority and the pattern of disability retirement suggest that a sensitization reaction which develops after repeated exposure is likely in these dermatitis cases.

1979 NIOSH Study

NIOSH studied dust exposures extensively in this plant in 1979 (15). At that time, the industrial hygiene controls at this plant were considered by NIOSH to be among the better controls in this industry Among NIOSH's conclusions were that the compounding operation appeared to be a major contributor to dust exposure. Although ventilation controls had some deficiencies, the greatest contributor to worker exposure to dust appeared to be work practices associated with materials handling, especially weighing and moving materials in bins (all of which is done manually). Twenty-three work practices contributing to dust exposure and seven practices maximizing dust exposure were observed.

University of Cincinnati Study

The comments and recommendations from the University of Cincinnati's 1979 study (16) at this plant are included to provide additional background.

All studies of this kind are subject to weaknesses and this is no exception. While the initial plans called for the specific cohort characteristics; e.g., random selection of persons with dermatitis, random selection of persons without dermatitis and those seen by consultants, the response to the recruitment was such, especially in the September series, that these qualifications could not strictly be fulfilled. Hence, in the evolution of the study, a careful analysis of all of the relevant information was made on all subjects examined without regard to prior cohort designation. The history of dermatitis or other skin complaints was elicited through interview at two levels. The presence of skin conditions was determined by examination. The significance of the historical, as well as clinical, findings was determined by the examining physician and the study group, in light of diagnostic tests, such as patch tests. The significant data which has emerged indicate that, although 15.5% of the population examined appeared to have clearly defined occupationally-related skin problems, another 31% had conditions which could be suspected of being occupationally related. In the case of the suspected origin, this judgment was made on the basis largely of historical data rather than current findings. There were a number of instances in which the worker as well as his or her physician were of the opinion that it was occupationally-related and compensable. In reviewing the records and examining the subjects a substantial number of these cases were regarded by the study group as not occupationally related.

There has been a good deal of concern about what was regarded as an annual frequency of occupational skin disease in this plant. Our review, which recorded positive histories for a period of ten years prior to the examination, is really reporting on an aggregate occurrence. It would be much more enlightening to determine the number of new cases, occupational and non-occupational, which occurred during one month or during one year. This is necessary in order to determine incidence of true occupational skin problems.

It is recommended that a record-keeping system be developed to determine incidence data which would include not only the designation of eczematous problems, but also other occupationally-related conditions, such as folliculitis, acne, xerosis, etc. It is also essential to develop a system of referral to a qualified dermatologists(s) who is (are) well informed about occupational skin problems and the potential for exposure at the plant and who can carry out proper testing procedures including patch tests, biopsies, cultures, etc.

The Cincinnati study group would be available to review all of the cases which have occurred since September 1979, by year, and compare the diagnostic and etiologic information with that which has emerged from this study. It would provide a measure of determining changes in frequency, as well as patterns of condition, and also determine what process areas need further attention.

METHODS AND MATERIALS

The University of North Carolina was assigned this health hazard evaluation (HHE) with the intention that our approach would be to review Industrial Hygiene reports of the Goodyear Gadsden Plant from which some dermatitis data were generated by the Occupational Health Studies Group personnel, then reevaluate the plant conditions with the current Industrial Hygiene data obtained during this survey. It was anticipated that an evaluation could be made to determine if conditions were more or less conducive for skin exposure to chemical dusts now than in the past. Medical surveillance of workers at the Gadsden Plant were not included in this HHE due to time restraints and the extensive previous medical studies.

Environmental evaluation consisted of interviews with company and union personnel about environmental conditios, a walk-through industrial hygiene survey, review of properties of chemicals used kand collection of air samples for analysis for organic vapors and for gravimetric analysis for total and respirable particulates. Questionnaires were not used; day shift employees observed were requested to provide such information as they were able in the interviews.

Seven personal and fifteen area air samples were collected and analyzed gravimetrically for total and respirabale particulated concentrations on 37 mm diameter, 5u pore-sized vinyl metricel filters, at a sampling rate of 1.7 liters/minute. Four area air samples were collected for organic vapor analysis using charcoal tubes. These were analyzed for 22 organic compounds by means of gas chromatography following elution with carbon disulfide.

V. EVALUATION CRITERIA

There are generally no standards or criteria for evaluating rubber chemical dust concentrations in air. These dusts are often mixtures of several substances, some of which may have no established exposure limits. In the absence of such criteria, the exposure standards

for nuisance dust were used as a frame of reference, with the caveat that nuisance dust standards are inadequate for evaluating exposure to substances which may be toxic or cause dermatitis. The ACGIH recommended limits for nuisance dust are 10 milligrams per cubic meter (mg/m^3) for total dust and 5 mg/m^3 for respirable dust (1). The corresponding OSHA limits are 15 and 5 mg/m^3 (2). Solvent concentrations assayed were so low that criteria for their evaluation are not presented. Results of these assays are in Section VI.

Rubber Processing Chemicals as Dermatitis Causing Agents

Rubber processing chemicals are chemicals added to rubber either to shorten the time of vulcanization or to gain certain desired properties of the rubber. A large number of different chemicals are used for different rubber products. As a group, the thiazole derivates and N, N' substituted p-phenylenediamines are used more than any other group of chemicals.

These chemicals are the major sources of so-called rubber itch or rubber dermatitis among rubber workers and persons using rubber articles. Specific agents which produce most cases of rubber dermatitis include 2-Mercaptobenzothiazole (MBT), Tetramethyl-thiuramdisulfide (TMDT), 1,3-Diphenylguanidine (DPG), Hexamethylenetetramine (HMT), N-Isopropyl-N'-phenylparaphenylenediamine (IPPD), and Paraphenylendiamine (PPD) (12,13,14). MBT, TMTD, and N, N' substituted paraphenylenediamine in particular are frequently described as major agents of rubber-related skin diseases in current studies. However, PPD and DPG seem to be compounds with highest skin sensitivity, followed by IPPD, TMTD, and MBT. The signs of rubber dermatitis from MBT or TMTD are usually reported as eczema or erythematous and papulovesicular eruption distributed over the body area where contact with rubber articles occurred.

Chemicals consumed at the plant in relatively high volume, i.e., MBT, TMTD, DPG, MBTS and HMT are almost identical with major rubber dermatitis causing agents discussed in the previous section.

VI. RESULTS AND DISCUSSION

The pigment blending area is isolated from other active processing areas. Only a few workers are engaged in pigment blending. Their major tasks are weighing and blending dry chemicals according to the "recipe" of the desired batch. Therefore, these workers are usually exposed to dry chemicals. Although ventilation in this area has been improved over the past few years, dust exposures still occur. Whenever the workers cut bags and poured chemicals into a hopper, a visible dust cloud arose around the hopper. This dust then settled to the surfaces of various equipment and the floor, covering the area with a layer of yellowish-white chemical dust. This material offers the potential for exposures of workers as long as it remains in the working environment.

Results of dust sampling in the pigment blending area are presented in Table 1. Two personal samplers worn by the pigment blender operator showed total particulate exposures of 1.83 and 0.89 mg/m^3 on two consecutive days. Four area samples of total airborne particulates at this location during the same period ranged from 0.08 to 0.88 mg/m^3, with a mean of 0.36 mg/m^3. Two area samples for respirable particulates showed concentrations of 0.15 and 0.25 mg/m^3.

Although tire and tube banburys are located in different buildings, their operations are similar. The workers are responsible for supplying the banbury with proper amounts of elastomers, blended dry chemicals, antioxidants, oils, carbon black and other desired materials for a given stock. Work in banbury areas involves risk of exposure to chemical agents. The quality and quantity of exposure to chemicals may vary from banbury to banbury and from time to time, since each banbury may process different stock and handle different materials at different times. Besides the processed chemicals, airborne dust may come from that which accumulates on the surfaces of machines or the floor, becoming airborne while workers clean up machines or dump and move materials.

Results of particulate air sampling in the banbury areas are presented in Table 2. Five personal samples of total particulate exposure to tire banbury operators ranged from 1.09 to 21.16 mg/m^3, with a mean of 7.35 mg/m^3. Four area samples for total particulates ranged from 0.52 to 11.67 mg/m^3, with a mean of 3.5 mg/m^3. A sample for total particulates in the tube banbury area showed 3.18 mg/m^3. Area respirable dust samples showed concentrations of 0.07 to 0.40 mg/m^3 in the tire banbury area and 0.35 mg/m^3 in the tube manufacturing area.

Total and respirable dust measurements made by NIOSH in 1979 (15) at this plant are shown in Table 3 for comparison. Total particulate concentrations found in the 1979 survey were about one-half those found in this survey, and respirable particulate concentrations were about the same in both surveys.

The bias-ply operation takes the rolls of calendered stock and cuts them into shapes necessary for tire building. Area air samples were taken near the bias-ply stock cutting machines #2 and #3 during operations. One sample showed a total particulate concentration of 0.10 mg/m^3. Two area samples taken in the milling area showed virtually zero concentration of 22 organic solvents in air. Two area air samples in the bias-ply area indicated concentrations of 7.4 ppm n-hexane as the highest air concentration of the solvents analyzed. Benzene concentrations found were 0.0 and 0.07 mg/m^3. All other solvent concentrations were on the order of only 1 percent of their respective allowable permissible exposure limits.

Milling and extrusion are two production units in close proximity on the first floor of the tube plant. The predominant environmental contaminants are fumes and talc dust arising from these processes which, with the high temperature, make the environment rather uncomfortable. Workers in both milling and extrusion have frequent contact with the processed stocks which at this stage are perhaps not fully reacted. Repeated contact

Table 1 - Results of Particulate Sampling in Pigment Blending Area

Sample		Sampling		Results
Type	No.	Time (min)	Location	(mg/m^3)
Personal, Total Particulate	1	265	Pigment blending oper. 8/30/83	1.83
Personal, Total Particulate	25	223	Pigment blending oper. 8/31/83	0.89
Area, Total Particulate	4	259	Near scale hopper on right corner of rail 8/30/83	0.08
Area, Total Particulate	28	223	Near scale hopper on right scale of rail 8/31/83	0.31
Area Sample Pair:				
Total Part.	2	261	Pigment blending	0.16
Respir. Part.	3	261	platform, right corner 8/30/83	0.15
Area Sample Pair:				
Total Part.	26	225	Pigment blending plat-	0.88
Respir. Part	27	224	form, right corner 8/31/83	0.25

Table 2 - Results of Particulate Sampling in the Tire Banbury and Milling Area and Tube Manufacturing Area

Sample Type	Sample No.	Sampling Time (min)	Location	Results (mg/m^3)
Personal, Total Particulate	9	245	Operator, banbury #6 8/30/83	4.06
Personal, Total Particulate	22	256	Operator, banbury #7 8/31/83	21.16
Personal, Total Particulate	8	246	Operator, banbury #8 8/30/83	1.09
Personal, Total Particulate	7	249	Operator, banbury #12 8/30/83	3.23
Personal, Total Particulate	24	249	Operatory, banbury #12 8/31/83	7.21
Area, Total Particulate	23	250	Control panel at banbury #3, 8/31/83	0.78
Area Sample Pair:				
Total Part.	10	242	Adjacent to banbury #8,	0.52
Respir. Part	11	242	5 ft. off floor 8/30/83	0.07
Area Sample Pair:				
Total Part.	21	262	Adjacent to banbury #8,	11.67
Respir. Part.	20	262	5 ft. off floor, 8/31/83	0.27
Area Sample Pair:				
Total Part.	14	235	On post between #3 and #4	0.97
Respir. Part.	13	235	wig wag, 5 ft. off floor 8/30/83	0.40
Area Sample Pair:				
Total Part.	31	221	Tube plant, on post #C-5,	3.18
Respir. Part.	30	221	5 ft. off floor 8/31/83	0.35

Table 3 - Airborne Particulates in Tire and Tube Manufacturing, 1979

Location or Operation	Airborne Particulates[a], mg/m^3		
	Area Sample,	Personal Sample	
	Total	Total	Respirable
Banbury	0.65(0.24-1.54)21	1.9(0.67-3.9)7	0.23(0.10-0.28)8
Curing	0.21(0.10-0.32)37	0.20(0.10-0.28)7	0.18(0.11-0.30)7

[a]Values given are: Mean (range) No. of samples

SOURCE: Heitbrink, W. A., et al., NIOSH Control Technology Assessment at Goodyear Tire and Rubber Company, Gadsden, Alabama (NTIS #PB83-162958), May 22, 1981 (Reference 15).

with unreacted chemicals in the hot stock may be a cause of skin problems for workers in this part of the plant. These unreacted chemicals may also be released as fumes and mists and deposited on nearby machine surfaces.

The flap plant is a separate building for milling, extrusion and curing of flaps and bladders. These areas are much cleaner than their counterparts in the tire and tube plant, since no raw material is used in this building. Therefore, direct contact with raw materials seems unlikely for workers in this area. However, dust on surfaces of the rubber line, curing presses and other equipment may still contain mercaptobenzothiozole (MBT), a common accelerator for stock processed in this plant. Unreacted MBT in the stock may be released into the air while the stocks are processed.

Dermatitis in the Rubber Industry

With the nature of chemical usage in the rubber industry, it is not surprising that dermatitis is a serious problem. This industry consumes a vast variety of chemicals. Even before the 1960s, there was already a long list of these chemicals reported as dermatitis-causing agents; among them primary irritants such as gasoline, petroleum products, aliphatic and aromatic solvents, alkalies, acids, cleansers and detergents as well as a number of sensitizers such as accelerators, antioxidants, softening oils, plasticizers, phenolformaldehyde resin and epoxy resin (3,4,5,6). The use of chemicals with extreme skin hazards has been discontinued by some manufacturers (5), but a large number of these chemicals are still in use. Furthermore, new chemicals introduced into this industry to replace hazardous chemicals are sometimes found to pose skin hazards to a degree no less than the ones replaced (7,8).

Unfortunately, a majority of these dermatitis causing chemicals are not regulated by health standards (2). Little information is available in the literature concerning toxicity of these chemicals. Only few of them have been reported to be associated with adverse health effects other than cutaneous hazards (9,10). The extent of their environmental occurrences is mostly unknown. Although clinical experience has long demonstrated the dermatitis potential of these chemicals, the relation between environmental exposure to these chemicals and development of dermatitis has not been well defined. Workers may develop dermatitis by direct contact with bulk chemicals, or with chemicals accumulated on surface of machinery and processed stocks, as well as airborne particulates. Evaluating the degree of exposure from air samples alone may underestimate true contact exposure and potential for developing skin diseases.

VII. CONCLUSIONS

Analysis of air samples collected in the banbury and milling areas of the plant revealed in some cases significantly high concentrations of total dust. Workers in compounding and blending areas handle chemicals for the manufacture of tires, tubes, flaps and bladders which are known to cause skin irritation to certain individuals who have become sensitized. Skin contact with these chemicals may come from

contact with airborne dust. Surrounding work areas, where the chemicals are not being used, could also contain these chemicals in the air and on surfaces, due to drifting of air. There is thus some potential for contact with chemical dusts anywhere in the manufacturing areas. There are generally no exposure limits or criteria for evaluating rubber chemical dust concentrations in air, and exposure limits for inert dust may not be adequate as a reference basis for controlling these dusts.

Potential for exposure to organic vapors was found to be low.

VIII. RECOMMENDATIONS

Remedial measures should focus on avoidance of skin contact with chemical dusts and prompt removal of dusts after contact. Suggested steps are:

1. Workers should be made aware through a management training and education program that they are working with chemicals or rubber stock that contains chemicals known to cause skin irritation.

2. Management should train and encourage employees in good work practices, to avoid direct contact with rubber stock on skin or clothes and to change clothing which has become contaminated with chemical dusts.

3. Workers should be encouraged to wash hands and face often; for example, before breaks and lunchtime, and to shower after the work day.

4. Workers should avoid wearing home the clothes worn during the work day. Provision of clothing for plant use and laundering facilities should be provided by management.

5. It may be necessary for the company to relocate employees who have become sensitized to a particular stock or chemical.

6. The cloth liners used to separate the rubber stock may be contaminated with dermatitis-causing chemicals. These liners are handled by many workers and cross department lines. Consideration should be given to a program of periodic cleaning or replacement of these liners.

7. Efforts should be made to keep airborne chemical dusts at as low a concentration as practicable. The dust control program should be augmented by a program of surveillance with frequent monitoring of dust levels.

8. Management should continue present surveillance of dermatitis cases and expand surveillance efforts in engineering controls, observation of working conditions, monitoring and recordkeeping of all changes in the working environment. A standard policy for these practices should be made and followed by both management and employees. The

problem of dermatitis at the Gadsden plant still exists, and a greater effort to relieve the problem is management's responsibility.

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X. AUTHORSHIPS AND ACKNOWLEDGEMENTS

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Evaluation conducted and report prepared by:

Industrial Hygiene Evaluation and Report:	Ted M. Williams, M.S.P.H.
Industrial Hygiene Evaluation and Report:	John L.S. Hickey, Ph.D., C.I.H.
Laboratory Analyses:	Carolyn C. Bishop, M.S.P.H.
Report Typed By:	Susan G. Kirstein
Originating Office:	Occupational Health Studies Group School of Public Health University of North Carolina Chapel Hill, NC 27514
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(b) United Rubber, Cork, Linoleum and Plastic Workers of America, Local No. 12, East Gadsden, Alabama
(c) U.S. Department of Labor, OSHA, Region IV
(d) NIOSH region IV
(e) Alabama State Department of Health (Ira M. Myers, M.D., State Health Officer)
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