TALC DUST AND INDUSTRIAL HYGIENE SURVEY

PLYMOUTH RUBBER COMPANY
Canton, Massachusetts

SURVEY CONDUCTED BY:
John Dement
Harry Donaldson
Patrick Shuler
Richard Spiegel M.D.

REPORT PREPARED BY:
John Dement
Patrick Shuler

Environmental Investigations Branch
Division of Field Studies and Clinical Investigations
National Institute for Occupational Safety and Health
1014 Broadway
Cincinnati, Ohio

DATES OF SURVEY:
April 26-27 & May 10-11, 1972

Place Visited	:	Plymouth Rubber Company Rivere Street Canton, Massachusetts 617-828-0220
Dates of Trip	:	April 26-27 and May 10-11, 1972
Persons Making Trip	:	John Dement Harry Donaldson Patrick Shuler Richard Spiegel M.D.
Persons Contacted	:	Mr. Bernard Wax Vice President Mr. Charles Rowe Special Project Manager Mr. Salvatore Romanelli Safety and Personnel Director
Purpose of Trip	:	To make an industrial hygiene survey of the facility and evaluate workers exposure to talc in the rubber band operation.

INTRODUCTION

On April 26 and 27, 1972 the Division of Field Studies and Clinical Investigations made a plant visit to the Plymouth Rubber Company in Canton, Massachusetts. The visit was made by John Dement, Harry Donaldson, Patrick Shuler, and Dr. Richard Spiegel. The purpose of the visit was to make an industrial hygiene survey of the facility and to evaluate the rubber workers talc exposure.

As a result of the initial tour through the plant, it was decided that the rubber band operation appeared to be the dustiest operation. Free silica and asbestos fiber were found to be present in the talc being used. Personal and general air samples were used to evaluate each of these exposures. In addition to total airborne dust levels being excessive, both free silica and asbestos exposures were found to be grossly in excess of present standards.

The following paragraphs describe the plant operations and housekeeping procedures. Sampling procedures and results are also given along with recommendations for needed improvements and further testing.

DESCRIPTION OF THE PLANT

The plant is located in Canton, Massachusetts, approximately 15 miles south of Boston. The plant site is composed of approximately 15 acres with approximately 400,000 square feet of manufacturing and storage area. Products of the plant include the following:

1. Coated Textile Products
2. Rubber Bands and Garden Hose
3. Friction, Rubber, and Plastic Tapes
4. Vinyl & Crepe Rubber Shoe Soling Slabs
5. Vinyl Coated Fabrics

The plant's first buildings were constructed in 1896. The coated textile products division was moved from Rockland, Massachusetts to Canton in 1961. The total employment in the Canton facility is presently approximately 1000 persons. The daytime shift is the primary shift although some operations are carried out 24 hours per day. The rubber band operation involves about 100 employees over three shifts approximately 40 of which are engaged in the actual band production.

Plant medical personnel consists of one registered nurse during the day. Dr. Ruben, a local general practitioner, serves as plant consultant. There are also two supervisors on each shift who have some training in first aid. All employees are given a pre-employment physical. This excludes taking a blood test or X-ray unless the worker has a history of respiratory problems. No further physicals are offered to the employees by the company on a routine basis.

The personnel director is responsible for both safety and security at the plant. A committee has been organized consisting of the safety director, union president, four supervisors and union officials from each division of the plant. Each of the four divisions is inspected by the committee on a

monthly basis. Safety consultation is available from the companies insurance agent, Liberty Mutual.

The company does not have a full time industrial hygienist but does obtain consultation services from a local industrial hygienist.

DESCRIPTION OF THE PROCESS

The talc is used at Plymouth Rubber in conjunction with the manufacture of rubber bands. Bales of pure synthetic or natural rubber, purchased as the starting raw material, has fillers, accelerators, antioxidants, and vulcanizers mixed in Banbury mixers. After leaving the mixer, slabs of material are formed on a roller. The strips are thrown on a cart and dusted with talc with a broom, so that the sheets will not stick together. The rubber from the mixing area is sent to various departments for further processing, including the rubber band department.

The band department passes the rubber from the mixing area through a primary calender where more sulfur is added to produce vulcanization. This material next goes through a heated calender where it is cut into strips two inches wide and passed through a talc dip to lubricate it. These narrow strips are fed into an extruder that forms a tube of rubber which is cut to a length of about ten feet. While exiting the extruder the material is continuously dusted with talc both inside and out, again for purposes of lubrication. A metal rod is inserted in each rubber tube and placed on a rack. This rack is placed into an autoclave to complete the vulcanizing process. Next, the tubes are separated from the rods, weighed, and crosswise sections sliced off by a rotary cutter to form rubber bands. The bands are then ready for packing and shipping.

Plymouth Rubber has just installed a new machine that takes the rubber strips and extrudes and cures the tubes of rubber continuously in a single housing, thus eliminating many material transfers and dusting operations. However, current plans do not include the elimination of the present system in the near future.

INSPECTION OF PLANT

Potential Health Hazards: The major potential health and safety hazards encountered were:

1. Asbestos and other fiber exposure during talc dusting.
2. Free silica exposure during talc dusting.
3. High talc concentrations in the rubber band producing area.
4. Large uncovered, unguarded pulleys and gears in the rubber solvating area.

Personal Protection: The company provides gloves, safety glasses, and other protective devices in areas where required. A program for subsidizing the purchase of safety shoes is underway. Respirators are not required in any area but some employees do wear them voluntarily.

Ventilation: A line diagram of the Band Room ventilation layout, together with the capacities of the various fans and blowers was supplied by Plymouth Rubber and is included in the Appendix to this report. This also gives some idea of the general layout of the equipment in the room. The Massachusetts Department of Labor and Industries has done a survey previously

(see Appendix) in which hood velocities were checked and no recommendations for ventilation improvements made. However, in our opinion, the systems provided are poorly designed and generally located too far from dust generation points to be effective.

There is floor ventilation at the weighing stations near the vulcanizer, but the hoods are too far from the dustiest operation in the area, the removal of the rods from the cured rubber tubes, to be effective. The hoods at the extruding stations are unflanged and are located approximately one foot above the machine. Talc is sprayed downward onto the extruded tubes, therefore, the ventilation must overcome additional inertia to capture the dust. A better solution might be to enclose the spraying operation and use downdraft ventilation to capture the created dust.

The canopy hooding over the calendars is effective in venting dust in the general air, but can not be as effective as properly designed local exhaust ventilation. There is some general ventilation in the packing area, but nothing immediately in the vicinity where the workers handle the dust laden rubber bands to pack them. All local exhaust ventilation is vented to a Sly bag type collector rated at 17,200 cfm. The collector is located outside and appeared to function properly.

The bands from the cutters are conveyed to the packing area pneumatically thereby eliminating another dusty material transfer inside the band room. The bands are separated from the conveying air stream by cyclones located on the roof. This system also provides local exhaust ventilation for the cutters.

Housekeeping: In general, the housekeeping in the portion of the plant where the rubber bands are manufactured is very poor. Talc powder in some spots is piled up to three inches deep on the floor. Cleaning at the end of each shift is done only by hand sweeping the band area. There does appear to be enough floorspace to prevent overcrowding and congestion in the walkways.

Survey Procedures: Actual sampling was confined to the mixing and rubber band areas where the talc is used extensively. The objective was to determine the worker's exposure to total talc dust, free silica, and asbestos fiber. The following sampling methods were employed to determine these dusts quantitatively:

1. General air samples were taken with Staplex hi-volume samplers equipped with Whatman 41 filters. The filters were tared and reweighed to determine total dust concentrations and free silica determined using the Talvitie[1] method.
2. Personal sampling units equipped with Millipore Type AA cellulose ester filters were used to determine fiber concentrations by phase contrast microscopy.
3. Personal sampling units with silver membrane filters were utilized to ascertain both total dust concentrations and free silica determined using the Talvitie[1] method.
4. Personal respirable samples were taken using the same system mentioned above, equipped with a 10mm nylon cyclone and a pulsation dampener[2].
5. Pictures have been taken through a microscope at 500X to document and characterize the fibers in the talc. Plans are being made to also do this at much higher magnification using an electron microscope.
6. Bulk samples of talc are currently undergoing X-ray diffraction analysis to determine the percentage by weight of free silica and asbestos.

RESULTS AND DISCUSSION

The sample results of the industrial hygiene survey are given in Tables I, II, and III. In general, dust levels were grossly excessive, even if talc were considered only a nuisance dust. In addition, fibrous talc and free SiO_2 concentrations were in excess of present OSHA standards. The standards are as follows:

1. For fibrous talc, the asbestos standard must be used. The present asbestos standard took effect upon publication in the Federal Register December 7, 1971. The standard is as follows:

   "The 8-hour time-weighted average airborne concentration of asbestos dust to which employees are exposed shall not exceed five fibers per milliliter greater than five microns in length, as determined by the membrane filter method at 400-450X magnification (4 millimeter objective) phase contrast illumination. Concentrations above five fibers per milliliter but, not to exceed ten fibers per milliliter, may be permitted up to a total of 15 minutes in an hour for up to five hours in an 8-hour day."

2. The present standard for free silica exposure in a total dust sample is computed by the following formula:

$$\text{Standard } (Mg/M^3) = \frac{30}{\% \ SiO_2 + 3}$$

3. The present standard for free silica exposure in a respirable dust sample is computed by the following formula:

$$\text{Standard } (Mg/M^3) = \frac{10}{\% \ SiO_2 + 2}$$

From the attached tables, it is obvious that the average asbestos standard was exceeded in all but two of the rubber band operations. In addition to exceeding the average standard, extruder operators and vulcanizers had samples which exceeded the peak allowable value of 10 fibers greater than five microns in length per milliliter.

Chemical analysis of the airborne dust indicates that free silica comprises 2-3% of the airborne fraction. Based on these findings, allowable total dust concentrations should be less than 6 Mg/M^3 and allowable respirable concentrations should be less than 3 Mg/M^3. All operations in the band production area had average total dust concentrations above 6 Mg/M^3 and all operations except band cutting had average respirable concentrations above 3 Mg/M^3.

CONCLUSIONS AND RECOMMENDATIONS

The industrial hygiene survey shows that talc, free silica, and asbestos exposures are grossly excessive. The following conclusions and recommendations for improvements are made:

1. Talc is being used in excess of that needed for lubrication. Decreasing the amount of talc used for dusting would result in lower airborne concentrations. In addition, it would be advisable to use a grade of talc which is lower in free silica content.

2. Talc dusted materials are being handled in a careless, dust creating manner. Two examples are the removal of rubber slabs from storage carts and the removal of the metal curing rod from the cured rubber tubes. Material handling methods need to be investigated to mechanize these operations. In addition, workers should be advised of the potential health effects of excessive talc exposure.
3. Ventilation in the area is extremely poor. Local exhaust hoods should be provided in the packing, vulcanizing, and milling areas. Hoods at extruding stations should be re-designed to enclose the spraying operation and down draft ventilation provided.
4. The use of brooms should be discontinued and a vacuum system installed for floor and machine cleaning.
5. Until the above improvements are made and it has been determined that exposure levels are safe, workers should be required to wear Bureau of Mines approved respirators for pneumoconiosis producing dusts.

REFERENCES

1 Talvitie, N.A. "Determination of Free Silica: Gravimetric and Spectrophotometric Procedures Applicable to Airborne and Settled Dust", American Industrial Hygiene Association Journal, 25, 169 (1964).

2 LaViolette, P.A. and P.C. Reist. "An Improved Pulsation Dampener for Use with Mass Respirable Sampling Devices," Submitted to American Industrial Hygiene Association Journal.

APPENDIX

TABLES

FIGURES

ATTACHMENTS

TABLE I

PERSONAL SAMPLE RESULTS

Plymouth Rubber Company

Canton, Massachusetts

April 26-27 & May 10-11, 1972

JOB	SAMPLE #	SAMPLE TYPE	FILTER TYPE	CONCENTRATION Mg/m³	CONCENTRATION FIBERS >5µ/ml
Primary Calender	11	Total Mass	Silver	23.4	
Primary Calender	11	Fibers	Millipore "AA"		6.9
Warm Up Mill	9	Total Mass	Silver	54.9	
Warm Up Mill	17	Total Mass	Silver	113	
Warm Up Mill	9	Fibers	Millipore "AA"		4.7
Hot Mill	10	Total Mass	Silver	35.7	
Extruder	1	Total Mass	Silver	63.8	
Extruder	2	Total Mass	Silver	24.5	
Extruder	3	Total Mass	Silver	49.6	
Extruder	4	Total Mass	Silver	54.6	
Extruder	5	Total Mass	Silver	47.4	
Extruder	6	Total Mass	Silver	50.0	
Extruder	13	Respirable Mass	Silver	7.8	
Extruder	15	Respirable Mass	Silver	4.1	
Extruder	16	Respirable Mass	Silver	2.5	
Extruder	1	Fibers	Millipore "AA"		10.2
Extruder	2	Fibers	Millipore "AA"		4.9
Extruder	3	Fibers	Millipore "AA"		10.1
Extruder	4	Fibers	Millipore "AA"		15.8
Extruder	5	Fibers	Millipore "AA"		7.6
Extruder	6	Fibers	Millipore "AA"		19.2
Extruder	13	Fibers	Millipore "AA"		12.3
Extruder	14	Fibers	Millipore "AA"		5.7
Extruder	15	Fibers	Millipore "AA"		9.2
Vulcanizer	7	Total Mass	Silver	198.5	
Vulcanizer	8	Total Mass	Silver	84.3	
Vulcanizer	21	Respirable Mass	Silver	5.3	
Vulcanizer	22	Respirable Mass	Silver	6.1	
Vulcanizer	8	Fibers	Millipore "AA"		19.2
Cutter	5	Total Mass	PVC	13.7	
Cutter	23	Total Mass	Silver	9.8	
Cutter	4	Respirable Mass	PVC	.9	
Cutter	24	Respirable Mass	Silver	1.3	

TABLE I

(continued)

JOB	SAMPLE #	SAMPLE TYPE	FILTER TYPE	CONCENTRATION Mg/m^3	CONCENTRATION FIBERS >5μ/ml
Packer	18	Total Mass	Silver	75.5	
Packer	19	Total Mass	Silver	4.8	
Packer	20	Total Mass	Silver	107.1	
Packer	17	Fibers	Millipore "AA"		.9
Packer	18	Fibers	Millipore "AA"		.8
Packer	19	Fibers	Millipore "AA"		1.4
Duster in Rubber Mixing Building	12	Total Mass	Silver	5.4	
	12	Fibers	Millipore "AA"		7.7

A laboratory analysis for free silica using the Talvitie Colorimetric Method[1] showed airborne dust averaged between 2-3% free silica by weight.

TABLE II

SUMMARY OF PERSONAL SAMPLE RESULTS BY JOB TYPE
Plymouth Rubber Company
Canton, Massachusetts
April 26-27 & May 10-11, 1972

JOB	# OF SAMPLES	SAMPLE TYPE	MEAN CONCENTRATION Mg/M^3	FIBERS >5μ/ml
Duster in Mixing Bldg.	1	Total Mass	5.4	
Duster in Mixing Bldg.	1	Fibers		7.7
Primary Calender	1	Total Mass	23.4	
Primary Calender	1	Fibers		6.9
Warm-Up Mill	2	Total Mass	84.0	
Warm-Up Mill	1	Fibers		4.7
Hot Mill	1	Total Mass	35.7	
Extruder	6	Total Mass	48.3	
Extruder	3	Respirable Mass	4.8	
	9	Fibers		11.3
Vulcanizer	2	Total Mass	141.4	
Vulcanizer	2	Respirable Mass	5.7	
Vulcanizer	1	Fibers		19.2
Cutter	2	Total Mass	11.7	
Cutter	2	Respirable Mass	1.1	
Packer	3	Total Mass	62.5	
Packer	3	Fibers		1.0

TABLE III

GENERAL AIR SAMPLE RESULTS
Plymouth Rubber Company
Canton, Massachusetts
April 26-27 & May 10-11, 1972

SAMPLE #	AREA SAMPLED	CONCENTRATION Mg/M³ Total Dust	Respirable Dust
Hi-Vol			
1	By extruders	22.7	
2	Between extruders and storage racks	20.4	
3	Near vulcanizer	17.6	
4	Where Packer bands	14.2	
5	Near sheet dusting in mixing area	5.7	
6	Near Bambury mixer	5.7	
Personal			
VM1	Near the vulcanizer	34.7	
VM2	Near the vulcanizer		1.3

A laboratory analysis for free silica using the Talvitie Colorimetric Method [1] showed airborne dust averaged between 2-3% free silica by weight.

Figure 1
Ventilation System, Plymouth Rubber Company

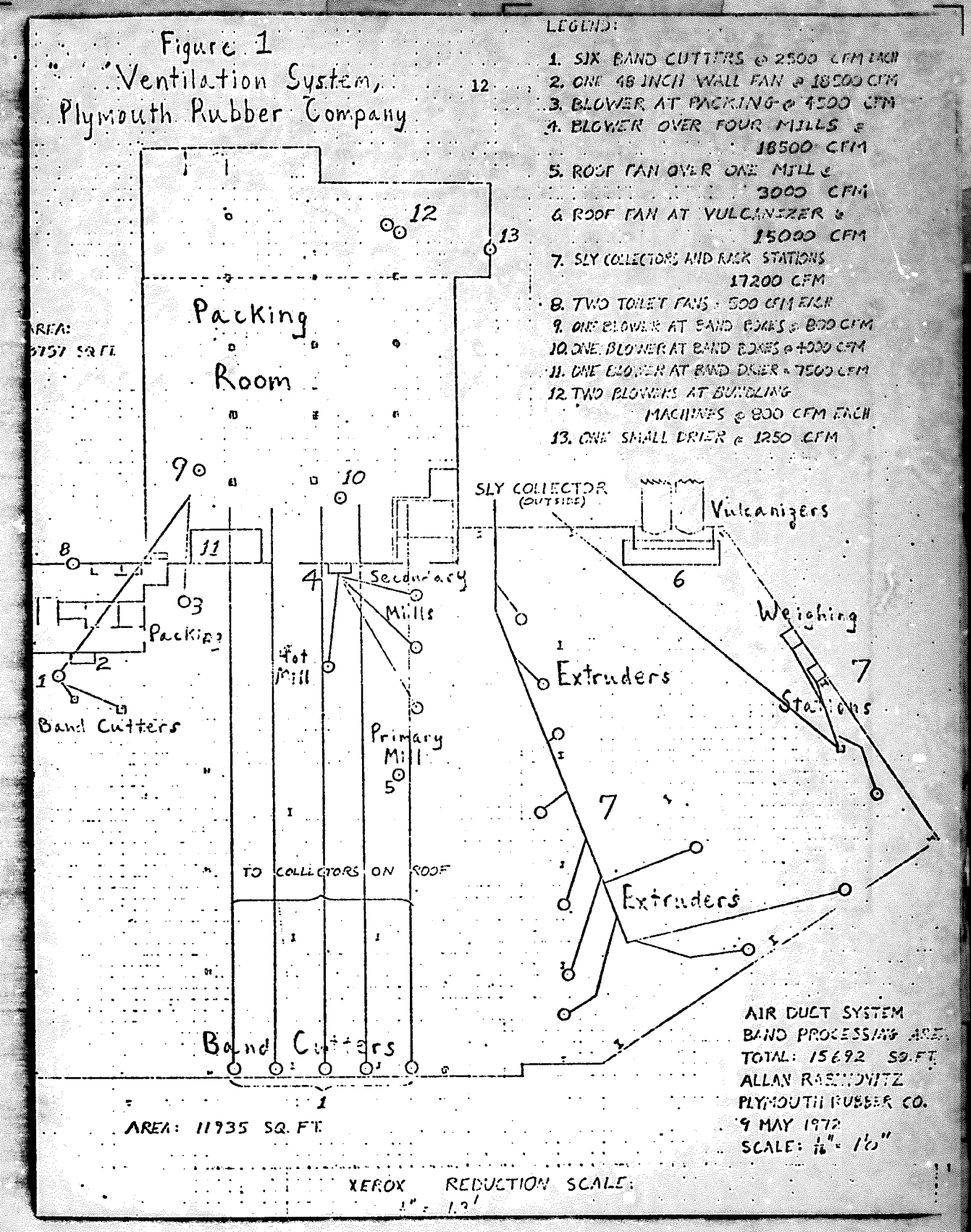
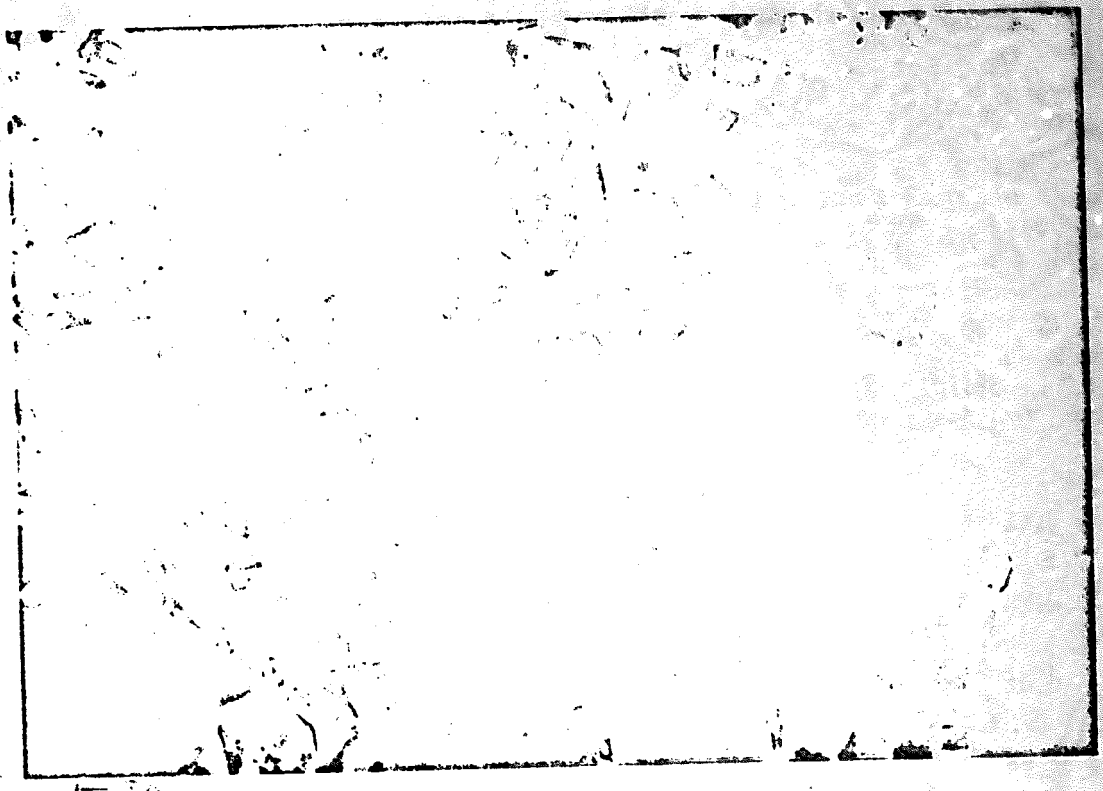


FIGURE 2

Photograph of Airborne Talc Sample
Taken At
500X Under Phase Contrast Illumination



Robert E. Cashins

Attachment 1

The Commonwealth of Massachusetts
Department of Labor and Industries
DIVISION OF OCCUPATIONAL HYGIENE
39 BOYLSTON STREET
BOSTON, MASSACHUSETTS 02116

November 19, 1971

[illegible]

TO: [illegible]
FROM: [illegible] Brugsch & [illegible] Cashins
SUBJECT: Plymouth Rubber Company
Mr. Simonelli, Plant Manager
[illegible]: Mr. Robert Annese, Safety Director
Dr. Julius Rubin, Plant Physician
DATE OF VISIT: November 12, 1971

[illegible] exposure on the [illegible].

Dust samples were collected [illegible] TPA. [illegible]

DUST TABLE

Sample Number	Min. Time	Location	TALC Millions of particles Per Cubic Foot of Air
		OPERATOR'S EXPOSURE	
1	5	[illegible]	17.4
2	5	[illegible] unstacking and weighing talc dusted stock	47.6
3	10	At basket fill location of [illegible] cut off mill	16.0
4	10	At elastic band packing station	27.3
5	10	General air in mill area	18.3
		Maximum Allowable Concentration	20.0

Dust concentrations [illegible] to be excessive.

[illegible] is the handling of the talc dusted stock prior to milling. [illegible]

To partially eliminate this source of contamination two men instead of one [illegible] be assigned to the task of unstacking and weighing the stock. It is hoped that two men will handle the stock a bit more gently thus reducing the dust airborne. [illegible] No. 5 indicates [illegible] the dust is dispersed to other [illegible]. Samples No. [illegible] and [illegible] probably be reduced to within safe limits if the ambient dust concentration in the [illegible] department was reduced. This could be accomplished by instructing the men to be very careful when they are handling any material which is dusted with talc. Another change that will help reduce the dust dispersion is to cut down as much as possible on the amount of talc that is used to dust the stock. Large quantities of talc were observed on some of the stock sections. Excessive amounts of talc dust was also observed on the floor throughout the department. This settled dust should be removed using a vacuum cleaner. The floor should also be vacuumed at the end of each shift.

A ventilation survey was made throughout the [illegible] department using an Alnor Velometer. The results of the survey are tabulated below.

VENTILATION TABLE

Location	Air Velocity (fpm) Found	Air Velocity (fpm) Required
Mill #2 (½ way between mill and conveyor)	100-125	100
[illegible] Mill		
Left (½ way between mill and conveyor)	100	100
Right (" " " " " ")	100	100
Cut off mill (½ way between mill and conveyor)	75-100	100
Extruder exhaust, 1' from inlet (9 locations)	300+	150

The ventilation provided is considered adequate.

In addition the medical department was visited with particular attention to the follow-up blood counts [illegible] of employees exposed to benzene. It was found that [illegible] is now deceased and has not had any tests done for several years.

Twenty-two employees exposed to talc dust should be followed up medically. Arrangements have been made for chest X-rays by the [illegible] County Hospital and at the same time Pulmonary Function Tests may be done.

The management stated that the dusty operation would be eliminated February 1972 and replaced by automated machinery housed in a nearby building.

[illegible]