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OFFICE OF INDUSTRIAL RESEARCH

McGILL UNIVERSITY
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The following contract with the

Office of Industrial Research
McGill University,
P.O.Box 6070,
Montreal, Quebec,
H3C 3G1

sets out certain work to be undertaken by

Dr. Graham Gibbs,
Dept. of Epidemiology & Health,
3775 University St.,
Montreal, Quebec,

on

THE DIMENSIONS OF (a) AIRBORNE ASBESTOS FIBRES RELEASED FROM TRIBESTOS AND NOVATEX MITTENS IN A LABORATORY SIMULATION EXPERIMENT (b) AIRBORNE ASBESTOS FIBRES IN THE WORK ENVIRONMENT OF THE NOVATEX MANUFACTURING PLANT OF RAYBESTOS-MANHATTAN INC.

by

Graham W. Gibbs, MSc, PhD

A Protocol submitted to Raybestos-Manhattan Inc., Connecticut.

This work will be undertaken through the Office of Industrial Research.

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EXHIBIT
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CRMC-Motley1000-Subj-002247

This proposal sets out certain work to be undertaken for Raybestos-Manhattan Inc. through the Office of Industrial Research, McGill University, by Dr. Graham Gibbs, Department of Epidemiology and Health.

OBJECTIVE

1. To determine the length and diameters of fibres released from Tribestos and Novatex mittens during simulation tests in the laboratory. (see Phase IV)

2. To describe the diameter and length distributions of airborne fibres encountered during the manufacture of Novatex cloth. (see Phase V).

SCOPE OF WORK; Phase IV

Measurements of length and diameter will be made on fibres collected during tests of asbestos mittens (Novatex and Tribestos) under controlled conditions in the laboratory.

SCOPE OF WORK: Phase V

Airborne samples of dust will be collected at selected sites in the Novatex manufacturing plant of Raybestos-Manhattan Inc.. Measurements of length and diameter of fibres will be made and the total number concentrations encountered in the work environment during the manufacture of the Novatex material reported.

Observations of fibres will be made using electron microscopy.

METHODS: Phase IV

Airborne samples of fibres will be collected during laboratory tests of five pairs of Novatex and five pairs of Tribestos mittens. Tests will be performed in the chamber using the equipment designed for tests of asbestos mittens (see final report to Raybestos-Manhattan Inc., April 1974). The movements of the mittens (i.e. rubbing or clapping) will be adjusted to settings which previously produced the highest release of asbestos fibres. Sufficient airborne dust will be collected to provide a reasonable loading on filters for electron microscopic studies. The airborne dust will be collected on nucleopore and millipore membrane filters placed side-by-side at breathing zone height above the mittens. The nucleopore filters will be scanned using a scanning electron microscope and the millipore using transmission electron microscopy.

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The following parameters will be measured: 1) coil length 2) coil diameter 3) true diameter 4) stretched length.

The study will provide information on the size distribution (length and diameter) of airborne fibres likely to be encountered during the use of materials manufactured from Novatex. Such information will be necessary to intrepret the relevance of tests of fibre carcinogenicity being conducted at the Edinburgh and Cardiff, Wales Pneumoconiosis Research Unit to the use of safety garments, etc., manufactured from Novatex.

METHODS: Phase V

Airborne samples of dust will be collected at selected sites and using personal monitors attached to personnel employed in the Raybestos-Manhattan plant manufacturing Novatex cloth. The sites and plant personnel to be studied will be selected after a visit to the plant. Airborne samples of dust will be collected over as long a period as necessary to produce samples suitable for examination by scanning or transmission microscopy. It is envisaged that the sampling survey will be of 3-5 days duration. The measurements which will be made on each fibre will be as described under phase IV. The results will include the total concentration of asbestos fibres in the breathing zone of workers during the manufacture of Novatex and a complete description of the physical parameters of airborne fibres in this work environment.

SUPPORT TO BE PROVIDED BY RAYBESTOS-MANHATTAN INC.

Raybestos-Manhattan will provide all garments and cloths to be tested, free of charge, to be delivered to McGill University. For Phase V Raybestos-Manhattan will provide reasonable access to its plant and personnel for the purposes of measuring dust exposure of workers.

PERSONNEL

The work will be conducted under the direction of Dr. Graham Gibbs, who will act as project director.

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CONDITIONS

We believe that the data and results produced will be as accurate as can be reasonably expected, however, we accept no responsibility for damages arising out of the use and application of the data and results by others nor in any event in respect to a specific special or indirect or consequential loss or any loss of anticipated revenues or profits whether or not we have been advised to the possibility of such loss. No agreements or understandings not expressed or stated here shall be binding to the parties hereto. No alterations of this agreement shall result unless specifically agreed upon in writing by both parties. Upon prior notification to Raybestos-Manhattan Inc., the University shall be free to publish the findings of the research after twelve months from submission of the final report. The name of Raybestos-Manhattan will not be used in connection with any publication without written consent of Raybestos-Manhattan Inc.

TIMETABLE

The tests (phase IV) can start within one month of the contract being signed and receipt of authorization to proceed. The estimated time to complete the study is four months from start of work. The field study (phase V) can be conducted within two months of authorization to proceed and a final report will be submitted within four months of completion of the survey. A final report on each phase will be submitted to Mr. J. Marsh within one month of completion of the study.

COST

The cost of the laboratory studies (phase IV) including technicians, monitoring equipment, electron microscopy and supervision is $8,385 payable in two installments as follows: $4,385 upon authorization to proceed and the balance of $4,000 on receipt of the final report.

The cost of phase V including travel equipment, electron microscopy, technicians and supervision is $9,630 payable in two installments as follows: $5,630 upon authorization to proceed and the balance of $4,000 on receipt of the final report.

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All payments should be made to the Office of Industrial Research, McGill University, Room 408, Dawson Hall, P.O. Box 6070, Montreal 101, Quebec. This proposal is submitted for your acceptance on/or before June 15,1973. If this proposal sets out your understanding of our agreement kindly sign both copies and return one to us as an authorization to proceed.

Mr. John H. Marsh,
Director of Environmental Affairs,
Raybestos-Manhattan, Inc.

Michael S. Green, Assistant Director,
Office of Industrial Research,
McGill University.

Dr. Sidney Lee, Chairman,
Dept. of Epidemiology & Health,
McGill University.

Graham Gibbs, Environmental Section,
Dept. of Epidemiology & Health,
McGill University.

Associate Dean Dr. T.L. Sourkes,
Faculty of Medicine,
McGill University.

Dean Walter F. Hitschfeld,
Graduate Studies & Research,
McGill University.

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LABORATORY TESTS OF FIBRE RELEASE FROM ASBESTOS FABRICS

by

Graham W. Gibbs, MSc,PhD,L.R.I.C.

A report to Raybestos Manhattan Inc.

*With the technical assistance of R. Robb and D. Barber

Occupational Health & Safety Unit
Institute for Mineral Industry Research
McGill University
Gault Estate
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July 7, 1975

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CRMC-Motley1000-Subj-002252

Introduction

The following tests were undertaken at the request of Mr. John Marsh, Director of Environmental Affairs, Raybestos Manhattan Inc. In the original contract (dated April 18, 1975) it was agreed that 16 samples of fabric would be tested. During the testing program, Raybestos Manhattan Incorporated requested tests of 3 additional fabrics. The results in this report were obtained on 14 fabrics received as of July 4, 1975 and the test results for the 5 outstanding fabrics will be submitted to Raybestos Manhattan as an addendum to this report.

Materials

The fabrics tested were as follows:

1.	20H120	Underwriters' Acrylic Treated 3M finish
2.	20H120	Plain
3.	12P110N	Plain, wet brushed, Acrylic treated
4.	14P166	AA Acrylic treated 2%
5.	14P166	AA untreated
6.	9P135N	Plain wet brushed, Acrylic treated
7.	13P190	Underwriters' brushed, Silvabestos (Acrylic
8.	13P190	Wet brushed back side (Water
9.	L71-1133	Underwriters', brushed Acrylic treated
10.	L71-1133	Untreated
11.	28P067N	Grade AAAA Plain unbrushed
12.	28P067N	Grade AAAA Plain Neoprene filled
13.	36P064NN	Primed (Gentex type) non aluminized
14.	Weldgard	Grade Ind.

Methods

a) The testing Machine - The testing machine and chamber are shown in Plate I. The system permitted the palm side of the fabricated mittens to be subjected to stresses produced by clapping and rubbing actions. The clapping speed and force as well as the rubbing time and frequency could be adjusted. The clapping action was achieved by means of pneumatic cylinders. The rubbing action took place on a smooth wooden board and rubbing was achieved by a combination of rotational movements of the hands and the board. The movements of the hands and board were controlled entirely pneumatically using a central compressed air supply, not from cylinders as illustrated.

The control system was based on a simple memory-chain type of 5-step programmer. The testing cycle was as follows:

- the hands clapped against each other once in the "off-board" position
- the hands separated
- the hands moved into "on-board" position
- the hands clapped once against the board, remained, and the rubbing action followed
- the hands separated and moved back to the "off-board" position.

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The settings for this series of tests were adjusted so that the mittens were rubbed against the board 5 times every 10 seconds, and then brought together in a single clapping action. The rubbing action lasted 10 seconds.

The same equipment was used for tests described in the report to Raybestos Manhattan Inc. entitled "A laboratory study of fibre release from mittens manufactured from Novatex and Tribestos asbestos cloths dated March 15, 1974." The settings were different.

b) Preparation of fabrics for testing - Rolls of asbestos fabric were supplied to us by Raybestos Manhattan. For testing, the fabric was cut from these rolls and fashioned into "mittens" which would fit on to the hands on the rubbing and clapping machine in the chamber. These mittens had an approximate surface area of 150 sq.in. with approximately 75 sq.in. in contact with the rubbing board during a test. The edges of the"mittens" which were cut by our laboratory were covered with adhesive tape to prevent ragged ends from releasing dust into the atmosphere of the chamber (see Plates 2-15). The edges cut by Raybestos Manhattan were left exposed. For testing the mittens "were placed over the hands in the same way as shown in Plate I)

c) Sampling - The extent to which fibre was released by the various fabrics was assessed by comparing the fibre concentrations at fixed points in the test chamber averaged over 1 hour periods during rubbing and clapping cycles. For this purpose membrane filters (Millipore MAWP037A0, 0.8 micrometer pore size) were placed at a height of 12 inches above the "mittens" when in the vertical clapping position. Dust samples were taken in duplicate (the two membrane filters placed in close proximity to one another at the same height). The sampling sites were fixed and did not change throughout the testing program. The sampling rates at the two sampling points were 2.9 and 3.2 l/pm respectively and these flow rates were maintained using critical orifices and were checked during the testing program.

d) Counting - Counts were all performed by the same observer. This Technician had no knowledge of the fabric types under test. The membrane filters were mounted using the method recommended by the British Occupational Hygiene Society (1) and counted at 400X magnification using phase contrast illumination on a Zeiss Research microscope. Fifty fibres or 100 fields were counted depending on which was reached first.

e) Test procedure - Details of the procedure adopted for all tests was as follows:

1. The clapping and rubbing cycle times, were established and remained the same for all tests.

2. The chamber was purged with filtered air which entered the chamber through millipore membrane filters (0.8 μm) located near the top of the chamber. This purging took 10 minutes.

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3. The machine was operated without "mittens" for 1 hour and an airborne sample of dust collected for the 1 hour period. This constituted the "blank".

4. The chamber was opened, the filter from the "blank test" removed and the prepared mittens were placed on the hands. The chamber was closed and the machine set in operation for 1 hour. Samples of airborne dust were collected in duplicate during this test period. (First hour test samples).

5. At the end of the 1 hour period the chamber was purged as before (see No. 2)

6. The chamber was opened and the samples collected during the first hour test period were removed.

7. The chamber was closed and the machine operated with the same fabric in position for 2 hours.

8. At the end of this 2 hour period the chamber was purged as before (see No. 2).

9. The chamber was opened and 2 new membrane filters were placed in position.

10. The machine was started with the same fabricated "mittens" in position and operated for 1 hour. Samples of airborne dust were collected in duplicate during this test period (Fourth hour test samples).

11. At the end of 1 hour the machine was turned off, the chamber purged with filtered air.

12. The chamber was opened and the filters and used gloves removed.

13. Steps 2 - 12 were repeated for all fabric tests.

Using the above procedure it was possible to determine:

a) the background fibre concentration in the chamber during the operation of the machine without fabric in position,

b) the concentration of fibre arising as the result of fabric abrasion during the first hour of the test,

c) the concentration of fibre resulting from fabric abrasion during the 4th hour (i.e. after the fabric had been rubbed for 3 hours).

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In order to determine whether the results obtained on tests of the same fabrics at the beginning and the end of the test program were in agreement, the tests of fabrics 20H120 Treated and Untreated were performed at the beginning and the end of the test program. The dates on which tests were performed are shown in Table 1.

Results

The concentrations of fibre measured at the sampling positions during the first hour and fourth hour of the test program are shown in Table 1.

The following observations were made:

1. The wear on the fabric was reasonably even on both pieces of fabric in contact with the board. The degree of wear was quite variable. Photographs of the fabrics taken after the tests shown the pattern of wear and to some extent the degree of wear (Plates 2-15). In four cases holes developed in the fabric during the test. The materials which developed holes were as follows:

    1. 9P135N Type wet brushed Acrylic treated
    2. 28PC67N Grade AAAA Plain unbrushed
    3. 28PC67N Grade AAAA Plain Neoprene filled
    4. Weldgard

As the holes developed mainly in the same location first, there was evidently some additional abrasion at this point. Extra wear might have been predicted along the edge of the "hand", in particular along the leading edge. The fact that holes developed in all but one of the Novatex materials tested (assuming the N code represents Novatex) suggests that the Novatex fabric may have a wear problem. The composition of the Weldgard fabric was not provided.

2. The results in Table 1 showed a reduction in the concentration of fiber associated with tests of the acrylic treated fabrics. (see pairs AC1 and AC3, AC4 and AC5, AC7 and AC9, AC8 and AC13.) In most intances the reduction was marked.

3. There was good agreement between the duplicate samples collected during an individual test (Compare 1st hour and b, and 4th hour and b).

4. There was evidence of reasonable reproducibility of the test as shown by the repeat tests on fabrics 20H120 treated and untreated. These were tested at the beginning and end of the test program. In order to determine with some accuracy the reproducibility of the test procedure it will be necessary to repeat the tests of fabrics and examine the within fabric and between fabric variation to determine whether the observed differences are statistically valid.

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Nevertheless, in almost all cases the duplicate dust concentrations measured during a single test were within 20% of the mean whereas there were much longer differences between the concentrations associated with the treated and untreated fabrics and between the different types of fabric.

5. There was tendency for the concentration of fibres associated with the test during the fourth hour of rubbing to be lower than during the first hour of the test. This suggests that loosely handed fibre is released early in the test and that the fibre release decreases with time as the surface of the fibre becomes "smoothed".

6. Photomicrographs of typical fibres present in the airborne dust collected during the first and fourth hour of the tests of each fabric are shown in Plates 16-44.

Limitations of the tests

In interpreting the results of these tests the following points should be considered.

1. The results in all but 2 instances are based on a single test of each fabric.

2. The degree of abrasion between the fabric and the board and between the fabrics when clapped will depend on the surface properties of fabric. During the tests it was noted that certain fabrics tended to slow down the rub cycle slightly probably due to increase friction with the surface of the fabric. This increased friction might be desirable to aid handling with asbestos mittens but might influence fibre release.

3. There was some wear on the rubber of the hand of the machine resulting from the initial "blank test" when the machine was operated without fabric on the "hands". This abrasion was due to friction with the board. The results for the 20H120 fabrics indicated that this did not affect the results, but this wear and the production of holes in fabric in similar areas suggested some light unevenness of rubbing. As this was the same for all tests, it does not invalidate comparisons.

4. The results given in this report can be used:

   a) to compare release of fibres from fabric during the first and fourth hour of test.

   b) to compare the release of fibres by the various fabrics.

5. The concentrations of airborne fibre measured at the fixed site

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were obtained under the test conditions described. Extrapolation of these concentrations to situations in which manufactured products might be used are not valid and tests of fibre release using different test procedures may result in different concentrations.

Conclusions

The single tests of fibre release from 14 asbestos fabrics indicate:

1. The acrylic treatment of the fabrics tested reduced their fibre release.

2. The fibre release of fabrics tended to decrease with the time of rub action.

3. Novatex fabrics and the Welgard fabric developed holes more readily than the other fabrics tested.

Recommendations

1. The results indicate the trends in fibre release by various fabrics. Fabrics of interest to Raybestos Manhattan Inc. should be tested in pairs (Acrylic and untreated) and a sufficient number of tests performed to determine whether the results obtained for the two fabrics are statistically differnet at some predetermined level of probability.

2. In order to determine whether differences exist between different types of manufactured product, these results might be used to identify a small number of fabrics which should be tested for reproducibility of fibre release.

3. The degree of fibre release should be examined in relation to the surface properties of the fabric to determine whether this is influencing the extent to which the fabrics release fibre during the test.

Reference

1. Committee on Hygiene Standards. Hygiene standards for Asbestos Dust. Ann. Occup. Hyg. 11 47-69. 1968

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Conditions

The data and results produced are as accurate as can be reasonably expected however we accept no responsibility for damages arising out of the use of application of the data results by others nor in any event in respect to a specific special or indirect or consequential loss or any loss of anticipated revenues or profits whether or not we have been advised of the possibility of such loss.

The name of the Investigator or McGill University shall not be used in any publication or pamphlet without prior written consent of the principal investigator.

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