NLM/TIRC-80/2

ASBESTOS IN AIR

A Bibliography with Abstracts
1964-1980

J. G. Pruett and S. G. Winslow

Toxicology Information Response Center

Oak Ridge National Laboratory

July 1980

FEDERATION OF AMERICAN SOCIETIES FOR EXPERIMENTAL BIOLOGY FASEB

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INFORMATION RESPONSE TO CHEMICAL CRISES PROJECT
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FEDERATION OF AMERICAN SOCIETIES FOR EXPERIMENTAL BIOLOGY

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Through its Toxicology Information Program, the National Library of Medicine develops and operates toxicology information services for the scientific community. Among these is a query response service in the form of literature searches provided through the Toxicology Information Response Center at the Oak Ridge National Laboratory. The Center also publishes reviews and annotated bibliographies in toxicology journals or as separate publications. Recently, the Center has agreed to supply literature search support for the Information Response to Chemical Crises Project.

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Several governmental organizations have joined in the establishment of an Information Response to Chemical Crises (IRCC) Project.

This project was established in recognition of the fact that various government organizations share a common need for basic information in the event of a "chemical crisis." The primary objective of the IRCC Project is to provide IRCC member organizations with a rapid response literature search service which addresses the "crisis" chemicals(s) or topic(s). A second objective is to prepare bibliographies on substances or topics, which, although noncrisis in nature, are of communal interest to the IRCC project organizations. The IRCC Project is sponsored by the DHEW Committee to Coordinate Environmental and Related Programs, the Department of Agriculture, the Environmental Protection Agency, the National Institute of Environmental Health Sciences, the National Oceanic and Atmospheric Administration, the National Institute for Occupational Safety and Health, and the Center for Disease Control.

IRCC literature searches have been performed on 2,3,7,8-tetrachlorodibenzodioxin; dichloroethylenes; the effects of environmental chemicals on the immune system; asbestos levels in the air; and on the toxicity of urea formaldehyde foams and acid in rain. For further information, contact: Dr. Terri Damstra; IRCC Project Coordinating Officer; The National Institute of Environmental Health Sciences; P.O. Box 12233, Research Triangle Park, N.C. 27709.

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ASBESTOS IN AIR

A Bibliography with Abstracts
1964-1980

by

J. G. Pruett and S. G. Winslow
Toxicology Information Response Center
Information Center Complex/Information Division
Oak Ridge National Laboratory*
Oak Ridge, Tennessee 37830

Prepared for the

Information Response to Chemical Crises Project

July 1980

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CONTENTS

INTRODUCTION

Asbestos in Air is an annotated bibliography spanning the years 1964 to present. Arranged in alphabetic order by author's last name, this bibliography includes references pertaining to quantitative methods of determining airborne asbestos particles and quantitative levels of atmospheric asbestos fibers. A permuted title index (KWOC) appears at the end of the bibliography.

SOURCES SEARCHED

Source	Time Coverage
MEDLINE and BACKFILES	1966 - present
TOXLINE and TOXBACK	1964 - present
DIALOG®	
Biological Abstracts	1969 - present
Chemical Abstracts	1970 - present
Excerpta Medica	1975 - present
TIRC Library	

BIBLIOGRAPHIC REFERENCES

1
ACGIH-AIHA Aerosol Hazards Evaluation Committee. 1975. **Recommended procedures for sampling and counting asbestos fibers. Procedures for the evaluation of occupational exposures to airborne asbestos.** *Am. Ind. Hyg. Assoc. J.* 36(2):83-90.

Procedures which define a standard of sampling and of processing the samples collected in order to evaluate occupational exposure to asbestos fibers are outlined in detail.

2
ACGIH-AIHA Aerosol Hazards Evaluation Committee. 1975. **Background documentation of evaluation of occupational exposure to airborne asbestos.** *Am. Ind. Hyg. Assoc. J.* 36(2):91-103.

Background information and literature documentation supplementing the "Recommended Procedures for Sampling and Counting Asbestos Fibers: Procedures for the Evaluation of Occupational Exposure to Airborne Asbestos" prepared by the joint ACGIH-AIHA Aerosol Hazards Evaluation Committee are presented. The nature of the inhalation hazard associated with exposure to airborne asbestos, sampling and analytical methods used, and a recommendation for the monitoring of airborne asbestos using the sampling-optical phase microscope assay method are discussed.

3
Addingley, C. G. 1965. **Dust measurement and monitoring in the asbestos industry.** *Ann. N.Y. Acad. Sci.* 132(1):298-305.

Monitoring for asbestos fibers in workroom air was performed using a Royco particle counter which operates on the light-scattering principle and the impinger method which involves the collection of a sample with subsequent examination and counting under the microscope. Although the Royco instrument had limitations, it was concluded that this is a satisfactory method for dust testing in asbestos factories.

4
CA 85:197367j. Alste, J.; Watson, D.; Bagg, J. 1976. **Airborne asbestos in the vicinity of a freeway.** *Atmos. Environ.* 10(8):583-589.

Asbestos fibers taken from fresh or worn brake linings or collected from the atmosphere near a freeway were examined by electron microscopy and electron diffraction. Braking separates bunches of fibers and reduces their average length but does not alter their crystal structure. The airborne concentration at a site where slight braking took place was too low to measure but at a site where considerable braking occurred a concentration approximately 5 x 10(5) particles/m3 was found, each particle consisting of a small bundle of fibers.

5
Anderson, D. 1973. **Emission factors for trace substances.** *U.S. NTIS Report* PB-230894, EPA-450/2-73-001, 30 pp.

This document presents emission factors (average rate of release of pollutant to the atmosphere for unit production of main product) for eight trace pollutants including asbestos. Emission data on which these factors are based have been compiled for use by individuals and groups responsible for conducting air pollution inventories. When no source test data are available, these factors can be used to estimate the quantities of the trace pollutants being released from a source.

6
HEEP 75:8443. Antweiler, H. 1973. **Chemicophysical noxious substances from atmospheric pollution.** *Verh. Dtsch. Ges. Inn. Med.* 79:38-46.

7
Ayer, H. E.; Lynch, J. R.; Fanney, J. H. 1965. **A comparison of impinger and membrane filter techniques for evaluating air samples in asbestos plants.** *Ann. N.Y. Acad. Sci.* 132:274-287.

A comparison of dust counts by impinger sampling to fiber counts from membrane filters is considered. Data are presented (1) as a rough indication of the relationship of impinger counts to fiber counts, (2) as an index which may be used to estimate the proportion of asbestos in a mixed dust exposure, and (3) to give an indication of the relationship for fiber counts from personal samplers using membrane filters.

8
Baker, D. P. 1979. **Too much asbestos in CEQ's building.** *Washington Post,* 7 April 1979, p. A4.

An analysis of a fibrous material that was sprayed on the ceilings for fire protection . . . revealed that it contained 30 times the amount of asbestos now regarded as safe.

9
Barratt, R. S. 1978. **Ambient asbestos levels in perspective.** *R. Soc. Health J.* 98(1):26, 49-50.

Results from a study undertaken to evaluate asbestos dust contamination in a number of locations where asbestos products were used in construction are presented.

10
HEEP 74:5567. Bartosiewicz, L. 1973. **Improved techniques of identification and determination of airborne asbestos.** *Am. Ind. Hyg. Assoc. J.* 34(6):252-259.

Collection, identification and data analyzing techniques are presented for airborne mineral fibers and limitations of the techniques are discussed.

11
Bates, D. V. 1979. **Community air pollution in Canada: A review and predictions for the 1980's.** *Can. Med. Assoc. J.* 120(10):1252-1256.

Changes in the most commonly measured air pollutants in Canada are reviewed. The major pollutants include suspended particulates, sulfur dioxide, ozone, and nitrogen dioxide; other pollutants considered are arsenic and asbestos.

12
Beaman, D. R.; File, D. M. 1976. **Quantitative determination of asbestos fiber concentrations.** *Anal. Chem.* 48(1):101.

The quantitative determination of asbestos fiber concentrations in environmental samples was studied using a transmission electron microscope equipped with selected area electron diffraction (SAED) and energy dispersive spectrometry capabilities is detailed.

13
CA 89:185726v. Beaman, D. R.; Walker, H. J. 1977. **Difficulties encountered in the identification of asbestos fibers by analytical transmission electron microscopy.** *DHEW Food and Drug Administration Report* FDA-77-1033, IN Symp. Electron Microsc. Microfibers, pp. 98-105.

In studying chrysotile (12001-29-5), morphological identification is more reliable than energy dispersive x-ray spectrometry (EDXA) which is more reliable than selected area electron diffraction (SAED). In studying amphiboles, EDXA identification is more reliable than SAED which is more reliable than morphology. Reproducible data are only forthcoming if corrections are made for losses during sample preparation and for the dependence of apparent fiber composition on fiber size. The fraction of amphibole fibers classified can be increased by using standards to correct for the observed deficiencies in SAED patterns. Analysis with the analytical transmission electron microscope is time consuming but the variation in multiple analysis is generally better than plus or minus 30% when the errors are avoided or taken into account.

14
Beckett, S. T. 1973. **The evaluation of airborne asbestos fibres using a scanning electron microscope.** *Ann. Occup. Hyg.* 16(4):405-408.

Asbestos fibres sampled on Nucleopore filters can be directly examined by scanning electron microscopy in much greater detail than is possible using the conventional optical microscope/membrane filter technique. Results obtained by the two methods for fibres greater than 5 um in length were in good agreement.

15
Beckett, S. T.; Attfield, M. D. 1974. **Inter-laboratory comparisons of the counting of asbestos fibres sampled on membrane filters.** *Ann. Occup. Hyg.* 17(2):85-96.

Two series of exchanges of slide-mounted asbestos samples have been conducted to determine the degree of agreement between different laboratories counting the same slides. It was found that disagreements between laboratories that were isolated or new to fibre counting were large, but were reduced by direct personal consultation. Main causes for these differences were uncertainties in the counting of irregular fibres and fibre masses, failure to scan the full depth of focus in which fibres were present, and misalignment of the microscope phase rings. It is concluded that there is a need for closer definition and standardization of counting procedures.

16
Beckett, S. T.; Gylseth, B.; Krantz, X.; Paris, I. M.; Schneider, T. 1979. **An exchange of membrane filter samples of airborne asbestos between one United Kingdom and three Scandinavian laboratories.** *Scand. J. Work. Environ.* 5(1):42-49.

Unmounted and mounted membrane filters with asbestos fibers were exchanged between laboratories in Sweden, the United Kingdom, Norway, and Denmark. Differences in counting techniques lead to differences in the counting of fibers. Slides made two years previously were also reexamined.

17
HEEP 77:2409. Beckett, S. T.; Hey, R. K.; Hirst, R.; Hunt, R. D.; Jarvis, J. L.; Rickards, A. L. 1976. **A comparison of airborne asbestos fiber counting with and without an eyepiece graticule.** *Ann. Occup. Hyg.* 19(1):69-76.

When asbestos fibers on membrane filters are counted over the whole field of view of the microscope, lower concentration values are obtained than when the counting is confined to a central graticule grid area. This grid effect was verified and its magnitude determined for chrysotile and amosite asbestos fibers. The effects of various physical and human factors were investigated. More accurate counts are obtained in the evaluation of airborne asbestos dust concentrations by using an eyepiece graticule method.

18
HEEP 76:8560. Beckett, S. T.; Middleton, A. P.; Dodgson, J. 1975. **The use of infrared spectrophotometry for the estimation of small quantities of single varieties of U.I.C.C. asbestos.** *Ann. Occup. Hyg.* 18(4):313-320.

An IR technique has been developed to measure small quantities of single varieties of asbestos. This has been used to monitor airborne fiber concentration. Advantages of this method are that it requires minimal labor, and is relatively simple to perform, while the precision for estimation of micro-quantities of asbestos is greater than by direct weighting.

19
HEEP 74:1974. Bennett, R. L. 1973. **Status of research and development in measurement technology of hazardous substances in emissions from stationary sources.** *Environ. Health Perspect.* (4):96-97.

The Clean Air Act of 1970 provides that the Environmental Protection Agency designate substances for which national emission standards for hazardous air pollutants be set. The initial list included asbestos, beryllium, and mercury. A program for developing research and compliance sampling methods and instrumentation for monitoring these emissions is now underway.

20
Bent, R. 1979. **Some problems in monitoring airborne asbestos dust.** *J. Soc. Environ. Eng.* 18-3(82):19, 20, 25.

Difficulties in standardizing procedures for monitoring airborne asbestos in areas where asbestos is being removed are discussed. It is necessary to set hygiene standards to be achieved before these areas can be re-occupied.

21
Berry, G.; Gilson, J. C.; Holmes, S.; Lewinsohn, H. C.; Roach, S. A. 1979. **Asbestosis: A study of dose-response relationships in an asbestos textile factory.** *Br. J. Ind. Med.* 36:98-112.

A follow-up study of a group of 379 men who had worked at an asbestos textile factory for at least 10 years is presented. Crysotile was the predominant type of asbestos processed, although a substantial amount of crocidolite had been processed previously. For each job description a dust level was calculated for each year. There were no dust measurements before 1950; fibre counts were not available from 1951 - 1960; however, thermal precipitator counts were available for 1952 and 1960. The prevalence of crepitations, "possible asbestosis," certified asbestosis, small opacities in the chest radiograph, and values of lung function were related to dust levels. Results of the study show that it is important to continue to reduce dust levels to values as low as possible.

22
CA 86:8238e. Birks, L. S.; Fatemi, M. 1976. **Multielectrode apparatus and techniques to prepare aligned asbestos fibers on a thin substrate.** *U.S. Patent* 3963439, United States Dept. of the Navy.

A method is described for forming parallel aligned chrysotile asbestos fibers on a thin substrate for use in a system for identifying the chrysotile asbestos in air pollution samples.

23
CA 83:168108d. Birks, L. S.; Fatemi, M.; Gilfrich, J. V.; Johnson, E. T. 1975. **Quantitative analysis of airborne asbestos by x-ray diffraction. Feasibility study.** *U.S. NTIS Report* AD-A-7530, 14 pp.

Special x-ray diffraction geometry was developed to distinguish chrysotile asbestos from serpentine and other clay minerals. The x-ray method requires alignment of the chrysotile fibers, and the technique for accomplishing this alignment was developed and tested. The limit of detection of chrysotile was 0.2 mug in the absence of extraneous material from real air samples.

24
CA 91:61834a. Birks, L. S.; Gilfrich, J. V.; Sandelin, J. W. 1978. **X-ray analysis of airborne asbestos. Final report: design and construction of a prototype asbestos analyzer.** *U.S. NTIS Report* PB-288512, 27 pp.

A prototype asbestos analyzer was designed and constructed for use by the Environmental Protection Agency, which incorporates the principle of broad-beam x-ray optics and the special fiber-aligned sample described in earlier reports (PB-241285 and PB-266671). The prototype instrument uses 2 detectors for simultaneous measurement of diffracted signal and background; the mass of asbestos is simply the net difference in intensity for these 2 detectors normalized by the sensitivity of the analyzer as determined using standards. The prototype analyzer is contained in a vacuum box and is mounted on top of a standard commercial x-ray power supply. It uses a Cr target spectrograph tube which is located in a separate Pb-loaded enclosure in the box. The mechanics of selecting the 2 theta diffracting angles for different forms of asbestos are unique and especially designed to minimize the space required. The beam trap is a critical component of the instrument; it reduces the backscattered noise signal to less than 100 photons/sec from an incident beam of about 1011 photons/sec. Preliminary tests with the analyzer indicate a sensitivity of 18 photons/sec-mug of chryostile and a calculated sigma detection limit of 0.1 mug for a 500 sec measurement.

25
CA 88:78301k. Borcherding, C. H. 1976. **Health hazard evaluation/toxicity determination; Pittsburgh Plate Glass Industries, Mt. Zion, Illinois.** *U.S. NTIS Report* PB-269102, 12 pp.

A health hazard evaluation of roll fabrication operations at the Pittsburgh Plate Glass Industries plant, Mt. Zion, Illinois, revealed that airborne asbestos fibers in excess of the proposed Occupational Safety and Health Administration (OSHA) standard prevailed at several locations within the plant. Recommendations were made to reduce worker exposure to airborne asbestos.

26
Bourne, G. 1978. **Asbestos contamination in school buildings.** *Public Interest Research Group,* 30 pp.

Discovery of incidents of nonoccupational contamination through exposure to asbestos has increased in the past few years. Following the practice of spraying asbestos-containing materials for insulating, fire proofing, acoustical, and decorative purposes in public buildings, pupils in a number of school systems have been exposed to asbestos dust in quantities large enough to cause alarm. Background information including proposals issued by federal agencies, local laws and regulations, and citizen action strategies aimed at protection of the population at risk from exposure to asbestos fibers are presented in this report.

27
CA 89:168111y. Bruckman, L. 1978. **Monitored asbestos concentrations indoors.** *IN Jt. Conf. Sens. Environ. Pollut., Conf. Proc.*, 4th, pp. 871-875.

To define the magnitude of the hazard posed by the application of asbestos-containing surface coatings to the inside structural framework of schools and other public buildings and the subsequent release of asbestos into the indoor air environment, an air asbestos survey was conducted in the boys' swimming pool located in the University of Connecticut's Field House. Airborne asbestos levels at the pool were well below (i.e., less than 1 ng/m(3)) Connecticut's proposed 30 ng/m(3) (or 30,000 fibers/m(3)) asbestos ambient air quality standard.

28
CA 84:140114z. Bruckman, L.; Rubino, R. A. 1975. **Asbestos: Rationale behind a proposed air quality standard.** *J. Air Pollut. Control Assoc.* 25(12):1207-1215.

A proposed asbestos air quality standard and the rationale utilized in its formulation are discussed. An ambient air quality asbestos standard of 30 ng/m(3), based on a 30-day average sample is recommended. In addition, a preliminary asbestos stack sampling train has been developed requiring electron microscopy as the analytical procedure to be used to determine the sample asbestos content.

29
Bruckman, L.; Rubino, R. A. 1978. **Monitored asbestos concentrations in Connecticut.** *J. Air Pollut. Control Assoc.* 28(12):1221-1226.

To define the magnitude of the health hazard posed by airborne asbestos fibers in Connecticut prior to promulgation of the state's proposed asbestos air quality standard, an air asbestos survey was conducted between late 1974 and early 1977. Results of this survey during which samples were collected from approximately 40 monitoring sites using a newly developed low volume particulate sampler with subsequent chrysotile asbestos electron microscope determination are presented.

30
Burilkov, T. D.; Kolev, K.; Michailova, L. 1979. **Concentration of asbestos dust in textile and cement factories and in areas with ethnic asbestosis, and the effects on health.** *Toxicol. Res. Proj. Dir.* 4(4).

This study involves the determination of contamination by asbestos in the air of factories manufacturing asbestos-containing textiles and cement as opposed to areas where there is no industrial air pollution by asbestos. Simultaneously, the general health of the exposed population is registered and compared with data from previous health checkups. An attempt is made to answer questions regarding the epidemiology of asbestos tumors including: 1) incidence of asbestos-induced neoplasms in relation to other neoplasms; 2) a relationship of endemic pleural placques to serosal tumors and lung cancer of the population; and 3) correlation between asbestos fiber type and tumor frequency.

31
CA 87:11105k. Carlin, A. P. 1977. **Hazardous wastes: A risk-benefit framework applied to cadmium and asbestos.** *U.S. Environ. Prot. Agency Off. Res. Dev.* EPA-600/5-77-002, 268 pp.

A decision framework was developed for evaluating hazardous waste standards in terms of social risks and product benefits. The analysis was focused on cadmium and asbestos as examples of land waste disposal problems and includes waste quantities in air and water, human exposure, and economic effects.

32
Cavagnaro, D. M. 1978. **Asbestos and silicate pollution. Volume 1, 1964-1976 (Citations from the NTIS Data Base). Report for 1964-1976.** *U.S. NTIS Report* PS-781243, 185 pp.

Aspects of air and water pollution by asbestos, silica, silicon dioxide, and silicates including sources, detection methods, control, and biological effects on plants and animals are contained in this bibliography of federally-funded research projects.

33
Cavagnaro, D. M. 1978. **Asbestos and silicate pollution. Volume 2, 1977-November 1978 (Citations from the NTIS Data Base). Report for 1977-November 1978.** *U.S. NTIS Report* PS-781244, 141 pp.

Federally funded research reports on water and air pollution by asbestos, silica, silicates, and silicon dioxide are cited in this bibliography. References to effects on humans, animals, and plants are included as well as the sources of exposure and methods for detection and control of these substances.

34
Cavagnaro, D. M. 1978. **Asbestos and silicate pollution (Citations from the Engineering Index Data Base). Report for 1970-November 1978.** *U.S. NTIS Report* PS-781245, 180 pp.

Sampling, detection, control, and chemical analysis of environmental asbestos and silicate pollution are included in this bibliography of worldwide research reports.

35
Cecchetti, G.; Marconi, A.; Rossi, L. 1978. **Asbestos fiber sampling, quantitative determination and identification in relation to recently recommended workroom limits.** *Ann. Ist. Super. Sanita.* 14(3):641-649.

36
HEEP 77:10134. Champness, P. E.; Cliff, G.; Lorimer, G. W. 1976. **The identification of asbestos.** *J. Microsc. (Oxf.)* 108(3):231-250.

Techniques for distinguishing between and identifying six varieties of asbestos are described. X-ray or simple optical methods are useful when fibers are large or numerous. Electron microscopy can be employed for positive identification of asbestos in environmental samples.

37
CA 81:145121x. Chatfield, E. J. 1974. **Quantitative analysis of asbestos minerals in air and water.** *IN Electron Microsc. Soc. Am. Proc. - Annu. Meet.* 32:528-529.

A detailed protocol for the collection and identification of asbestos minerals in air and water is given. Levels in air and water were detected at concentrations of greater than or equal to 0.01 fibers/ml and greater than or equal to 10(4) fibers/ml, respectively.

38
CA 84:64717f. Chatfield, E. J. 1975. **Asbestos background levels in three filter media used for environmental monitoring.** *IN Electron Microsc. Soc. Am. Proc. - Annu. Meet.* 33:276-277.

The fiber counts in 47 mm diameter Nuclepore and Millipore membrane filters and a 8 in X 10 in polystyrene Delbag filter were: the chrysotile fiber content was 3.3 X 10(3), 4.2 X 10(4), and 2.6 X 10(4), the amphibole count was 5.7 X 10(2) and 9.6 X 10(2), respectively. No amphibole fiber was detected for the Delbag. The minimum detectable levels for air sampling, corresponding to twice the standard deviation of the mean fiber count and assuming a 24 hr sampling period, were for chrysotile 6.0 X 10(-5), 1.2 X 10(-3), and 2.0 X 10(-5), respectively, and for amphibole 3.0 X 10(-5) and 3.6 X 10(-5), respectively, with no fibers detected for Delbag. The minimum detectable levels in H20, assuming a 200 ml sample, for the Nucleopore and Millipore samples were for chrysotile 0.0087 and 0.17, and for amphibole 0.0043 and 0.0052 million fibers/l, respectively.

39
CA 91:43709. Coates, J. P. 1978. **The infrared analysis of quartz and asbestos.** *Int. Environ. Saf.* March-April:18-21.

40
Cook, P. M.; Smith, P. L.; Wilson, D. G. 1978. **Amphibole fiber concentration determination for a series of community air samples: Use of X-ray diffraction to supplement electron microscope analysis.** *U.S. Environmental Protection Agency* EPA/600/J-78/059, 15 pp.

Accurate measurements of annual average mineral fiber concentrations at various air sampling sites provides an index of non-occupational inhalation exposure to fibers in a community located near an industrial source of airborne amphibole fibers. Two techniques for the analysis of airborne asbestos, transmission electron microscopy and x-ray diffraction analysis, are discussed.

41
Cooper, C.; Brogan, P.; Tapscott, G., eds. 1979. **EPA to provide technical guidance on control of asbestos in ceilings.** *Pestic. Toxic Chem. News* 7(11):32-33.

42
Cooper, W. C.; Murchio, J.; Popendorf, W.; Wenk, H. R. 1979. **Chrysotile asbestos in a California recreational area.** *Science (Wash., D.C.)* 206(4419):685-688.

Dustfall along roads and trails being used recreationally in the Clear Creek area of San Benito County, California, located in the New Idria serpentinite, was found to be 90% or more chrysotile asbestos. Personal samplers worn by motorcyclists using one of the trails showed concentrations of airborne fibers ranging from 0.3 to 5.3 fibers/milliliter according to methods prescribed for monitoring occupational exposures. The present workplace standard for brief exposures to asbestos is 10 fibers/milliliter; 5 fibers/milliliter is the proposed standard. The average total dust concentration estimated from personal samplers was approximately 20 milligrams/cu m of roughly 90% chrysotile. To our knowledge, this is the first demonstration of asbestos exposures of this magnitude, in size ranges known to be pathogenic, resulting from natural deposits not associated with mining, milling, or industrial use. (Auth)

43
HEEP 72:275. Cralley, L. J. 1971. **Identification and control of asbestos exposures.** *Am. Ind. Hyg. Assoc. J.* 32(2):82-85.

Asbestos can be safely used in industry providing adequate precautions are taken to prevent excessive exposure. New techniques must be developed to distinquish between asbestos and other fibers. Air-borne fibers should be sampled and evaluated using membrane filter and phase contrast microscopy techniques. Control measures should include procedures for adequate exhaust ventilation and personnel protection in industry, safe transport of asbestos and safe disposal of waste dusts, and the prevention of nonoccupational exposure.

44
Cross, A. A. **Effect of changed working techniques on asbestos dust levels in the working environment.** *IARC (Int. Agency Res. Cancer) Sci. Publ. No. 13.* IN Environmental Pollution and Carcinogenic Risks, Proc., ed. C. Rosenfeld and W. Davis, pp. 121-126. Lyon: International Agency for Research on Cancer.

Methods are presented for controlling levels of asbestos dust in the working environment. Modern technology has made possible the attainment of standards that are effective in the control of asbestos related diseases. Special attention has been given to the specific needs of people working with asbestos on building sites. As part of its activities to promote new and improved methods of dust control, the Environmental Control Committee prepared a series of control and safety guides and a code of practice for the disposal of asbestos waste material.

45
CA 89:174492q. Cunningham, H. M.; Pontefract, R. D. 1976. **Measurement of asbestos in air, water, foods, tissues, and excreta.** *DHEW Food and Drug Administration Report* FDA-77-1033, IN Symp. Electron Microsc. Microfibers, pp. 162-165.

A method whereby asbestos fibers can be detected in biological samples, including air, is described. The material to be tested for asbestos contamination is passed through Millipore filters which are then oxidized in plasma chanbers. The resulting ash is taken up into water, and the asbestos detected by electron microscopy.

46
Curtis, R. A.; Bierbaum, P. H. 1975. **Technological feasibility of the two fibers/cc asbestos standard in asbestos textile facilities.** *Am. Ind. Hyg. Assoc. J.* 36(2):115-125.

Presented in the paper are the results of industrial hygiene surveys, including 243 asbestos air samples, conducted at two asbestos textile production facilities which have achieved the two fibers/cc standard.

47
Davis, J. M. G.; Beckett, S. T.; Bolton, R. E.; Collings, P.; Middleton, A. P. 1978. **Mass and number of fibres in the pathogenesis of asbestos-related lung disease in rats.** *Br. J. Cancer* 37(5):673-688.

Chrysotile asbestos caused more lung fibrosis than did crocidolite or amosite fibers following inhalation studies in rats. All malignant pulmonary neoplasms were in animals treated with chrysotile. Fiber-number calculations used for generation of the dust clouds were evaluated using parameters recommended by the Health and Safety Executive in 1976, by which fibers 5 um long are counted using a phase-contrast light microscope. Using another technique, scanning election microscopy, it was found that chrysotile asbestos contains many fibers over 20 um in length. Indications are that neither the present fiber number standards nor a single mass standard are satisfactory.

48
De Pedrini, C. 1968. **Observations on methods of collection and counting asbestos dust in work environments.** *Arch. Sci. Med.* 125(12):769-776.

49
CA 80:99654c. Distler, T. M.; Barry, P. E. 1973. **Thermoluminescence of asbestos.** *Report* UCRL-51422, pp. 5-7.

Results of a feasibility study to determine whether thermoluminescence (TL) of irradiated asbestos can be used as a method for monitoring airborne asbestos contamination are presented.

50
HEEP 78:7176. Dobreva, M. 1976. **Criteria for standardization and methods for measurement of asbestos dust in the air of working areas.** *Khig. Zdraveopaz.* 19(3):290-296.

Criteria upon which Bulgarian norms for asbestos-containing dust should be based are presented in this paper.

51
Dobreva, M.; Burilkov, T.; Tocheva, V.; Mikhailova, L.; Lukanova, R. 1979. **Occupational risk in asbestos textile manufacture.** *Probl. Khig.* 4:32-40.

Detailed investigations of the environment in asbestos textile industry ("Asbestos produce" plant in the town of Sevlievo) were carried out. The parameters determined were: overall dusting, amount of asbestos in aerosol, its mineral and disperse composition. Data on the degree of dusting in the plant for the period 1960–1976 were analyzed and summarized. Professiograms were elaborated, with chronometry and appraisal of the burden of the work operations. All workers were tested clinically and roentgenologically. The data obtained on the degree of dusting in the different departments were re-calculated as amount of inhaled asbestos, depending on how hard the work is, respectively, and the pulmonary ventilation. The actual risk of asbestos injury was highest in the carding department, followed by the preparatory and the spinning departments. A distinct correlation exists between the degree of professional risk, determined by the asbestos contaminations, and the clinical and laboratory findings. (Auth)

52
HEEP 79:8185. Dobreva, M.; Dinolova, B. 1978. **Hygienic evaluation of dust in the production and usage of asbestos materials.** *Khig. Zdraveopaz.* 21(4):339-344.

Measurements of asbestos contamination in the air of the working place, were conducted by the weight method for total dust and respirable fraction according to BDS 2200/1971 and by the number method using membrane filters. The sanitary norm in the asbestos-textile production was 5 mg/m3. For the right evaluation of the real asbestos exposure it was necessary to use weight and number indices. Mass equivalent of the number norm could be determined for single objects and the routine measurements could be performed by the weight method according to BDS 2200/1971.

53
HEEP 78:12146. Du Toit, R. S. J.; Gilfillan, T. C. 1977. **Simultaneous airborne dust samples with konimeter, thermal precipitator and dosimeter in asbestos mines.** *Ann. Occup. Hyg.* 20(4):333-344.

Airborne dust samples were taken simultaneously in asbestos mines using three types of instruments: konimeter, thermal precipitator, and dosimeter. Statistical analyses of the results are presented and formulae to convert fiber concentrations recorded by the thermal precipitator and konimeter into those expected with the membrane filter sampling method are outlined.

54
CA 89:48265e. Duggan, M. J.; Culley, E. W. 1978. **The counting of small numbers of asbestos fibers on membrane filters: A comparison of results from some commercial laboratories.** *Ann. Occup. Hyg.* 21(1):85-89.

Urban air samples, taken on membrane filters and counted by phase-contrast microscopy, were analyzed by nine commercial laboratories; the range of results and standard errors show that the magnitude of discrepancies is too great to obtain reliable results.

55
Edwards, G. H.; Lynch, J. R. 1968. **The method used by the U.S. Public Health Service for enumeration of asbestos dust on membrane filters.** *Ann. Occup. Hyg.* 11:1-6.

Air-borne mineral dust samples are collected by drawing air through cellulose ester membrane filters. Particles smaller than nominal pore size are retained. Samples are mounted on standard microscope slides and rendered transparent. Particles which lie on the surface of the filter are counted with a phase contrast microscope. Data are recorded in a form allowing for reduction and statistical analysis by electronic computer. The method is highly suited for developing basic data for a more precise recommendation of the limit for asbestos.

56
HEEP 73:9311. Einbrodt, H. J. 1971. **Threshold values for dust-like air pollutants and other anti-pollution measures.** *Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Erste Abt. Orig. Reihe B Hyg. Betriebshyg. Praev. Med.* 155(3):296-299.

A German antipollution commission has studied technically and economically feasible air pollutant levels. A preliminary classification is proposed: acutely toxic dusts including asbestos, dangerous dusts, dusts dangerous for some persons, and generally inert dusts. Proposed limiting values ranged from 20 - 150 mg/m(3).

57
PESTAB 79:739. Etz, E. S.; Rosasco, G. J.; Blaha, J. J. 1977. **Observation of the Raman effect from small, single particles: Its use in the chemical identification of airborne particulates.** *Environ. Sci. Res.* 13:413-456.

A report is presented on the use of a Raman microprobe for chemical analysis of airborne particulates. Principles of Raman spectroscopy using reflected light from a laser are detailed. Applications of the probe are demonstrated including the identification of asbestos minerals. Drawbacks of Raman spectroscopy are discussed and future uses of this technique are considered.

58
CA 84:94792u. Faulring, G. M.; Forgeng, W. D.; Kleber, E. J.; Rhodes, H. B. 1975. **Detection of chrysotile asbestos in airborne dust from thermosetting resin grinding.** *J. Test. Eval.* 3(6):482-490.

Chrysotile asbestos levels in airborne dust samples, generated during grinding of thermosetting polyester resin plaques containing 0.8-18% asbestos, were analyzed by iodine in solution or as a vapor for selectively staining and increasing its visibility. No free fibers were detected in dust from polyester plaques containing 0.8% asbestos, a few at 2%, and a low level at 4-18%. An electron microprobe method was applied to water-collected samples to measure the number of asbestos particles/1000 dust particles and showed that asbestos was usually present as equidimensional, resin-encapsulated particles that were frequently conglomerated with other materials.

59
CA 88:78331v. Faulring, G. M.; Forgeng, W. D.; Kleber, E. J.; Rhodes, H. B. 1975. **Detection of chrysotile asbestos in air-borne dust from thermoset resin grinding.** *IN Resumes Commun. - Conf. Int. Phys. Chim. Miner. Amiante,* 3rd, 11 pp.

Chrysotile can be detected in the dust from grinding of filled samples of epoxy resins and polyesters by selective staining with iodine. An electron microprobe method for determining the free chrysotile content of dust samples and for distinguishing resin-bound from free chrysotile is described.

60
Felton, J. S. 1979. **A comprehensive program in asbestos hazard surveillance and education.** *Am. Ind. Hyg. Assoc. J.* 40(1):11-19.

The surveillance program of asbestos workers at the Long Beach Naval Shipyard consists of clinical examinations and consultations; educational updates; environmental measurement; maintenance of literature; and records and report maintenance.

61
Fischbein, A.; Rohl, A. N.; Langer, A. M.; Selikoff, I. J. 1979. **Drywall construction and asbestos exposure.** *Am. Ind. Hyg. Assoc. J.* 40(5):402-407.

Results of a study of health hazards of asbestos exposure in the drywall construction trade in the United States are described. Air samples collected utilizing standard NIOSH techniques for asbestos sampling and analysis showed fiber concentrations which exceeded maximum levels set by U.S. government regulations. During pole sanding, 7 out of 10 samples exceeded the then existing TLV of 5 fibers/cm3 longer than 5 um. The TLV is now 2 fibers/cm3 longer than 5 um. Hand sanding generated fiber concentrations close to or in excess of the TLV. Mixing of the drywall taping compounds, a procedure not frequently employed, generated fiber counts of 7 - 10 times the TLVs. In addition, detectable fiber concentrations were present in adjacent rooms during the various procedures. Standard procedures using optical microscopy reflect only a small portion of fibers present since fibers shorter than 5 um in length and 0.5 um in width are not detailed. Electron microscopic analyses of these air samples showed a large number of these smaller fibers.

62
Fontaine, J. H.; Trayer, D. M. 1975. **Asbestos control in steam-electric generating plants.** *Am. Ind. Hyg. Assoc. J.* 36(2):126-130.

A program to control industrial work exposures to airborne asbestos fibers is presented. Consistent with OSHA standards and with current good industrial hygiene practices, the program includes methods of problem evaluation, the establishment of provisions for environmental and medical surveillance, and effective corporate standards.

63
HEEP 72:1056. Gadsden, J. A.; Parker, J.; Smith, W. L. 1970. **Determination of chrysotile in airborne asbestos by an IR spectrometric technique.** *Atmos. Environ.* 4(6):667-670.

A new method of determining chrysotile in airborne asbestos using IR absorption is described.

64
Gale, R. W.; Gregory, P. J. 1979. **Automatic detection and counting of asbestos fibers.** *Am. Ind. Hyg. Assoc. J.* 40(7):A50-A53.

The development of two new techniques for rapid assessment of airborne asbestos fibers is reported. Rapid monitoring equipment, based on light scattering techniques applied to fibers aligned in a magnetic field, can assess up to 30 conventional air samples per hour, yielding digital readout of fibers/ml air. A second technique detects and counts individual asbestos fibers using the Magiscan computerized image analysis system. These techniques are expected to eliminate human error associated with manual counting.

65
Gentry, J. W. 1980. **Development of glass array impactors for separation of fibrous aerosols.** *Toxicol. Res. Proj. Dir.* 5(1).

The objective is to develop a means for sampling fibrous aerosols that will separate fibers from non-fibrous or isometric particles and thus facilitate the measurement of airborne fiber concentrations; e.g., of asbestos, by reducing interferences by background particles. APPROACH: Based on previously reported observations by applicant and his co-workers that fibers are aligned by flow gradients as they approach and pass through parallel capillary arrays such as Nucleopore filters and porous glass disks of sufficiently large pore size.

66
Gentry, J. W. 1979. **The effect of gas composition on the filtration of spherical and nonspherical particles.** *Toxicol. Res. Proj. Dir.* 4(12).

This research concerns membrane filtration of aerosols and the mechanisms whereby the prevailing particulate deposit alters the subsequent pressure drop and capture efficiency. The work will be extended to techniques for monitoring airborne asbestos fibers. This is a renewal of ENG76-09381 A01. The specific tasks in this study are: (1) The experimental procedure will be modified to measure the collection properties of asbestos fibers. In carrying out this research amosite and crocidolite (two types of asbestos) will be used. (2) The effect of particle concentration and size on the pressure drop across grid filters will be quantitatively investigated. (3) The study of clogging of nuclepore filters will be completed and the criteria for deciding which method of clogging is dominant will be developed. (4) The use of electron micrographs and deposition patterns to delineate between mechanisms will be developed. (5) The measurement of the collection efficiency in the regions where the efficiency measurements show an extrema will be carried out. A correlation of these extrema (a minimum due to the transition from a diffusional dominant region to an inertial dominant region and a maximum due to the re-entrainment or bounce-off of particles) will be developed.

67
HEEP 72:6240. Ghezzi, I.; Maranzana, P.; Zannini, D. 1971. **On asbestosis in Piedmont, Liguria and Lombardy.** *Med. Lav.* 62(2-3):111-119.

Epidemiologic data and results of 466 measurements of air dustiness carried out in as many work places are reported. The maximal concentration of asbestos was observed in the atmosphere of a textile department (carding).

68
HEEP 73:5017. Gibbs, G. W. 1971. **Qualitative aspects of dust exposure in the Quebec asbestos mining and milling industry.** *Inhaled Particles III*, ed. W. H. Walton, pp. 783-799.

69
HEEP 76:8548. Gibbs, G. W. 1975. **Fiber release from asbestos garments.** *Ann. Occup. Hyg.* 18(2):143-149.

Concentrations of airborne fibers in the breathing zones of workers wearing asbestos safety garments were measured using the membrane filter method. At a plant where men wore asbestos coats, hoods, and mittens, concentrations of fibers ranged from 0.3 - 5.0 fibers/cm3 and the 8 hr time-weighted concentrations from 0.1 - 1.1 fibers/cm3. At another plant where hoods, coats, mittens, and leggings were worn, concentrations of airborne fibers ranged from 9.9 - 26.2 fibers/cm3 and the 8 hr time-weighted average concentration was 4.7 fibers/cm3. Approximately 2.3-32% of the total airborne fibers collected on Nucleopore filters and examined by scanning electron microscopy were greater than or equal to 5 mum in length. There is a need to identify and to reduce the release of fiber from asbestos safety garments.

70
HEEP 78:12112. Gibbs, G. W.; Baron, P.; Beckett, S. T.; Dillen, R.; Du Toit, R. S. J.; Koponen, M.; Robock, K. 1977. **A summary of asbestos fibre counting experience in seven countries.** *Ann. Occup. Hyg.* 20(4):321-332.

Results of an international counting trial of asbestos fibers using the membrane filter method by centers in nine countries were published recently. This report summarizes the results of internal exchanges of membrane filters for asbestos counting in seven of these countries.

71
CA 88:78332w. Gibbs, G. W.; Hwang, C. Y. 1975. **Physical parameters of airborne asbestos fibers.** *IN Resumes Commun. - Conf. Int. Phys. Chim. Miner. Amiante,* 3rd, 17 pp.

The diameter and length of airborne fibers collected during dumping of crude amosite at an asbestos products plant were greater than those of fibers collected during application of amosite insulation. Chrysotile fibers collected in the carding area of asbestos textile plants tended to have diameters smaller than those of fibers collected in drier and bagging areas of asbestos mills. The fiber dimensions indicated that the degree of protection afforded workers by optical counts using membrane filters depends on the type of asbestos and the stage of its processing. Asbestosis may be related to the mass of airborne dust, and primary malignant mesothelial tumors to exposure to fibers in a specific range of diameter and length.

72
Gibbs, G. W.; Hwang, C. Y. 1975. **Physical parameters of airborne asbestos fibres in various work environments-preliminary findings.** *Am. Ind. Hyg. Assoc. J.* 36(6):459-466.

Results of a pilot investigation to describe the physical parameters, aspect ratio, length, mass and shape of airborne fibres in a number of industries producing, processing, and handling three asbestos fiber types are described. Measurements of fibre dimensions indicate that the degree of protection afforded a worker by optical counts using the membrane filter technique is likely to depend on variety of asbestos and stage of processing.

73
HEEP 72:8684. Gibbs, G. W.; Lachance, M. 1972. **Dust exposure in the chrysotile asbestos mines and mills of Quebec.** *Arch. Environ. Health* 24(3):189-197.

Features of the Quebec chrysotile mining and milling environment and methods used to establish indices of exposure for epidemiological studies are described. Though dust levels within the industry fluctuated widely, there was a steady fall from an average of approximately 75 million particles per cubic foot (MPCF) in 1948 to less than 10 MPCF in 1968. Variation in the fiber content of airborne dust in this industry suggests that any safety standard should probably take into account fibrous and nonfibrous components.

74
Gravatt, C. C.; LaFleur, P. D.; Heinrich, K. F. J., eds. 1978. *NBS Spec. Publ. 506.* IN Proceedings of Workshop on Asbestos: Definitions and Measurement Methods, 496 pp. Washington: National Measurement Lab., National Bureau of Standards.

This document contains invited papers which were given at a workshop on 'Asbestos: Definitions and Measurement Methods' which was jointly sponsored by the National Bureau of Standards of the U.S. Department of Commerce and the Occupational Safety and Health Administration of the U.S. Department of Labor. The discussion portions of the Workshop also have been included as has written material appropriate to the topics under consideration which was submitted to the editors at a later date. The Workshop covered four major topics: Mineralogical Aspects, the Relationship Between Chemical and Physical Properties and Health Effects, Analytical Methods, and Regulatory Positions and Criteria. Also included in these Proceedings is a summary of each of these topics. These summaries serve to define those factors for which there was general agreement at the Workshop, identify remaining points of controversy, and, in some cases, describe additional research required to resolve remaining problems.

75
Guillemin, M. 1977. **Problems caused by asbestos.** *Soz- Praeventivmed.* 22(4):193-194.

The biological significance of short fibres, analytical methodology, and permissible levels of asbestos fibres are discussed in view of future needs for research.

76
Hammad, Y. Y.; Diem, J.; Weill, H. 1979. **Evaluation of dust exposure in asbestos cement manufacturing operations.** *Am. Ind. Hyg. Assoc. J.* 40(6):490-495.

The asbestos-exposure assessment, by the current membrane filter methods, indicate the same health history despite fiber-particle correlation coefficients of 0.18-0.91. The ratio of fiber concentration-to-particulate count was 0.63-2.5. The correlation of 0.91 was obtained in dusty areas where asbestos and silica were handled in a dry form. The fiber concentrations were less than or equal to 2 fibers/cm3 and less than or equal to 0.5 fiber/cm3 in 80% and 60% of personal samples.

77
HEEP 76:488. Harwood, C. F.; Oestreich, D. K.; Siebert, P.; Stockham, J. D. 1975. **Asbestos emission from baghouse controlled sources.** *Am. Ind. Hyg. Assoc. J.* 36(8):595-603.

Results of emission testing conducted in five asbestos processing plants where emissions are controlled by baghouses are presented. Membrane filter samples of the effluent were examined by optical and electron microscopy. The mass removal efficiency frequently exceeded 99.00%. The number of fibers less than 1.5 mum was 10(7) - 10(8)/fibers/m3, while the number of fibers greater than 1.5 mum in length was about 10(4) - 10(5)/m3. The significance of fiber size in terms of probable health effects is discussed briefly.

78
CA 88:93965y. Harwood, C. F.; Yamate, G. 1975. **The detection and quantification of asbestos present in the environment.** *IN Resumes Commun. - Conf. Int. Phys. Chim. Miner. Amiante,* 3rd, 21 pp.

The review, with 26 references, covers the detection of asbestos in air, water, and food using light microscopy, x-ray diffraction, IR spectroscopy, atomic absorption, neutron activation, emission spectroscopy, thermal analysis, scanning electron microscopy and transmission electron microscopy.

79
HEEP 75:5724. Hayashi, H. 1973. **Quantitative determination of airborne asbestos dust in occupational environment by x-ray diffraction using conventional and rotating anode x-ray tube.** *Ind. Health* 11(4):225-236.

An x-ray diffraction method for qualitative and quantitative determination of asbestos in airborne dust in the occupational environment is described. The procedure can be carried out routinely in a laboratory and in an occupational environment when the total amount of sample is of the order of 0.01 mg of glass fiber filter of 3.8 cm(2) in area. Results of a field survey indicate very high concentrations of both asbestos and total dust in working areas of the asbestos industry, especially of sprayed mineral fiber containing asbestos.

80
CA 91:162373e. Heidermanns, G. 1978. **Methods for the identification and quantitative analysis of asbestos by application of the technical standard concentrations for asbestos.** *STF-Rep.* 2, 36 pp.

The use of available analytical methods for determining workplace concentrations of hazardous fibers is described.

81
CA 85:9818k. Heidermanns, G.; Kuehnen, G.; Schuetz, A.; Prochazka, R. 1975. **Dust concentrations in the fabrication of friction coatings containing asbestos and their handling in car repair shops.** *Staub - Reinhalt. Luft* 35(12):433-436.

Asbestos dust concentrations were measured in the manufacturing and fitting of brakelinings to motor vehicles. Concentrations (mg/m3) during the different processes were (total dust/chrysotile dust) sawing (0.90/0.20), turning (0.65/0.16), polishing (0.85/0.14), grinding (0.75/0.10), drilling (0.45/0.09), ambient room air (0.25/0.05). Thus, chrysotile constitutes about 20% of the total, and workers are exposed to more than the TLA values of 0.15 mg/m3 for some of the time, but this does not exceed 1 hr/shift or 3 hr/week.

82
HEEP 75:4218. Holmes, S. 1973. **Sampling methods.** *IARC (Int. Agency Res. Cancer) Publ. No. 8.* IN Biological Effects of Asbestos, Proc., ed. P. Bogovski, pp. 109-112. Lyon: International Agency for Research on Cancer.

Problems associated with the sampling and analysis of fibrous dusts including asbestos are discussed. Merits and disadvantages of sampling methods based on mass determination and fiber counting are reviewed in relation to sampling in environmental and occupational situations.

83
Holmes, S. 1965. **Developments in dust sampling and counting techniques in the asbestos industry.** *Ann. N.Y. Acad. Sci.* 132(1):288-297.

A history of the monitoring of industrial environments for airborne asbestos dust is presented. Included are discussions of early dust sampling instruments including the Konimeter and more modern instruments such as the "Royco".

84
HEEP 76:12579. Johari, O. 1976. **Part II. Physical applications of the scanning transmission electron microscope; Part III. Techniques for particulate matter studies in the scanning electron microscope; Part IV. Microelectronic device fabrication and quality control with the scanning electron microscope.** *Scanning Electon Microsc.* 1:782.

Papers presented at the Ninth Annual Scanning Electron Microscopy Symposium are included in the first volume of a two-volume set covering all the proceedings. The second volume contains the papers given at the workshops which were part of the sessions on Biological Applications of the Scanning and Scanning Transmission Electron Microscopy. Included in Volume II are papers from a workshop which dealt with techniques for employing scanning electron microscopy (SEM) in particulate matter studies. One topic discussed in this workshop was the use of SEM in the measurement of airborne asbestos particles.

85
CA 86:46823z. John, W.; Berner, A.; Smith, G.; Wesolowski, J. 1976. **Experimental determination of the number and size of asbestos fibers in ambient air.** *U.S. NTIS Report* PB-254086, 45 pp.

Transmission electron microscopy was used for analyzing asbestos in air. Asbestos fiber concentrations ranged from less than or equal to 1,000,000 fibers/m3 or 10,000 ng/m3 with downwind concentrations approximately 100 times greater than those upwind. Large tangles of asbestos occurring due to the proximity of the source were excluded from the analysis. The size distributions indicated that fibers shorter than the pore size penetrated the filters. The principal source of the emissions appeared to be windblown material from open ore and tailing piles.

86
Jones, J. S. P.; Pooley, F. D.; Smith, P. G. 1976. **Factory populations exposed to crocidolite asbestos - A continuing survey.** *IARC (Int. Agency Res. Cancer) Sci. Publ. No. 13.* IN Environmental Pollution and Carcinogenic Risks, Proc., ed. C. Rosenfeld and W. Davis, pp. 117-120. Lyon: International Agency for Research on Cancer.

87
Kogan, F. M.; Troitski'i, S. Iu. 1966. **Hygienic assessment of the measures for controlling dust in asbestos concentration plants.** *Gig. Sanit.* 31(6):108-110.

Considerable liberation of asbestos dust into workroom air was observed following studies of working conditions from 1947-1952 in the asbestos dressing industry. Discharges of dust-collecting chambers were the principle source of atmospheric pollution. Following the installation of electric precipitators for the dedusting of these discharges, average dust contents in the air of the various workroom areas was reduced. Other methods for dedusting procedures are discussed.

88
Kolonel, L. N. 1979. **Navy environment: health effects of asbestos exposure among Pearl Harbor naval shipyard workers.** *Toxicol. Res. Proj. Dir.* 4(9).

The purpose of this study is to determine the disease risks associated with different levels of exposure to airborne asbestos in a naval shipyard. Exposure to asbestos and disease incidence are being examined in a working population primarily exposed to a straight fiber type with a small diameter which permits penetration into the lungs. Detailed medical histories are being obtained and measurements of concentrations of asbestos fibers are being collected using individual samplers near the breathing zone. Data collected will be stored in a computer data base system.

89
CA 82:174866v. Kramer, J. R.; Mudroch, O. 1974. **Asbestos research at McMaster University.** *Can. Res. Dev.* 7(6):31-32, 55.

The development of a reproducible quantitative method for the detection of asbestos fibers in water and air is reviewed. Methods of transmission electron microscopic analysis of asbestos fiber in water and chemical analysis with electron microprobes are given.

90
CA 90:75898r. Kuenzler, U.; Reber, E.; Sutter, E. 1978. **Dust measurements, evaluation, and interpretation.** *Chimia* 32(12):496-505.

General criteria for safety in the workplace and the concept of maximum permissible concentrations as a function of analytical methods are discussed. Since dust determinations are carried out from a particular viewpoint, the planning for sampling, sampling, and evaluation of the samples and results are very important. For reliable results, a suitable method is required, as exemplified for quartz and asbestos. These minerals are identified and detected by x-ray diffraction and IR and chemical analysis. Methods for storage of the data are described.

91
HEEP 75:10623. Langer, A. M. 1974. **Approaches and constraints to identification and quantitation of asbestos fibers.** *Environ. Health Perspect.* 9:133-136.

A discussion of various techniques available for the evaluation and identification of asbestos fibers in air, water, and tissue samples is presented.

92
CA 91:180472r. Lee, R. S., ed. 1979. **Automatic detection and counting of asbestos fibers.** *Am. Ind. Hyg. Assoc. J.* 40(7):A50-A53.

An apparatus is described that utilizes a magnetic field to align the asbestos fibers which are examined by a microscope to identify the type of fiber and a microprocessor to determine the light-scattering peaks which indicate the number of fibers. The size and shape distribution of fibers is determined by Magiscan, a microscope-television camera-computerized image-analysis system.

93
Leffingwell, S.; Robinson, C.; Zumwalde, R. 1980. **Mortality, morbidity and industrial hygiene study of brake lining workers.** *Toxicol. Res. Proj. Dir.* 5(3).

The NIOSH recommended standard for asbestos exposure of 2.0 fibers longer than 5 micron per cubic centimeter of air was made with the recognition that: 1) health data was not available for exposures to low levels, and that 2) definitive information on the biological response to different size fibers was not available. Industrial hygiene surveys have been conducted in six automobile facilities by the Industrial Hygiene Section. Optical counting and electromicroscopic analyses are being performed in order to characterize the nature of the exposures occurring in these types of operations. A contract has been let to the Environmental Sciences Laboratory, Mt. Sinai School of Medicine, to evaluate health effects of exposure to asbestos-containing dusts in brake-lining maintenance and repair. The contract consists of two evaluations: (1) a feasibility study, to locate a cohort of brake lining repair and maintenance workers with sufficient latency to conduct a retrospective mortality study of these workers; and (2) a cross-sectional medical survey, to define the current health status of a representative cross-section of workers occupationally exposed to brake lining dusts. In conjunction with the cross-sectional medical study, NIOSH will undertake industrial hygiene assessments at a representative sample of work establishments, from which the study participants have been drawn. While the cross-sectional medical survey final report is due October 30, 1978, it is apparent that the report will not be finished until the second quarter of FY'79. Industrial hygiene assessment will be performed following receipt of work establishments from which participants were drawn. The contractor has promised the final report on the mortality feasibility study to NIOSH by 11/1/78.

94
Leidel, N. A.; Bayer, S. G.; Zumwalde, R. D.; Busch, K. A. 1979. **USPHS/NIOSH membrane filter method for evaluating airborne asbestos fibers.** *U.S. NTIS Report* PB-297731 (NIOSH 79-127).

This report describes the equipment and procedures for collecting, mounting, sizing, and counting asbestos fibers on cellulose ester membrane filters for the evaluation of personal samples or airborne asbestos fibers. Procedures for treating random and systematic errors are presented. These include statistical procedures for determining compliance with asbestos exposure standards. An evaluation of five phase contrast microscopes for asbestos counting is also given. The purpose of the method presented is to determine an employee's exposure to airborne asbestos fibers as referenced in the Federal standard on occupational exposure to asbestos and Mine Safety and Health Administration (MSHA) air quality standards. The method is used by the National Institute for Occupational Safety and Health (NIOSH) and the Occupational Safety and Health Administration (OSHA).

95
Levine, R. J., ed. 1978. **Asbestos: an information resource.** *DHEW National Institutes of Health Report* 78-1681, 105 pp.

A review of the uses of asbestos, the biological effects of ingesting asbestos and the studies linking asbestos with disease, is included in this book. Also provided are descriptions of the types of occupations that might experience high levels of airborne fibers. The book also reviews the exposure to asbestos from nonoccupational sources. Strategies and programs for control of the asbestos hazard are considered.

96
CA 91:43780a. Lilienfeld, P.; Elterman, P. B.; Baron, P. 1979. **Development of a prototype fibrous aerosol monitor.** *Am. Ind. Hyg. Assoc. J.* 40(4):270-282.

The Fibrous Aerosol Monitor was developed for on-the-spot selective detection, counting and sizing of discrete acicular-shaped particles. The sensing procedure is based on induced fiber rotation and concurrent detection of the resulting light scattering signature associated with these fibers even in the presence of other, nonacicular particles (in concentrations by factors of less than or equal to 10(6)).

97
Lilienfeld, P.; Trudeau, M. 1979. **A comparison: The GCA Model FAM Fibrous Aerosol Monitor to the NIOSH recommended procedure for asbestos sampling and microscopic counting. Tests performed by five Quebec companies in August and December 1978.** *Asbestos* 61(2):4, 6, 8, 10.

GCA Corporation's Fibrous Aerosol Monitor was demonstrated to measure asbestos concentrations at least as accurately as the microscopic reference method.

98
Little, A. D., Inc. 1972. **Impact of proposed OSHA Standard for Asbestos. First report to the United States Department of Labor.** *U.S. NTIS Report* PB-283478, 125 pp.

Results of a study undertaken to identify the impact of proposed standards for asbestos are reported. Major findings and conclusions are presented. Separate appendices containing techniques employed and data are included.

99
Lynch, J. B.; Ayer, H. E. 1966. **Measurement of dust exposures in the asbestos textile industry.** *Am. Ind. Hyg. Assoc. J.* 27(5):431-437.

Data obtained from environmental surveys of nine asbestos textile mills, which represent the baseline for the textile segment of the PHS epidemiological study of asbestos processing industries are presented. From these data concentration ranges are derived which yield significant differences between typical sample groups. Various ratio tests of different methods of counting and analysis were made and count weight ratios based on magnesium analyses for asbestos were calculated.

100
Lynch, J. R.; Ayer, H. E.; Johnson, D. L. 1970. **The interrelationships of selected asbestos exposure indices.** *Am. Ind. Hyg. Assoc. J.* 31(5):598-604.

An index was developed which yields the concentration in numbers of asbestos fibers visible under 430x phase-contrast illumination, based on the assumption that the biological effect of asbestos is related to the concentration of respirable fibers. Data are presented relating this index to overall dustiness as measured by impinger counts and to absolute fiber concentration and distribution as measured by electron microscopy.

101
Mamantov, G.; Shults, W. D., eds. 1972. **Determination of air quality.** *IN ACS Symp. on Determination of Air Quality,* 197 pp. Los Angeles.

An up-to-date summary of work on air pollution, including environmental contamination by airborne asbestos is presented. Surveillance programs, items covered in these programs, sampling sites, type of equipment, EPA authority definitions from the Clean Air Act as amended, data uses, sampling and reporting times, data validation, analysis, storage and retrieval, and other topics are discussed. Recommended procedures for analysis are detailed.

102
CA 86:160226g. Markham, M. C.; Wosczyna, K. 1976. **Determination of microquantities of chrysotile asbestos by dye adsorption.** *Environ. Sci. Technol.* 10(9):930-931.

A method of analysis for airborne asbestos was developed using a differential dye adsorption technique. Estimation of quantities of chrysotile asbestos is possible down to the 100-mug level and requires only a differential-reading spectrophotometer. This method is also applicable to crocidolite.

103
Massachusetts Commission on Asbestos. 1976. **Report of the special commission relative to evaluating the extent of the use of asbestos as fireproofing in the schools and public buildings of the Commonwealth and its containment and removal (House Document Number 5344).** *U.S. NTIS Report* PB-285276, 34 pp.

Presented is a summary of studies concerning the control and measurement of asbestos fibers, occupational hazards, and community effects prepared for the Massachusetts Commission on Asbestos.

104
Meranger, J. C.; Reid, W. W.; Davey, A. B. 1979. **Chrysotile asbestos: The correlation between x-ray diffraction response and phase contrast microscopy count.** *Can. J. Spectrosc.* 24(3):75-79.

X-ray diffraction was investigated as a screening technique for the determination of airborne chrysotile asbestos fibers in the presence of serpentine ore dust and compared with the phase contrast microscopy count. Although relationship between fiber count and diffraction response was observed, the x-ray diffraction method is not sufficiently reliable to be used in rapid screening situations.

105
Mercer, T. T.; Morrow, P. E.; Stober, W. 1972. **Assessment of airborne particles: Fundamentals, applications, and implications to inhalation toxicity.** *IN Rochester International Conference on Environmental Toxicity,* 3rd, ed. T. T. Mercer, P. E. Morrow, and W. Stober, 540 pp. Springfield: Charles C. Thomas.

Proceedings of a conference on airborne particles dealing with generation, filtration, measurement, size distribution, and the results of inhalation studies, deposition sites, and diseases are presented. Included is a chapter on asbestos.

106
CA 90:209023w. Meylan, W. M.; Howard, P. H.; Lande, S. S.; Hanchett, A. 1978. **Chemical market input/output analysis of selected chemical substances to assess sources of environmental contamination: Task III. Asbestos. Final report.** *U.S. NTIS Report* PB-285531, 331 pp.

This report considers the sources of asbestos environmental contamination. Marketing information, available monitoring data, and engineering assumptions were used to estimate asbestos emissions. Asbestos is used in thousands of products including friction materials (brakes and clutches), asbestos-cement pipe and sheet, roofing, paper, flooring, insulation, packing and gaskets, textiles, coating and paints, and plastics. The available information could not be used for any quantitative estimates and rarely was an ambient level attributable to a particular source. Exceptions were crushed serpentinite rock containing asbestos that was used to pave roads and driveways, demolition of buildings containing asbestos construction material, and automotive brake linings adjacent to toll plazas where cars brake to a stop. Municipal incineration may also be a potential source of significant asbestos fiber emission to ambient air. Release of asbestos fibers from A/C pipe used for drinking water appears to be minor, except where the water is very corrosive.

107
HEEP 78:12430. Middleton, A. P. 1978. **On the occurrence of fibres of calcium sulphate resembling amphibole asbestos in samples taken for the evaluation of airborne asbestos.** *Ann. Occup. Hyg.* 21(1):91-94.

A comparison of scanning electron microscopy (SEM) and energy-dispersive x-ray analysis (EXDA) for examination of asbestos dust samples collected during a survey to establish concentrations of airborne asbestos are presented.

108
HEEP 79:9411. Mimura, K. 1978. **A study on the working conditions and health of the workers handling asbestos in a shipyard.** *Okayama Igakkai Zasshi* 90(7-8):981-992.

An environmental investigation and health examination were carried out in a shipyard where such materials were increasingly used to clarify the influence of asbestos on the health of the workers using asbestos materials. The air surrounding the workers was measured and had 4 to 55.4 fibers/cm3 of maximum asbestos. The lack of experience and knowledge for asbestos-works delayed protection measures.

109
Mirick, W. 1980. **Asbestos sealant evaluation.** *Toxicol. Res. Proj. Dir.* 5(2).

The objective is to evaluate commercially available, waterbase, sprayable liquid sealants for suitability to be used to hold friable, sprayed-asbestos material fibers in place to prevent fiber release into the indoor air in buildings. Also to participate in seminars to acquaint responsible school building engineers with corrective action options for friable asbestos problems. APPROACH: Solicit candidate materials from manufacturers, screen them, select ten for tests of impact resistance flexibility, abrasion resistance, and smoke and toxic products emitted when burned. Select four of the ten for test applications on 10 x 14 foot ceiling area in a building. Evaluate the flame spread index of these four. Measure asbestos fiber count in air before, during, and after applying sealant in building. PROGRESS: Three materials appear to be satisfactory for the purpose intended-two of the four applied in a building on this project and one with widespread previous use both in Europe and the United States. Air samples verify the existence of large numbers of invisible asbestos fibers during activities disturbing the asbestos containing materials, and verify the need for protective practices by the workers.

110
Napoli, S. 1975. **Asbestos pollution: Criticism on methods and experiences in the city of Bari.** *Lav. Um.* 27(5):148-155.

Results of the measurement of air pollution in the city of Bari are given. Critical remarks on the air sampling and identification technique used for examination of the samples is included.

111
National Cancer Institute. 1979. **Oncology overview: Selected abstracts on the role of asbestos in human cancer.** *U.S. NTIS Report* NTISUB/E/229-001, 325 pp.

112
Nicholson, W. J. 1978. **Chrysotile asbestos in air samples collected in Puerto Rico.** *Report to The Consumer Products Safety Commission,* March 16, Contract CPSC 77128000.

113
Nicholson, W. J. 1978. **Chrysotile asbestos in air samples collected in Puerto Rico.** *U.S. NTIS Report* PB-282363, 59 pp.

Results of a study of asbestos contamination from homes and schools constructed of asbestos/cement panels in Puerto Rico are presented. Although the investigation was unable to determine the source of contamination, levels higher than background were detected around certain school building sites.

114
Nicholson, W. J.; Rohl, A. N.; Sawyer, R. N.; Swoszowski, E. J., Jr.; Todaro, J. D. 1978. **Control of sprayed asbestos surfaces in school buildings: a feasibility study.** *Report to the National Institute of Environmental Health Sciences,* June 15, Contract NO1-ES-7-2113.

115
Noro, L. 1968. **Occupational and "non-occupational" asbestosis in Finland.** *Am. Ind. Hyg. Assoc. J.* 29(3):195-201.

Following examination of gravimetric and breathing zone samples by x-ray diffraction techniques, it was shown that dust levels in 75% of the 225 jobs tested were below threshold limits. Epidemiological studies indicate that while asbestosis is an important occupational disease in Finland, non-workers should not be overly concerned by this problem.

116
Ortiz, L. W.; Ettinger, H. J.; Fairchild, C. I. 1975. **Calibration standards for counting asbestos.** *Am. Ind. Hyg. Assoc. J.* 36(2):104-112.

Details of a laboratory proficiency testing program initiated by NIOSH to permit standardization of asbestos counting procedures by various state agencies are presented.

117
CA 86:110541k. Pattnaik, A.; Meakin, J. D. 1976. **Development of scanning electron microscopy for measurement of airborne asbestos concentrations.** *Scanning Electron Microsc.* 9(Pt. 1):441-450.

Airborne asbestos concentrations were measured by scanning electron microscopy (SEM). The fibers were identified by energy discriminating x-ray fluorescence system in conjunction with SEM. The particulates were collected on Millipore MF-type membrane. Techniques which can be used to substantiate identification and counting include transmission electron microscope-selected area diffraction approach.

118
Rajhans, G. S.; Bragg, G. M. 1975. **A statistical analysis of asbestos fiber counting in the laboratory and industrial environment.** *Am. Ind. Hyg. Assoc. J.* 36(12):909-915.

Reproducibility of standard fiber counts in the laboratory and four industrial plants is discussed in detail. It is concluded that the standard method is sufficiently precise for industrial measurements.

119
Rajhans, G. S.; Bragg, G. M.; Morton, J. S. 1978. **A review of asbestos exposures in Ontario.** *Am. Ind. Hyg. Assoc. J.* 39(9):767-771.

A review of asbestos sampling data collected in Ontario from 1972 to 1976 using the membrane filter technique is provided.

120
HEEP 74:3484. Reber, E. 1973. **Air quality in work areas.** *Chimia* 27(5):284-290.

Criteria for the determination of good air are given. A list of maximum acceptable concentration values for dangerous concentration of various substances is included. Two measurement techniques are specified.

121
HEEP 75:12184. Reist, P. C. 1975. **Counting asbestos fibers by the most probable number method.** *Am. Ind. Hyg. Assoc. J.* 36(5):379-384.

A procedure which uses the most probable number (MPN) method of bacteria counting is described for evaluating asbestos fiber counts. Although the observer must estimate fiber concentrations to within an order of magnitude prior to counting, the technique is faster than more conventional counting techniques and is approximately as accurate. Due to its speed and convenience, this procedure may be more desirable than conventional counting for the routine monitoring of large numbers of asbestos samples in air.

122
Rickards, A. L. 1978. **The routine monitoring of airborne asbestos in an occupational environment.** *Ann. Occup. Hyg.* 21:315-322.

A discription of the strategy and techniques employed in monitoring an asbestos textile factory is given. A rapid background monitoring system based on a portable Royco particle counter was established to examine the efficiency of fixed ventilation systems within the factory. In addition a personal sampling program was devised.

123
CA 77:155998v. Rickards, A. L. 1972. **Estimation of trace amounts of chrysotile asbestos by x-ray diffraction.** *Anal. Chem.* 44(11):1872-1873.

X-ray diffraction techniques utilizing an external and internal standard were used to detect 10 ug and 50-100 ug chrysotile in urban atmospheres.

124
CA 79:96387m. Rickards, A. L. 1973. **Estimation of submicrogram quantities of chrysotile asbestos by electron microscopy.** *Anal. Chem.* 45(4):809-811.

Trace amounts of chrysotile greater than or equal to 0.1 ng/m(3) are estimated by observing the dimensions of chrysotile fibers in samples and using the theoretical density to calculate the mass of chrysotile.

125
CA 76:17472x. Rickards, A. L.; Badami, D. V. 1971. **Chrysotile asbestos in urban air.** *Nature (London)* 234(5324):93-94.

An electrostatic precipitation and x-ray diffraction analytical method is described for determining the presence of greater than 0.1 ug/m(3) chrysotile concentrations in the atmosphere from an asbestos processing plant. An election microscopy technique under development has a detection limit of approximately 0.1 ng/1000 m(3).

126
CA 92:10653d. Riediger, M. G. 1979. **Asbestos fiber release from protective garments during manufacture and use.** *Cah. Notes Doc.* 96:425-433.

Testing of commercial fabric and garments, analysis of air at workplaces for the cutting, sewing, and stamping of asbestos-based fabrics, and detection of fiber release from protective asbestos clothing during use in the iron and steel industry indicated that although appreciable amounts of asbestos fibers are released in all cases, they rarely exceed the permissible limit of 2 fibers/cm3.

127
Roach, S. A. 1965. **Measurement of airborne asbestos dust by instruments measuring different parameters.** *Ann. N.Y. Acad. Sci.* 132:306-315.

This paper records an investigation of eight different methods for measuring airborne dust exposure. In addition to four instruments designed for measuring the number of concentration of dust in air, there were four samplers which were designed to measure the mass concentration of dust in air.

128
CA 87:57609f. Rohl, A. N.; Langer, A. M.; Selikoff, I. J. 1977. **Environmental asbestos pollution related to use of quarried serpentine rock.** *Science (Wash., DC)* 196(4296):1319-1322.

Crushed serpentine quarried in Montgomery County, Maryland, has been extensively used for paving roads and other surfaces. The mineral assemblage includes antigorite or lizardite as well as chrysotile and tremolite. Air samples taken in the vicinity of serpentine-paved roads show that chrysotile concentrations are about 103 times greater than those typically found in urban ambient air in the U.S.

129
HEEP 77:4753. Rohl, A. N.; Langer, A. M.; Wolff, M. S.; Weisman, I. 1976. **Asbestos exposure during brake lining maintenance and repair.** *Environ. Res.* 12(1):110-128.

Data obtained on asbestos exposure of garage mechanics during brake lining maintenance and repair work show that fiber concentrations frequently in excess of regulated limits are common. Chrysotile, ranging from 2-15%, in brake drum dusts, was demonstrated by x-ray diffraction, selected area electron diffraction, transmission EM, and electron microprobe analyses. Unaltered chrysotile was found in air and brake drum dust samples. The chrysotile asbestos content of personal air samples, taken during automobile brake repair work, was measured by EM and optical microscopic techniques. The present technique of optically counting asbestos fibers may considerably underestimate the levels of total asbestos exposure.

130
Rubino, G. F.; Piolatto, G.; Newhouse, M. L.; Scansetti, G.; Aresini, G. A.; Murray, R. 1979. **Mortality of chrysotile asbestos workers at the Balangero Mine, Northern Italy.** *Br. J. Ind. Med.* 36:187-194.

The mortality from 1946 to 1975 of over 900 North Italian chrysotile asbestos workers first employed between 1930 and 1965 has been studied. Nine deaths were certified as attributable to asbestosis, and eleven to lung cancer. One death was attributed to mesothelioma of pleura, but this diagnosis was not supported by histological examination. Comparison with the national figures for all Italy did not reveal an excess of deaths from lung cancer but during the last quinquennium of observation, the SMR for lung cancer rose to 206. Simulation experiments enabled a dust index in fibre/years to be attached to each man in the cohort. All but two of the deaths from lung cancer occurred in the higher exposure group. The relative risk of lung cancer in this group was 2.89. The eleven workers who died from lung cancer were all cigarette smokers. A further period of observation is required to monitor the mortality of the surviving workers. (Auth)

131
CA 89:203146n. Ruch, R. B., Jr.; Serper, A. 1978. **Ambient measurements of asbestos in the vicinity of asbestos sources.** *IN Jt. Conf. Sens. Environ. Pollut., Conf. Proc.,* 4th, pp. 867-870.

After the measurement of atmospheric asbestos levels in the vicinity of an inactive asbestos refuse pile with a monitoring network comprising 13 air samplers and one portable wind system, measurable asbestos levels were observed on only eight filters. The results of the filter analysis are presented with respect to existing meteorological conditions, the physical state of pile, and the activities of other potential sources. Based on these results, it appears that this pile has sufficiently stabilized so that the level of exposure of the nearby community to airborne asbestos emission s from the pile is extremely low.

132
CA 91:26501t. Russell, P. A.; Hutchings, A. E., eds. 1978. *Electron microscopy and X-ray application to environmental and occupational health analysis.* 278 pp.

133
CA 90:28362b. Ryer, F. H. 1978. **Air pollution exposures to five target health hazards.** *Am. Ind. Hyg. Assoc. J.* 39(11):928-931.

Health hazards of asbestos, carbon monoxide, cotton dust, lead, and silicon dioxide were evaluated by the Occupational Safety and Health Administration (OSHA). OSHA's permissible exposure levels for these pollutants are reported.

134
Samudra, A. V.; Bock, F. C.; Harwood, C. F.; Stockham, J. D. 1978. **Evaluating and optimizing electron microscope methods for characterizing airborne asbestos. Final report June 75-June 77.** *U.S. NTIS Report* PB-284828, 198 pp.

Electron microscope methods for measuring airborne asbestos fiber concentrations and size distributions were evaluated by studying variables and subprocedures in a 5-phase program using elaborate statistically designed experiments and regression techniques. The optimized method for estimating airborne chrysotile should include collecting an air sample on a Nucleopore filter; coating the Nucleopore filter with carbon; transferring the particulate deposit to a 200-mesh electron microscope grid using CHC13 in a modified Jaffe-wick washer; examining the grid at approximately 10,000 X magnification (20,000 X for counting very fine fibers); counting fibers using a field of view method; and identifying the type of asbestos from morphology and selected area electron diffraction. A provisional manual of instructions was prepared.

135
Samudra, A. V.; Harwood, C. F. 1977. **Electron microscope measurement of airborne asbestos concentrations. A provisional methodology manual. Final report June 75-June 77.** *U.S. NTIS Report* PB-285945, 57 pp.

This manual describes a provisional optimum electron microscope (EM) procedure for measuring the concentration of asbestos in air samples.

136
Samudra, A. V.; Harwood, C. F. 1979. **Evaluation of EM methods for measurement of airborne asbestos concentrations and evolvement of an optimal procedure.** *Toxicol. Res. Proj. Dir.* 4(3):3888.

An evaluation of electron microscope methods used in several laboratories for analysis of airborne asbestos fibers is presented. After selection of an optimum procedure from these techniques, a handbook containing detailed instructions will be prepared. Following analysis of samples in various laboratories, test results from the different locations will be evaluated.

137
CA 89:11381p. Samudra, A. V.; Harwood, C. F.; Stockham, J. D. 1977. **Electron microscope measurement of airborne asbestos concentrations-A provisional methodology manual. Final report June 1975-June 1977.** 58 pp. Chicago: IIT Research Inst.

138
CA 86:145018x. Sawyer, R. N. 1977. **Asbestos exposure in a Yale building. Analysis and resolution.** *Environ. Res.* 13(1):146-169.

Asbestos fiber concentrations in the building, which had ceilings sprayed with a mixture of asbestos, fiber glass, and cementitious binder, in some cases exceeded OSHA allowable limits for industrial exposure and in all cases exceeded ambient city levels. The procedures used for removal of the asbestos are outlined, and results of air sampling during surveillance, experimentation, and removal are discussed.

139
Schoenberg, J. B.; Mitchell, C. A. 1974. **Implementation of the federal asbestos standard in Connecticut.** *J. Occup. Med.* 16(12):781-784.

In June 1972, the U.S. Occupational Safety and Health Administration (OSHA) issued a "Standard for Exposure to Asbestos Dust", the first federal standard for asbestos. To determine how the standard was being implemented, a survey of Connecticut companies using asbestos products was conducted. Results of this survey are presented.

140
CA 89:141301y. Sebastien, P.; Billon, M. A.; Janson, X.; Bonnaud, G.; Bignon, J. 1978. **Use of the transmission electron microscope (TEM) for the measurement of asbestos contaminations.** *Arch. Mal. Prof. Med. Trav. Secur. Soc.* 39(4-5):229-248.

An electron microscopic method for detection of asbestos in environmental and biological samples is described. Morphological, crystallographic, and chemical criteria for identification are discussed.

141
Selikoff, I. J.; Lee, D. H. K. 1978. *Asbestos and disease,* 544 pp. New York: Academic Press.

This book gives a comprehensive, critical review of current knowledge on the relationship of exposure to asbestos and the subsequent development of disease. The book sets forth a model approach to consideration of desease production by an environmental agent. Systematically proceeding from the extraction and processing of the mineral, it continues on to review the manufacturing processes of asbestos and opportunities for exposure; distribution in the environment; the etiology, prevalence, and clinical features of the resultant disease; the cellular mechanisms of pathogenesis; and the legal and engineering procedures involved in prevention and control.

142
HEEP 73:1592. Selikoff, I. J.; Nicholson, W. J.; Langer, A. M. 1972. **Asbestos air pollution.** *Arch. Environ. Health* 25(1):1-13.

Occurrence of asbestos air pollution is now established. Measurement of asbestos content of ambient air in New York City and other locations showed levels of 10 to 50 x 10(9) g/cu m. Lungs of New York residents examined at autopsy regularly showed chrysotile fibrils. Since urban air pollution is derived from commercial and industrial sources, the asbestos industry has both important responsibility and opportunity for its control.

143
Seshan, K. 1978. **On the utility of dark field electron microscopy in the determination of the degree of deformation in chrysotile asbestos: An environmental research application.** Berkeley: Lawrence Berkeley Laboratory, University of California.

The degree of microcrystalline deformation in fibers of chrysotile asbestos may be distinguished using high resolution dark-field electron microscopy. This can be seen by comparing UICC standard reference samples which are partially deformed as a result of milling in the mixing process with undeformed chrysotile. Using this technique it was shown that crysotile asbestos in various stages of deformation is present in automobile brake drum dust. Dark-field images such as these can be used to identify sources of asbestos in environmental pollution samples.

144
Smithson, G. R.; Clark, R.; Nowacki, L. 1979. **Evaluation of sealants for spray-on asbestos-containing material in buildings.** *Toxicol. Res. Proj. Dir.* 4(6):5444.

It has been found that asbestos fibers from sprayed-on asbestos-containing construction materials can enter the atmosphere following deterioration of the material, accidental impact, or operations involving removal or replacement of the material. Protocols for the evaluation of commercially available sealants for inhibition of the release of asbestos fibers into ambient air are presented. Techniques for the collection and analysis of samples containing asbestos are included.

145
Sperduto, B.; Burragato, F.; Altieri, A. 1977. **Asbestos minerals: Their recognition and determination.** *Ann. Ist. Super Sanita* 13(1-2):127-135.

Fibers of amphibole and serpentine asbestos may be optically distinguished by treatment of the fibers with a fluorochrome coloring agent prior to fluorescent microscope examination. The technique has been applied with satisfactory results in asbestos cement factories.

146
Spooner, C. M. 1979. **Asbestos in schools - A public health problem.** *N. Engl. J. Med.* 301(14):782-784.

The serious public health hazard of asbestos exposure, is discussed. Asbestos mixed with other materials was sprayed onto surfaces in building interiors from 1945 until 1973. Over a period of years, the asbestos-containing surfaces break down. The material must be sampled and the degree of friability and the asbestos content determined. The best method for identifying airborne asbestos fibers is by the polarized light microscope. Once identified, school officials may choose to remove or encapsulate a potential asbestos hazard. A serious impediment to the removal of asbestos in schools in the United States is the failure of the federal government to make funds available to states or communities for such work.

147
CA 92:10568e. Spurny, K. R.; Stoeber, W. 1977. **Electron microprobe identification of fibrous aerosols in ambient air.** *IN Proc. Third Int. Conf. Nucl. Methods Environ. Energy Res.*, ed. J. R. Vogt, pp. 69-82.

Nuclepore filters were used for sampling fibrous particles from air, and filter counting and fiber size were determined by SEM. Asbestos fibers were identified by electron microprobe analysis as were other fibers. In remote ambient air, high concentrations of fibrous particles, 103-104/m3, were measured, although concentrations of asbestos fibers were 102/m3.

148
CA 84:110737n. Spurny, K. R.; Stoeber, W. 1975. **Asbestos measurements in ambient air.** *Clean Air (Melbourne)* 9(2):38-41.

Sampling and preparation techniques for the quantitative assessment of airborne asbestos fibers are described. Electron microscopy and electron-microprobe analysis of single fibers on filter surfaces enabled the chemical composition of the fibers to be determined.

149
CA 90:173813d. Spurny, K. R.; Stoeber, W.; Opiela, H.; Weiss, G. 1979. **On the evaluation of fibrous particles in remote ambient air.** *Sci. Total Environ.* 11(1):1-40.

The number of fibers, distribution of fiber lengths and diameters, and the estimated fiber aerodynamic diameters were determined. The specific identification of asbestos fibers was made by electron microprobe analysis. In remote ambient air relatively high concentrations of other fibrous particles were found.

150
CA 87:10728d. Spurny, K. R.; Stoeber, W.; Opiela, H.; Weiss, G. 1976. **Microscopy and analysis of asbestos aerosols in ambient air.** *IN Atmos. Pollut., Proc. Int. Colloq.* 12th, pp. 459-469.

Nucleopore filters were used for sampling and microscopy of atmospheric asbestos aerosols. Samples for transmission electron microscopy were prepared by replication. For scanning electron microscopy and microprobe analysis the filters were coated on both sides with gold. Fibers were counted, measured, and analyzed for magnesium, silicon, and iron. Measurements at rural stations showed that asbestos cannot be distinguished satisfactorily from other fibrous mineral particles without physicochemical identification of individual fibers. Fiber concentrations of 103-104/m3 were found, but less than 10% were asbestos.

151
Stewart, J. D., ed. 1979. **NIOSH develops simple procedure for detection in building atmospheres.** *Chem. Regul. Rep.* 3(32):1351.

152
Stewart, J. D., ed. 1978. **EDF petition charges EPA negligent on school asbestos problem.** *Chem. Regul. Rep.* 2(39):1740-1741.

153
Stewart, J. D., ed. 1979. **Subcommittee hears of difficulties in linking asbestos levels to effects.** *Chem. Regul. Rep.* 2(41):1799-1801.

154
Stewart, J. D., ed. 1979. **Asbestos in nine percent of schools in Michigan study, house panel told.** *Chem. Regul. Rep.* 2(42):1966.

155
Stewart, J. D., ed. 1979. **NBS report on asbestos workshop available from printing office.** *Chem. Regul. Rep.* 2(43):1990-1991.

156
Stolwijk, J. A.; Dubin, S. B.; Leaderer, B. P. 1979. **Continuous optical monitoring of asbestos in air.** *Toxicol. Res. Proj. Dir.* 4(6):647-648.

The development and testing of a continuous monitor for the identification and counting of asbestos fibers in the air of occupational and residential environments is described.

157
HEEP 75:5907. Svirskii, E. L.; Kogan, F. M. 1973. **Dust factor in the production of asbestos board.** *Gig. Tr. Prof. Zabol.* 17(3):39-40.

A medical examination and roentgenography of 56 workers engaged in the production of asbestos board with service of 6-30 years is described. Dust pollution due to asbestos board production can be reduced by wetting the raw materials during mixing and grinding, sealing the equipment and installing effective ventilation.

158
Taylor, M. 1978. **Methods for the quantitative determination of asbestos and quartz in bulk samples using x-ray diffraction.** *Analyst* 103(1231):1009-1020.

Procedures are described for the quantitative determination of the asbestos and alpha-quartz contents of bulk samples by use of x-ray powder diffractometry. The method gives satisfactory results for several different types of asbestos and for mixtures of two or more different types. The detection limits for asbestos are 2-6%, depending on type.

159
HEEP 73:5065. Thompson, R. J.; Morgan, G. B. 1971. **Determination of asbestos in ambient air.** *Identification and Measurements,* ed. B. Westley, pp. 154-157.

160
CA 87:140390y. Timbrell, V. 1977. **Magnetic separation of respirable asbestos fibers.** *Filtr. Sep.* 14(3):241-242.

Respirable asbestos fibers, in liquid suspension, will align in a magnetic field. A dilute aqueous suspension of dust is transferred to a spectrophotometer cell of a light-scattering system. An estimate of fiber concentration is made from measurements on the chart recorder of the intensity distribution in the scattering pattern produced by the aligned fibers. Where heavy contamination exists, a separator is needed to retain the fibers and allow them to be recovered.

161
HEEP 76:8561. Timbrell, V. 1975. **Alignment of respirable asbestos fibers by magnetic fields.** *Ann. Occup. Hyg.* 18(4):299-311.

Alignment of respirable asbestos fibers by magnetic fields has many advantages in investigations of biological effects of asbestos. Their alignment in thin films or on membrane filters facilitates determination of diameter and length distributions using light and electron microscopes. Fibers aligned in thin film or in liquid suspension produce distinctive light-scattering patterns when illuminated by a laser beam. Photoelectric measurement of the light intensity distribution aids identification of the geographical source of the asbestos and also permits estimation of fibers in air samples.

162
Tucker, J. H.; Cook, P. M.; Phipps, G. L.; Stokes, G. N.; Lima, P. H. 1978. **Asbestos - a bibliography.** *U.S. NTIS Report* PB-286486, 100 pp.

A bibliography compiled by the asbestos research group at the Environmental Research Laboratory-Duluth, Duluth, Minnesota, which contains 1,425 references pertaining to the chemical, physical, biological and medical properties, and effects of asbestos in the environment.

163
U.S. Department of Health, Education, and Welfare, Public Health Serice. **Criteria for a recommended standard - occupational exposure to asbestos.** *DHEW Public Health Service Report,* 100 pp.

A long report on diseases associated with industrial uses of asbestos is presented. There are still some problems related to the kind of asbestos, the effects of fibre length, the effects of metallic impurities, the effect of adsorbed hydrocarbons, and as to whether the results are affected by smoking. But there is certainly evidence of a strong association between the diseases and exposure to asbestos, particularly in the insulation and textile industries. Although problems have complicated the setting of standards, the tentative standard is chosen as a time-weight average for an 8 hr day of not more than 2 fibres longer than 5 microns per milliliter of air, with no peak greater than 10 fibres per milliliter. Appraisal of employees of hazard, medical surveillance of exposed workers, protective clothing and respirators, work practices designed to reduce dust, monitoring and record keeping are specified. The report contains many other details, basis for the standards, especially about sampling methods, and experience in industries in several countries.

164
U.S. Department of Health, Education, and Welfare, National Institutes of Health. 1979. **Asbestos and health- an annotated bibliography of public and professional education materials.** *DHEW National Institutes of Health Report* 79-1842, 60 pp.

165
Vigliani, E. C., ed. 1969. **Criteria for the determination of maximum tolerable concentration of silica and asbestos in the air.** *Med. Lav.* 60(2):85-89.

166
HEEP 73:10129. Vigliani, E. C., ed. 1972. **Evaluation of the exposure to asbestos in the working spaces: Recommendations of the sub-committee on asbestosis of the Permanent Commission and International Association of Industrial Medicine.** *Med. Lav.* 63(1-2):1-6.

Uniform procedures for the collection, identification, and enumeration of airborne asbestos fibers have been proposed by the asbestosis subcommittee of the Permanent Commission and International Association of Industrial Medicine following increased use of asbestos in industrial and consumer products.

167
HEEP 77:10790. Walton, W. H.; Attfield, M. D.; Beckett, S. T. 1976. **An international comparison of counts of airborne asbestos fibers sampled on membrane filters.** *Ann. Occup. Hyg.* 19(3/4):215-224.

Results of an asbestos fibre counting trial based on examination of mounted and unmounted membrane filter samples by laboratories in nine countries is presented. Differences in counting techniques and in filter cleaning methods were studied and compared.

168
HEEP 78:1249. Walton, W. H.; Beckett, S. T. 1977. **A microscope eyepiece graticule for the evaluation of fibrous dusts.** *Ann. Occup. Hyg.* 20(1):19-24.

Advantages of using a microscope eyepiece graticule designed for counting respirable fibrous dusts (including airborne asbestos) is described. The technique is particularly useful in determining fiber length and diameter.

169
CA 87:140399h. Wesolowski, J. J.; Stanley, R.; Smith, G.; Carpenter, L.; Berner, A. 1975. **Asbestos measurements in the California environment.** *Comm. Eur. Communities (IN Proc. Int. Symp. Recent Adv. Assess. Health Eff. Environ. Pollut.)* 3:1729-1737.

Electron microscopy was used to identify, count and size asbestos particles in air and water.

170
White, G. L. 1978. **Hazard evaluation and technical assistance report no. TA 78-4, Smithsonian Institution, Washington, D.C. Final report.** *U.S. NTIS Report* PB-291661, 9 pp.

Results of a hazard evaluation and technical assistance survey of airborne asbestos levels at the Smithsonian Institution's Silver Hill, Maryland, Tract B facilities are presented. Personal and general area air samples were taken during separate time periods under different conditions: 1) in the undisturbed building; 2) during simulated rain; and 3) after simulated rain, and collected on millipore filters. No airborne asbestos was detected in the undisturbed building during a 2 hr sample, except for one instance. However, there was a significant increase in airborne asbestos concentrations when a 30 to 45 min rain was simulated using fire hoses. Monitoring of routine janitorial tasks 2 hr after the rain showed the employee's exposure to be 80% of an 8 hr time-weighted average daily exposure criteria.

171
CA 87:140397f. Wilcox, S. L.; Keitz, E. L.; Duncan, L. J. 1975. **Establishing safe ambient air quality levels for eighteen hazardous pollutants.** *Comm. Eur. Communities (IN Proc. Int. Symp. Recent Adv. Assess. Health Eff. Environ. Pollut.)* 3:1241-1248.

Data are provided for the development of safe ambient air quality levels for 18 hazardous pollutants including asbestos.

172
Woodbury, M. A.; Rusch, H. P. 1980. **Wisconsin Cancer Reporting System - Cancer surveillance and research.** Toxicol. Res. Proj. Dir. 5(3).

The overall objective of the epidemiological study section of the Wisconsin Cancer Reporting System is the identification of high risk population groups, environmental factors and potential carcinogenic agents. This is a long-range plan currently directed toward developing the tools necessary for providing a mechanism for identifying cancer morbidity and mortality events or patterns significantly deviating from past trends. A computer program will be written to indicate such occurrences. Specific epidemiological studies will determine the factors involved, should the unusual event or pattern not be the result of changes in reporting habits. A computer program will also be developed to correlate an ongoing basis on various environmental conditions with cancer morbidity and mortality. (For example, a study of the degree correlation of cancer mortality by distance from a taconite mine with measurements of asbestos in air, water, and soil by distance from the mine). It is anticipated that such computerized surveillance will substantially increase the ability to recognize changes early and to set in action the analytical epidemiological studies required.

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BA 68:32081. Zielhuis, R. L. 1977. *Public health risks of exposure to asbestos: Report of a working group,* 149 pp.

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TITLE INDEX

TOXICOLOGY INFORMATION RESPONSE CENTER
INFORMATION CENTER COMPLEX

NATIONAL LIBRARY OF MEDICINE

TOXICOLOGY INFORMATION PROGRAM

The Toxicology Information Response Center (TIRC) was founded in 1971 to establish a national and international center for toxicology information. TIRC provides information to all individuals on a variety of chemicals such as food additives, pharmaceuticals, industrial chemicals, environmental pollutants, heavy metals, and pesticides; and other topics of toxicologic concern.

ORGANIZATION—TIRC is sponsored by the National Library of Medicine's Toxicology Information Program. Located at the Oak Ridge National Laboratory, TIRC is part of the Information Center Complex, a major scientific and technical unit within the Information Division. This Complex coordinates the functions and activities of several information units at the Laboratory. These associations provide a unique opportunity for scientific and technical interactions.

INFORMATION SERVICES—As an information analysis center, TIRC acquires, selects, stores, retrieves, evaluates, analyzes, and synthesizes comprehensive literature packages according to a user's specific request or a current need. TIRC provides extensive toxicology information assistance and reference services to the scientific, administrative, and public communities—health science students, educators, practitioners, scientists, and administrators. Interested persons may request: (1) specific published toxicology data, (2) individualized literature searches, (3) topical bibliographies, (4) annotated and/or key-worded bibliographies, (5) state-of-the-art overviews, (6) custom searches of computerized data bases, (7) SDI service, (8) access to over 650 bibliographic collections generated annually, (9) in-Center use of the toxicology reference library, and (10) selected reports available from the National Technical Information Service.

INFORMATION RESOURCES—TIRC utilizes a variety of information sources. On-line access is available to several computerized data systems: MEDLINE and TOXLINE, RECON, and the diversified files of commercially available data systems such as DIALOG® (Lockheed), ORBIT® (Systems Development Corporation), and BRS® (Bibliographic Retrieval Services, Inc.). The ORNL data files are searchable in batch mode and also provide SDI service.

Hard copy secondary sources used by TIRC include *Biological Abstracts, BioResearch Index, Chemical Abstracts, Current Contents, Excerpta Medica, Index Medicus, ATOMINDEX, Science Citation Index, Energy Research Abstracts, Nutrition Abstracts and Reviews, Air Pollution Abstracts*, and others. In addition, the ORNL library system provides an abundance of valuable resources with more than 250,000 bound volumes and 800,000 technical reports. Of the 4,000 subscription journals, about 1,200 are biologically or environmentally oriented.

As part of the Information Center Complex, TIRC maintains ready access to consultation and information exchange with other distinct, discipline-oriented entities which specialize in: (1) preparing evaluative multimedia monographs, state-of-the-art reviews and overviews, (2) building an interactive computerized Toxicology Data Bank, (3) constructing and maintaining computerized reference and data files on mutagens and teratogens, (4) compiling environmentally oriented data files, and (5) collecting and distributing published energy information as well as ongoing research and development data.

SEARCH REQUEST INFORMATION—Literature searches are initiated after receiving from the requester certain background information: (1) definition of the search request in detail, (2) subject, scope, time and literature coverage, languages, suggested completion date, and (3) agreement on the cost estimate of the completed search.

COST—Searches are accomplished for requesters under a fee-for-services system. The rate is $30/hour with a minimum charge of $35 for domestic search requests. Charges for search requests from foreign countries are $35/hour with a $40 minimum charge. Computer-associated charges, reproduction costs, as well as use fees for copyrighted materials, are assessed in addition to the hourly rate.

Following agreement between TIRC and the requester, a thorough literature search is conducted utilizing on-line computerized data bases and traditional library sources. Scope, time coverage, and search parameters determine the overall search cost.

Payment is collected by the National Technical Information Service in Springfield, Virginia 22161, either by direct billing or through deposit accounts.

Work for government agencies can be accomplished through interagency agreements.

SEARCH COMPLETION TIME—Response times vary from an immediate telephone answer to eight to twelve days for computerized data base searching to three to four weeks for detailed literature searches.

PERSONNEL—TIRC's professional staff members possess multidisciplinary scientific backgrounds covering chemistry, biology and medicine, pharmacology and toxicology, microbiology, bacterial physiology, information sciences, and administration. The staff specializes in bibliographic literature compilations, state-of-the-art overviews, and consultations. Scientific interaction occurs with personnel from the other information centers within the Information Center Complex as well as with the multidisciplinary Laboratory research staff.

CONTACT THE CENTER—Telephone inquiries can be made by direct dialing (615)576-1743. For those who have access to the Federal Telecommunications System (FTS), the number is 626-1743. Written requests for information or searches should be mailed to:

Toxicology Information Response Center
Oak Ridge National Laboratory
Post Office Box X, Building 2024
Oak Ridge, Tennessee 37830

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TIRC PUBLICATIONS

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Toxicology Information Response Center Literature Search Index. I. 101 to 2100. Toxicology Information Response Center Staff. 205 pages, 2,000 references, $7.50.

ORNL/TIRC-76/2*
Trichloroethylene: I. An Impact Overview. E. M. Waters, H. B. Gerstner, and J. E. Huff. II. An Abstracted Literature Collection, 1907-1976. E. M. Waters and S. A. Black. 265 pages, 1,673 references, $20.00.

ORNL/TIRC-76/3*
Kepone. I. A Literature Summary. J. E. Huff and H. B. Gerstner. II. An Abstracted Literature Collection, 1952-1977. S. A. Black. 52 pages, 175 references, $15.00.

ORNL/TIRC-76/4*
Mirex. I. An Overview. E. M. Waters. II. An Abstracted Literature Collection, 1947-1976. E. M. Waters. 98 pages, 325 references, $10.00.

ORNL/TIRC-76/5*
Toxicology Information Response Center Literature Search Index. II. 2101-2600. Toxicology Information Response Center Staff. 99 pages, 500 references, $7.50.

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Lead Analysis: Literature Collection, 1966-1976. S. A. Black and K. C. Miller. 214 pages, 1,552 references, $18.00.

ORNL/TIRC-77/1*
Selected Case Histories and Epidemiological Examples of Human Mercury Poisoning. I. State-of-the-Art Review. Herbert B. Gerstner and J. E. Huff. II. An Abstracted Literature Collection, 1947-1976. S. A. Black. 101 pages, 566 references, $20.00.

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Methoxyflurane. I. An Overview. E. M. Waters and B. E. Ricci. II. An Abstracted Literature Collection, 1947-1976. B. E. Ricci and E. M. Waters. 120 pages, 1,071 references, $22.50.

ORNL/TIRC-77/3*
Vinylidene Chloride. I. An Overview. II. A Literature Collection, 1947 to 1977. H. S. Warren and B. E. Ricci. 52 pages, 117 references, $15.00.

ORNL/TIRC-77/4*
Health Aspects of Chloroform—A Review. S. G. Winslow and H. B. Gerstner. An Abstracted Literature Collection, 1907 to 1977. S. G. Winslow. 252 pages, 1,387 references, $28.00.

ORNL/TIRC-77/5*
Asbestos: A Perspective. I. An Overview. J. E. Huff. II. An Annotated Literature Collection, 1960-1974. J. E. Huff, A. S. Hammons, C. Y. Dinger, B. W. Kline, and B. L. Whitfield. III. An Abstracted Literature Compilation, 1974-1977. S. A. Black. 214 pages, 867 references, $28.00.

ORNL/TIRC-77/6*
Toxicology Information Response Center Literature Search Index. III. 2601-3100. Toxicology Information Response Center Staff. 77 pages, 500 references, $7.50.

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Toxicology Information Response Center Literature Search Index. IV. 3101-3600. Toxicology Information Response Center Staff. 69 pages, 500 references, $9.00.

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Polychlorinated Biphenyls, Polybrominated Biphenyls, and Their Contaminants: Literature Compilation, 1965-1977. S. G. Winslow and H. B. Gerstner. 374 pages, 2,068 references, $25.00.

ORNL/TIRC-78/3*
Vinyl Chloride. A Review, 1835-1975. An Annotated Literature Collection, 1835-1975. A Literature Compilation, 1976-1977. H. S. Warren, J. E. Huff, and H. B. Gerstner. 218 pages, 1,153 references, $28.00.

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Leptophos. An Overview. A Literature Compilation, 1969-1979. E. M. Waters and Herbert B. Gerstner. 94 pages, 501 references, $17.50.

ORNL/TIRC-78/5*
Health and Environmental Effects of Toxaphene — A Literature Compilation, 1962-1978. S. A. Mashburn. 114 pages, 853 references, $17.50.

Other TIRC Publications

NLM/TIRC-80/1**
Health and Environmental Effects of Acid Rain. An Abstracted Literature Collection, 1966-1979. N. S. Dailey and S. G. Winslow. 202 pages, 961 references, $15.00.

Composition of Toxic Substances in Chemical Dumps (in preparation).

The Effects of Environmental Chemicals on the Immune System of Humans and Animals (in preparation).

*Available from the National Technical Information Service, Springfield, Virginia 22161.

**Available from the Federation of American Societies for Experimental Biology, Bethesda, Maryland 20014.