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GUIDELINES: ASBESTOS HANDLING IN THE CHLOR-ALKALI INDUSTRY

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1. INTRODUCTION

1.1 SCOPE

Increased awareness of the health hazards of asbestos, coupled with regulations promulgated by governmental agencies over the past several years, emphasize the desirability of developing guidelines for the safe handling of asbestos fiber and waste products by chlor-alkali producers.

Industry and government share concern and responsibilities to insure the health and welfare of workers and the general public that might be exposed to asbestos, especially that which is airborne and can be inhaled, by providing safeguards to protect them from hazards associated with asbestos mining, transport, fabrication, use and disposal operations.

This pamphlet is limited to considerations relative only to asbestos safe handling and disposal practices applicable to the chlor-alkali industry. Examples of satisfactory asbestos control practices, where given, are intended to be only illustrative and are not to be construed either as having universal applicability or representing the only available or suitable means of control.

1.2 DEFINITIONS

In this pamphlet the following meanings apply:

Asbestos means chrysotile, amosite, crocidolite, tremolite, anthophyllite, and actinolite and, in the case of OSHA regulations, those of such fibers that are longer than 5 micrometers. (The chrysotile variety accounts for most of all fiber used in the U.S.).

CFR means the U.S. Code of Federal Regulations.

DOL means the U.S. Department of Labor.

EPA means the U.S. Environmental Protection Agency.

INSTITUTE means The Chlorine Institute, Inc.

NIOSH means the National Institute for Occupational Safety and Health of the U.S. Department of Health, Education and Welfare.

OSHA means the Occupational Safety and Health Administration of the U.S. Department of Labor.

OSH Act means the U.S. Occupational Safety and Health Act of 1970 (P.L. 91-596).

Particulate asbestos material means finely divided particles of asbestos material.

Visible emissions means any emissions which are visually detectable without the aid of instruments and which contain particulate asbestos material.

1.3 DISCLAIMER

The information in this pamphlet is drawn from sources believed to be reliable. The Institute and its members, jointly and severally, make no guarantee, and assume no liability, in connection with any of this information. Moreover, it should not be assumed that every acceptable procedure is included, or that special circumstances may not warrant modified or additional procedures. The user should be aware that changing technology or regulations may require a change in the recommendations herein. Appropriate steps should be taken to insure that the information is current when used. These suggestions should not be confused with federal, state, provincial, municipal or insurance requirements, or with national safety codes.

1.4 APPROVAL

The Institute's Environmental Protection Committee approved the First Edition of this pamphlet on February 13, 1978.

1.5 REVISIONS

Suggestions for revisions should be directed to the Secretary of the Institute.

1.6 REPRODUCTION

The contents of this pamphlet are not to be copied for publication, in whole or in part, without prior Institute permission.

2. ASBESTOS USE IN CHLORINE MANUFACTURING

Most of the World's chlorine is produced by the electrolysis of brine in either mercury cells or diaphragm cells. In the electrolytic process, it is necessary to keep chlorine separated from the alkali metal hydroxide co-product to prevent chemical reaction. In addition, hydrogen produced with the alkali must be kept separated from the chlorine to prevent potentially violent explosions.

In mercury cells, separation is achieved by hydraulic seals which separate the chlorine and spent brine in the electrolyzer from the decomposer where the alkali metal hydroxide product and hydrogen are produced. No asbestos is involved.

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In diaphragm cells, separation is achieved by use of a diaphragm which is basically a porous mechanical barrier separating the anolyte and catholyte chambers. Brine is fed to the anolyte chamber where the chloride ion is electrolyzed to chlorine. The depleted brine and the cation percolate through the diaphragm to the cathode where hydrogen and alkali metal hydroxide are produced.

The key to successful operation of a diaphragm cell is the diaphragm material. To be suitable, it must have the following properties:

- sufficient mechanical strength;
- high chemical resistance;
- low electrical resistance;
- readily depositable on the cathode with uniform thickness and without voids;
- appropriate physical structure to permit percolation of depleted brine with minimum back-migration of hydroxyl ion; and
- acceptable service life.

These properties are of prime importance as they have a very significant effect on both capital and manufacturing costs. Asbestos is uniquely suitable as a diaphragm material, as it exhibits a most favorable combination of these properties.

Asbestos is a general term covering a group of impure, naturally occurring magnesium silicate minerals which exist in fibrous form. One of these is the mineral chrysotile which is made up of comparatively long and strong flexible fibers. It is a highly hydrated magnesium silicate of general composition, $Mg_6(OH)_8Si_4O_{10}$. Over 95% of the asbestos mined is chrysotile and it is the form used for diaphragms by the chlor-alkali industry.

A great deal of research has been done to study the behavior of asbestos in chlor-alkali cell environments to explain its unique behavior. The deposited fibers do not merely function as a deposited mat such as is found in a filter bed. The gel layer that forms in the mat under proper cell diaphragm depositing conditions plays an important role in the performance of the diaphragm, particularly in minimizing back-migration of the hydroxyl ion.

North American consumption of asbestos for chlor-alkali cells in 1978 is estimated to be in the order of 3,500 tons per year. Asbestos consumption per ton of chlorine produced has been significantly reduced over the years through advancements in cell design, improved brine purification techniques and new anode materials. Asbestos diaphragm life has been increased very significantly. The first major increase occurred with the change-over from carbon to graphite anodes. More recently the change to metal anodes has extended diaphragm life by some three to four fold compared to experience with graphite anodes. A newer development, resin bonding of the deposited asbestos fibers, is expected to increase the stability of asbestos diaphragms and further extend their life.

Asbestos is the universally accepted material for chlor-alkali cell diaphragms, and if handled properly, it can be used and disposed of safely both with respect to worker health and protection of the environment.

3. REGULATIONS

3.1 UNITED STATES

Currently in the U.S. regulations applicable to asbestos have been issued by the EPA, OSHA, DOT, Food and Drug Administration, the Consumer Product Safety Commission and the Mining Safety and Health Administration. Only the first two are of direct concern in the operation of chlor-alkali plants. States may also promulgate standards which can be more stringent than the Federal standards.

3.1.1 OSHA

The stated purpose of the OSH Act is to "assure so far as possible every working man and woman in the nation safe and healthful working conditions". OSHA's activities are the development, promulgation and enforcement of Federal safety and health standards; the development aspect is shared with NIOSH. The current OSHA asbestos standard was published in 37FR11318 (June 7, 1972) and is embodied in 29CFR1910.1001.

In summary, the standard:

- * Establishes an eight-hour time-weighted average (TWA) worker exposure limit of airborne asbestos at two(2) fibers per cc of air longer than 5 micrometers. And, as a ceiling concentration, the regulation states that no employee shall be exposed at any time to asbestos concentrations in excess of 10 fibers per cc of air longer than 5 micrometers [29CFR1910.1001(b)(2) and (3)];
- * Prescribes various methods of compliance, including engineering methods and controls such as isolation, exposure, dust collection and exhaust ventilation, and work practices including rules governing wet methods, handling of asbestos products etc. [29CFR1910.1001(c)(1) and (2)];
- * Permits for purposes of compliance the use of work shift rotation (preferred) and respirators only in certain work situations. (See §5.1). The regulations further specify the type of respirators to be used under various conditions [29CFR1910.1001(d)(1) and (2)];
- * Provides that employers shall provide and require the use of protective clothing for employees exposed to asbestos concentrations exceeding the prescribed ceiling level. [29CFR1910.1001(d)(3)].

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- *Prescribes that employers shall provide change rooms at any fixed place of employment exposed to airborne concentrations of asbestos fiber in excess of allowable exposure limits, and two separate lockers or containers for each employee to keep street clothes separate from work clothes. [29CFR1910.1001(d)(4)];
- *Provides for the labeling, transport and laundering of asbestos contaminated clothing, including off-premises laundering [29CFR1910.1001(d)(4)(iii)];
- *Establishes a method for measuring the airborne concentration of asbestos. (See §9.1) [29CFR1910.1001(e)];
- *Establishes monitoring methods and frequency relating both to the work environment and individual employees, and requires that employees or their representatives be given a reasonable opportunity to observe the monitoring and to have access to monitoring records [29CFR1910.1001(f)];
- *Prescribes rules for the posting of caution signs in areas where asbestos concentrations may exceed the allowable limits, and labels to be affixed on raw materials, mixtures, scrap, waste, debris or their containers [29CFR1910.1001(g)];
- *Establishes certain housekeeping requirements including the cleaning of the work place and asbestos waste disposal [29CFR1910.1001(h)];
- *Establishes certain recordkeeping requirements governing individual and environmental monitoring exposure records, employee access to exposure records, and employee notification of exposure to asbestos [29CFR1910.1001(i)].
- *Requires preplacement, annual, and work termination medical examinations and the maintenance of, and employee access to, medical records [29CFR1910.1001(j)].

3.1.2

EPA-Air

Emission standards on asbestos applicable specifically to the chlor-alkali industry were published by EPA in 38FR8820 (April 6, 1973) and amended 40FR8292 (October 14, 1975), as part of the Clean Air Act's §112 National Emission Standards for Hazardous Air Pollutants (NESHAP). They are embodied in 40CFR Part 61, Subpart B.

In summary, the standard:

- *Provides that there shall be no visible emissions to the outside air (i.e. air outside buildings and structures) or directly from chlorine manufacturing operations if they are conducted outside of buildings or structures [40CFR61.22(c)]; or,
- *Provides, at the owner/operator's option, use of specified methods to clean emissions containing particulate asbestos material before such emissions escape to, or are vented to, outside air [40CFR61.22(f) and 40CFR61.23];
- *Requires asbestos waste generators to insure that the waste is disposed of in a properly operated disposal site [40CFR61.22(j) and 40CFR61.25];
- *Establishes reporting requirements in connection with the handling of asbestos-containing waste materials [40CFR61.24].

3.1.3

EPA-Wastewater

PL 92-500, the Federal Water Pollution Control Act Amendments of 1972, as amended (PL 95-217), requires that industrial sources treat their effluent by applying the "best practicable control technology currently available" (BPT) by July 1, 1977. Effluent limitation guidelines establish the degree of effluent quality necessary to meet BPT limits. Though not specific for asbestos BPT total suspended solids limitations applicable both to existing and new diaphragm cell chlorine manufacturing operations are established [415.62(b)] as follows:

Daily Maximum		30-day Average Maximum	
kg/1000	lbs/1000	kg/1000	lbs/1000
kgCl ₂	lbsCl ₂	kgCl ₂	lbsCl ₂
0.64	0.64	0.32	0.32

3.1.4

EPA-Hazardous Wastes

Regulations pursuant to Subtitle C of PL 94-580, the Resource Conservation and Recovery Act of 1976, have not yet been promulgated. Such regulations as do currently apply to the handling of asbestos-contaminated wastes are embodied in the NESHAP regulations discussed in §3.1.2.

3.1.5

DOT-Hazardous Materials

Regulations relative to commercial asbestos shipments were published by DOT in 43FR56664 (December 4, 1978). They are embodied in 49CFR, Parts 172 thru 177; see § 9.2.1.

3.2

CANADA

Canada is the Western world's largest producer of asbestos and supplies about 35 per cent of the global production. As is the case for U.S., both Federal and Provincial regulations are applicable.

3.2.1

Workplace

No Federal regulations have thus far been promulgated. At the provincial level, the Quebec Draft Regulations dated February 1975 propose to reduce the present allowable level from 12 fibers/cc (all forms > 5 micrometers) to 5 fibers/cc. The workplace standard for the province of Ontario, however, is 2 fibers/cc.

3.2.2

Air

Federal Clean Air Act regulations for asbestos promulgated July 13, 1977 require that air emitted to the atmosphere from crushing, drying and milling operations and dry rock storage shall not contain more than 2 fibers/cc of air (fibers being > 5 micrometers in length and having a length to width ratio of > 3).

3.2.3

Water

No Federal asbestos regulations have yet been promulgated but they are in process of development. At the Provincial level, it has been established with the Quebec Ministry of Environment that "Asbestos sludge must be prevented from entering the water course and can only be removed from the site after consultation with an Environmental Official".

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4. CONTROL PROCEDURES

4.1 GENERAL

This pamphlet is limited to considerations relative only to asbestos safe handling and disposal practices applicable to the chlor-alkali industry. Examples of satisfactory asbestos control practices, where given, are intended to be only illustrative and are not to be construed either as having universal applicability or representing the only available or suitable means of control.

4.2 PURCHASING

While the handling of asbestos is presumed to start when a box car or truck is received at the plant, there are some earlier opportunities for minimizing later handling problems such as at the time of issuance of purchase orders. See §9.2.1.

It is recommended that purchase orders be written to the vendor which includes two items, namely: (1) palletizing of the asbestos bags in the rail car or truck, and (2) provision for a shrink-wrapped coating of Visqueen or other non-porous material covering the palletized bags. This procedure is especially effective in preventing torn bags and minimizing the threat of loose material during unloading. In addition, the palletized, shrink-wrapped packaging procedure allows ease of movement to the confinement areas.

In plants that do not have forklift unloading, it is suggested that asbestos shipments have sufficient dunnage included to prevent movement and damage to the bags during transport.

4.3 RECEIVING

Where asbestos is received in palletized form, whether by rail car or truck, the contents should be carefully inspected before the unloading operation begins. If broken bags or loose asbestos are in evidence at the time, a heavy duty vacuum cleaner should be used before the major work crew is called for the unloading operation. A heavy duty bag vacuum cleaner closely approximates the blower/bag system recommended by EPA for emission control. Broken bags should be enclosed in a heavy duty plastic bag before the vacuum clean up is started. That person charged with the initial inspection of the shipment should be equipped with an approved dust mask (§5.3) as well as wear suitable protective clothing (§5.4). If unsafe conditions exist all other individuals should be kept away from the area until such time as the condition is corrected.

When transporting palletized asbestos to storage, care should be taken to prevent puncturing the bags with the forks of the truck or damage by running into corners or loose objects. The plastic-wrapped pallet cover makes it possible to unload even during inclement weather, if desired. The operator of the fork truck should have available a dust mask and wear appropriate protective clothing if the situation warrants. An effort should be made to keep to a minimum the number of employees used for the unloading operation, while at the same time avoiding any safety risks. Contract labor used by the plant must be protected in the same manner as a permanent employee. Workable agreements between the company and the contractor, preferably in writing, should be clearly understood and adhered to at all times.

4.4 STORAGE

An important aspect of the total asbestos handling program is an appropriate storage area. All plants require an inventory of asbestos on hand for normal operations, and careful thought should be given to the storage area design.

Ideally the asbestos storage area should have no direct interconnection with the primary work area of the cell renewal operation. The entry should be sufficiently large to permit easy access of the forklift into the storage compound. The entry door should be equipped with a rubber gasket on the sealing lip to provide for a reasonably tight system. The ceiling should be as low as possible to limit unused space and at the same time provide the clearance height needed for pallet stacking. The approach to the storage area must be appropriately marked with a caution sign stipulated by OSHA regulations (29CFR19.1001(g)).

When an access way exists between the asbestos storage area and the major work area of a cell renewal operation it should have a well-fitted door with good weather stripping. The door should remain closed at all times and should be marked with an OSHA-approved caution sign. In such cases it is recommended that the storage area be maintained under a slight negative pressure.

Another means of storage is the "assigned" railroad car, if trackage is available near the operation area. This method not only insures improved condition of asbestos shipments but also decreases the amount of handling and the potential for spillage. The rail car must be properly marked with warning signs.

A first-in, first-out inventory system is recommended and, thus, if possible, the storage area should be designed and appropriately sized to accommodate this type of inventory control. The logic of a first-in first-out inventory control is simply that this control reduces problems associated with long term storage of asbestos bags.

The asbestos storage area should be kept clean and free of loose asbestos fiber. This can best be accomplished with a common sense approach to housekeeping. Wooden pallets should not be allowed to accumulate in the storage area. Any area or surface showing signs of asbestos, whether on floors, walls, or pallets, should be vacuumed using an appropriate industrial-type vacuum cleaner. The disposal of the vacuum cleaner bag must be handled in an environmentally sound manner such as by enclosing it in a labeled, heavy plastic type bag or other impervious

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container that will be sent to an approved asbestos landfill site. Alternatively, the area may be washed into a waste asbestos collection system or the asbestos wetted down and picked up.

It is suggested that a periodic inspection of the storage area be made by a supervisor and that immediate action be taken to prevent or reduce the possibility of airborne asbestos fiber.

4.5

USING-DIAPHRAGM DEPOSITING

A potential exposure to asbestos in chlor-alkali operations occurs when it is being prepared for use in making diaphragms.

When handling industrial bags from storage to point of use, care should be taken to be sure that the bag is not split or open. A supply of large heavy duty plastic bags should be available for containing any broken bags before movement is allowed to take place. Those employees working in direct contact with asbestos should wear an approved dust mask and appropriate protective clothing.

Bags of asbestos to be added to the diaphragm bath should be moved carefully to prevent or minimize any dust emission that may arise. Bags should never be thrown or dropped as this will result in asbestos contamination of the air.

There are a variety of safe ways of handling dry asbestos in preparing for diaphragm depositing operations. Regardless of the approach used, it is imperative that emissions of dry asbestos in the worker breathing zone or to the ambient air be controlled to within regulatory limitations. The mere weighing and dumping of asbestos into a depositing bath without benefit of a vacuum venting system to contain and trap asbestos dust should be avoided. As a minimum, asbestos bag cutting, emptying, sorting, weighing and slurry preparation should be performed under a vented hood; see Figure 1. A more sophisticated approach would be to perform such operations in a tightly sealed, vented enclosure into which the operator inserts his hands in gloves fastened to the inside of the enclosure.

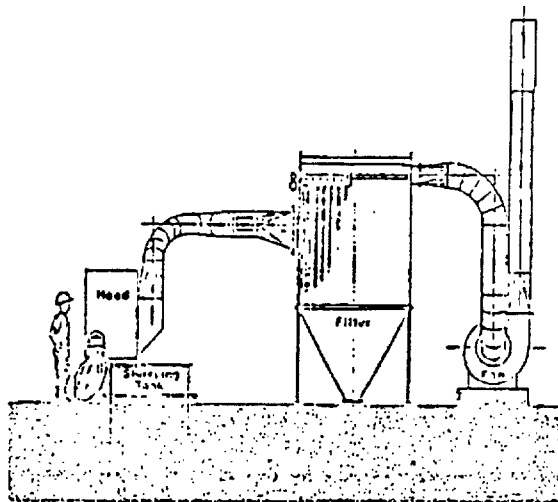


FIGURE 1. ASBESTOS DUST COLLECTOR

Written detailed operating procedures should be available to workers and it should be determined they are being followed. These should include information as to the types of protective clothing and masks to be worn, including their ultimate disposal; checking of vacuum and exhaust system; details of slurry make-up operations; shut-down and housekeeping procedures etc.

4.5.1

Sorting and Weighing

Greatest care should be exercised in opening asbestos bags, especially if not done within a sealed system. A suggested technique is to use a heated knife to cut the bags. Bags should be fully slit, always under a vacuum vent system, and carefully folded over to allow emptying of the bag with a minimum disturbance of the contents. Bags should never be shaken. Any necessary dumping of asbestos similarly should be done cautiously to minimize dust release.

Empty bags should be carefully folded with slit area inside, again within the sealed or vacuum vent system. Within that system they should be deposited in a lidded, labeled container reserved for the purpose or placed in a labeled, plastic bag that is tied or otherwise fastened shut.

When only partial contents of a bag is required, the bag should be resealed effectively, such as with wide duct tape, to contain the remaining asbestos.

Weighing of asbestos should be done, again within a sealed or vacuum vent system, in such a manner as to minimize dust release. The same applies to preparation of the asbestos slurry. Containers of weighed asbestos must have a lid in place as soon as the proper weight is obtained.

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- 4.5.2 Protective Equipment
Workers involved in asbestos bag transfer and slitting, sorting, weighing, and slurry-preparation operations should wear an approved mask or respirator as well as suitable protective clothing.
- 4.5.3 Housekeeping
Upon completion of operations any asbestos fibers should be removed, such as by a vacuum hose. The work area should then be carefully flushed down with water; hitting dried asbestos with high/medium pressure water might cause some of it to become airborne.
- 4.5.4 Personal Hygiene
Used dust masks, gloves, and other protective clothing should be removed and placed in the labeled receptacle(s) set aside for the purpose, and the receptacle then should be closed or otherwise fastened. Non-disposable protective clothing should be inspected and any fibers vacuum-removed; clothing should not be air blown, shaken or brushed for this purpose. Workers should wash hands and face before leaving asbestos-contaminated areas.
- 4.6 SPENT ASBESTOS
- 4.6.1 Wash Area
Asbestos diaphragms need be removed and replaced at some frequency depending on cell type, brine quality, and other variables.

The wash area should be constructed with a smooth surface to prevent asbestos from adhering and drying, and from becoming a possible source of airborne asbestos. The area should also contain a trench system for receiving and carrying away the asbestos to a sump or pit. If possible, some sort of minimum sloping of the concrete floor should be used to facilitate drainage. The collection trench should be covered with removable type grating to allow for ease of clean-up.

After use of the wash area and at the end of each work day, all areas should be carefully flushed to remove all traces of asbestos. If water use is a problem the area can be initially cleaned using a large rubber squeegee; final wash down then can be accomplished with a minimum quantity of water.
- 4.6.2 Disposal
As is the case with diaphragm depositing operations, there are several alternate ways of safely disposing of spent asbestos. Separation of spent asbestos from the diaphragm water wash generally is accomplished by approved pond settling or by filtering, such as in plate and frame filters. The system chosen will depend largely on the availability of space and its optimum utilization.

Ponding and settling of asbestos-containing cell renewal wastes can be facilitated by the addition of a polyelectrolyte flocculant. Pond size will, of course, depend on the volume of waste to be handled, climatic conditions, etc. Ponds will require occasional clean-out of settled materials; this can be accomplished by a carefully-planned clam shell bucket transfer operation with the solids being emptied into covered, water-tight trucks for transfer to an approved landfill disposal site.

Conventional plate and frame filters effectively remove asbestos particles* and require regular maintenance. Filtered asbestos should be deposited into a suitable water-tight, covered container, for eventual transfer to an approved landfill disposal site. Such containers should be kept wetted to prevent any airborne asbestos and must bear the required OSHA caution label.
- 4.6.3 Water Re-Use
If water reuse from a diaphragm renewal operation is contemplated, some treatment prior to use may be necessary.
- 4.6.4 Landfills
Landfills into which asbestos wastes are deposited, whether on or off-premises, are strictly controlled by EPA [40CFR61.25], as are reports pertaining to same [40CFR61.24]. Transportation of wastes to contract disposal sites must be accomplished in accord with any applicable regulations.

5. EMPLOYEE PROTECTION

5.1 GENERAL

Asbestos can cause serious health problems unless it is properly used and handled. Excessive exposure to asbestos dust can cause human disease, specifically pulmonary fibrosis, carcinoma and pleural mesothelioma. The qualification of the health risk associated with specific airborne concentrations, fiber dimensions, and the chemical composition of the fibers, however, is inexact. In addition the problem of estimating the magnitude of the risk is complicated by the 20- to 40-year latency period between the onset of exposure and the appearance of disease. Consequently, human exposure must be reduced to within allowable exposure levels.

Regulations require that engineering controls, such as, but not limited to, isolation, enclosure, exhaust ventilation, and dust collection, be employed to meet the limiting TWA and ceiling level exposure concentrations [29CFR1910.1001(c)]. They also require, insofar as practicable, that asbestos be handled, mixed, applied, removed etc. in a wet state sufficient to prevent the emission of airborne fibers in excess of the limiting worker exposure concentrations. Compliance

* While filters are effective for asbestos particles or bundles, it has been suggested that they are not effective on small fibrils.

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may not be achieved by the use of respirators or shift rotations except in those work situations where (a) prescribed engineering control methods and/or work practices are technically not feasible or feasible to an extent insufficient to reduce the airborne concentrations of asbestos fibers below permissible TWA and ceiling concentrations, and (b) during emergencies; in those instances, and where both respirators and personnel rotation are practicable, personnel rotation shall be preferred and used [29CFR1910.1001(d)].

5.2 CAUTION SIGNS AND LABELS

Caution signs must be provided and displayed at each location where airborne concentrations of asbestos may exceed limiting worker exposure concentrations [29CFR1910.1001(g)(1)] and at and around asbestos waste disposal sites [40CFR61.22(i)]. The signs must be of such dimensions and posted in such a manner that a person may easily read them and take necessary precautions and protective measures before entering the area marked [29CFR1910.1001(g)(1)] and [40CFR61.22(i)(2)]. It is recommended that caution signs be posted wherever asbestos is handled or used.

Caution labels must be affixed to all raw materials, mixtures, scraps, waste, debris etc., containing unbonded asbestos, or to their containers [29CFR1910.1001(g)(2)], including sealed, leak-tight containers of asbestos-containing wastes (e.g. empty bags, dust masks, disposable clothing, sludges etc.) destined for ultimate disposal at approved landfill sites [40CFR61.22(j)].

5.3 RESPIRATORS

Where use of respirators are permitted they must be selected from those approved by either the U.S. Bureau of Mines or MIOSH/Mining Enforcement and Safety Administration [29CFR1910.1001(d)(2)] (See Ref. §8.1.1) or other appropriate approving authority.

OSHA General Industry Standards on Respiratory Protection [29CFR1910.1001.134] require that a respiratory protective program be established by the employer and that the respiratory protective equipment used be effective. (See also 29CFR1910.1001(c)(2)).

It is recommended that employees wear an approved dust respirator whenever there exists a good possibility of exposure in excess of allowable standards. This is especially applicable when performing maintenance work on dust collector components.

5.4 PROTECTIVE CLOTHING

Regulations require that workers exposed to asbestos in excess of the allowable ceiling concentration of 10 fibers/cc wear protective clothing such as overalls or similar whole body clothing, head coverings, gloves and foot coverings; such clothing must be employer-provided [29CFR1910.1001(d)(3)]. It is recommended that protective clothing contain no pockets or side openings.

Employers also are obligated to provide change rooms for workers in situations where workers may be exposed to asbestos fiber in excess of the allowable TWA and ceiling concentrations, and two separate lockers or other containers for each worker so separated or isolated as to prevent contamination of the worker's street clothes from his work clothes [29CFR1910.1001(d)(4)].

Many employers prefer to provide disposable-type overalls although reusable ones are permitted. In the latter case, anti-static, cotton polyester fabric of fine weave has proven highly satisfactory. Laundering, whether on or off premises, should be done in such a way as to prevent airborne contamination in excess of allowable limits. Where contract laundering exists, it is incumbent on the employer to inform the launderer (preferably in writing) of this obligation [29CFR1910.1001(d)(4)]; it is also recommended that the operation be inspected on a periodic basis.

Soiled protective clothing, whether of the reusable or disposable type, should be placed in sealed, impermeable bags or other closed, impermeable containers which must bear the required caution label [29CFR1910.1001(d)(4)(iii)]; [40CFR61.22(j)]. Use of water-soluble laundry bags, if available, would minimize exposure potential in handling operations.

It is recommended that protective clothing be issued and collected on a daily basis.

Soiled disposable type protective clothing should be considered to be contaminated with asbestos and, therefore, disposal must be in accord with EPA regulations [40CFR61.22]. Reusable clothing should be vacuum-cleaned prior to placing in containers for laundering; they should not be shaken, brushed, or air blown.

5.5 HOUSEKEEPING

All external surfaces in any place of employment must be maintained free of accumulations of asbestos fiber. If with their dispersion, there would be an excessive concentration [29CFR1910.1001(h)]. This can be accomplished with the use of a controlled central vacuum system or disposable-bag vacuum cleaner designed so that there is no discharge of asbestos from the filter.

6. MONITORING

Prescribed monitoring involves both industrial hygiene sampling and medical surveillance programs.

6.1 HYGIENE MONITORING

Both personal and environmental monitoring are prescribed. The sampling frequency and patterns must be such as to represent with reasonable accuracy the worker's exposure levels. For workers whose exposure to asbestos may reasonably be foreseen to exceed the limiting TWA and ceiling concentrations, the intervals must not exceed six months [29CFR1910.1001(f)]. Workers or their representatives must be given opportunity to observe any required monitoring, as well as access to results of same.

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6.1.1 Personal Monitoring

Samples for determination of both TWA and ceiling asbestos concentrations must be taken within the worker's breathing zone; See Figure 2.

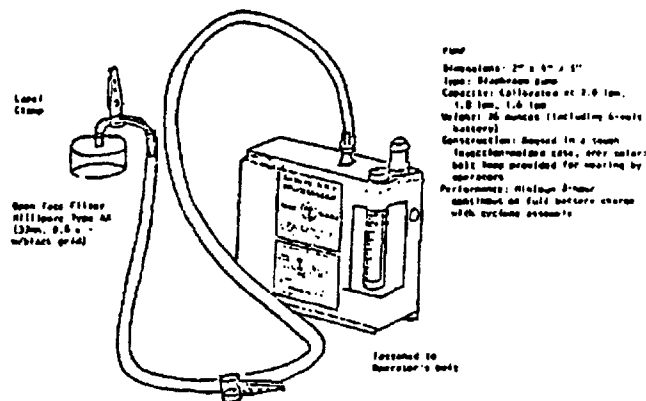


FIGURE 2. ASBESTOS SAMPLER

6.1.2 Environmental Monitoring

Samples must be collected from areas of a work environment that are representative of airborne concentrations of asbestos which may reach workers breathing zones.

6.1.3 Records

Environmental and personal monitoring records required by OSHA regulations must be maintained for a minimum of 20 years and, upon request, must be made available to OSHA and NIOSH authorities and their authorized representatives [29CFR1910.1001(1)].

6.1.4 Employee Access and Notification

Present and past employees are guaranteed right of access to hygiene monitoring records pertaining to their individual asbestos exposure. Employees exposed to asbestos in excess of limiting TWA and ceiling concentrations must be notified within five days of the finding and of corrective action being taken [29CFR1910.1001(1)(2) and (3)]. It is recommended that records be kept of any such notifications.

6.2 MEDICAL SURVEILLANCE

OSHA regulations [29CFR1910.1001(j)(3)] provide for medical surveillance of workers "engaged in any occupations exposed to airborne concentrations of asbestos fibers." Required medical examinations must be provided, or made available, by the employer.⁴

6.2.1 Pre-Placement

A comprehensive medical examination is required within 30 days of a worker's assignment to an occupation involving exposure to airborne asbestos. As a minimum the examination shall include:

- *Chest roentgenogram (Posterior-Anterior, 14" x 17")
- *History, to elicit symptomatology of respiratory disease
- *Pulmonary function tests, including forced vital capacity (FVC) and forced expiratory volume at 1 second (FEV_{1.0})

In addition, it is recommended that a complete smoking history should be recorded, including average daily consumption. The examining physician shall make a determination of the ability of the worker to effectively wear a respirator.

6.2.2 Periodic

Regulations require that employer's provide or make available a comprehensive medical examination at least annually and including, as a minimum, those elements listed in §6.2.1.

6.2.3 Termination

Regulations require that employers provide or make available a comprehensive medical examination within 30 days before or after termination of employment including, as a minimum, those elements listed in §6.2.1.

6.2.4 Record Retention

Employers are obligated to maintain all medical records for a minimum of 20 years.

⁴ An administrative interpretation is provided in OSHA Program Directive #300-16 (10/11/78); the term "exposed to airborne concentrations of asbestos fiber" is interpreted to mean "exposed to a minimum of 0.1 asbestos fibers larger than 5 micrometers per cubic centimeter of air." Also, that medical examinations are required for any 7 to 8-hour time-weighted average concentration of 0.1 f/cc, or for a greater concentration.

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6.2.5

Employee Access

Contents of records of required medical examinations must be made available for inspection and copying [29CFR 1910.1001 (j)] to:

- *The Assistant Secretary of Labor for OSHA and/or to his authorized physician and medical consultants;
- *The Director of NIOSH and/or to his authorized physician and medical consultants;
- *Upon request of an employee or former employee, his physician.

7. EMPLOYEE TRAINING

The effectiveness of a program for the safe handling of asbestos depends in large measure upon the manner it is implemented by workers. Management has a responsibility not only to provide a safe workplace but, through detailed work practices and adequate protective equipment, the means by which employees can protect themselves in the event of excessive airborne asbestos emissions. Inherent and fundamental to the success of the program is the need to provide regular worker training in the handling of routine job assignments.

7.1

OPERATING PROCEDURES

It is recommended that workers having a potential for exposure to airborne asbestos have available to them, and follow, written operating instructions specific to their job assignment. Management should determine that these instructions are being applied.

Preparatory to being assigned to a job having a potential for exposure to airborne asbestos, workers should be apprised of all hazards, and proper conditions and precautions concerning asbestos use or exposure, including personal hygiene and housekeeping practices. OOL OSHA Form 20 "Material Safety Data Sheet," or the equivalent, should be kept on file and readily accessible to workers; See Exhibit No. 1. Review of the contents of MSDS's is a valuable tool for worker orientation and periodic training exercises. Other valuable sources are indicated in §8.4.

7.1.1

Respirators

Employers are obligated to have written standard operating procedures governing the selection and use of respirators [29CFR 1910.134(b) (3) and (e)(5)]. The employer respirator training program must include, as a minimum:

- *The nature of respiratory hazards in the workplace and how to select respirators
- *Use of respirators and proper fitting
- *Capabilities and limitations of respirators
- *Cleaning, disinfection, inspection, maintenance and storage of respirators

Dates of training and subject matter presented should be retained by employers.

7.1.2

Protective Clothing

Operating Procedures should incorporate information on the selection, use, care and disposal of protective clothing.

7.1.3

Personal Hygiene

High standards of personal hygiene should be established and maintained. Workers should be prevented from eating in areas where asbestos is stored, processed, used or disposed. They should be instructed to wash hands and face before eating.

7.1.4

Smoking

Employees should be made aware that it has been established that cigarette smoking greatly increases the risk of developing lung cancer in persons exposed to asbestos. On the other hand, asbestos workers who do not smoke cigarettes, and who never have smoked regularly, have shown no greater frequency of lung cancer than the average person who does not smoke. In any event, smoking should be permitted in assigned areas only.

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8. REFERENCES

- 8.1 DHEW (U.S.)
- 8.1.1 "Certified Respirator Equipment" (12/15/75) and "Cumulative Supplement" (6/77) and/or later issues. Available from DHEW, NIOSH, Morgantown, . 26505
- 8.1.2 "Criteria for a Recommended Standard: Occupational Exposure to Asbestos," Report HSM72-10267 (1972). Available from U.S. Government Printing Office, Washington, D.C. 20402
- 8.1.3 "NIOSH Manual of Sampling Data Sheets - 1977 Edition", Available from DHEW, Center for Disease Control, Cincinnati, OH 45226
- 8.1.4 "NIOSH Revised Recommended Asbestos Standard," DHEW Publication 77-169 (December 1976). Available from U.S. Government Printing Office, Washington, D.C. 20402
- 8.1.5 "Membrane Filter Method for Evaluating Airborne Asbestos Fibers," NIOSH Publication TR84 (1976). Available from the U.S. Government Printing Office, Washington, D.C. 20402
- 8.2 EPA (U.S.)
- 8.2.1 "Electron Microscope Measurement of Airborne Asbestos Concentrations, A Provisional Methodology Manual," EPA Report 600/2-77-178 (June, 1978). Available from EPA Office of Research and Development, Research Triangle Park, NC 27711.
- 8.2.2 "Evaluating and Optimizing Electron Microscope Methods for Characterizing Airborne Asbestos," EPA Report 600/2-78-038 (June, 1978)." Available from EPA Office of Research and Development, Research Triangle Park, NC 27711.
- 8.2.3 "Preparation of Water Samples for Asbestos Fiber Counting by Electron Microscopy," EPA Report 600/4-78-011 (January, 1978). Available from EPA Office of Research and Development, Athens, GA 30601.
- 8.3 MISCELLANEOUS
- 8.3.1 "Measurement of Asbestos Exposure," J. Occupational Medicine 10:1, 21 (January 1968).
- 8.3.2 "Asbestos: An Information Resource," DHEW Publication (NIH) 78-1681 (May 1978). Available from office of Cancer Communications, National Cancer Institute, Bethesda, MD 20014
- 8.4 OTHER INFORMATION SOURCES
- 8.4.1 Asbestos Information Association, 1745 Jefferson Davis Highway, Crystal Square 4, Arlington, VA 22202
- 8.4.2 Johns Manville Corporation, Environmental Affairs Department, P O Box 5108, Denver, CO 80217

9. APPENDICES

- 9.1 ANALYTICAL METHODS
- 9.1.1 EPA Method for Asbestos in Water
- 9.1.2 NIOSH Sampling Data Sheet #2.02 (Sept. 4, 1975)
- 9.2 REGULATIONS
- 9.2.1 DOT : 49 CFR Parts 172 - 177
- 9.2.2 EPA : 40 CFR Part 61
- 9.2.3 DOL-OSHA : 29 CFR 1910.1001

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