

OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR CELLULOSE

INTRODUCTION

This guideline summarizes pertinent information about cellulose for workers and employers as well as for physicians, industrial hygienists, and other occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs. Recommendations may be superseded by new developments in these fields; readers are therefore advised to regard these recommendations as general guidelines and to determine periodically whether new information is available.

SUBSTANCE IDENTIFICATION

• Formula



• Synonyms

Abicel; β -Amylose; Avicel; α -Cellulose; Cellex MX; Arbocel; Cupricellulose; Cellulose 248; Hydroxycellulose; Pyrocellulose; Sulfite cellulose

• Identifiers

1. CAS No.: 9004-34-6
2. RTECS No.: FI5691460
3. DOT UN: None
4. DOT label: None

• Appearance and odor

Cellulose is the principal fiber cell wall material of green terrestrial and marine plants; it is the most abundant polysaccharide produced in nature. Cellulose is a white substance that is odorless and tasteless. Natural cellulose exists both in microcrystalline and nonfibrous forms.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 300,000 to greater than 1,000,000 depending on the degree of polymerization of the particular cellulose
2. Boiling point: Not applicable
3. Specific gravity (water = 1): 1.27 to 1.61
4. Vapor density: Not applicable
5. Melting point: 260° to 270°C (500° to 518°F) (decomposes)
6. Vapor pressure: Not applicable
7. Solubility: Insoluble in water and organic solvents; dissolved by concentrated zinc chloride solutions, by ammoniacal copper hydroxide solutions, and by caustic alkali with carbon disulfide
8. Evaporation rate: Not applicable

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health
Education and Information Division

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

Reactivity

1. Conditions contributing to instability: Heat or moisture
2. Incompatibilities: Contact of cellulose with water, bromine pentafluoride, sodium nitrate, or fluorine may cause fires and violent explosions.
3. Hazardous decomposition products: Toxic gases and particulates (such as carbon monoxide and carbon dioxide) may be released in a fire involving cellulose.
4. Special precautions: None reported

Flammability

The National Fire Protection Association has not assigned a flammability rating to cellulose; however, cellulose is combustible and may be flammable under certain conditions.

1. Flash point: Data not available
2. Autoignition temperature: Data not available
3. Flammable limits in air: Data not available
4. Extinguishant: Use water to fight fires involving cellulose.

Fires involving cellulose should be fought upwind from the maximum distance possible. Isolate the hazard area and deny access to unnecessary personnel. Firefighters should wear a full set of protective clothing and self-contained breathing apparatus when fighting fires involving cellulose.

EXPOSURE LIMITS

OSHA PEL

The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for cellulose is 15 mg/m³ (total dust) and 5 mg/m³ (respirable fraction) as 8-hr time weighted average (TWA) concentrations [29 CFR 1910.1000, Table Z-1].

NIOSH REL

The National Institute for Occupational Safety and Health (NIOSH) has established a recommended exposure limit (REL) of 10 mg/m³ (total dust) and 5 mg/m³

(respirable fraction) as TWAs for up to a 10-hr workday and a 40-hr workweek [NIOSH 1992].

ACGIH TLV

The American Conference of Governmental Industrial Hygienists (ACGIH) has assigned cellulose (total dust) a threshold limit value (TLV) of 10 mg/m³ as a TWA for a normal 8-hr workday and a 40-hr workweek [ACGIH 1993].

Rationale for limits

The OSHA and ACGIH limits are based on the risk of local irritant effects associated with exposure to cellulose.

HEALTH HAZARD INFORMATION

Routes of exposure

Exposure to cellulose can occur through inhalation and eye or skin contact.

Summary of toxicology

1. *Effects on Animals:* There are no acute or chronic toxicity studies in animals for cellulose.
2. *Effects on Humans:* Like all dusts, cellulose dust produces mechanical irritation of the eyes, skin, or mucous membranes if it contacts these tissues in excessive amounts; there are no reports of other exposure-related effects of cellulose in humans.

Signs and symptoms of exposure

1. *Acute exposure:* No signs or symptoms of acute exposure to cellulose, other than those of local irritation, have been reported.
2. *Chronic exposure:* No signs or symptoms of chronic exposure to cellulose have been reported.

Emergency procedures

WARNING

Seek immediate medical attention for severely affected victims or for victims with signs and symptoms of irritation!

Keep unconscious victims warm and on their sides to avoid choking if vomiting occurs. Initiate the following emergency procedures:

1. *Eye exposure:* Irritation may result. **Immediately and thoroughly** flush the eyes with large amounts of water, occasionally lifting the upper and lower eyelids.
2. *Skin exposure:* Irritation may result. **Immediately and thoroughly** wash contaminated skin with soap and water.
3. *Inhalation exposure:* Move the victim to fresh air **immediately**. Have the victim blow his or her nose, or use a soft tissue to remove particulates or residues from the nostrils.

If the victim is not breathing, clean any chemical contamination from the victim's lips and perform cardiopulmonary resuscitation (CPR); if breathing is difficult, give oxygen.

4. *Ingestion exposure:* Seek medical attention and take the following steps if a large amount of cellulose is ingested:
 - Have the victim rinse the contaminated mouth cavity several times with a fluid such as water.
 - Have the victim drink a fluid such as water.
5. *Rescue:* Remove an incapacitated worker from further exposure and implement appropriate emergency procedures (e.g., those listed on the material safety data sheet required by OSHA's hazard communication standard [29 CFR 1910.1200]. All workers should be familiar with emergency procedures and the location and proper use of emergency equipment.

EXPOSURE SOURCES AND CONTROL METHODS

The following operations may involve cellulose and may result in worker exposures to this substance:

- Manufacture of paper, fillers, cellophane, and rayon in the textile and paper industries
- Production of chemical derivatives such as certain explosives

—Use as a source of ethanol (enzymatic hydrolysis) and methanol (destructive distillation of wood)

—Use in the food industry to produce stabilizers, thickeners, and texturizers and in fillings and meringue

—Generated during wood processing and logging

The following methods are effective in controlling worker exposures to cellulose, depending on the feasibility of implementation:

—Process enclosure

—Local exhaust ventilation

—General dilution ventilation

—Personal protective equipment

Good sources of information about control methods are as follows:

1. ACGIH [1992]. Industrial ventilation—a manual of recommended practice. 21st ed. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
2. Burton DJ [1986]. Industrial ventilation—a self study companion. Cincinnati, OH: American Conference of Governmental Industrial Hygienists.
3. Alden JL, Kane JM [1982]. Design of industrial ventilation systems. New York, NY: Industrial Press, Inc.
4. Wadden RA, Scheff PA [1987]. Engineering design for control of workplace hazards. New York, NY: McGraw-Hill.
5. Plog BA [1988]. Fundamentals of industrial hygiene. Chicago, IL: National Safety Council.

MEDICAL MONITORING

Workers who may be exposed to chemical hazards should be monitored in a systematic program of medical surveillance that is intended to prevent occupational injury and disease. The program should include education of employers and workers about work-related hazards, early detection of adverse health effects, and referral of workers for diagnosis and treatment. The occurrence of disease or

other work-related adverse health effects should prompt immediate evaluation of primary preventive measures (e.g., industrial hygiene monitoring, engineering controls, and personal protective equipment). A medical monitoring program is intended to supplement, not replace, such measures. To place workers effectively and to detect and control work-related health effects, medical evaluations should be performed (1) before job placement, (2) periodically during the term of employment, and (3) at the time of job transfer or termination.

- **Preplacement medical evaluation**

Before a worker is placed in a job with a potential for exposure to cellulose, a licensed health care professional should evaluate and document the worker's baseline health status with thorough medical, environmental, and occupational histories, a physical examination, and physiologic and laboratory tests appropriate for the anticipated occupational risks. These should concentrate on the function and integrity of the eyes and skin.

A preplacement medical evaluation is recommended to detect and assess medical conditions that may be aggravated or may result in increased risk when a worker is exposed to cellulose at or below the prescribed exposure limit. The licensed health care professional should consider the probable frequency, intensity, and duration of exposure as well as the nature and degree of any applicable medical condition. Such conditions (which should not be regarded as absolute contraindications to job placement) include a history and other findings consistent with diseases of the eyes or skin.

- **Periodic medical examinations and biological monitoring**

Occupational health interviews and physical examinations should be performed at regular intervals during the employment period, as mandated by any applicable Federal, State, or local standard. Where no standard exists and the hazard is minimal, evaluations should be conducted every 3 to 5 years or as frequently as recommended by an experienced occupational health physician. Additional examinations may be necessary if a worker develops symptoms attributable to cellulose exposure. The interviews, examinations, and medical screening tests should focus on identifying the adverse effects of cellulose on the eyes and skin. Current health status should be compared with the baseline health status of the individual worker or with expected values for a suitable reference population.

Biological monitoring involves sampling and analyzing body tissues or fluids to provide an index of exposure to a toxic substance or metabolite. No biological monitoring test acceptable for routine use has yet been developed for cellulose.

- **Medical examinations recommended at the time of job transfer or termination**

The medical, environmental, and occupational history interviews, the physical examination, and selected physiologic or laboratory tests that were conducted at the time of job placement should be repeated at the time of job transfer or termination. Any changes in the worker's health status should be compared with those expected for a suitable reference population.

WORKPLACE MONITORING AND MEASUREMENT

A worker's exposure to airborne cellulose (total dust) is determined by using a tared, low-ash polyvinyl chloride (LAPVC) filter (5 microns). Samples are collected at a maximum flow rate of 2.0 liters/min until a maximum air volume of 960 liters is collected. Analysis is conducted by the gravimetric (weighing) method. This method has a sampling and analytical error of 0.10 and is described in the OSHA Computerized Information System [OSHA 1989], the *OSHA Chemical Information Manual* [OSHA 1987], and in NIOSH Method No. 0500 in the *NIOSH Manual of Analytical Methods* [NIOSH 1984].

A worker's exposure to airborne cellulose (respirable fraction) is determined by using a tared, low-ash polyvinyl chloride (LAPVC) filter (5 microns) preceded by a 10-mm nylon cyclone. Samples are collected at a maximum flow rate of 1.7 liter/min until a maximum air volume of 816 liters is collected. Analysis is conducted by the gravimetric (weighing) method. This method has a sampling and analytical error of 0.10 and is described in the OSHA Computerized Information System, the *OSHA Chemical Information Manual*, and in NIOSH Method No. 0600 in the *NIOSH Manual of Analytical Methods* [NIOSH 1984].

PERSONAL HYGIENE

If a large amount of cellulose dust collects on the skin, workers should wash the affected areas with soap and water.

Clothing excessively contaminated with cellulose should be removed to avoid local irritation of the skin.

A worker who handles cellulose should thoroughly wash hands, forearms, and face with soap and water before eating, using tobacco products, using toilet facilities, or applying cosmetics.

Workers should not eat, drink, use tobacco products, or apply cosmetics in areas where cellulose is handled, processed, or stored.

STORAGE

Cellulose should be stored in a cool, dry, well-ventilated area in tightly sealed containers. Containers of cellulose should be protected from physical damage and should be stored separately from heat, sparks, and open flame.

SPILLS

In the event of a spill involving cellulose, the following steps should be undertaken: use a clean shovel and place the material into a clean, dry container.

SPECIAL REQUIREMENTS

U.S. Environmental Protection Agency (EPA) requirements for emergency planning, reportable quantities of hazardous releases, community right-to-know, and hazardous waste management may change over time. Users are therefore advised to determine periodically whether new information is available.

- **Emergency planning requirements**

Cellulose is not subject to EPA emergency planning requirements under the Superfund Amendments and Reauthorization Act (SARA) [42 USC 11022].

- **Reportable quantity requirements for hazardous releases**

Employers are not required by the emergency release notification provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) [40 CFR 355.40] to notify the National Response Center of an accidental release of cellulose; there is no reportable quantity for this substance.

- **Community right-to-know requirements**

Employers are not required by Section 313 of SARA to

submit a Toxic Chemical Release Inventory Form (Form R) to EPA reporting the amount of cellulose emitted or released from their facility annually.

- **Hazardous waste management requirements**

EPA considers a waste to be hazardous if it exhibits any of the following characteristics: ignitability, corrosivity, reactivity, or toxicity as defined in 40 CFR 261.21-261.24. Although cellulose is not specifically listed as a hazardous waste under the Resource Conservation and Recovery Act (RCRA) [42 USC 6901 et seq.], EPA requires employers to treat waste as hazardous if it exhibits any of the characteristics discussed above.

Providing detailed information about the removal and disposal of specific chemicals is beyond the scope of this guideline. The U.S. Department of Transportation, EPA, and State and local regulations should be followed to ensure that removal, transport, and disposal of this substance are conducted in accordance with existing regulations. To be certain that chemical waste disposal meets EPA regulatory requirements, employers should address any questions to the RCRA hotline at (800) 424-9346 or at (202) 382-3000 in Washington, D.C. In addition, relevant State and local authorities should be contacted for information about their requirements for waste removal and disposal.

RESPIRATORY PROTECTION

- **Conditions for respirator use**

Good industrial hygiene practice requires that engineering controls be used where feasible to reduce workplace concentrations of hazardous materials to the prescribed exposure limit. However, some situations may require the use of respirators to control exposure. Respirators must be worn if the ambient concentration of cellulose exceeds prescribed exposure limits. Respirators may be used (1) before engineering controls have been installed, (2) during work operations such as maintenance or repair activities that involve unknown exposures, (3) during operations that require entry into tanks or closed vessels, and (4) during emergencies. Workers should use only respirators that have been approved by NIOSH and the Mine Safety and Health Administration (MSHA).

- **Respiratory protection program**

Employers should institute a complete respiratory protection program that, at a minimum, complies with the

requirements of OSHA's respiratory protection standard [29 CFR 1910.134]. Such a program must include respirator selection, an evaluation of the worker's ability to perform the work while wearing a respirator, the regular training of personnel, respirator fit testing, periodic workplace monitoring, and regular respirator maintenance, inspection, and cleaning. The implementation of an adequate respiratory protection program (including selection of the correct respirator) requires that a knowledgeable person be in charge of the program and that the program be evaluated regularly. For additional information about the selection and use of respirators and about the medical screening of respirator users, consult the *NIOSH Respirator Decision Logic* [NIOSH 1987b] and the *NIOSH Guide to Industrial Respiratory Protection* [NIOSH 1987a].

PERSONAL PROTECTIVE EQUIPMENT

Protective clothing should be worn to prevent repeated or prolonged contact of the skin with cellulose dust. Safety glasses, goggles, or face shields should be worn during operations in which cellulose might contact the eyes (e.g., through dust particles).

REFERENCES CITED

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