Industry Guide

Pulp and Paper Mills

The manufacture of pulp, paper, and paper products is one of the world's largest industries employing more than 3.5 million people worldwide. As of 1993, production of wood pulp alone was approximately 140 million tons with the major producing countries being the United States, Canada, Japan, Sweden, and Finland.[1] Pulping is the process by which the bonds within the wood structure are broken. Methods for pulping wood include mechanical pulping, chemical pulping, and repulping waste paper. This sampling guide will focus only on chemical pulping using alkaline (i.e., sulphate or kraft) and acidic (i.e., sulphite) processes. Pulp and paper production workers may be exposed to health and safety hazards including:

Chemical agents
- such as reduced sulfur compounds (hydrogen sulfide, methyl mercaptan, dimethyl sulfide, dimethyldisulfide), sulfur dioxide, chlorine, chlorine dioxide, terpenes, and wood dust

Biological agents
- such as bacteria or fungi

Physical agents
- such as heat and noise

The nature and magnitude of these hazards will vary depending on the process area and the type of pulping process used.

This publication is designed to assist health and safety professionals in choosing the appropriate equipment and methodology to assess the major chemical agents found in pulp and paper mills. Sources of additional information are described below.

The National Council for Air and Stream Improvement, Inc. (NCASI) *at 919-558-1999 or fax 919-558-1998 or www.ncasi.org has a Workplace Measurement Methods Advisory Group that publishes technical bulletins on sampling compounds that may be present in workplace atmospheres.*

SKC Inc. *at 724-941-9701 or www.skcinc.com offers equipment to evaluate noise, heat stress, and biological hazards in workplace atmospheres.*

Reduced Sulfur Compounds

Workers in kraft pulp mill operations may be exposed to reduced sulfur gases including hydrogen sulfide, methyl mercaptan, dimethyl sulfide, and dimethyldisulfide when the digester is opened and the contents are dumped.[2] Reduced sulfur compounds are potent eye irritants and can cause headaches and nausea. Olfactory fatigue, where workers can no longer smell the distinctive "rotten egg" smell, can result from exposures in the range of 50 to 200 ppm. Higher concentrations can result in unconsciousness, respiratory paralysis, and death.[1]

The U.S. Occupational Safety and Health Administration (OSHA) recommends a Ceiling of 20 ppm for hydrogen sulfide and a Ceiling value of 10 ppm for methyl mercaptan. OSHA has not issued Permissible Exposure Limits (PELs) for dimethyl sulfide and dimethyldisulfide.

While various sampling methods exist for several of these individual compounds, NCASI recommends collection in Tedlar® bags with analysis by gas chromatography with a flame photometric detector (GC-FPD).[3] Due to the removal of Tedlar from the air sampling market, SKC recommends using FlexFoil PLUS sample bags as an alternative bag material for this application. See performance data at www.skcinc.com/instructions/1805.pdf. Reference the following SKC publications:

Chemical Fact Files®

Dimethyl sulfide/Dimethyldisulfide
By NCASI Technical Bulletin 656
SKC Publication 1413

Hydrogen Sulfide
By NCASI Technical Bulletin 656
SKC Publication 1414

Methyl Mercaptan
By NCASI Technical Bulletin 656
SKC Publication 1412

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Sulfur Dioxide, Chlorine, and Chlorine Dioxide

Exposure to sulfur dioxide, chlorine, or chlorine dioxide normally occurs as a result of a process upset, spill, or leak. Pulp mill workers likely to be exposed to these compounds include maintenance workers, bleach plant workers, and construction workers. Exposures to high levels of these compounds can cause lung injury and respiratory disorders. Even low level exposures to chlorine or chlorine dioxide can trigger the development of asthma or other respiratory problems such as coughing and wheezing that may persist for many years following exposure.(1)

OSHA regulates sulfur dioxide as an eight-hour time-weighted average (TWA) of 5 ppm, chlorine as a 1 ppm Ceiling, and chlorine dioxide as an eight-hour TWA of 0.1 ppm.

For details on sampling these compounds, reference the following SKC publications:

Chemical Fact Files

Sulfur Dioxide
By OSHA Method ID 200
SKC Publication 1461

Sulfur Dioxide
By NIOSH 6004
SKC Publication 1331

Chlorine
By NIOSH 6011
SKC Publication 1332

Chlorine
By OSHA ID 101
SKC Publications 1052 and 1289

Chlorine Dioxide
By OSHA ID 202
SKC Publication 1462

Terpenes

Pulp mill workers can become exposed to terpenes, including compounds such as alpha-pinene and beta-pinene, in turpentine recovery processes. Exposures to high concentration of these substances can lead to respiratory irritation.

There are no exposure guidelines for these compounds in the U.S. at this time.

For details on sampling terpenes, reference the following SKC publications:

Terpenes Using Passive Samplers
Validated by the Swedish National Institute of Occupational Safety and Health
SKC Publication Passive Samplers for Organic Vapors

Chemical Fact Files

Terpenes
By NIOSH 1552
SKC Publication 1463

Wood Dust

Exposure to wood dust is a concern in the wood preparation area as well as in the initial stages of pulping. Wood dust has been classified as a human carcinogen by the International Agency for Research on Cancer (IARC) due to nasal cancers evidenced in workers exposed to hardwood dust.

OSHA regulates hardwood and softwood dust as an eight-hour TWA of 15 mg/m^3.

For details on collecting dust using gravimetric methods, reference the following SKC publications:

Chemical Fact File

Dust: Total, Particulates Not Otherwise Regulated
By NIOSH 0500
SKC Publication 1035

References

(1) Jeanne Mager Stellman, *Encyclopedia of Occupational Health and Safety,* 4th Ed., Vol III, International Labor Organization, Geneva, 1998, pp 78.2-78.30

(2) William A. Burgess, *Recognition of Health Hazards in Industry: A Review of Materials and Processes*, 2nd Ed., John Wiley & Sons, New York, 1995, pp 303-317

(3) *A Study of the Use of Tedlar Bag Sampling for the Determination of Reduced Sulfur Gas Concentrations in Workplace Atmospheres*, National Council of the Paper Industry for Air and Stream Improvement, December 1993, Technical Bulletin No. 656

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