



# 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.<sup>(1)</sup> 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 of the Paper Industry for Air and Stream Improvement, Inc. (NCASI) at 919-558-1999 or fax 919-558-1998 or [www.ncasi.org](http://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](http://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.<sup>(2)</sup> 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 50-200 ppm. Higher concentrations can result in unconsciousness, respiratory paralysis, and death.<sup>(1)</sup>

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<sup>®</sup> bags with analysis by gas

chromatography with a flame photometric detector (GC-FPD).<sup>(3)</sup> Reference the following SKC publications:

### **Chemical Fact Files<sup>®</sup>**

#### **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**

# Sulfur Dioxide, Chlorine, and Chlorine Dioxide

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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.<sup>(1)</sup>

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 Method 6004  
**SKC Publication #1331**

### Chlorine

By NIOSH Method 6011  
**SKC Publication #1332**

### Chlorine

By OSHA Method ID 101  
**SKC Publications #1052 and #1289**

### Chlorine Dioxide

By OSHA Method ID 202  
**SKC Publication #1462**

# Terpenes

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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 Method 1552  
**SKC Publication #1463**

# Wood Dust

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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<sup>3</sup>.

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

## Chemical Fact File

### Dust: Total, Particulates Not Otherwise Regulated

By NIOSH Method 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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