Industry Guide

Iron and Steel

In 1995 the world's raw steel production was 828 million tons, with the majority of production in Asia (37%) and Europe (27%).[1] Integrated steel production, from the initial handling of coal and iron ore to the loading of the finished products, presents a myriad of health and safety hazards. Those hazards may include:

Chemical agents

└─ such as dust and fumes, carbon monoxide, coal tar pitch volatiles, coke oven emissions, silica, and acid mists

Physical agents

└─ such as heat stress, noise, and vibration

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 the iron and steel industry. Contact SKC Inc. at 724-941-9701 or www.skcinc.com for equipment to evaluate noise and heat stress.

Dusts and Fumes

Steel workers at particular risk for exposure to dusts and fumes include those involved in handling coal and ore, manufacturing coke, charging and tapping furnaces, and working with molten metals. Of particular concern are exposures to heavy metals such as nickel, chromium, manganese, and zinc that may occur during the manufacture of specific types of steel products such as steel alloys.[1]

The health effects of these air contaminants will vary depending on chemical composition, airborne concentration, and particle size. Metal fume fever is a common temporary illness among workers exposed to the zinc fumes and other metals such as copper, manganese, and iron. New workers and those returning to work after a weekend are more likely to experience symptoms of nausea, headache, fever, and chills associated with exposure.

The U.S. Occupational Safety and Health Administration (OSHA) has set Permissible Exposure Limits (PELs) for individual metals. Particulates not otherwise classified have an OSHA exposure limit of 15 mg/m^3 as total dust and 5 mg/m^3 as respirable dust.

For details on sampling dusts and fumes according to government methods, reference the following SKC publications:

Chemical Fact Files®

Metal and Metalloid Particulates in Workplace Atmospheres
By OSHA Method ID 125G
SKC Publication 1371

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

Dust: Respirable, Particulates Not Otherwise Regulated
By NIOSH 0600
SKC Publication 1038

Carbon Monoxide

Carbon monoxide is found in blast furnace, coke oven, and converter gases. Exposures can occur due to leaks from furnaces or gas pipelines or during maintenance procedures in or around blast furnaces. Carbon monoxide can cause asphyxiation by interfering with the oxygen-carrying capacity of blood.

OSHA established an eight-hour PEL of 50 ppm for carbon monoxide.

For details on sampling carbon monoxide by OSHA Method ID 209 using a direct-reading instrument, contact SKC.

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Coal Tar Pitch Volatiles and Coke Oven Emissions

Coal tar pitch volatiles, which are distilled off when coal is carbonized to produce coke, are a serious health hazard to coke oven workers. Other significant hazards are coke oven emissions that are defined as the benzene soluble fraction of the airborne particulate generated during the carbonization of coal. Coal tar pitch volatiles and coke oven emissions contain Polynuclear Aromatic Hydrocarbons (PAHs) such as benzo(a)pyrene, benz-fluoranthene, and chrysene. Epidemiological studies have revealed that coke oven workers are at risk for many types of cancer. Those employed for more than five years evidenced excess lung cancer mortality rates up to ten times higher than was expected.[(2)]

OSHA has set PELs of 0.2 mg/m^3 for coal tar pitch volatiles and 0.15 mg/m^3 for coke oven emissions.

For details on sampling these compounds according to government methods, reference the following SKC publications:

Chemical Fact Files

Coal Tar Pitch Volatiles
By OSHA 58
SKC Publication 1076

Polynuclear Aromatic Hydrocarbons
By NIOSH 5506 and 5515
SKC Publication 1464

Silica

The main exposure to silica occurs during installation of refractory brick materials in the lining of furnaces and ovens and during furnace maintenance procedures. In recent years, these exposures have been lowered through substitution of other materials for linings and through the automation of processes. If crystalline silica enters the lung, fibrotic nodules and scarring can occur around the trapped silica particles. This fibrotic condition of the lung is called silicosis. If the nodules grow too large, breathing becomes difficult and death may result. Silicosis victims are also at high risk of developing active tuberculosis.

NIOSH recommends that crystalline silica levels not exceed 0.05 mg/m^3 as an eight-hour time-weighted average (TWA). OSHA's standard is determined by performing a calculation which takes into consideration the percentage of silicon dioxide (SiO_2) in the sample.

For respirable dust containing quartz, this calculation is as follows:

$$\frac{10\ \text{mg/m}^3}{\%SiO_2 + 2}$$

For details on sampling crystalline silica, reference the following SKC publications:

Sampling Guide for Silica Dust
SKC Publication 1365

Chemical Fact Files

Silica, Crystalline, Quartz, Respirable Dust
By OSHA ID 142
SKC Publication 1003

Silica, Crystalline by XRD
By NIOSH 7500
SKC Publication 1370

Acid Mists

Exposure to hydrochloric and sulfuric acid mists can occur in the pickling area resulting in skin, eye, and respiratory irritation. OSHA has established a 5 ppm Ceiling for hydrochloric acid and an eight-hour TWA of 1 mg/m^3 for sulfuric acid.

For information on sampling acid mists according to government methods, reference the following SKC publications:

Chemical Fact Files

Inorganic Acids
By NIOSH 7903
SKC Publication 1016

Sulfuric Acid
By OSHA ID 113
SKC Publication 1465

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

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