

Workplace Health and Safety Bulletin



Coal Dust at the Work Site

Coal is a brown to black combustible material made from decayed plant matter that has been compressed by rock formations over a long period of time. It is found throughout the world and is the most abundant of the fossil fuels. Coal is classified by its type, grade and rank. The type of coal depends on the plant materials the coal is made from, grade is the purity of the coal and rank relates to the geological age of the coal. The major types of coals, in order of lowest to highest rank, are:

- *Lignite* — This coal is brown to black in colour and contains the most moisture. While it has low heat value, there are vast deposits of it throughout the world. It is mined widely in eastern Europe, Germany and Australia to generate electricity.
- *Sub-Bituminous* — This coal is black and contains about 15 to 30% moisture. It ignites less easily than lignite coal, but burns cleaner. It is used extensively for heating and electricity generation.
- *Bituminous* — This coal is the most common and important to industry. Its heat value and coking qualities can vary a great deal. Bituminous coal of good coking quality (metallurgical coal) is used to make coke. Coke is a porous fuel formed when bituminous coal is heated to high temperatures. Several commercially valuable products, such as gas, light oil and some chemicals, are formed during this process and the coke itself is used in the manufacture of steel. Bituminous coal that is not of good coking quality (thermal coal) is used to generate electricity, as a domestic fuel and in a number of manufacturing processes e.g. the production of aluminum, cement, paper and textiles. Large deposits of bituminous coal are found throughout Europe, Britain, the United States and Canada.

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Government of Alberta ■
Employment and Immigration

- *Anthracite* — This type of black coal is usually found deeper than bituminous coal. Only a small amount of the world supply of coal is anthracite. It has a very high carbon concentration and a high heat value. It is hard to ignite. But once burning, it does so with little smoke. It is used mainly as a domestic fuel.

The main types of coal mined in Alberta are sub-bituminous (used in the power generating industry) and bituminous (mostly exported).

Geologically younger coals tend to form fine dust more easily than older coals. This is important to Alberta since the coal found in the Prairies is some of the geologically youngest in the world.

In Alberta, coal is mined mainly by surface mining techniques. Strip mining is used where the coal lies close to the surface and the ground is fairly flat. Open pit mining is used in more mountainous areas where the deposits are large and close to the surface. Once mined, coal is prepared for use and export by removing non-coal contaminants, screening, sizing and drying.

There is some underground coal mining in Alberta. Conventional room and pillar mining techniques are used. Shuttle cars and conveyor belts are used to bring the coal to the surface.

Coal mine dust is a mixture that contains more than 50 substances. The mineral content depends on the particle size of the dust and the coal seam. The most commonly found minerals in coal mine dust include kaolinite, illite, calcite, pyrite and quartz (silica). Dust from high rank coals usually contains more silica particles than dust of lower rank coals.

Most workplace exposure to coal dust occurs during mining, however exposure can also occur during handling of the mined product during cleaning and blending processes or bulk handling at large coal fired facilities.

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Health effects

Coal Workers Pneumoconiosis (CWP)

Black lung was first recognized as a disease of British coal miners in the mid-17th century. The term “pneumoconiosis” (“dusty lung”) was introduced in the 1870s. The cause of the disease in coal miners was first thought to be due to silica, until studies in the United Kingdom showed that exposure to coal dust containing very little silica could also lead to CWP. Black lung includes CWP, bronchitis, emphysema and silicosis in association with employment history in coal mines.

CWP is inflammation and scarring of the lungs caused by the deposit of coal dust in the lungs and the response of the body to the dust. Diagnosis of CWP is usually based on the findings from x-rays and a history of working with coal. Damage to the lungs often looks similar to that from silicosis. The disease appears to occur when dust is breathed into the lungs faster than the lungs can remove it. Among a group of people with similar exposures to coal dust, some may develop CWP and some may not. Factors that may contribute to this are differences in the effectiveness of lung clearance mechanisms, differences in the auto-immune reaction in the lung tissue, possible genetic susceptibility and smoking. However, CWP can develop without smoking exposure.

CWP is a lung disease caused by the deposit of coal dust in the lungs and the response of the body to the dust.

There are two types of CWP, simple and complicated (also called progressive massive fibrosis or PMF). With simple CWP there are often no symptoms. Cough and shortness of breath that worsens as the disease progresses are symptoms that may be present in the later stages of the disease. PMF is associated with significant decreases in lung function and oxygen diffusing capacity. PMF may continue to progress even when exposure has stopped. It may start in workers who have latter stages of simple CWP. Workers who smoke may be more severely affected. It also appears that the higher the rank of coal, the greater the risk of contracting the more developed stages of simple CWP or PMF. This is of more concern where anthracite coal is mined and processed. There is no effective treatment for CWP, apart from removing the individual from further exposure.


Silicosis

Since crystalline silica is often present in the rock formation containing the coal, coal mine dust often contains crystalline silica. As a result, workers exposed to coal mine dust are at risk of developing silicosis.

Silicosis is caused when respirable crystalline silica particles of less than 10 microns in size are inhaled and deposited in the lung. The lung tissue reacts by developing fibrotic nodules and scarring around the trapped silica particles. If the nodules grow too large and if scarring is extensive, breathing becomes difficult and death may result.

Workers exposed to coal mine dust are at risk of developing silicosis.

For more information

 http://employment.alberta.ca/documents/WHS/WHS-PUB_ch059.pdf
Crystalline Silica in the Workplace

Chronic Obstructive Pulmonary Disease (COPD)

COPD related to coal dust exposure refers to two diseases:

- chronic bronchitis, and
- emphysema.

Restriction of airflow and shortness of breath are common symptoms of COPD. Reduced pulmonary function has been demonstrated with increasing cumulative coal dust exposure even after accounting for smoking and other factors.

Medical monitoring

The purpose of the health assessment is to provide the worker with a baseline health evaluation. Periodic health assessment help detect early changes to the lungs that have occurred. However prevention of dust related diseases requires reduction of exposure.

Medical assessment of coal-exposed workers consists of health history information, a chest x-ray and radiologist's report, a spirogram (lung function test) and a physician's written interpretation and explanation of the health assessment. The history includes identifying the worker, their employer, the worker's previous work and non-work exposure to coal or other dusts, indications of any existing respiratory disease, smoking history and the date on which the worker had their most recent chest x-ray or lung function test.

The chest x-ray consists of a single back-to-front (postero-anterior) view of the chest and needs to be interpreted by a radiologist and the report is sent to a physician. Digital imaging format of x-rays is being used by some radiologists. Digital imaging can be used to meet the requirements in the OHS Code, Section 40(2) provided the imaging facility is able to print to film when requested. Typically, the x-ray finding in simple CWP is the presence of rounded spots up to 1 cm in size in the upper lung zones. If the size is greater than 1 cm, PMF is present. Where the spots have an irregular shape, other occupational exposures (such as asbestos or silica) or non-occupational disease must be considered. Other occupational exposures (asbestos, silica) or non-occupational disease may produce differing distribution and presentation.

The spirogram is conducted by a pulmonary function technician. It consists of forced vital capacity (measure of volume of air taken in) and forced expiratory volume in the first second. Medical monitoring may identify abnormalities which require further assessment.

It is the employer's responsibility to ensure that exposed workers have health assessments. These assessments are provided at no cost to workers. A health assessment must be conducted within 30 days of a worker becoming an exposed worker (as defined in the legislation) and must be done every two years thereafter. The information from the health assessments is confidential and the persons having custody of the information must ensure that it is kept confidential.

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Preventive measures

Preventing exposure to coal dust is the best way to protect the health of workers. Options that should be considered include the following (listed in order of preference):

- Use of engineering controls
- Changes in work practices to reduce exposure (administrative controls)
- Use of personal protective equipment

Engineering controls

Engineering controls are processes that are used to eliminate exposure to a contaminant. Engineering controls remove the dust from the air or separate the worker from the contaminant. Examples of engineering controls that can be used to prevent exposure to coal dust include:

- use of wet processes or water spray systems,
- installation of local ventilation hoods,
- installation of dust collection systems onto machines or equipment, and
- use of enclosures (this would include remote operated machinery and enclosure of chutes or transfer points).

Engineering controls are processes that are used to eliminate exposure to a contaminant.

If engineering controls are working properly, they will eliminate or greatly reduce the potential health hazard. Engineering controls only need to be installed once and do not place a physical burden on workers. However, an initial investment is required and the systems must be properly operated and maintained once installed.

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Administrative controls

Work practices that can be implemented in the workplace to reduce potential exposure to coal dust include:

- Educating workers so that they understand the hazards associated with coal dust. Workers must participate in training and monitoring programs in the workplace.
- Good hygiene practices: Workers must not eat, drink or use tobacco products in areas contaminated by coal dust. The hands and face must be washed before eating, drinking or smoking.
- Ensuring that engineering controls and other equipment used to reduce exposure are maintained and used properly.





Implementing work practices to reduce exposure are often less expensive than other control measures. However to successfully implement work practices, the employer needs to ensure that workers are properly trained, they follow the practices appropriately and that this is monitored in the workplace.

Personal protective equipment

If it is not practicable or feasible to implement engineering controls or change work practices to reduce the potential for exposure, personal protective equipment (PPE) is needed. The most common way in which workers are exposed to coal dust is by inhaling the dust. The type of PPE used to prevent this is respiratory protective equipment. There are many types of respirators available and it is important to select the correct one for the work being done. If air purifying respirators are used, the employer must ensure that they are equipped with a P100 filter.

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For more information:

-  http://employment.alberta.ca/documents/WHS/WHS-PUB_ppe004.pdf
Guideline for the Development of a Code of Practice for Respiratory Protective Equipment (PPE004)
-  http://employment.alberta.ca/documents/WHS/WHS-PUB_ppe001.pdf
Respiratory Protective Equipment: An Employer's Guide (PPE001)
-  http://employment.alberta.ca/documents/WHS/WHS-PUB_mg005.pdf
Medical Assessment of Fitness to Wear a Respirator (MG005)
-  <http://www.cdc.gov/niosh/userguide.html>
NIOSH Guide to the Selection and Use of Particulate Respirators (96-101)

While the use of personal protective equipment may initially seem to be less costly, workers need to be trained on the protective equipment they are using. Employers need to monitor use and ensure that the protective equipment is properly maintained. In some cases, personal protective equipment can create a hazard to workers (heat stress, limited vision, allergic reactions to the equipment material). These issues need to be evaluated when personal protective equipment is selected.

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Regulatory requirements

The *Alberta Occupational Health and Safety Act, Regulation* and Code have general and specific requirements for coal dust. The Occupational Exposure Limit (OEL) for coal dust is provided in the Occupational Health and Safety Code, Schedule 1, Table 2. This limit applies to workers directly involved with tasks involving coal and also to workers in the workplace who may be exposed to coal dust indirectly from these operations.


Additional specific requirements include:


- Definition of an “exposed worker” (a worker who may reasonably be expected to work in a restricted area at least 30 work days in a 12-month period. (A “restricted area” is an area of the work site where there is a reasonable chance that the airborne concentration of coal dust exceeds the OEL.)
- Minimizing the release of coal dust to the air and keeping the worksite clear of unnecessary accumulations of coal dust.
- Training of workers on the health hazards associated with the exposure to airborne coal dust.
- Health assessments for exposed workers.
- Requirements for respiratory protective equipment.


Crystalline silica should be sampled simultaneously with coal dust. Coal dust often contains silica and even if the coal dust contains only a small amount of free silica by weight, there still may be enough silica to generate concentrations of crystalline silica over the OEL.

Contact us:

Province-Wide Contact Centre

 Edmonton & surrounding area:
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- **1-800-232-7215**
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 www.worksafely.org

Getting copies of OHS Act, Regulation & Code:

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 www.qp.gov.ab.ca

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Workplace Health and Safety

 <http://employment.alberta.ca/whs-ohs>

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