



COAL DUST AND OCCUPATIONAL LUNG DISEASE

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The aim of this leaflet is to describe and emphasise the dangers of coal dust for underground coal miners, and to promote good practice in terms of dust control and the wearing of dust masks during work.

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BACKGROUND

Over the last 15 to 20 years there has been a resurgence in coal mine dust lung diseases in the USA¹ and Australia², and this is likely to be the same in Europe. This has happened despite huge efforts and legislation during the previous few decades to manage levels of potentially toxic coal dust in mines and worker exposure. Worryingly, it is not just long-career and retired miners who are suffering ill effects, but also younger workers who have spent their whole working lives under modern dust control regulations¹. The reasons for the resurgence in disease are not fully understood, but may, in part, relate to the general downturn in the coal industry with, in at least some mines, less attention and spending on protecting respiratory health. One aspect that was clear from recent visits to European coal mines is that miners are not always wearing their dust masks underground.

The following information is for underground coal mines but dust may be also dangerous in open pit operations and processing facilities.

¹ Graber, J.M., Harris, G., Almborg, K.S., Rose, C.S., Petsonk, E.L., Cohen, R.A., 2017. Increasing severity of pneumoconiosis among younger former US coal miners working exclusively under modern dust-control regulations. *J. Occup. Environ. Med.*, 59, 105–111.

² Perret, J., Plush, B., Lachapelle, P., Hinks, T.S.C., Walter, C., Clarke, P., Irving, L., Brady, P., Dharmage, S.C., Stewart, A., 2017. Coal mine dust lung disease in the modern era. *Respirology* 22, 662–670.

TESTIMONIALS

Greg Kelly – 54 years old, 30 years underground

*"There's a lot of scarring and stuff in my lungs. That's something you don't want nobody to face, is having to struggle to breathe. That's scary."*³

Charles Shortridge –

*"I can't plan for tomorrow because I never know if I'm going to live to see tomorrow. There's no cure for me. It's black lung. It's a death sentence."*³

Rodney Sexton – 30 years underground

*"I wake up smothered. And [I] run and run through the house ... trying to get breath ... [because] I think I'm dying."*⁴

Bernard Carlson Jr – 40 years underground

*"Things that used to take me an hour or two to do, take me five to six hours now because I stop more frequently. And in the mornings you get up hacking, spitting black and blood."*⁴

Ray Anthony Bartley – 47 years old, 25 years in the mines.

*"I used to play sports, big time hunter, fisherman. But now if I have to do anything I have to wear oxygen."*⁵

Mackie Braman Jr – 39 years old, 18 years underground.

*"For the miners out there that are going underground... just remember, take care of yourself, because right now I've got two nine year olds that I can't even play basketball with... You can't do what you used to. And as far as providing, I'm sitting at home, getting a check that is nowhere half of what you used to bring home. It's rough."*⁵

Peyton Michael Mitchell – 42 years old

"All the activity that I could do outside, I can't do no more. I'm pretty well on oxygen 24/7 in the house... I just can't do anything no more."

Peyton died at 43, leaving behind his wife and child⁵.

³ Schuknecht, C., 2019. 'I Figured It Was Going To Be A Horrible Death, And It Probably Will Be'. NPR, [online] Available at: <<https://www.npr.org/2019/01/23/686000458/i-figured-it-was-going-to-be-a-horrible-death-and-it-probably-will-be>> [Accessed 23 March 2020].

⁴ Berkes, H. and Jingnan, H., 2019. Coal Miners To Demand Congress Restore Full Black Lung Benefits Tax. NPR, [online] Available at: <<https://www.npr.org/2019/07/23/743152782/coal-miners-to-demand-congress-restore-full-black-lung-benefits-tax>> [Accessed 23 March 2020].

⁵ NIOSH, 2020. Faces of Black Lung II. Wolfe A, Yancheski M, Halldin C. Morgantown, WV: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2020–109D (revised 05/2020), [online] Available at: <<https://doi.org/10.26616/NIOSH PUB2020109D revised052020>> [Accessed 12 June 2020].

WHAT IS COAL DUST?

Atmospheric dust can be classified by size, and, according to where it is deposited in the human respiratory tract, into two different types: inhalable and respirable.

Inhalable dust is visible to the naked eye, with an aerodynamic diameter nominally less than 0.01 mm, known as PM₁₀. It can be breathed in, but dust of this size will be caught in the nose, mouth and upper respiratory tract.

Respirable dust is nominally smaller than 0.004 mm (PM₄) and therefore invisible. This fine dust can be breathed into the human lungs. This is particularly true for the very fine fraction dust, approximately smaller than 0.0025 mm (PM_{2.5}), which can reach the deepest parts of the lungs, potentially entering the tiny alveoli air sac where oxygen is exchanged between the breathed-in air and the blood.

Coal dust is made of:

- Coal particles
- Minerals and metallic particles
- Rock particles

Coal dust from a lignite mine in Europe was found to contain seven metallic elements concentrated in the respirable dust fraction: copper, antimony, tin, lead, zinc, arsenic and nickel⁶. All of these could have adverse health effects, depending on whether they are in a form that can be taken up and transported within the human body.

Rock particles can include crystalline silica, usually quartz, which is categorized by the International Agency for Research on Cancer as a human carcinogen⁷.

Dust components do not have to be breathed in to enter the body. They can also enter by absorption through the skin, hair follicles and sebaceous glands, as well as the digestive tract.

⁶ Moreno, T., Trechera, P., Querol, X., Lah, R., Johnson, D., Wrana, A. and Williamson, B., 2019. Trace element fractionation between PM₁₀ and PM_{2.5} in coal mine dust: implications for occupational respiratory health. *Int. J. Coal Geol.*, 203: 52–59.

⁷ IARC (International Agency for Research on Cancer), 1997. *Monographs on the evaluation of carcinogenic risks to human. Silica, some silicates, coal dust and para-aramid fibrils*, p. 506.

WHY WORRY ABOUT COAL DUST?

There are several coal mine dust occupational lung diseases, including coal workers' pneumoconiosis (CWP) and silica dust silicosis, **neither of which can be cured.**

These are usually caused by long term exposure to dust, particularly the respirable (PM₄) and fine fraction (PM_{2.5}).

The body reacts to particles in the lungs by sending white blood cells to break down and remove them. If the concentration of dust particles is too high this reaction can cause irreparable damage. Scar tissue may develop around the dust particles, which can eventually lead to the formation of nodules. A build-up of scar tissue in the alveoli reduces the ability of oxygen to transfer to the blood. It also reduces the volume and expansion of the lungs, making it difficult to breathe⁸.



Figure 1: Normal lung (left) vs lung with coal workers' pneumoconiosis (right)⁸.

Coal workers' pneumoconiosis (Fig. 1) takes several years to develop, **silicosis** is often faster. Both diseases may begin with only mild symptoms, such as a cough and shortness of breath, however this can progress to cause death as a result of respiratory failure.

Other symptoms include: chronic cough, chronic chest infection, shortness of breath even at rest, black mucus, emphysema, and heart problems.

There is no cure, although a lung transplant can sometimes add a few years of life.

Further information can be found at: <https://www.lung.org/lung-health-diseases/lung-disease-lookup/black-lung/symptoms-diagnosis>

⁸ Colinet, J., Rider, J., Listak, J., Organiscak, J. and Wolfe, A., 2010. Best Practices For Dust Control In Coal Mining. Information Circular 9517. [online] Pittsburgh: Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. Available at: <https://www.cdc.gov/niosh/mining/works/coversheet861.html> [Accessed 23 March 2020].

RESPIRATORY PROTECTIVE EQUIPMENT

Coal mine dust lung diseases are **entirely preventable** through the use of respiratory protective equipment (RPE) and dust control measures (next section).

RPE is protective equipment designed to protect the wearer's respiratory health. In general, the type and specifications of RPE required may vary depending on the:

- Type of mine and coal
- Job conditions
- Dust monitoring results – including both particle size and concentration

Masks can either be disposable or re-useable. The re-useable masks have filters which can be replaced to allow repeated use.

It is important that a mask fits well to the wearer's face. If it does not have a good seal, air will enter around the edges of the mask, rather than through the filter. This will result in the wearer breathing in dusty air rather than filtered air.

Every worker should have face-fit testing to check that there is a good mask-face seal before they enter the mine or other dusty working environment.

It is also important that the masks are comfortable, can be worn in conjunction with any other protective equipment, such as eye protection, and do not overly hinder the wearer in their work. If the RPE is uncomfortable or irritating the wearer is unlikely to use it properly, or at all.

DUST SUPPRESSION SYSTEMS

There are numerous sources of dust in underground coal mines, including:

- Mechanical coal cutting processes, in the longwalls and roadways, mainly from shearers and road headers
- Conveyor belts
- Maintenance or development operations, e.g. installing electrical infrastructure or moving roof supports (mainly involving resuspension of dusts)

Produced coal dusts should be suppressed as close to the source as possible in order to protect human health, as well as to reduce the risk of explosions. Dedusting and spraying can prevent and remove airborne dust. Spraying can be made more efficient by adding surfactants to the water, lowering the water's surface tension.

Dedusting devices and spraying installations are commonly sited in the area of:

- Coal cutting machinery (cutting drums and heads)
- Canopies of powered roof supports
- On conveyor transfer points
- In roadways to form barriers
- As part of the ventilation system

It is important that the size and amount of droplets produced by the spraying installations is correct for the size and concentrations of dust particles being sprayed.

Blast holes can be drilled using a water scrubber and the face area can be watered before blasting. The run-of-mine can then be watered after blasting and periodically during loading for transport.

**PLEASE ALWAYS WEAR YOUR DUST MASK -
CORRECTLY!**