

Wood-burning stoves - harmful or safe?

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Wood-burning stoves are a popular source of heating in many countries. However in recent years there has been much debate about the potential negative health effects associated with wood smoke. A Norwegian researcher has studied the influence of combustion conditions on the emissions and their health effects.

Wood-burning is controversial in many countries, including the USA and Canada. Some groups wish to ban wood-burning whereas others are trying to convince opponents that clean-burning technology is environmentally friendly.

"The physical and chemical properties of particulate matter from wood-burning have great influence on how these [particles](#) may affect our health. Worsening of cardiovascular diseases and [respiratory diseases](#) such as [asthma](#) and [chronic obstructive pulmonary disease](#) are the main concerns," says Anette Kocbach Bølling from the Norwegian Institute of Public Health. During 2011, Bølling was invited to several international symposia to share her findings on how [wood smoke](#) particles generated under different [combustion](#) conditions may influence our health.

Different burning conditions give different particles

"Particulate matter from different sources has different physical and chemical properties, and several factors are important when we study their [health effects](#)" says Bølling.

These include:

- Chemical composition - some metals and organic substances are more harmful to the cells in our bodies than others.
- Solubility - water soluble particles will dissolve easily in the lung lining fluid and be removed from the lungs.
- Size - particle size determines the deposition rate and probability in our lungs. In addition, the smallest particles have a larger surface per mass unit, providing a larger area for interaction with the cells in our lungs.

How do we burn wood?

There are many types of stoves available, and people use different types of fuels of varying quality. During good combustion conditions with sufficient oxygen supply and high temperature, most of the organic substances will be burnt in the stove.

There are several factors that determine how complete the combustion process is in a stove:

- type of fuel (wood versus pellets)
- moisture content
- draught
- combustion technology in the stove (new clean-burning versus old, conventional stove)

Particles emitted during burning

Wood-burning particles can be split into three classes based on their physical and chemical properties and the combustion conditions:

The particles emitted from poor combustion conditions ("smouldering" combustion) contain relatively large amounts of unburned organic substances from the wood, some of which may be carcinogenic, such as polycyclic aromatic hydrocarbons (PAHs). These particles are quite water soluble and are assumed to be removed relatively quickly from the lungs.

With improved combustion conditions ('burning with flames'), carbon particles with an insoluble core are formed. Depending on how good the combustion conditions are, the carbon particles have varying amounts of organic compounds on the surface. These particles are likely to remain in the lungs for longer periods of time since they are insoluble.

With complete combustion, for instance in pellet stoves, all the organic material in the wood is broken down in the combustion chamber. Non-combustible substances (ash) will be emitted from the chimney, these are mainly water-soluble salt particles like potassium sulphate. When these particles are deposited in the lungs, they will dissolve quickly in the lung lining fluid and thus be removed.

How do these different particles affect our health?

Particles from complete combustion (salts) seem to have the least effect on lung cells in culture and are removed most quickly from the lungs. The amount of particles emitted from complete combustion is relatively small, so overall these particles seem to have limited influence on human health.

When it comes to emissions from burning of logs in old stoves versus stoves with new clean-burning combustion technology, we don't have enough knowledge to distinguish between the health effects of particles from smouldering and flaming combustion. The only thing we can say with certainty is that emissions are reduced by improved combustion

conditions and that we are thus exposed to smaller amounts of particles when new stoves are used. More research is needed to be certain of how particles from different combustion conditions affect our health.

Several of the major cities in Norway have programmes to replace old, conventional stoves with new clean-burning ones. The purpose is to reduce [emissions](#) of particulate matter and contribute to cleaner air.

Provided by Norwegian Institute of Public Health

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