

CC5: Chemicals – Extra Information



When a cigarette burns, it releases a dangerous cocktail of over 5000 chemicals including:

- more than 70 cancer-causing chemicals
- hundreds of other poisons
- nicotine, a highly addictive drug, and many additives designed to make cigarettes taste nicer and keep smokers hooked.

Cancer-causing chemicals in tobacco smoke

- Acrolein - formerly used as a chemical weapon
- Arsenic - used in wood preservatives
- Benzene - an industrial solvent, refined from crude oil
- 1,3-Butadiene - used in rubber manufacturing
- Cadmium - used in batteries
- Chromium - used to manufacture dye, paints and alloys
- Formaldehyde - used in mortuaries and paint manufacturing
- Nitrosamines – a group of DNA-damaging chemicals
- Polonium-210 - a highly radioactive element
- Polycyclic aromatic hydrocarbons - another group of dangerous DNA-damaging chemicals
- Tar - a mixture of dangerous chemicals
- Other chemicals

Other poisons in cigarette smoke

- Ammonia - used to make fertiliser and explosives
- Carbon monoxide - found in car exhausts and used in chemicals manufacturing
- Hydrogen cyanide - used as an industrial pesticide
- Nitrogen oxides - a major component of smog

The chemicals in second-hand smoke

There are two types of tobacco smoke:

- *mainstream smoke*, directly inhaled through the mouth end of the cigarette, and
- *sidestream smoke*, which comes from the burning tip of the cigarette.

Second-hand smoke consists mainly of sidestream smoke, which is about four times more toxic than mainstream smoke, although people inhale it in a more diluted form. Sidestream smoke contains much higher levels of many of the poisons and cancer-causing chemicals in cigarettes, including:

- up to three times as much carbon monoxide

- five times more cadmium
- 3-10 times more polycyclic aromatic hydrocarbons
- 10-40 times more nitrosamines
- about 15 times more benzene
- 40-70 times more ammonia

Why are these chemicals in cigarettes?

- The tobacco industry adds these kinds of chemicals to 'mask the pain' or 'increase the addictiveness' of their product, in order to sell more and make more money.
- Some of the chemicals improve the flavour of cigarettes and deliver nicotine more efficiently.
- Some chemicals are used to improve combustion and give the cigarette an even burning quality.

Cancer-causing chemicals in tobacco smoke	
Acrolein	<p>Acrolein is a gas with an intensely irritating smell and is one of the most abundant chemicals in cigarette smoke. It belongs to the same group of chemicals as formaldehyde and acetaldehyde, both of which can cause cancer.</p> <p>Until now, it wasn't clear if acrolein causes cancer as well, but recent experiments suggest that it can. We now know that acrolein can cause DNA damage that is similar to the damage seen in lung cancer patients. Since smoke contains up to 1,000 times more acrolein than other DNA-damaging chemicals, it could be a major cause of lung cancer.</p> <p>Acrolein also stops our cells from repairing DNA damage, like arsenic and cadmium. And like hydrogen cyanide, it kills the hairs that normally clean our lungs of other toxins.</p>
Arsenic	<p>Arsenic is one of the most dangerous chemicals in cigarettes. It can cause cancer as well as damaging the heart and its blood vessels.</p> <p>Small amounts of arsenic can accumulate in smokers' bodies and build up to higher concentrations over months and years. As well as any direct effects, it can worsen the effect of other chemicals by interfering with our ability to repair our DNA.</p> <p>Fish and seafood can be major sources of arsenic, but in a form that is less toxic and more readily removed from the body. In contrast, tobacco smoke contains arsenic in a more dangerous form.</p>
Benzene	<p>Benzene is a solvent used to manufacture other chemicals, including petrol. It is well-established that benzene can cause cancer, particularly leukaemia. It could account for between a tenth and a half of the deaths from leukaemia caused by smoking.</p> <p>Tobacco smoke contains large amounts of benzene and accounts for a big proportion of our exposure to this poison. The average smoker inhales about ten times more benzene than the average non-smoker.</p> <p>And some studies have estimated that the amount of benzene that a person inhales through second-hand smoke over their lifetime could increase their risk of cancer.</p>
1,3-Butadiene	<p>1,3-butadiene or BDE is an industrial chemical used in rubber manufacture.</p> <p>Some scientists believe that of all the chemicals in tobacco smoke, BDE may present the greatest overall cancer risk. It may not be as good at causing cancer as some of the other chemicals listed here, but it is found in large amounts in tobacco smoke.</p>

Cadmium	<p>Cadmium is a metal used mostly to make batteries. The majority of cadmium in our bodies comes from exposure to tobacco smoke. Smokers can have twice as much cadmium in their blood as non-smokers.</p> <p>Studies have found that the amounts of cadmium present in tobacco smoke are capable of affecting our health. It is a known cause of cancer, and can also damage the kidneys and the linings of the arteries. Our bodies have proteins that mop up harmful chemicals like cadmium, but the amounts in smoke can overload these proteins. Cadmium can also prevent our cells from repairing damaged DNA, which can make the effects of other chemicals worse.</p>
Chromium	<p>Chromium is a metal used to make metallic alloys, dyes and paints and comes in different types. Chromium III or 'trivalent chromium' is most commonly used. It is available as dietary supplements and is harmless.</p> <p>On the other hand, chromium VI or 'hexavalent chromium' is very toxic, is found in tobacco smoke, and is known to cause lung cancer. It allows other cancer-causing chemicals (such as polycyclic aromatic hydrocarbons) to stick more strongly to DNA and damage it.</p>
Formaldehyde	<p>Formaldehyde is a smelly chemical used to kill bacteria, preserve dead bodies and manufacture other chemicals. It is one of the substances in tobacco smoke most likely to cause diseases in our lungs and airways.</p> <p>Formaldehyde is also a known cause of cancer. It is believed that even the small amounts in second-hand smoke could increase our lifetime risk of cancer.</p> <p>Tobacco smoke is one of our major sources of formaldehyde exposure. Places where people smoke can have three times the normal levels of this poison.</p>
Nitrosamines	<p>Nitrosamines are a group of chemicals that can directly damage DNA, like polycyclic aromatic hydrocarbons (PAHs).</p> <p>They are found in small amounts in food. But tobacco products, including those that are chewed rather than smoked, are by far our largest source of exposure to these chemicals. Even though they are found in relatively small amounts in cigarettes, they are very strong cancer-causing chemicals.</p>
Polonium-210	<p>Polonium is a rare, radioactive element and polonium-210 is its most common form. Polonium strongly emits a very damaging type of radiation called alpha-radiation that can usually be blocked by thin layers of skin.</p> <p>But tobacco smoke contains traces of polonium, which become deposited inside their airways and deliver radiation directly to surrounding cells.</p> <p>The lungs of smokers can be exposed to four times more polonium than those of non-smokers and specific parts may get a hundred times more radiation. One study estimated that someone smoking one and half packs a day receives the equivalent amount of radiation as someone having 300 chest X-rays a year.</p>
Polycyclic aromatic hydrocarbons	<p>Polycyclic aromatic hydrocarbons or PAHs are a group of powerful cancer-causing chemicals that can damage DNA and set cells down the road to becoming tumours.</p> <p>One of these chemicals - benzo(a)pyrene or BAP - is one of the most widely studied of all tobacco poisons. BAP directly damages p53, a gene that normally protects our bodies against cancer.</p>
Tar	<p>Tar is a term that describes a collection of solid particles that smokers inhale when they light a cigarette. It is a mixture of lots of chemicals, many of which can cause cancer. When it settles, tar forms a sticky, brown residue that can stain smokers' teeth, fingers and lungs.</p> <p>Because tar is listed on packs, it is easy to believe that it is the only harmful part of cigarettes. But some of the most dangerous chemicals in tobacco smoke are present as gases, and do not count as part of tar. This means that cigarettes with less tar still contain all the other toxic chemicals.</p>

Other chemicals	<p>Some of the other cancer-causing ingredients of tobacco smoke include:</p> <p>Metals such as nickel, lead, cobalt and beryllium. While you may be exposed to some of these metals through domestic items or food, inhaling them in tobacco smoke is worse, because they are easily absorbed by the lungs. Acetaldehyde, which is also formed in your tissues when you drink alcohol - it is responsible for many nasty hangover symptoms hydrazine, a very toxic chemical used mainly in rocket fuel.</p>
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Other poisons in cigarette smoke	
Carbon monoxide	<p>Carbon monoxide is a colourless gas with no smell. It is formed when we burn carbon-based fuels, such as gas in cookers or petrol in car engines. It can make up as much as 3-5% of tobacco smoke.</p> <p>Carbon monoxide sticks to our red blood cells in place of oxygen. This lowers our blood's ability to transport oxygen and deprives our tissues and organs of this vital gas.</p> <p>Like hydrogen cyanide, it kills cilia and reduces our lungs' ability to clear away toxins. This means that while carbon monoxide does not cause cancer directly, it makes it easier for other chemicals to do so.</p>
Hydrogen cyanide	<p>Hydrogen cyanide is a poisonous gas. Of all the chemicals in tobacco smoke, it does the most damage to the heart and blood vessels.</p> <p>Hydrogen cyanide does not cause cancer, but it increases the risk of other chemicals causing cancer by damaging cilia. These are tiny hairs lining the airways that help to clear toxins away. By killing cilia, hydrogen cyanide causes other dangerous chemicals to be stuck in the lungs and airways.</p>
Nitrogen oxide	<p>Nitrogen oxide is a gas found in car exhaust fumes and tobacco smoke.</p> <p>Our bodies use it in very small amounts to carry signals between cells. But in large amounts, it is a major air pollutant. It directly damages lung tissue and causes inflammation in the lungs.</p> <p>Normally, our bodies produce small amounts of nitrogen oxide, which causes our airways to expand. The large amount of nitrogen oxide in tobacco smoke changes things in two ways:</p> <p>When smokers are smoking, it expands their airways even further, making it easier for their lungs to absorb nicotine and other chemicals.</p> <p>When they are not smoking, it shuts off their internal nitrogen oxide production line, causing their airways to constrict. This is one reason why regular smokers often have difficulty breathing.</p>
Ammonia	<p>Ammonia is a gas with a strong, irritating smell, and is used in some toilet cleaners. Some studies have found that ammonia enhances the addictive power of nicotine. It changes nicotine into a gas that is more readily absorbed into the lungs, airways and bloodstream.</p> <p>Like carbon monoxide and hydrogen cyanide, ammonia also kills cilia.</p>
More poisons	<p>Tobacco smoke also contains many other poisons that produce harmful effects. These can be carried throughout the body via our blood vessels.</p> <p>As well as hydrogen cyanide and ammonia, gases like sulphur dioxide also kill cilia (protective hairs) in our lungs. This stops them from being able to clear away other harmful chemicals.</p> <p>Chemicals like hydrogen sulphide and pyridine irritate our airways. Toluene can damage brain cells and interfere with their development.</p>

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