

# Benzene

## General information

### Key Points

#### Fire

- Highly flammable volatile liquid
- Vapour/air mixtures may be explosive
- In the event of a fire involving benzene, use normal foam and wear liquid tight clothing and breathing apparatus

#### Health

- Toxic by inhalation and ingestion
- Harmful and irritant
- Carcinogen and possible mutagen
- Short term exposure to low levels can be irritating to eyes and can result in drowsiness, rapid heart rate, headaches, tremors, confusion and unconsciousness
- Long term exposure to low levels can cause onset of a range of diseases including cancer
- Exposure to high levels may result in death
- Benzene can cause leukaemia (a type of blood cancer)
- It is not known if benzene can cause damage to the unborn child

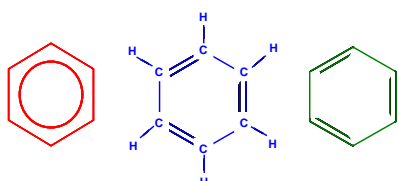
#### Environment

- Avoid release into the environment
- Inform Environment Agency of substantial release incidents

## Background

Benzene is mainly produced from crude oil and is a colourless, volatile liquid with a characteristic sweet odour.

Benzene is described as an “aromatic” hydrocarbon and is composed of a ring of six carbon atoms which can be represented by any one of three structures:



Benzene is normally present in the air at low concentrations, ranging from around 1 part per billion (ppb) in rural locations to 67 ppb at peak times in industrial areas. Nearly all airborne benzene is due to human activity, a proportion of which is due to road traffic emissions.

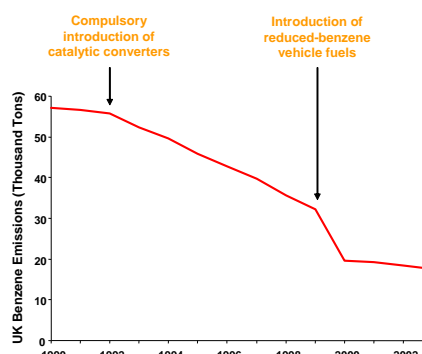


Benzene is also produced as a product of combustion and can be found in smoke arising from fires and tobacco products.

Around 640 thousand tons of benzene is used annually in the UK, mainly in the manufacture of other chemicals such as plastics, foams, dyes, detergents, solvents, drugs and insecticides. Before its toxic nature was realised, benzene was previously used in cosmetics (e.g. aftershaves), domestic (cleaning) solvents and in the process of decaffeinating coffee. Its use in such consumer products or processes is no longer permitted.



Two measures have substantially contributed to the reduction of benzene emissions in the UK; the compulsory introduction of catalytic converters on car exhausts and legislation to reduce benzene levels in car fuels:



Benzene is toxic, has mutagenic properties and can cause cancer in humans. Short term exposure to low levels can be irritating to eyes, cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion and in some cases unconsciousness. Exposure to high concentrations can result in death.

In the past, occupational exposure has been shown to produce a range of diseases, including a decrease in white blood cells (which normally help fight infections), leukaemia (a type of blood cancer) and damage to DNA (mutagenicity). Therefore, exposures to benzene in the workplace are now subject to very strict limits.

## Production and Uses

### Key Points

- Benzene is commercially produced from crude oil.
- Air emissions of benzene predominantly arise from road traffic.
- The UK consumption of benzene in 2004 was approximately 640 000 tons.
- Benzene is an important chemical required for the manufacture of a wide range of industrial, domestic, medicinal and agricultural products.

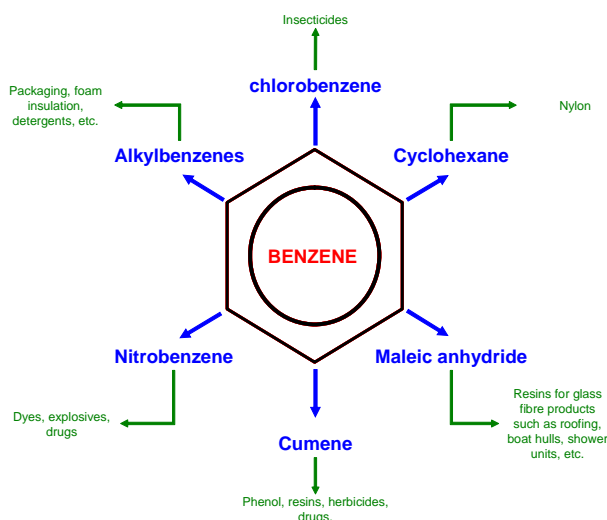
The vast proportion of benzene is currently obtained from crude oil by processes known as 'cracking', 'reforming' and/or 'disproportionation'.

Cracking describes various processes that can be used to break up larger molecules found in crude oil into smaller molecules such as benzene. This usually involves harsh conditions such as high temperature or pressure combined with steam (steam cracking), catalysts (catalytic cracking) or hydrogen (hydrocracking). The process of cracking produces 'raw pyrolysis gas' (abbreviated to RPG) which contains a large proportion of benzene.

Reforming uses the naphtha fraction distilled from crude oil. Naphtha is the generic term given to a range of hydrocarbons, including molecules containing six to ten carbon atoms arranged in a straight chain (alkanes). Following removal of sulphur and treatment with hydrogen (hydroforming), the naphtha fraction is passed over a metal catalyst under pressure which causes the straight chain molecules to rearrange into ringed (aromatic) structures such as benzene, methylbenzene (toluene) and dimethylbenzene (xylene).

The process of disproportionation generally follows naphtha reformation where an excess of toluene is converted to benzene and xylene. This requires hydrogen, high temperature and pressure and the use of various types of catalyst (to increase the rate of the reaction).

Benzene is a starting material for a wide range of chemicals which feed into major industrial manufacturing processes:



### Frequently Asked Questions

#### *What is benzene?*

Benzene is a colourless, volatile liquid with a characteristic sweet odour. Each molecule of benzene is composed of a ring of six carbon atoms (each connected to a hydrogen atom). Benzene is the starting material for a range of chemicals used in major industrial manufacturing processes.

#### *How does benzene get into the environment?*

The vast majority of benzene emissions are produced from internal combustion engines (i.e. from road traffic) and manufacturing processes, with smaller amounts being produced from fires and recycling processes.

#### *How can I be exposed to benzene?*

As a volatile liquid, benzene rapidly evaporates and is a common air pollutant, although generally present in very low concentrations. Therefore, most exposures are from inhalation. An additional (significant) source of benzene is from smoking tobacco products.

#### *If there is benzene in the environment will I have any adverse health effects?*

The presence of benzene in the environment does not always lead to exposure. Clearly, in order for it to cause any adverse health effects you must come into contact with it. You may be exposed by breathing, eating, or drinking the substance or by skin contact. Following exposure to any chemical, the adverse health effects you may encounter depend on several factors, including the amount to which you are exposed (dose), the way you are exposed, the duration of exposure, the form of the chemical and if you were exposed to any other chemicals.

In general, the concentrations of benzene in the air are very low and are unlikely to contribute to ill health. Short term exposure to low levels of benzene by inhalation can cause irritation to eyes, also drowsiness, dizziness, an increase in heart rate, the onset of headaches, tremors, confusion and in some cases can result in unconsciousness. Exposure to high concentrations of benzene by inhalation can result in death. Long term exposure has been shown to result in a range of diseases such as aplastic anaemia and leukaemia (a type of blood cancer).

#### *Can benzene cause cancer?*

Yes. Benzene is known to produce leukaemia in humans.

#### *Does benzene affect children or damage the unborn child?*

There is little information on the effects of benzene on children. However, they may be more susceptible to the effects of benzene due to their smaller size. No definite association has been made between exposure during pregnancy and birth defects. However, exposure to benzene during pregnancy should be avoided.

### *What should I do if I am exposed to benzene?*

You should remove yourself from the source of exposure.

If you have got benzene on your skin, remove soiled clothing, wash the affected area with lukewarm water and soap for at least 10 – 15 minutes and seek medical advice.

If you have got benzene in your eyes, remove contact lenses, irrigate the affected eye with lukewarm water for at least 10 – 15 minutes and seek medical advice.

If you have inhaled or ingested benzene, seek medical advice.

This document will be reviewed not later than 3 years or sooner if substantive evidence becomes available.