
Local Air Pollution

Introduction

Historically, in both developed and developing countries the main cause of air pollution was smoke and sulphur dioxide arising from the burning of fossil fuels for industrial purposes.

Now, the main cause of air pollution is traffic emissions. Both petrol and diesel engines emit a range of pollutants including sulphur dioxide, carbon monoxide, nitrogen oxides, volatile organic compounds and particulate matter.

Air pollution levels vary from day to day and area to area. The levels of pollution can be affected by a variety of things, including:

- local and regional sources of pollution
- seasonal variations in weather conditions
- local landscape and surroundings

High levels of pollution are often found in the following locations:

- where there is a high usage of solid fuels for domestic heating
- near busy roads with high traffic volumes
- in towns and cities ;located in valleys
- in cold, still, foggy weather, in urban areas
- in hot, still, sunny weather in suburban and rural areas

Lower levels of pollution are found in the following locations:

- towns and cities located on hills
- near roads with light traffic volumes
- in areas where smokeless fuels are used for domestic heating
- in rural areas away from factories and major roads
- in wet and windy weather at any time of the year

Note : Not all air pollution is caused by human activity. Naturally occurring forest fires caused by lightning strikes and pollution from volcanic eruptions also cause air pollution.

Pollution from traffic

Traffic produces various pollutants, including:

- **Sulphur dioxide (SO₂)**

Sulphur dioxide combines with water vapour in the air to produce acid rain which affects trees and other vegetation, causes deterioration of buildings and pollutes water courses with consequent adverse effects on aquatic life forms.

Sulphur dioxide in the air can also affect human health directly by worsening the effects of asthma and chronic lung diseases.

- **Carbon Monoxide (CO)**

Carbon monoxide is a toxic gas resulting from the combustion of hydrocarbons. Approximately 90% of carbon monoxide pollution comes from road traffic emissions.

Carbon monoxide survives in the atmosphere for about a month before being oxidised to carbon dioxide.

Carbon monoxide reduce the capacity of the blood to transport oxygen. This can have adverse effects on people, particularly those who have heart disease.

- **Nitrogen oxides (NO_x)**

Nitrogen oxides are produced when burning fuels. The main source of nitric oxide (NO) and nitrogen dioxide (NO₂) is road traffic emissions.

Nitrogen oxides irritate the lungs and lower resistance to respiratory infections such as influenza.

- **Ozone**

This is formed at low levels of the atmosphere as a product of the reaction between nitrogen dioxide, hydrocarbons and sunlight.

Unlike sulphur dioxide, nitrogen oxides and carbon monoxide, which have high concentrations in urban areas, ozone has higher concentrations in rural areas.

Ozone irritates the lungs affecting those who suffer from asthma.

- **Toxic organic micro pollutants (TOMPs)**

These are produced by the incomplete combustion of fuels. Although they are only produced in minute quantities, they are highly carcinogenic.

Pollution from traffic

- **Volatile organic compounds (VOC's)**

These are present in vehicle exhaust gases either as unburnt fuel or combustion products. They are also present in the atmosphere from the evaporation of solvents and fuels.

They can cause disorders of the liver and kidney, the central nervous system, the reproductive system and they can also cause cancers such as leukaemia and lymphoma.

- **Lead and other heavy metals**

Lead particles are emitted into the air from fossil fuel combustion, waste incineration and metal production industries.

As tetra-ethyl lead it has been used for decades as an additive to petrol. With the increasing use of unleaded petrol, lead concentrations in the atmosphere have reduced in recent years.

Even small amounts of lead can be harmful especially to infants and children. It causes neurological damage affecting memory and attention span.

- **Particulate matter (PM₁₀)**

Particulate matter varies widely in its chemical and physical composition. Particulates having a size less than 10µm (micrometres) are the main cause for concern. They arise mainly from diesel engine emissions.

They can penetrate deep into the lungs where the fine particles cause inflammation. This has adverse effects on those with heart and lung disease.

Smog

Originally the term **smog** referred to a mixture of smoke and fog experienced in London during the 1950's. At the same time, cities on the west coast of the USA were experiencing a different type of pollution, called **petrochemical smog**, which was produced by the action of sunlight on a mixture of hydrocarbons and nitrogen oxides.

Smog alerts are common in cities, in various parts of the world, with large traffic volumes. Smog irritates people's eyes, nose and throat. It also affects people with heart and respiratory conditions.

Smog

It is estimated that breathing in the air in Mexico City is equivalent to smoking 2 packets of cigarettes per day. In Athens, the mortality rate during smog is six times greater than when there is no smog.

Generally there are two types of smog :

- **summer smog - (ozone)**

This is caused on hot, still, sunny days by a mixture of pollutants including:

- vapours from solvents and fluids
- road traffic emissions
- combustion of fossil fuels at power stations

The action of sunlight on these pollutants produces ozone which stays close to ground level. Ground level ozone is a colourless, highly irritating gas. Unlike the ozone that forms naturally in the stratosphere, ground level ozone does not provide protection from the sun's UV radiation, nor does it rise up to the upper atmosphere.

High levels of ground level ozone can also reduce crop yields of citrus fruits, grapes, potatoes and soy beans. In addition, prolonged exposure to ozone will cause cracking of rubber; cause fading of paints and dyes and weakening of synthetic fibres.

- **winter smog - (particulates)**

This is caused on cold, still, winter days by a mixture of pollutants including :

- road traffic emissions
- industrial emissions
- combustion of fossil fuels at power stations
- combustion of fuels used to heat homes, offices etc.

A layer of cold air traps the pollutants at a low level.

As well as reducing visibility, particulates affect human health, especially the respiratory system. Airborne particles also contribute to the soiling of buildings and fabrics and contaminate the soil.

Because pollutants move with the air flow, smog is not a problem confined to urban areas

The UK Air Quality Strategy

The government has published "**The Air Quality Strategy for England, Scotland, Wales and Northern Ireland**". This aims to establish the future standards of air quality in the UK and sets out the measures required to achieve them.

It sets air quality standards and objectives for eight key air pollutants to be achieved between 2003 and 2008:

1. benzene - from petrol vehicles, petrol refining and distribution
2. 1, 3 butadiene - from petrol and diesel vehicles
3. carbon monoxide - from petrol vehicles and industry
4. lead - from petrol vehicles and industry
5. nitrogen oxides - from petrol vehicles and power generation
6. ozone - reaction product
7. PM₁₀s - from diesel vehicles and industry
8. sulphur dioxide - from power generation and industry

Following a review and public consultation in 2001, an Addendum was published in February 2003. It introduces tighter objectives for particles, benzene and carbon monoxide and a new objective for polycyclic aromatic hydrocarbons.

Industry is a major polluter. Various government agencies have responsibilities regarding the control of pollution. These include:

- The Environment Agency - (England and Wales)
- The Scottish Environmental Protection Agency
- The Industrial Pollution and Radiochemical Inspectorate (Northern Ireland)

Local Authorities also have a role to play in improving air quality through a system of Local Air Quality Management. (LAQM).

It is, however, not just local and central governments responsibility to ensure good air quality, everyone has a part to play.

- **transport**
 - Individuals can help by walking or cycling rather than using a car
 - Sharing vehicles and using public transport also reduces pollution
 - Not using cars for short journeys
 - Keeping a car serviced regularly
- **in the home**
 - using water based paints and preservatives
 - using low solvent paints, varnishes and adhesives
 - not burning household waste, especially rubber and plastics

Assessment

Local Air Pollution

Questions 1 to 5 - Select the correct response for the following questions :

1. Historically the main cause of air pollution has been ?

A nitric oxide
B carbon dioxide
C sulphur dioxide
D carbon monoxide

2. In which of the following locations are high levels of air pollutants often found ?

A near busy roads with high traffic volumes
B in towns and cities located on hills
C in areas where smokeless fuels are used for domestic heating
D in wet and windy weather at any time of the year

3. Which of the following is the product of the reaction between nitrogen oxides, hydrocarbons and sunlight ?

A nitric oxide
B carbon dioxide
C sulphur dioxide
D ozone

4. Which of the following is formed on dry, cold, still days by a mixture of pollutants?

A acid rain
B summer fog
C winter fog
D global warming

5. The UK Air Quality Strategy sets air quality standards to be achieved by ?

A 2003
B 2005
C 2008
D 2010

Questions 6 to 10 - Decide whether each of these statements is True (T) or False (F).

6. i) Both petrol and diesel engines emit a range of pollutants including sulphur dioxide, carbon monoxide, volatile organic compounds and particulate matter.
ii) Not all air pollution is caused by human activity.

Which option best describes the two statements?

- A i) T ii) T
B i) T ii) F
C ii) F ii) T
D ii) F ii) F

7. i) Sulphur dioxide in the air can also affect human health directly by worsening the effects of asthma and chronic lung diseases.
ii) Carbon monoxide reduce the capacity of the blood to transport oxygen. This can have adverse effects on people, particularly those who have heart disease.

Which option best describes the two statements?

- A i) T ii) T
B i) T ii) F
C i) F ii) T
D i) F ii) F

8. i) Unlike sulphur dioxide, nitrogen oxides and carbon monoxide, which have high concentrations in urban areas, ozone has higher concentrations in rural areas.
ii) Volatile organic compounds, which are present in vehicle exhaust gases either as unburnt fuel or combustion products, do not affect human health.

Which option best describes the two statements?

- A i) T ii) T
B i) T ii) F
C i) F ii) T
D i) F ii) F

9. i) Particulates can penetrate deep into the lungs where the fine particles cause inflammation. This has adverse effects on those with heart and lung disease.
ii) Lead particles in the atmosphere affect adults but not infants and children.

Which option best describes the two statements?

- A i) T ii) T
B i) T ii) F
C i) F ii) T
D i) F ii) F

10. i) Summer smog contains mainly particulates.
ii) The responsibility for improving air quality lies only with national and local governments.

Which option best describes the two statements?

- A i) T ii) T
B i) T ii) F
C i) F ii) T
D i) F ii) F

Assessment

Local Air Pollution

Solutions

1. C
2. A
3. D
4. C
5. C
6. A
7. A
8. B
9. B
10. D