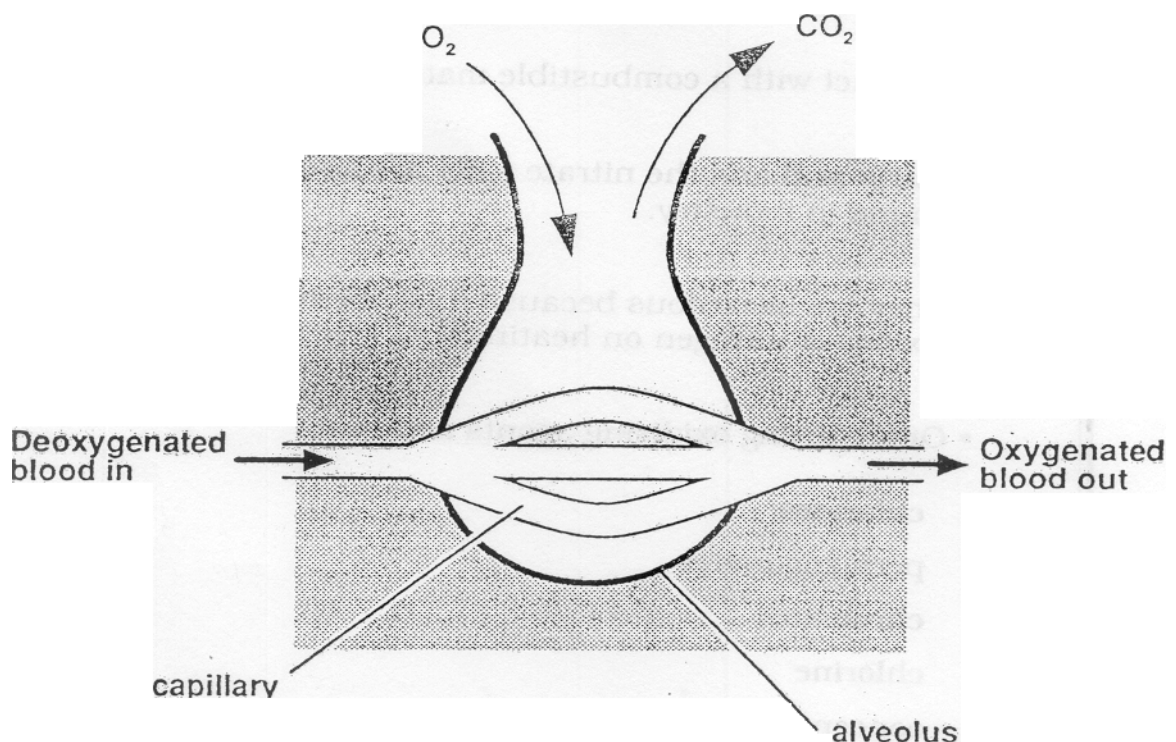


Noxious Fumes and Gases

The tissues of the body require oxygen O_2 for normal metabolic processes (ie. the oxidation of food to produce energy). They must also eliminate CO_2 , which is the waste product of respiration.

Gas exchange takes place in the lungs. Inhaled air enters an extensive system of sac-like structures called alveoli. Within each alveolus lies a vast network of capillaries (minute blood vessels). Gases can pass through the alveolar membrane into the capillaries.



Gas exchange in lungs

Oxygen is carried from the lungs to the tissues by the haemoglobin in the blood.



In the tissues the oxygen is given up by the haemoglobin and the waste CO_2 is picked up and carried to the lungs, where, it is exhaled.

Noxious fumes and gases may prevent respiration taking place in two different ways:

1. Damage the alveolar membrane which prevents gas exchange

Examples of "corrosive" fumes and gases are:

Hydrogen chloride HCl

Ammonia NH₃

Chlorine Cl₂

Nitrogen dioxide NO₂

Sulphur dioxide SO₂

These gases are described as having a 'choking' effect, and attack the tissues of the throat and lungs. Suffocation results, because gas exchange cannot take place.

**2. Enter the blood stream and have their toxic effect on the tissues.
("Systemic" poisons)**

- CO combines with the haemoglobin in the blood so preventing oxygen being transported to the tissues.
- HCN travels to the tissues where it prevents respiration occurring in the cells.
- H₂S attacks the nervous system causing paralysis of the respiratory centre.

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▪ **Carbon Monoxide, CO**

Uses

Fuel, preparation of Methanol. Ethane

Other Source. Incomplete combustion of carbon and other carbon containing materials. Carbon monoxide is produced in quantity nearly every time there is a fire involving ordinary combustibles, especially fires in baled or piled materials, or fires in enclosed spaces.

Properties

- Colourless gas
- No smell
- About the same density as air
- Almost insoluble in water
- Burns readily in air to form carbon dioxide
- CO combines with haemoglobin 200 times faster than O_2
- Low concentrations produces dizziness and headaches.
- Concentrations above one percent are fatal within a few minutes

Hazard

- Detection is difficult

▪ **Ammonia NH_3**

Uses

Manufacture of fertilisers (ammonium sulphate ammonium nitrate), nitric acid and urea. Used as a refrigerant, and solvent.

Properties

- Distinctive smell
- Colourless gas, fumes in moist air
- Flammable in a high concentration of oxygen
- Low density (about half that of air), so It rapidly diffuses upwards,

- Very soluble in water, so can be removed from air using water fog.
- Forms dense white fumes in the presence of HCl (used to detect leaks).
- Reacts with CO₂ (this is another method of removing ammonia)
- Easily liquefied under pressure (liquid ammonia is used as a refrigerant).

Hazard

- Irritates eyes and skin, attacks tissues of throat and lungs.
- Can be fatal in quite low concentrations, throat and lung passages swell and block airways-

Chlorine Cl₂

Uses: Water sterilisation (water supplies and swimming pools), bleach for paper and fabrics. Manufacture of dyes, drugs, HCl and solvents.

Properties

- Greenish yellow gas
Pungent smell
- High density (two-and-a-half times that-of air), so it will sink to lower areas such as basements.
- Easily liquefied under pressure.
- Oxidising agent - supports combustion of hydrogen and hydrocarbons, reactive metals such as sodium, magnesium, iron powder and reactive non-metals such as phosphorous and sulphur.
- Dissolves partially in water forming an acid solution.
- Reacts with CO to form phosgene COCl₂, a very toxic gas.
- Detection of leaks - forms white fumes with ammonia.
- Bleaches moist litmus paper.

Hazard

- Irritates eyes, nose and throat.
- Corrosive effect on respiratory tract causing suffocation.

Hazardous Chemicals

The bulk storage of chemicals may be hazardous for a variety of reasons.

Hazardous materials include

- Fuels - gases or liquids - highly flammable
- Solvents - liquids - highly flammable
- Oxidising agents (supporters of combustion)
- risk of explosion when in contact with combustible material
- Corrosive substances e.g. concentrated acids, alkalis
- Toxic substances e.g. pesticides etc., noxious fumes and gases
- Water-reactive substances e.g. sodium metal, concentrated sulphuric acid
- Radioactive substances

Summary

Noxious gases and fumes are toxic because they either

- Attack the lining of the lungs and prevent gas exchange occurring
or
- Pass into the blood stream where the poison is taken to the tissues.
(systemic poisoning)
- Carbon Monoxide CO
Ammonia NH₃
- Chlorine Cl₂ ... are common noxious gases
- Chemicals may provide a variety of hazards, especially when they are stored in bulk.