

WATER POLLUTION and CONTROL

Acid Rain

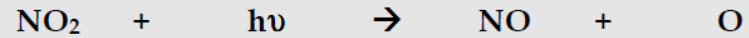
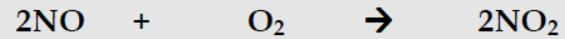
- Acid rain not only has an adverse effect on environmental ecosystems, but also affects human health and many of the materials, such as building stone and textiles, that are used in daily lives.

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- Acid rain has had major ecological consequences in other parts of the world.
 - Acid rain also has the potential to affect tree and plant life by direct contact with the plants, and also by modifying the acidity of soils
 - Different soils react differently to acid rain depending on their buffering ability, which is their ability to withstand large changes in pH.

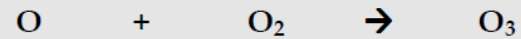
The effects on various materials of acid deposition (source: McCormick 1997)

Material	Effect	Principal air pollutants	Other factors
Metals	Corrosion, tarnishing	SO ₂ , acid gases	Moisture, air, particles, salt
Building stone	Surface erosion, soiling, black crust formation	SO ₂ , acid gases	Mechanical erosion, salt, particles, moisture, CO ₂ , temperature, vibration, micro-organisms
Paints	Surface erosion, discolouration, soiling	SO ₂ , H ₂ S	Moisture, ozone, sunlight, particles, mechanical erosion, micro-organisms
Paper	Embrittlement, discolouration	SO ₂	Moisture, physical wear, acid used in manufacture
Photographic materials	Small blemishes	SO ₂	Moisture, particles
Textiles	Soiling, reduced tensile strength	SO ₂ , NO _x	Moisture, particles, light, physical wear, washing
Paints	Surface erosion, discolouration, soiling	SO ₂ , H ₂ S	Moisture, ozone, sunlight, particles, mechanical erosion, micro-organisms
Leather	Weakening, powdered surface	SO ₂	Physical wear, residual acids used in manufacture
Rubber	Cracking		Ozone, sunlight, physical wear

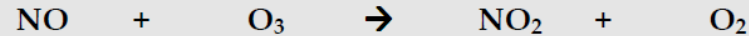
Nitric oxide can react with oxygen (O₂) to form nitrogen dioxide, which can be broken down again by sunlight (hν) to give nitric oxide and an oxygen radical (O):



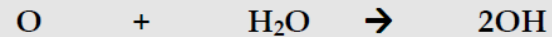
This oxygen radical then enables the formation of ozone (O₃):



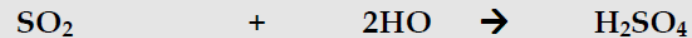
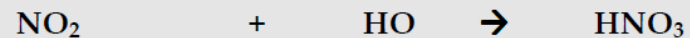
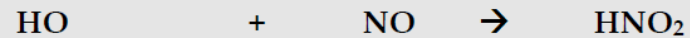
The presence of ozone causes the formation of more nitrogen dioxide by its reaction with nitric oxide:



Or the oxygen radical reacts with water to give the hydroxyl radical (OH):



This radical then reacts with nitric oxide to give nitrous acid (HNO₂) and nitrogen dioxide to give nitric acid (HNO₃). It also combines with sulphur dioxide (SO₂) to produce sulphuric acid (H₂SO₄):



How we can reduce acid rain

The most effective way to reduce the incidence of acid deposition is to reduce the emission of its causes—the ‘precursors’, nitrogen oxides and sulphur dioxide.

Nitrogen oxide reduction

The main method of lowering the levels of nitrogen oxides is by a process called ‘catalytic reduction’, which is used in industry and in motor vehicles. For example, a catalytic converter fitted to a car’s exhaust system will convert much of the nitric oxide from the engine exhaust gases to nitrogen and oxygen. In Australia, all motor vehicles built after 1985 must be fitted with catalytic converters.

Sulphur dioxide reduction

There are several methods to lower the sulphur dioxide emissions from coal-fired power stations. These include simple methods of prevention, such as using coal with a low sulphur content and physical coal cleaning.

- **Physical coal cleaning**

- Coal can be cleaned because sulphur in coal is often in the form of mineral impurities, such as pyrites, and these can be separated from the coal.
- The more finely coal is crushed before use, the more impurities such as sulphur that are removed from it.

- **Flue gas desulphurisation**

- Flue gas desulphurisation is based on using limestone to absorb the sulphur dioxide and is one of the most effective methods of removal.

References

- Anonymous 2004. EPA Information, Acid Rain-Why it's a Concern.