What are nitrogen oxides?

Nitrogen oxides (NO\textsubscript{x}), a mixture of nitric oxide (NO) and nitrogen dioxide (NO\textsubscript{2}), are produced from natural sources, motor vehicles and other fuel combustion processes. Indoor domestic appliances (gas stoves, gas or wood heaters) can also be significant sources of nitrogen oxides, particularly in poorly ventilated buildings. Nitric oxide is colourless and odourless and is oxidised in the atmosphere to form nitrogen dioxide, an odourous, brown, acidic gas that can affect human health and the environment. Nitrogen oxides are important components of photochemical smog.

Why do we measure nitrogen oxides?

Nitric oxide does not significantly affect human health but is important in reactions that generate photochemical smog.

Elevated levels of nitrogen dioxide cause damage to the human respiratory tract and can increase a person's susceptibility to, and the severity of, respiratory infections and asthma. Long-term exposure to high levels of nitrogen dioxide can cause chronic lung disease and may also affect sensory perception by reducing a person's ability to smell odours.

Nitrogen dioxide is also harmful to vegetation, can fade and discolour fabrics, reduce visibility, and react with exposed surfaces. Vegetation exposed to high levels of nitrogen dioxide can be identified by damage to foliage, decreased growth or reduced crop yield.

Sources of nitrogen oxides

Motor vehicles are the highest contributor to emissions of oxides of nitrogen (NO\textsubscript{x}), producing 63 per cent of all emissions in South East Queensland. Industry, other mobile sources including air, rail and shipping, and biogenic emissions from natural sources such as vegetation growth produce much less NO\textsubscript{x} than motor vehicles.

Air quality standards

The National Environment Protection Measure for Ambient Air Quality (Air NEPM) standard of 0.12 parts per million (one-hour exposure period) is intended to protect sensitive individuals such as children and asthmatics.

Typical outdoor nitrogen dioxide concentrations measured in recent years have been well below the Air NEPM goal for the protection of human health, and exposure at these levels does not generally increase respiratory symptoms.

However, with an increase in urban growth and motor vehicle use, the number of days with high nitrogen dioxide levels could become more frequent.

How are nitrogen oxides measured?

Nitrogen oxides are measured using a technique that is based on ‘chemiluminescence’, a chemical reaction that emits energy in the form of light. Essentially the reaction is the oxidation of nitric oxide (NO) to nitrogen dioxide (NO\textsubscript{2}) by ozone (O\textsubscript{3}).

It is an exothermic (heat-releasing) reaction that produces NO\textsubscript{2} in an activated state. When the NO\textsubscript{2} molecules return from their activated state back to normal, energy is emitted in the form of a small amount of light.

Since one NO molecule is required to form one NO\textsubscript{2} molecule, the intensity of the chemiluminescent reaction is directly proportional to the NO concentration in the sample. The analyser measures the amount of light emitted by the reaction and converts this value to a concentration.

The reaction only occurs between O\textsubscript{3} and NO; therefore the measurement of NO\textsubscript{2} is performed by diverting the incoming air stream through a converter, which reduces any NO\textsubscript{2} present to NO before entering the reaction cell. The difference between NO levels measured in the two streams is a measure of the amount of NO\textsubscript{2}.

For more information about air quality in Queensland, visit <http://www.qld.gov.au/environment/pollution/monitoring/air> or email: <air.sciences@dsiti.qld.gov.au>