Media communiqué

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Harmful Nitrogen Compounds in the Atmosphere

A Pressing Environmental Problem

Nitrogen oxides, which are found in automobile exhaust gases, are injurious to health. Ammonia produced by agricultural activity pollutes the soil and damages other ecosystems. The one day meeting on "Nitrogen Compounds in the Atmosphere" organized by Empa offered about 120 experts the opportunity to look in detail at emission sources, transport mechanisms, new metrological techniques and pollution reducing concepts.

In 2008 Switzerland emitted only about half the amount of nitrogen-containing pollutants as it did at the end of the 1980's. Enough reason to be complacent? "Not at all!" says Empa physicist Christoph Hueglin. Nitrogen oxide concentrations are still too high, above all in towns and cities and along major traffic routes. This is shown by measurements made by the National Air Pollution Monitoring Network (NABEL), which Empa operates in conjunction with the Swiss Federal Office for the Environment (FOEN). Nitrogen oxides, which are produced during the burning of fuels, among other processes, are damaging to human health, as are other pollutants such as ozone and fine particulates, in that they can encourage diseases affecting, for example, the respiratory organs.

A global problem

This unsolved problem is by no means unique to Switzerland, and is cause for concern internationally among air pollution specialists. Excessive emissions across the globe are affecting the Earth's nitrogen cycle on an unknown scale and also influencing in a complex way the carbon cycle – and thereby our planet's climate as well. One cause is our mobility. "The increasing level of mobility means that in 2010 there will be a global count of over one billion vehicles," explains Peter Hofer, a member of Empa's board of directors. "Predictions indicate that global saturation will occur at three to four billion vehicles. If engine technologies do not improve significantly in the meantime we will have to deal with an enormous increase in the emissions of nitrogen compounds."

And it is precisely when dealing with nitrogen oxide emissions by motor vehicles that significant improvements can be achieved thanks to effective technical measures. Through the systematic implementation of emission reducing technologies, such as catalytic converters based on ceramic foams (developed at Empa), it should be possible to solve the problem within the foreseeable future, according to Christian Bach, Head of Empa's Internal Combustion Engines Laboratory.

In addition to their disreputable role as precursor compounds in the generation of ozone and fine particulates, nitrogen oxides also have damaging effects on agriculture. True, ammonia was originally held in

high regard in the 19th century as the raw material from which many chemical products could be made (including synthetic fertilizers) and as such vaunted as an important agent in the battle against hunger. Fertilizers did indeed mean improved harvests, but the nitrogen compounds they contained caused acidification and eutrophication (over-fertilization) of the soil. Among the other consequences, not least were the negative effects on the balance of greenhouse gas emissions and associated ecosystems. Albrecht Neftel of the Agroscope Reckenholz-Taenikon Research Station ART explained how these ecosystems are currently being investigated in the «NitroEurope» European research project. It is vitally important that we drastically reduce agricultural ammonia emissions, which are far too high – for example by using low-emission spreading techniques for liquid manure application to fields. Despite the fact that some reduction measures are already implemented, ammonia emissions from agricultural activities in Switzerland and large areas of Europe remain stubbornly unchanged at excessively high levels.

Emissions must be halved

To achieved ecologically harmless nitrogen application levels current emission for nitrogen oxides and ammonia must be approximately halved. And since aerosols containing nitrogen compounds can be transported great distance in the atmosphere, international coordination of reduction measures is necessary. Empa researcher and symposium organizer Robert Gehrig showed attendees how in the European Monitoring and Evaluation Program (EMEP), with its network of over a hundred measuring stations in 51 countries, the transport and deposition of nitrogenous compounds is modeled and observed. As an example, about 14,600 tons (out of a total of 16,200) of nitrates deposited in Switzerland per year originate outside the country. On the other hand Switzerland “exports” about 20,000 tons to its European neighbors annually. Internationally coordinated emission reduction measures are therefore absolutely essential.

To undertake such extremely complex investigations, high performance analytical measuring instruments are required. One example of such an instrument using new spectroscopic techniques is the quantum cascade laser spectrometer developed by Empa researcher Lukas Emmenegger. This device is capable of rapid and very sensitive analyses, and can even differentiate between isotopically different kinds of N_2O (nitrous oxide, also known as laughing gas). This means that it can separate nitrous oxide emissions sourced from combustion processes and “biologically produced” N_2O emissions from sewage treatment works.

The one-day meeting on “Nitrogen Compounds in the Atmosphere – Results from NABEL and Research Projects” held on 21st January 2010 was organized by Empa’s Air Pollution and Environmental Technology Laboratory together with the Swiss Federal Office for the Environment (FOEN), with support from the Commission for Atmospheric Chemistry and Physics (ACP) of the Swiss Academy of Sciences (sc nat)

Further information

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Figure 1) Nitrogen oxide concentrations are still too high, above all in urban areas and along major traffic routes.

Figure 2) Current levels of ammonia emissions from agricultural activities are much too high, and must be reduced – for example by the systematic use of low-emission techniques for spreading liquid manure.

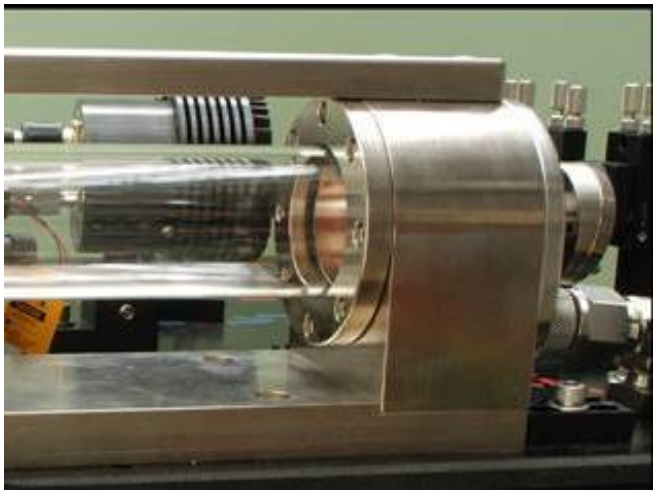

Figure 3) Powerful analytical measuring instruments are required to undertake the extremely complex investigations of air pollutant chemistry. One example is the new quantum cascade laser spectrometer developed at Empa, which uses new spectroscopic methods.

The images and the text in digital form can be obtained from redaktion@empa.ch.