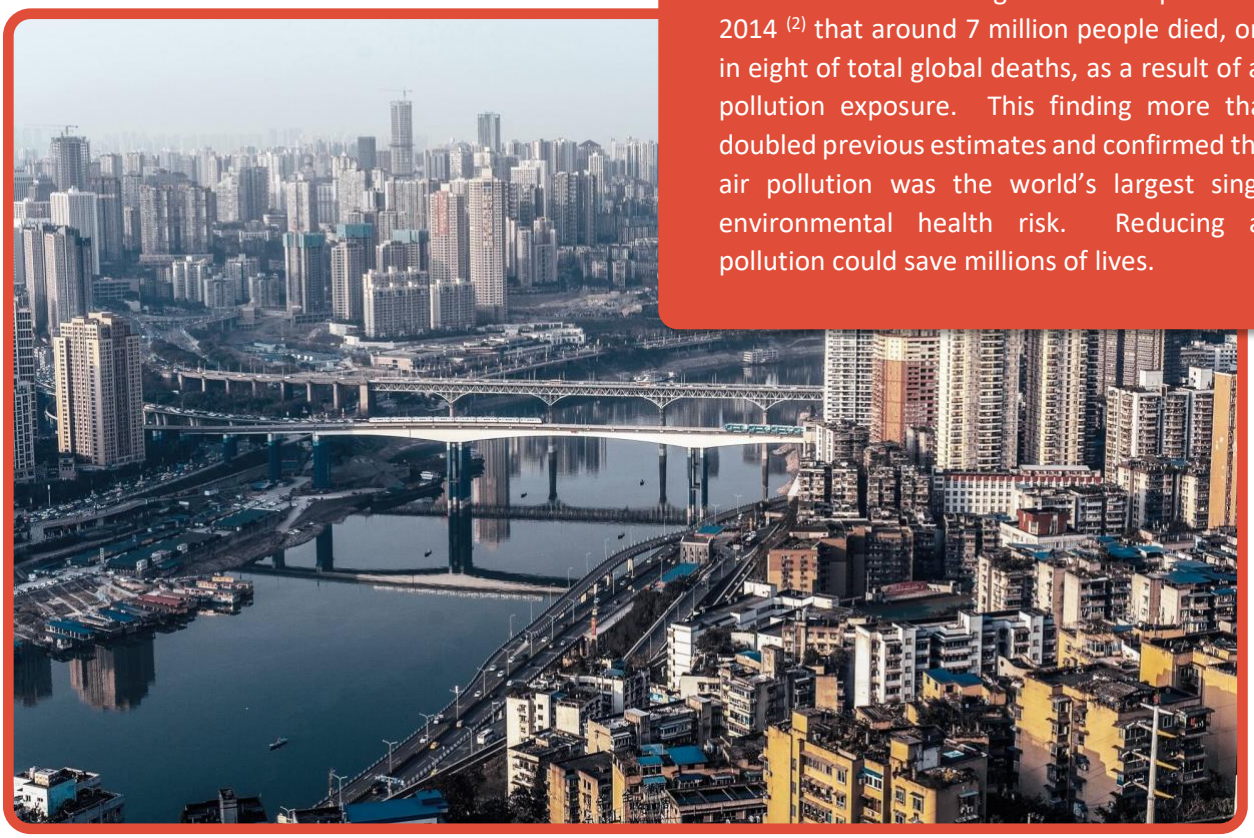
A guide to understanding air quality monitoring within the built environment

Sick building syndrome was identified many years ago when a pattern developed when workers became ill after working in new buildings. Many years later the problem still exists however we approach it differently

The ongoing issue

A recent Financial Times article [1] stated that, despite recent attempts to curb the use of coal as an energy source having gone some way to alleviate pollution in China, there is still work to be done. A time-lapse of satellite data revealed the extent of the pollution crisis, and how pollution spikes in winter, when coal is required for heating but it also reveals a troubling resurgence in pollution levels.

The World Health organization reported in 2014 [2] that around 7 million people died, one in eight of total global deaths, as a result of air pollution exposure. This finding more than doubled previous estimates and confirmed that air pollution was the world's largest single environmental health risk. Reducing air pollution could save millions of lives.



Photograph: Ming Chen

In particular, the new data revealed a stronger link between both indoor and outdoor air pollution exposure and cardiovascular diseases, such as strokes and ischaemic heart disease, as well as between air pollution and cancer. This is in addition to air pollution's role in the development of respiratory diseases, including acute respiratory infections and chronic obstructive pulmonary diseases.

Photochemical smog is produced when sunlight reacts with nitrogen oxides (NOX) and at least one volatile organic compound (VOC) in the atmosphere. NOX come from car exhaust, coal power plants, and factory emissions whilst VOCs are released from petrol, paints, and solvents. With time, the development of new technology coupled with legislation, lower emission targets and increased monitoring will hopefully mean that

such phenomena could become a thing of the past. The so-called dieselgate scandal has, however, put a renewed focus on air quality (NOX and particulates) which is driving Governments to enforce the adoption of electric cars and to move away from fossil fuels.

An urban world

According to professional services firm, Pricewaterhouse Coopers, our future is set to be urban. In a report [3], they state that more than half the world's population already live in urban areas and that 1.5 million people are added to the global urban population every week. Increasing population density means high rise living plus spending a lot of our time indoors. Whether at home or work or play, a US study [4] has put this latter figure at 90%.

So we are safe indoors, right? Unfortunately there are a plethora of agents that one might be subject to either singly or in combination and collectively impact on indoor air quality (IAQ) including:-

- Asbestos, once a commonplace building material which can be disturbed during renovation
- Radon, a naturally occurring, radioactive gas found in certain geographic areas
- Smoke, from burning fossil fuels for cooking typically found in developing countries
- Mold, a feature in wooden framed houses and commonplace in the US
- Carbon Monoxide from gas-fired heating
- Ozone, caused by sunlight on NOX, protective when in the upper atmosphere but poisonous at ground level
- Volatile Organic Compounds (VOCs) released from the adhesives in carpets, furniture , paint and cleaning products.

Photograph: Lorenzo Spoleti

Volatile Organic Compounds

VOCs in particular can cause immediate loss of life if inhaled directly from spray cans but repeated low level exposure can lead to chronic lung conditions. And because we are indoors, the pollutants do not disperse and become concentrated leading to poor IAQ.

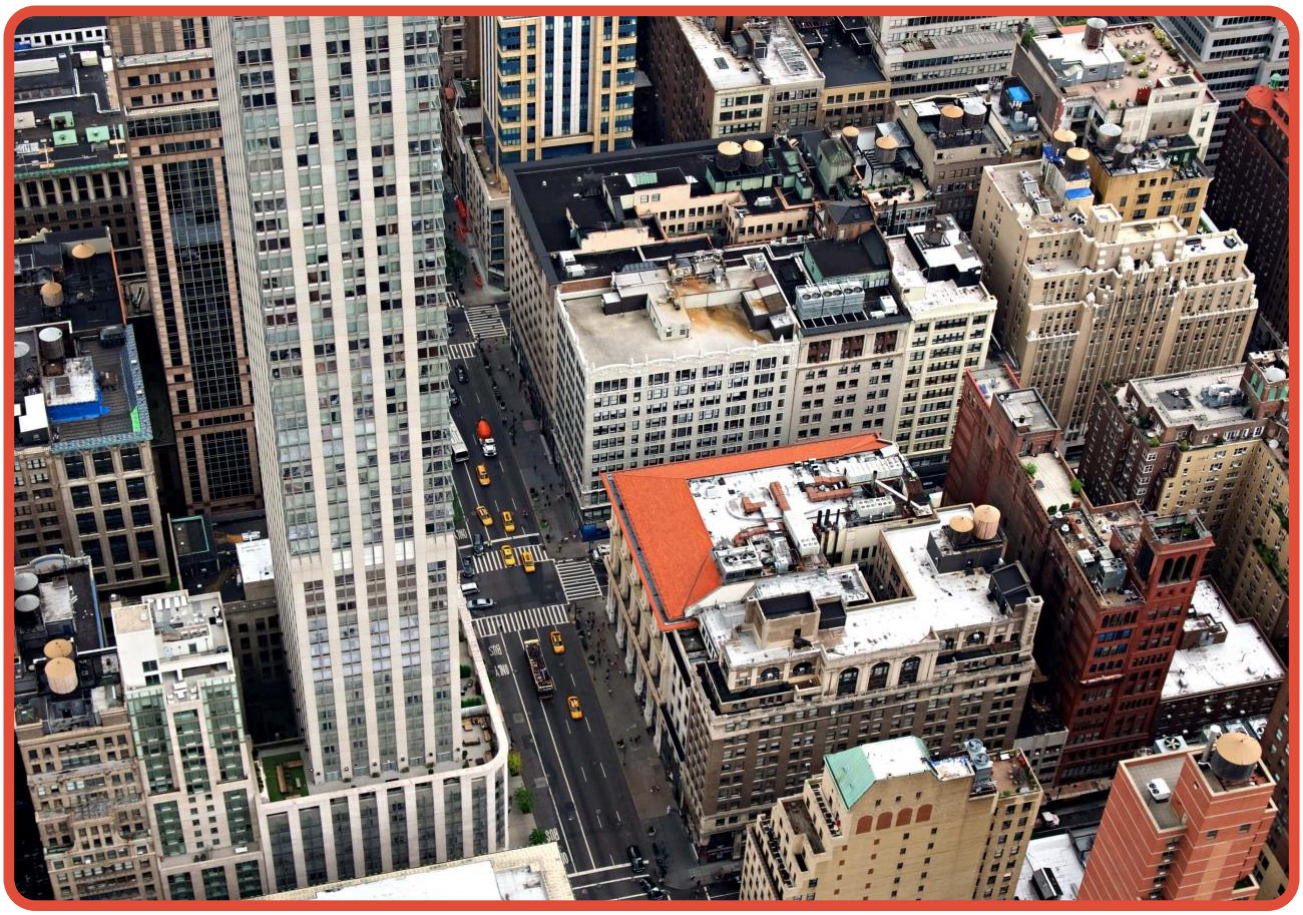
In the workplace there has been a lot of debate over a collection of acute symptoms which collectively are known as sick building syndrome the name for symptoms you only get while in a particular building, usually an office. Symptoms get worse the longer you're in a particular building and get better after you leave. Possible symptoms according to the NHS [5] include, headaches, blocked or runny nose, dry, itchy skin, dry, sore eyes, rashes, tiredness and difficulty concentrating, which means lower productivity.

Good ventilation is the key to overcoming many of these acute or chronic effects but heating, ventilating and air conditioning (HVAC) in office buildings tend to be energy hungry. Publically displaying your green credentials is becoming a must for organisations in our new sustainably-aware society. Multi-national companies are keen to show that every part of their business is green, including their buildings so building management systems (BMS) are one solution whereby widely distributed sensors that, for example, monitor temperature and humidity can be used to optimize HVAC performance but minimize energy use. Increasingly other agents are being incorporated including noise, particulates and VOCs.

IAQ is also affected by outdoor pollutants which may enter the building because of filter breakthrough due to poor maintenance and increasingly sensors are being deployed in the outdoor environment. Smart Cities use the data from widespread sensors to provide actionable insight that can be used in real-time for example to improve traffic flow, thus minimising pollution and energy usage. Sensors can also be sited at the fenceline of power plants and petrochemical manufacturing facilities to monitor their emissions, which again could be used as part of a feedback control system.

Summary

In conclusion, whilst the adverse link between the burning of fossil fuels, chemical pollutants and human health are well known, a solution in the form of green energy is still some way off. The demand for sensor technology which can be deployed in a wide variety of indoor and outdoor applications will drive particular developments in VOC sensors.



Photograph: Phil Hauser

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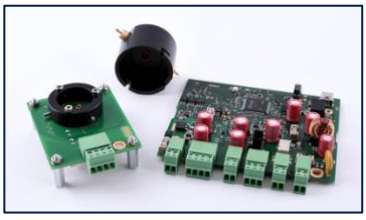
About ION Science

Ion Science provide a portfolio of handheld, fixed and portable photoionisation (PID) detection instruments and PID sensors for the rapid, accurate detection of volatile organic compounds (VOCs). Find out more about our industry leading range of VOC detection solutions by clicking on the links below.

Discover our PID sensor development kit.

THE SENSOR DEVELOPMENT KIT

To aid the integration of the Ion Science MiniPID sensor



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