

# Continuous Monitoring of Multiple Indoor Air Quality (IAQ) Parameters

**Gareth Evans, PPM Technology Ltd**

Unit 34-35 Cibyn Industrial Estate, Caernarfon, Gwynedd, UK. LL55 2BD

Tel: +44 (0) 1286 676999 • Email: gareth@ppm-technology.com • Web: www.ppm-technology.com

**Measuring and monitoring hazardous gases is a critical issue in industrial and workplace safety. Many facilities are especially vulnerable to the effects of an unhealthy indoor environment when fuel-burning vehicles are used indoors. Placing an IAQ monitoring system in buildings and facilities enables immediate identification of IAQ problems, the sources and causes of any problem can be eliminated before symptoms become evident.**



Image 1: PPM Technology's Wireless IAQ Profile Monitor

PPM Technology's IAQ monitoring instruments are frequently used to monitor dangerous levels of Carbon Monoxide and Nitrogen Dioxide in indoor ice rinks and arena's, these facilities are vulnerable to these pollutants as fuel-burning equipment such as the ice-resurfacing vehicle are used indoors.

Our technology is also suitable for use in any other buildings where fuel-burning vehicles and machinery emit Carbon Monoxide and other harmful pollutants. For example; in buildings where forklift trucks are present, indoor parking areas and any other facilities where vehicles are used indoors. Other sources of Carbon Monoxide include from improperly vented furnaces, malfunctioning gas ranges and poorly maintained combustion devices (e.g. boilers, furnaces).

Any building, which uses machinery, equipment or vehicles that emit carbon monoxide or nitrogen dioxide into the indoor environment should have a proper monitoring system in place.

Forklift trucks are often constantly in use in many buildings such as warehouses and large-scale manufacturing environments, highly dangerous levels of Carbon Monoxide can be emitted unless properly controlled.

Whether powered by Diesel, LPG fuels or Electricity, engine powered forklift trucks emit carbon monoxide into the atmosphere. Carbon Monoxide, known as the silent killer is extremely dangerous as it cannot be seen or smelt. Therefore it needs to be regulated and monitored, it is also imperative that there is adequate ventilation within the area where the forklift will be operated.

Over time Carbon Monoxide obstructs the blood from carrying oxygen around. It then mixes with haemoglobin; it is this mix,

which causes serious problems and abnormalities to a person's health. Prolonged inhalation of this gas can actually cause a person to lose consciousness, experience nausea and headaches in extreme cases it can be fatal. It is for those reasons that emissions from forklift trucks and other vehicles need to be monitored.

Exposure to low levels of carbon monoxide (about 20 ppm) over an extended period (approximately 8 hours) is reported to result in the absorption of sufficient amounts to cause slight changes in temporal judgment or visual activity. These changes are slight and unlikely to be noticed by the affected person. Pre-existing respiratory or circulatory ailments in individuals can be aggravated when exposure levels increase above 30 ppm.

As carbon monoxide exposure increases above 50 ppm, headaches are more frequently reported. Depending on levels in excess of 50 ppm, and the duration of exposure, symptoms will progress from headaches and drowsiness to rapid breathing, nausea, and vomiting. At extremely high levels (greater than 800 ppm) there is a risk of death.

Typical IAQ investigation and examination consists of taking single-point measurements of pollutant levels. This monitoring method is unreliable, as the pollutant levels are subject to hourly and daily fluctuations. Building service professionals and designers alike have regarded these examination methods as being inadequate considering today's environmental challenges. Continuous monitoring means trends can be identified, ensuring the presence of high levels of Carbon Monoxide in a building can be prevented.

There are many other factors that must be considered to ensure a building achieves a healthy indoor air environment, including good ventilation and a well-maintained HVAC system, emission of airborne and chemical pollutants from a variety of sources, emission of organic pollutants from building materials, carpeting and furniture and pollution entering buildings from external sources (e.g. vehicle fumes). The concentrations of pollutants can be amplified by factors such as humidity and temperature.

PPM Technology's Wireless IAQ Profile Monitor enables

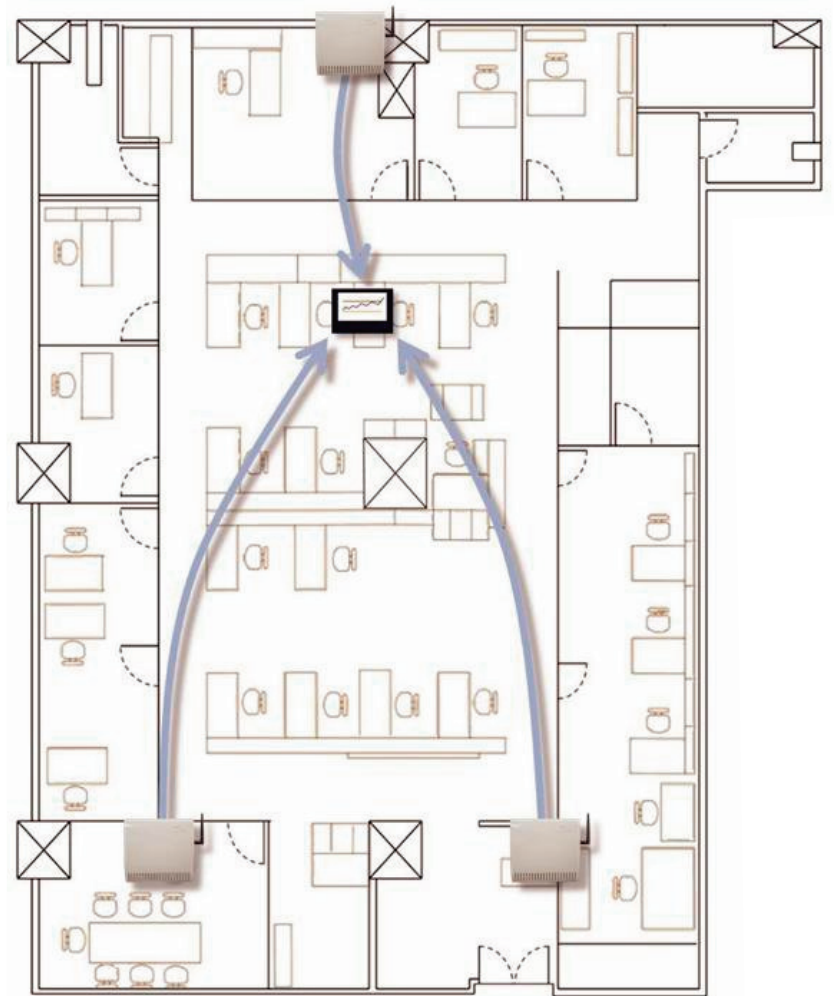


Image 2: Wireless monitoring units can be placed at various locations throughout an entire to achieve a complete and accurate profile of IAQ

simple, effective, and flexible management of air quality. It is able to collect a complete and accurate record of IAQ, presenting facility managers and health and safety officers with the data they need for effective air quality management within the building.

The wireless system enables simple continuous detection and measurement of many of the factors that contribute to a building's indoor air environment, including temperature, humidity, and numerous toxic gases and compounds, such as, carbon dioxide, carbon monoxide, nitrogen dioxide, sulphur dioxide, ammonia, formaldehyde, TVOCs, methane, ozone and smoke.

Controlling and monitoring these IAQ parameters would improve occupant comfort and work efficiency as well as immediate and long-term health.

Health effects from indoor air pollutants may be experienced

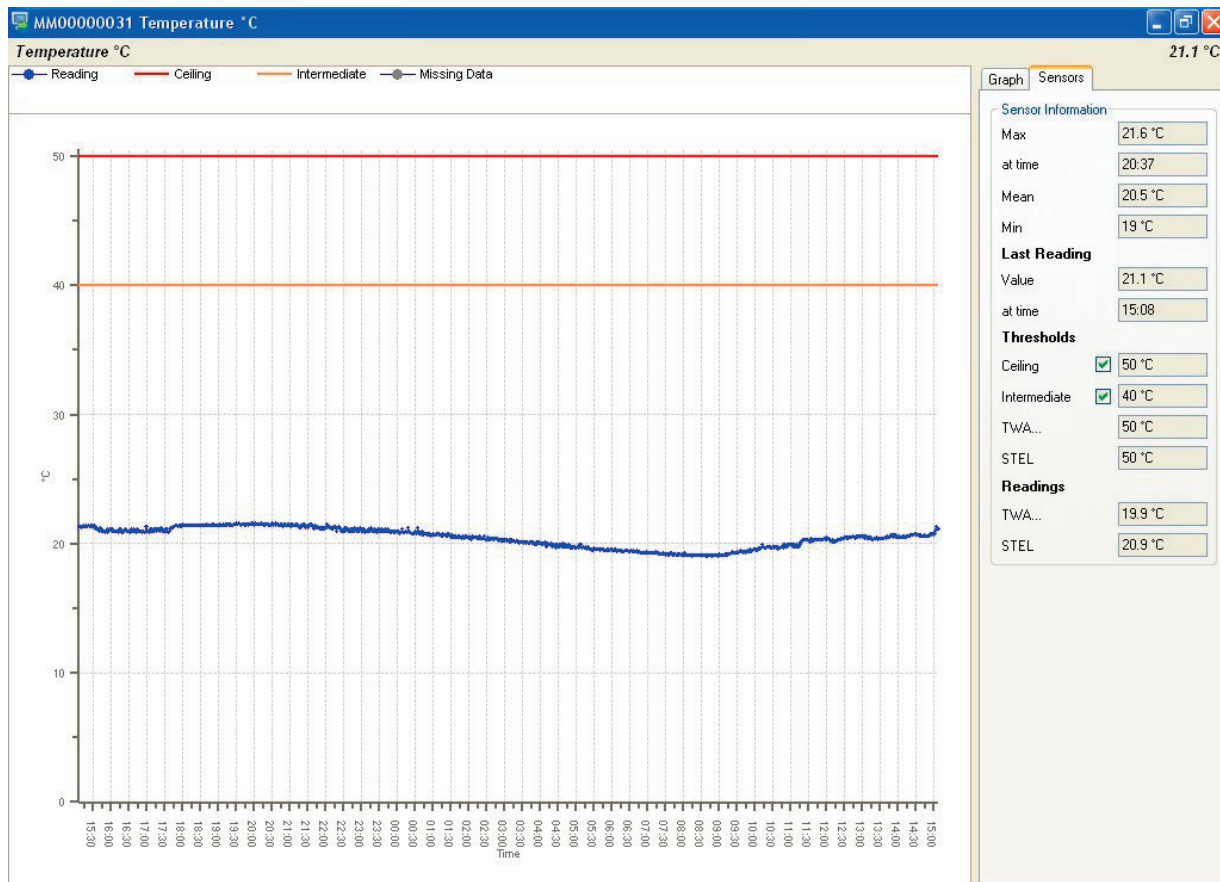


Image 3: The PPMonitor Software shows the collected data in real-time displayed in a graphical format

soon after exposure. The immediate ones are usually short-term and treatable such as eye, skin, nose, and throat irritation, headaches, dizziness and fatigue.

Long-term exposure to pollutant levels could have an effect on an individual's health in future years, these can be severely debilitating or become fatal illnesses, including some respiratory diseases, heart disease, and cancer.

The Wireless IAQ Profile Monitor uses the low-power, high-performance Zigbee wireless mesh network to communicate. A large number of units can be linked using this mesh networking; the system can show precise changes in concentration of selected IAQ parameters in various locations over time.

The collected data is presented on the controller PC in real-time. The graphical display enables the user to identify trends and patterns in the sampling; simple user interfaces enable easy operation of the software. The user can monitor and control each individual unit and sensor using the software. It is possible to create monitoring schedules using the software, which is ideal if monitoring only needs to take place for a set period of time (for example, during work hours only).

The software can set limits for temperature, humidity, and concentrations of hazardous gases, which when exceeded can activate and control the air-conditioning and ventilation systems. It can also turn heating on and off, and as a last resort trigger building alarms. The alarm can be triggered to give a warning that the gas concentration level has reached a non-critical but concerning level. A further alarm can give a more severe warning when this occurs.

An example of a 'multi-parameter' monitoring system recently supplied by PPM Technology was for the 'Secure Living' initiative based in Bolzano, Italy. The initiative aims to improve the quality of life of older citizens in the city of Bolzano, Italy. Allowing them greater independence and integration into society. This has been achieved through the introduction of a new system of remote monitoring and tele-assistance for people who need home care.

PPM Technology's wireless monitoring units were placed in a number of locations where vulnerable individuals live. The data is collected in real time and is analysed in the control room; if the data indicates immediate danger of any form, a dedicated team from Bolzano's Department of Social Services can be alerted and will take action if necessary.



Image 4: Forklift Trucks are commonly used indoors in manufacturing and warehouse facilities, they can emit potentially dangerous levels of Carbon Monoxide

The monitoring units supplied contained sensors for a number of parameters including temperature, humidity, carbon monoxide, carbon dioxide, natural gas - methane, smoke and water level. Monitoring of these parameters help ensure that vulnerable individuals are safe from over-exposure to the hazardous gases, and enable optimum indoor environment conditions to ensure the health, safety and well-being of the occupants and also to safeguard property.

A wireless IAQ sensor network has the ability for detailed monitoring in inaccessible locations where a wired infrastructure is not viable or possible. A building-wide network of monitoring units can be achieved, ensuring a more detailed representation of IAQ in general.

Continuous monitoring of IAQ enables a profile of the indoor air environment to be created, analysis of the recorded data through dedicated software allows for more efficient resource and energy management. The software can be used as an analytical tool to identify trends and rectify problem areas—leading to a better indoor environment and safer, more comfortable working conditions.