

Wireless Monitoring for a Safe Indoor Environment

In striving for the construction of energy efficient and cost-effective buildings, the imperative issue of the buildings Indoor Air Quality (IAQ) is often overlooked. This can often lead to an unhealthy indoor environment and even to conditions such as Sick Building Syndrome (SBS) or other Building Related Illnesses (BRI).

workers will spend their entire working day inside a building. Healthy, comfortable employees are invariably more satisfied and productive.

Measurement and monitoring of hazardous gases is a critical issue in industrial and workplace safety, conventionally worker safety has been concerned with acute levels of airborne pollutants, today there is also mounting concern about the affect of long-term exposure to low levels of pollutants.

There are many factors that can lead to an unhealthy Indoor Air Environment including poor or inadequate ventilation, airborne and chemical pollutants, Ozone emissions from printers and photocopiers, High concentrations of Total Volatile Organic Compounds (TVOC's), Formaldehyde and pollution from external sources (e.g. fumes). In the past few decades, energy conservation measures have led to airtight building construction that can create problems with IAQ. Frequently the ventilation systems are set to minimise the amount of fresh air entering and circulating within the building. This restriction impacts indoor air allowing a build up of air contaminants within the building that are not properly removed.

Sick building syndrome is said to occur when a substantial proportion of the occupants of a building experience symptoms associated with acute discomfort that are usually relieved upon leaving the premises. The mechanisms are still not fully understood, but poor indoor air quality is thought to be a major contributor to these problems.

Health effects from indoor air pollutants may be experienced soon after exposure, the immediate effects are usually short-term and treatable, including irritation of the eyes, skin, nose and throat, upper respiratory congestion, headaches, dizziness and fatigue.

Long term exposure to low levels of pollutants could have an affect on an individuals health in future years, these, according to the U.S. EPA/Office of Air and Radiation, can be severely debilitating or fatal illnesses including some respiratory diseases, heart disease, and cancer. Exposure to high levels of some pollutants, such as carbon monoxide, can even result in immediate death.

Typical indoor air quality investigation and examination consists of taking single point measurements of pollutant levels. This monitoring method is unreliable, as the pollutant levels is subject to hourly, daily and indeed seasonal fluctuations. Building service professionals and designers alike have regarded these IAQ examination methods as being inadequate considering today's environmental challenges.

Continuous monitoring means the problems associated with single-point measurements are eliminated, the advances in technology have made it possible for a wireless system to control and monitor IAQ parameters continuously in real-time. This has created a scientific approach to the systematic monitoring and management of any indoor air environment.

State of the art gas sensors, automatic sampling, data logging, digital technology and IT, has made it possible for IAQ profiling to be a accurate, efficient and therefore a cost effective system.

PPM Technology have utilised this technology in developing the Wireless IAQ Profile PPMonitor; it enables simple, effective and flexible management of Indoor 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 the effective management of air quality within the building.

A wireless system enables simple continuous detection and measurement of many of the factors that contribute to a building's Indoor Air Environment; such as Temperature, Humidity and a number of toxic gases and compounds including Carbon Dioxide, Carbon

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Controlling these IAQ parameters would improve the comfort and work efficiency of the occupants as well as their immediate and long-term health.

These substances are amongst the hundreds under the regulation of Occupational Exposure Limits (OEL). These are limits to control exposure to dangerous substances in the workplace; this is achieved by setting the maximum amount of (air) concentration of a specific substance. Limit values are laid down throughout the EU, but each Member State establishes its own national Occupational Exposure Limits. In the UK the Health and Safety Commission approved Workplace Exposure Limits (WEL) applies to all workplaces.

The limits intend to protect workers from excessive exposure to toxic substances, the exposure limits are averaged over a specified period of time referred to as a time-weighted average (TWA). Two time periods are used: long term (8 hours) and short term (15 minutes). Short-term exposure limits (STELs) are set to help prevent effects; such as irritations of the eye, nose and throat, headaches, dizziness and fatigue, these symptoms can occur following exposure for a few minutes.

Should the levels exceed the TWA and STEL limits for a specific parameter the software will give an immediate warning of this. The system can also initiate immediate audible and/or visible warning of the presence of harmful gases in the air thus protecting employees and the public; buildings can be immediately evacuated giving minimal exposure to the building occupants.

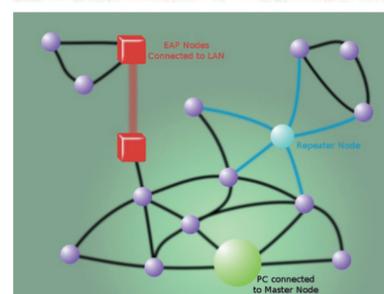
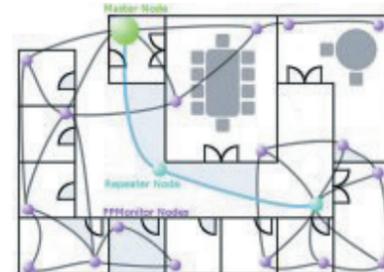
The alarm can be used to give a warning that gas concentration level has reached a non-critical but concerning level. It can then trigger the air conditioning system in response before the gas concentration reaches a critical level. A further alarm can give a more severe warning when the gas concentration reaches a critical level.

As a result the health of the workers/members of the public are safeguarded. The affected areas will not be contaminated for as long, thus minimising interruptions to the working day and consequently improving productivity.

A wireless gas detection system has many advantages over conventional detection techniques. First of all there is reduced installation costs, a wireless system means there is no need for expensive cables and underground cable conduits. The entire system can be configured and operational in less than a day.

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; this means a more detailed representation of indoor air quality in general. A network can be extended simply; by adding dedicated repeater nodes or additional wireless units, each unit with unique sensor specifications if necessary.

The PPMonitor utilises the low-power, high-performance Zigbee mesh wireless network to communicate. A large number of units can be linked using the Zigbee wireless mesh networking; the system can show precise changes in concentration of selected IAQ parameters in various locations overtime. The data can be received via the PC Zigbee





module; the data is then stored and can be used as detailed statistical data using the dedicated software. The software can also produce reports and also configure individual alarms for particular sensors.

The wireless system can integrate with the building automation system; dedicated Software allows an entire wireless system to be managed and controlled from a single PC, the software can set parameters for Temperature, Humidity and concentrations of hazardous gases which can then activate and control the air conditioning and ventilation systems, it can also turn on/off heating and as a last resort trigger building alarms.

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 ease of use and operation

of the software. The user can monitor and control each individual unit and sensor using the software. Limits can be set on each parameter, which when exceeded will set-off an on screen alarm. Relays can also be installed which can give visual and/or audible warnings if the limit is exceeded. The user can create monitoring schedules using the software. This is ideal if monitoring only needs to take place for a set period of time, for example during work hours only.

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 management of resources and energy. The software can be used as an analytical tool; trends can be identified, problem areas can be rectified; this should lead to better indoor air environment and safer, more comfortable working conditions.

If the building service engineer has the correct data relating to the day-to-day operation of the air conditioning system improvements to the design and management of the ventilation system can be made. A more effective air-conditioning or ventilating system also has a positive impact on the environment. It would also ensure optimum human comfort, energy conservation, cost effectiveness and health and well-being of those inside the building.

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