Area Monitoring for Chemical Warfare and Pharmaceutical Based Agents

Introduction

Area monitoring is a critical component of ensuring the safety and well-being of individuals and communities. Hazardous materials, in their many forms, can pose significant risks to human health and the environment, making it crucial to monitor their presence in the air. Whether it is due to industrial accidents, transportation mishaps, or deliberate acts of terrorism, hazardous materials can have severe consequences for public safety.

Area monitoring is the process of collecting, measuring, and analyzing samples of air to determine the presence, the type, and the concentration of hazardous materials in an area of concern. It is an essential tool in identifying and mitigating risks associated with hazardous materials, enabling responders to take timely and effective action to protect people and the environment.

Area monitoring is employed across numerous applications to ensure the safety of the public, laborers, or militaries operating in hostile environments. Environmental agencies across the world closely observe air quality through the use of various technologies in order to monitor levels of pollution hazards such as ozone (O_3) or $PM_{2.5}$ and PM_{10} particulates which pose inhalation hazards to the public. Militaries and first responders employ area monitoring technologies to safeguard critical infrastructure, key events, or for force protection. As threats have evolved over time, so have area monitoring technologies.

Traditional Area Monitoring Technologies

Over 100 years ago, canaries were first used in coal mines to alert workers to deadly levels of carbon monoxide. Since then, many technologies have been developed to detect various airborne threats. In the last fifty years, advances in technology made it possible to develop portable area monitoring equipment that could be used by first responders and militaries in the field. These devices were smaller, less expensive, and easier to use than the earlier equipment, and they made it possible for first responders to detect the presence of hazardous materials in the air quickly and accurately. These devices can detect a wide range of hazardous materials, including chemicals, gases, and particulates. Some devices can also provide real-time data, which can help first responders make decisions about how to respond to a hazardous materials incident. Many traditional area monitors utilize

Beacon Applications:

- **Hazmat response**
- **Large events**
- **Exclusion zone monitoring**
- **Decontamination monitoring**
- **VIP Protection**
- **Clandestine lab operations**
- **CBRN Vehicles**

technologies such as:

1. Photoionization Detectors- for detecting volatile organic compounds (VOCs)

2. Radiation Detectors- for detecting and measuring the presence of gamma radiation

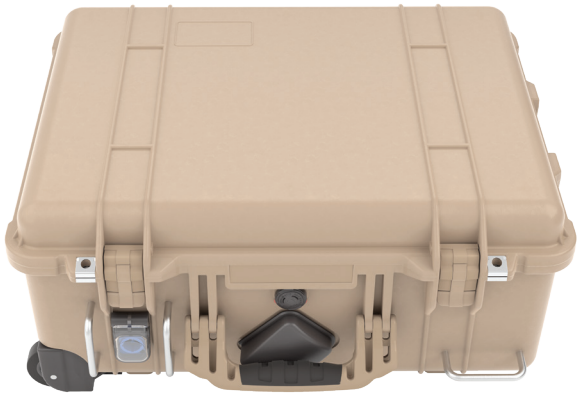
3. Electrochemical Sensors- for identification of various chemicals

4. FTIR Sensors- for identification of high concentration vapors

5. Meteorological Sensors- for monitoring environmental data such as wind and humidity

6. Biological detection suites- for early warning of potential pathogens and some toxins

This assortment of sensors provides broad coverage, but not without its challenges. Photoionization detectors (PIDs) provide trace (parts per billion/ppb) detection of VOCs but lack the ability to identify, by name, the threat present without a chemical separation technology, such as gas chromatography. For operators in the field, this is typically not an option. High concentrations of methane can hinder the performance of PIDs, and non-threat materials can generate cross sensitivities. Humidity can also effect PID performance, however some area monitoring solutions that incorporate meteorological sensors are able to automatically compensate for changing temperatures and humidities.



The MX908 Beacon is a remote area monitoring solution that provides real time identification of aerosol and vapor chemical warfare agents (CWAs) and pharmaceutical based agents (PBAs) for extended durations.

Many area monitoring solutions contain sensor slots which can be customized by the user. For example, an area monitor may have 3-5 sensor slots which can be filled with their choice of sensors for anything from a combustible sensor, carbon dioxide sensor, or any number of other toxic industrial chemicals (TICs). This provides great flexibility but can also be challenging as users are forced to decide which chemicals to detect or not detect. It's critical that PID calibration, sensor selection, and additional technologies are all considered in combination with likely threats to provide the best coverage possible for users.

Challenges and Gaps in Traditional Area Monitoring

While providing broad coverage for screening of VOCs, TICs, and gamma radiation, traditional area monitors lack the ability to identify, by name, more toxic threats such as chemical warfare agents (CWAs) and pharmaceutical based agents (PBAs). While there are many CWA detectors on the market, the ability to emplace and remotely monitor a device is less common. Furthermore, the ability to identify aerosolized threats is limited.

Traditional CBRNE detection equipment was designed to detect vapors which are characteristic of traditional G and V-series agents. Fewer technologies are available to detect and identify modern threats such as A-Series agents at operationally relevant levels in the field. This capability gap poses significant challenges to essential CBRNE tasks such as detection, determining limits of contamination, establishing control zones, selecting decontamination solutions, and verifying decontamination procedures. The US Department of Health and Human Services issued emergency response guidelines for these agents in 2019, where they noted that, "There is a limited fielded capability within hazardous materials teams to detect, characterize, and identify FGAs."

Pharmaceutical-based agents (PBAs) such as fentanyl and fentanyl analogs pose a similar threat due to their potency and potential lethality. In addition to their lethality, they also pose a challenge to first responders as they can be dispersed in an aerosolized form, which

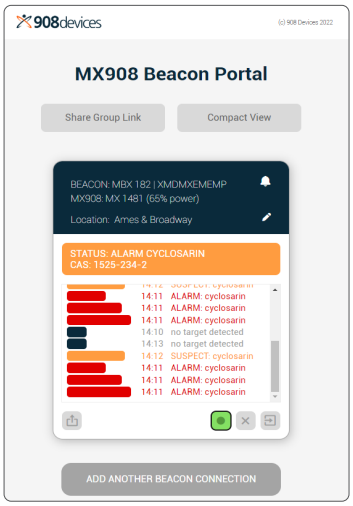
is not detectable by traditional vapor-phase area monitoring. PBAs were deliberately weaponized during the Moscow theater crisis where more than 100 people died from respiratory arrest after a PBA mixture was disseminated in aerosol form. Synthetic opioids are readily available through global illicit supply chains and are also synthesized by state actors making them a relevant threat all responders should consider when planning area monitoring missions.

Area Monitoring for Aerosol and Vapor CWAs and PBAs

With the introduction of the Aero module for the MX908, first responders had the ability to detect and identify vapor and aerosol threats simultaneously for the first time at point of contact. By easily switching sampling modules, a user can transition from analyzing solid and liquid samples to vapor and aerosol samples in seconds. While identifying vapor and aerosol threats with the MX908 provided a new and useful capability to responders, the need to do so remotely and for extended durations to support area monitoring missions became evident.

MX908 Beacon is compatible with any new or existing MX908 device. Users can access a remote portal to operate and view data in real time.

The MX908 Beacon™ is an accessory for the MX908 which enables remote operation and data viewing for extended durations to provide CWA and PBA threat coverage for area monitoring missions. By putting any MX908 into a Beacon case, users can access a remote portal on their laptop, phone, or other mobile device to operate the MX908, as well as view results in real-time. Additional batteries in Beacon allow for a unit to be in stand-by mode for up to 16 hours, followed by 8 hours of continuous operation. Longer operation time can be achieved by reducing stand-by time, and vice versa, or longer with direct power connection to standard outlets. The MX908 Beacon Portal provides a simple, easy to understand interface. From the portal, users can start and stop an analysis, view results, and share a link so that other team members can also view. The portal allows users to monitor a single MX908 Beacon, or multiple, if they are conducting a larger area monitoring mission. Individual Beacon units may be linked into the feed at any time, without needing to be synced in a centralized location first. The development of the MX908 Beacon presents a significant advancement in area monitoring capabilities for the detection and identification of vapor and aerosol chemical warfare agents (CWAs) and pharmaceutical-based agents (PBAs). By enabling remote operation and data viewing for extended durations, this technology fills critical gaps in traditional area monitoring, providing responders with the necessary tools to enhance public safety and effectively respond to hazardous materials incidents in various environments, while keeping their teams safe.



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