Research Title: KWT-MEC909

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1. Concept

Recently, in residential areas unpleasant odors have been detected coming from the manholes causing significant harm, distress, and flooding to the surrounding residents also, this problem is sometimes caused by a huge concentration of NH_3 or H_2S gases. To solve this problem, we can't depend on standard methods because they're neither efficient nor effective. That is why we developed a wireless sensor device (KWT-MEC909) to detect dangerous gases. With this device, we can obtain live readings for various gases through the combination of both software and hardware. It continuously sends live data to a database and compares it with standard data provided by the Ministry of Public Works. These sensors don't need wires to operate and can be powered by batteries, which saves money on installation and maintenance.

1.1 Challenges

There are some industries where the environment is harsh and human interference is not possible due to the high gas concentrations since exposure to high concentrations of NH3 or H2S in the air causes immediate burning of the eyes, nose, throat, and respiratory tract and can result in blindness, lung damage, or death. There is still no gas detector that is suited for such situations except for ours the (KWT-MEC909). Another challenge is that the normal sensors are so expensive compared to our wireless sensors.

1.2 Available Solution

The mobile air monitoring lab (MAML) is much larger, which makes it difficult to access tight manhole spaces. it requires a constant power supply that depends on a generator that can fail and stop operations. It also requires a specialized team, including a driver and trained technicians, which increases staff costs. This requires a high initial cost along with ongoing costs for fuel and vehicle maintenance, making it more expensive to operate

in the long term. During summer in Kuwait, the MAML will experience high temperatures, and dust can affect performance if there is no proper insulation and cooling.

1.3 Suggested idea (KWT-MEC909)

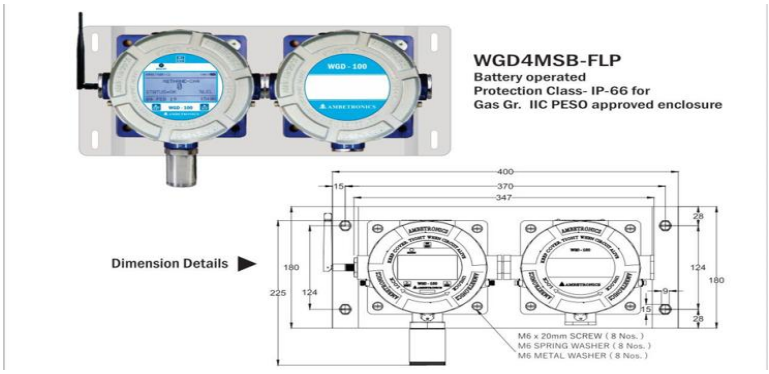
The (KWT-MEC909) is a wireless gas detector designed for continuous live monitoring of NH_3, H_2S, CH_4, and O_2. It has small size allows for easy installation in various locations, including above, below ground, or in both residential and industrial areas. In addition, it has a strong battery that lasts up to one year. The (KWT-MEC909) device uses 2G/3G/4G GSM connectivity with dual SIM slots and automatic switching to ensure data transmission without interruption by delivering live readings in less than 30 seconds. This device has an adapter that sends instant SMS alerts when gas levels exceed the limit, also stores all data in a cloud-based platform for analysis and comparison with KEPA standards. Using (KWT-MEC909) enhances safety, speeds up emergency response, and supports environmental monitoring.

1.3.1 Advantages

The (KWT-MEC909) device is much smaller, which offers easy installation in tight manhole spaces, and it has a strong battery that lasts for a whole year, which will end up reducing the overall maintenance cost in the future. With the dual SIM, the (KWT-MEC909) can send live readings in less than 30 seconds response time, providing remote monitoring for readings 24/7, which gives engineers enough time to respond to any change in the gases. Also, authorities can identify illegal discharges of toxic gases into stormwater or sewage networks, and this supports KEPA regulations by comparing collected data with environmental standards.

2. Methodology

The KWT-MEC909 device contains a microcontroller unit, gas sensor, monitoring screen, power supply, antenna, and housing case. By combining all of them, we have a powerful device that can monitor and give us live reads 24/7 and store them for feature analysis.



2.1 Microcontroller Unit (MCU)

It acts like the brain of the device that controls and processes everything, including the sensor data, and helps the antenna to send the collected data remotely into a cloud server.

2.2 Gas Sensor

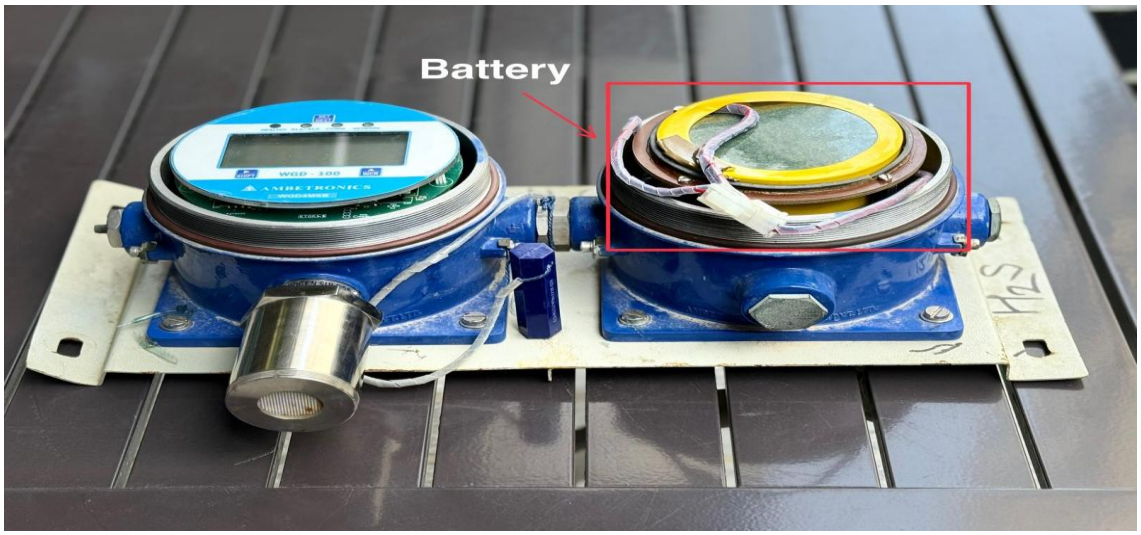
The main use of sensors is to detect different types of gases, mainly (NH_3 & H_2S) while monitoring them to certain levels, providing early detection of any illegal discharges of toxic gases.

2.3 Monitoring Screen

Graphical LCD screen that displays the concentration of gases and the device status, such as services, battery charge, PPM, and system alerts

2.4 Power Supply

Delivers power to the KWT-MEC909 device, ensuring continuous operation of the device with the help of a long-life rechargeable battery that is charged using solar panels.



2.5 Protective Housing

The case is made of cast aluminium that shields the device from moisture, dust, and mechanical damage inside manholes with the help of the glass cover.

2.6 GSM Communication Module

Transmit collected data wirelessly with the help of the antenna that extends the wireless range for the adapter with the availability of 2G/3G/4G connectivity with dual SIM slots for redundancy.

3.Data & Figures

During the project, multiple experiments and monitoring sessions were conducted using the (KWT-MEC909) to collect data live from selected manholes in West Abdullah Al-Mubarak, Al-Surra, and Al-Jabriya. The collected data focused on measuring Ammonia (NH_3), Hydrogen Sulphide (H_2S), and Methane (CH_4) concentrations.

3.1 Site Deployment and Monitoring

- Three manholes were equipped with a (KWT-MEC909) device for continuous gas monitoring.
- Data was transmitted wirelessly via GSM connectivity to a central database for live tracking and analysis.
- Alarms were activated when gas levels exceeded preset safety thresholds.

3.2 Key Recorded Data

5 April 2024

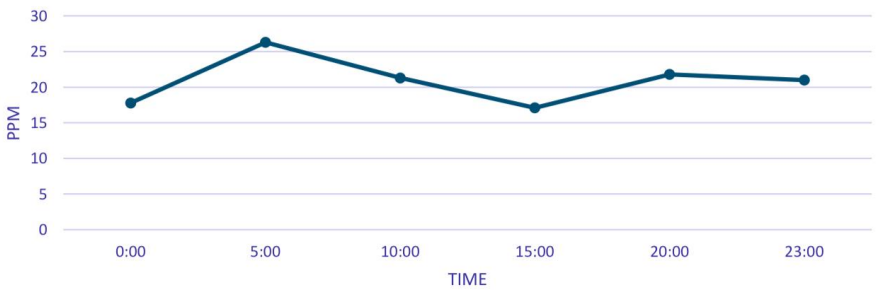
- NH_3 concentration measurements were compared with KEPA standards (Figure 3 & Figure 4).

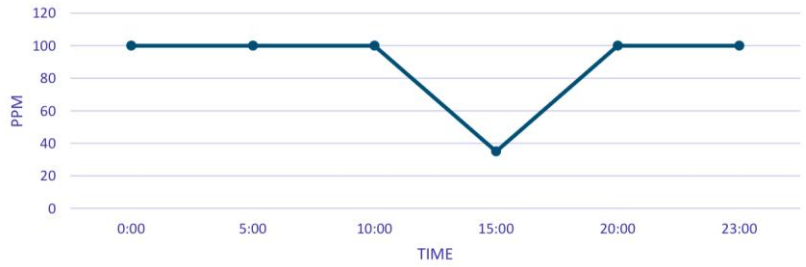
5 October 2021 – Al-Jabriya Site:

- CH_4 peaked at 41 PPM in the morning.
- H_2S exceeded 100 PPM at multiple intervals.

7 October 2021 – Al-Surra Site:

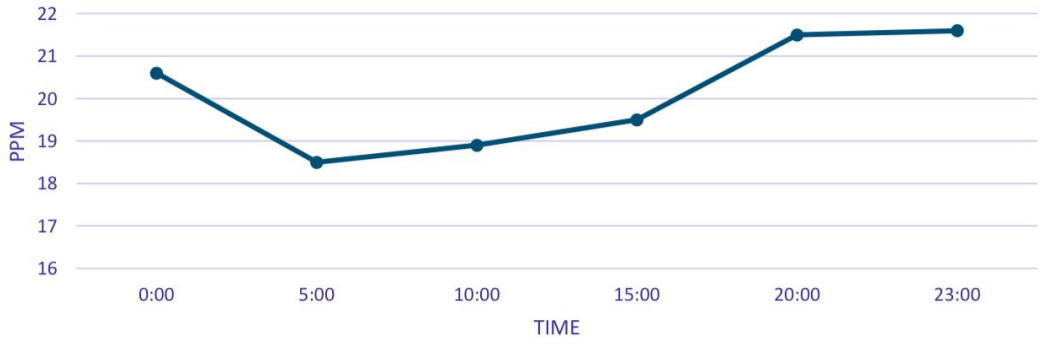
- CH_4 remained within the 17–26 PPM range.
- H_2S remained above 100 PPM for prolonged periods

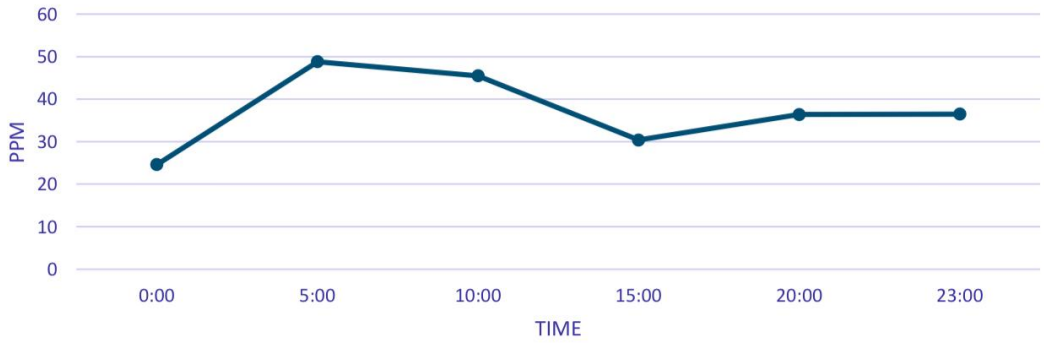




9 October 2021 – Mixed Sites:

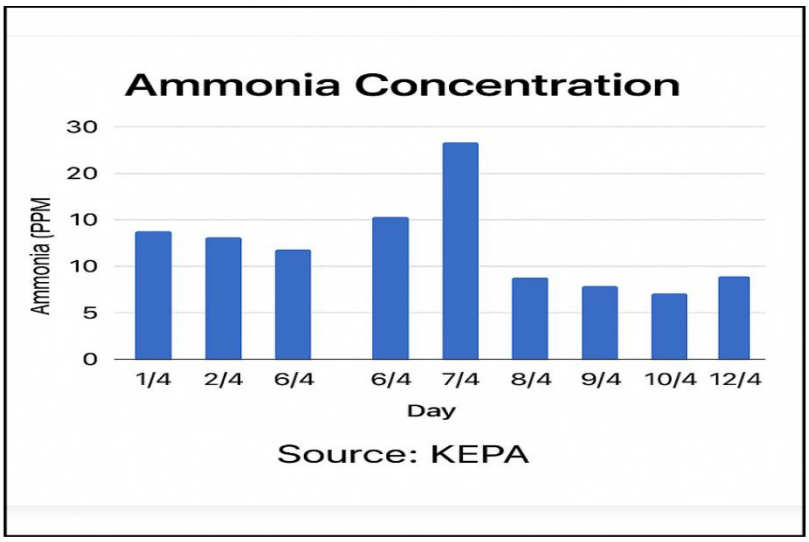
- CH_4 varied between 18–25 PPM, with sudden spikes.
- H_2S reached 45+ PPM in certain locations.





3.3 Recorded Gas Level Trends

- Peak gas levels were often recorded during early mornings and late evenings.
- H_2S levels were consistently higher than safe limits, indicating potential health hazards.
- CH_4 levels fluctuated throughout the day and rarely exceeded critical limits.



3.4 Data Visualization

Figures below illustrate the recorded concentrations and their comparison to KEPA safety standards:

- Figure 3 – NH_3 Gas Concentrations Recorded on 5 April 2024.
- Figure 4 – NH_3 Gas Concentrations Compared with KEPA Standards.