Case Study #1:

NuWave Sensors LU45 deployed to monitor microbial contamination in operating theatres

May 2017

Deployment Environment: Operating Theatre Environment

Background

Modern operating theatres are now highly regulated environments as the presence of microbial contamination can present a serious risk to patients undergoing surgery. Operating theatres employ various technologies including High Efficiency Particle Air (HEPA) filtration as well as clothing and hygiene practices designed to mitigate the risk of contamination.

The presence of microbial contamination in the air of operating theatres is known to have significant impact on the control of healthcare associated infections, and regular microbial monitoring can assess environmental quality and identify critical situations which require corrective intervention[1]. Typically, this is done by collecting air samples using settle plates or impactors. Both techniques require subsequent incubation of samples as well as lab testing and analysis.

A modern operating theatre

Specific Customer Requirements

The customer involved is currently undertaking a number of innovative approaches to monitoring air quality and microbial contamination in the air of the operating theatre. Monitoring of particulates in the air, which are known to transport harmful bacteria, was possible using existing sensor technologies. Monitoring of microbial contamination was made possible using the LU45 Pathogen Detection system. The objective was to have a complete monitoring system to track all possible sources of contamination in the air.

Key Advantages of the LU45 for the customer

For the customer, the key advantages of the LU45 were twofold. Firstly, the system could alert staff at the earliest possible time of microbial contamination in the operating theatre so intensive decontamination procedures could be carried out.

Secondly, the system's ability to communicate online, to the cloud based monitoring platform, allows the environment to be monitored externally, alongside any other on-site sensors, ensuring the surgical staff and environment are not disturbed during normal operating hours.

Configuration of System – Hardware

The LU45 operates using wireless technology which permitted a non-invasive installation of the sensor in the operating theatre. The sensor requires only a single power input to become operational, which allowed for a quick and easy installation in the theatre.

Outside the operating theatre a data gateway was installed which wirelessly receives data from the sensor, to which it pairs automatically. The data hub connects to the internet and is monitored via an online portal. This connection is normally via a standard Ethernet connection but in this case a GPRS connection was used to provide internet connectivity and ensure the installation could be carried out immediately.

Selection of Cartridge

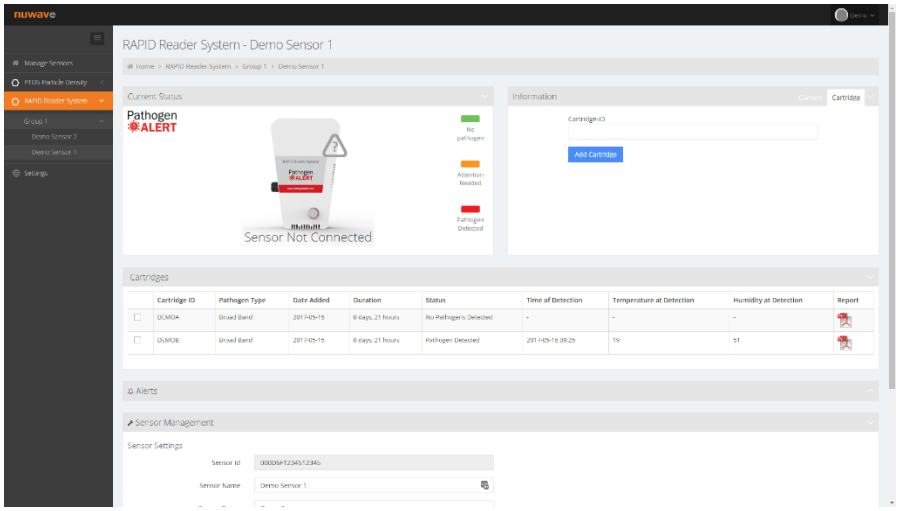
After assessing the requirements of the customer, a broadband cartridge targeting bacteria, yeasts and mold was chosen. These cartridges are used to throw a wide net over analysing potential contaminants in an environment, an important feature we felt considering the sensitivity of the location. Although more specific targets may be chosen, understanding the environments general bio-load is an important step in contamination control.

LU45 sensor and cartridges

Setup of Remote Monitoring

The customer manages the sensor via the NuWave Sensors online monitoring portal. Using their own login details they configure the sensor and have the ability to monitor multiple sensors in a single interface.

Once a cartridge is installed, and activated online, a system status is visible to users on login and should a pathogen be detected the status will change and the customer will be alerted by e-mail of the detection event.



LU45 Web Portal

In addition to the above management of the sensor, customers also have the ability to view and export an automatically generated cartridge test report which is created each time a cartridge concludes its monitoring cycle.

For more information on the LU45 please contact NuWave Sensors for information on distribution partners in your area: info@nuwavesensors.com

References

1. Napoli, C., Marcotrigiano, V., and Montagna, M. T., Air sampling procedures to evaluate microbial contamination: a comparison between active and passive methods in operating theatres. *BMC Pub. Health* 12:594, 2012

Case Study #2:

NuWave Sensors Remote Pathogen Monitoring System results in rapid detection of mold in a compromised laboratory

May 2017

Deployment Environment: IVF Laboratory

Background

Air quality in an IVF laboratory is extremely critical due to the impact it can have on the embryonic development process. Contamination can come from multiple sources including VOC's (Volatile Organic Compounds), particulate contamination, and microbial contamination - all of which can be harmful to embryo development. To protect against these contaminants, IVF labs are typically equipped with clean room grade technologies, such as high-quality air filtration systems coupled with positive pressure room control for air particulate control.

Specific Customer Concerns

Building works can be a cause of real concern for sensitive environments such as IVF laboratories, as it can introduce contaminants, such as VOC's, from new building materials, as well as disturb particulates which can transport contaminating bacteria. In one such instance, where remedial works in a building lead to water ingress in a room adjacent to the laboratory, a customer became aware of the possibility of the air being compromised with mold spores growing in the damp environment.

To alleviate worry and test for the presence of mold the customer required air sampling to be carried out. The LU45 was chosen for the experiment, as it offers several advantages over traditional methods, such as spot tests with petri dishes or impactors.

Key Advantages of the LU45 to the customer

The key advantages for the customer was that they could continuously monitor the indoor environment while the remedial works were finalised. Air sampling using a petri dish or impactor would give them a snapshot of contamination levels at particular times, whereas the LU45 could monitor over a period of weeks and alert them at the earliest possible time of mold being detected.

The remote monitoring capabilities proved an important factor, as laboratory maintenance staff and management typically have several labs to overlook, and could therefore carry on their duties knowing that if anything occurred a local (LED status change on unit) and online (e-mailed alerts sent to the user) alert kept them informed of any need for action or concern.

Configuration of System - Hardware

A pre-installation survey confirmed that a system could be installed at the earliest possible opportunity. The laboratory identified the area of concern which was accessible and confirmed that a data connection was also available to provide connectivity for the sensor to transmit data online.

A wireless LU45 sensor was installed in close proximity to the area of concern near which water ingress had previously occurred. From here laboratory technicians could access the sensor to install sampling cartridges when needed.

The wireless data hub was installed in a different part of the laboratory. This type of configuration gave the option for the installation of multiple sensors if required, which could all simultaneously communicate with the data hub.

LU45 Sensor and Gateway

Selection of Cartridge

An aspergillus cartridge was chosen as the most appropriate cartridge for mold testing. The cartridge is optimised to detect *Aspergillus* genus fungi, but will also detect other molds present in the air such, as *Penicillium*. The cartridge also contains an active antibiotic ingredient to ensure that only molds are detected, removing the chance for bacterial contamination. The cartridge is designed to sample for a period of 2 weeks, taking an air sample every 10 minutes, which provides continuous monitoring compared to a spot sampling approach using petri dishes or samples collected using an impactor.

Operational Outcomes

Once the sensor began operating it sampled for a period of 11 days before a detection was confirmed. Laboratory staff were made aware of the detection through an automated e-mail alert indicating that a detection event had occurred. This confirmed that there was a low presence of mold in the area. At this time, remedial works were ongoing and further monitoring was required once these works were completed to validate decontamination.

Automated Report

In addition to the automated e-mail alert, the customer also received an automated report detailing the detection time, details of the detection cycle and environmental conditions at the time of detection.


Pathogen Alert Detection Report

Pathogen ALERT

Name: Test | Sensor Name: Test Sensor | Sensor Group: Test Group | Report Date: 2017/01/24

Cartridge 10/1/17 - 19/1/17

Cartridge ID	Pathogen Type	Date Added	Duration	Status	Time of Detection	Temperature at Detection	Humidity at Detection
test3	Aspergillus	11-01-2017	8 days	Pathogen Detected	19-01-2017 00:45	21	62%

Environmental Monitoring

The following graphs show the environmental data collected by the Rapid Reader Sensor across the mounting cycle.

Temperature

Humidity

LU45 Automated Report

External Validation Report

Customers have an option to validate the sample that has been detected through a lab partner service. This involves sending the cartridge to an external testing laboratory for further analysis and identification of the detected pathogen. This option was availed of and results confirmed that there was fungal growth present. A detailed test report was also supplied with the results.

Ongoing Testing

An additional 3 mold cartridges were employed following the initial experiment, once the remedial works had been completed. Each operated for the full duration of their life cycle (2 weeks per cartridge) without a single detection of mold contamination. This indicated that the decontamination and cleaning procedures had successfully removed mold contamination.

After a consultation on the best way to continue to monitor the laboratory the customer made the decision to use a broadband cartridge for the detection of bacteria, yeast and molds. This non-specific cartridge is designed to detect the presence of most biological contaminants typically present in the air.

For the customer, this meant the system would act as an alarm system for the presence of microbial contamination in the air which could also affect embryonic development. This additional safeguard is used in conjunction with best in class air filtration and good laboratory practices to ensure the air remains as sterile as possible.

Benefits to the customer

For the customer, the benefits were clear;

- Rapid awareness to the confirm the presence of mold
- Continuous monitoring to confirm if decontamination procedures were effective
- Remote monitoring and alerts meant staff only needed to intervene when a contamination event occurred
- Ongoing monitoring of the presence of pathogens through the use of a non-specific agar cartridge

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