Repeatable H_2O_2 measurement during bio-decontamination: measurement technology, RH vs. RS and material selections

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Key objectives of topic

- Describe the differences between relative humidity (RH) and relative saturation (RS) measurement values
- Outline a novel method for measuring vaporized hydrogen peroxide and humidity
- Detail how different materials effect on vaporized hydrogen peroxide concentration
- Illustrate an amount of residual concentration of vaporized hydrogen peroxide in different materials after bio-decontamination cycles

Summarizing the topic

Vaporized hydrogen peroxide is a commonly used low-temperature bio-decontamination method. During decontamination, the level of vapor concentration is often measured to ensure that validated process conditions are being maintained. When measuring vaporized hydrogen peroxide concentration, it must be understood that certain environmental conditions and materials can influence the measured vapor concentration, e.g. the air can only contain limited amount of vaporized hydrogen peroxide. Also temperature and humidity affect the maximum hydrogen peroxide concentration that can be achieved. During bio-decontamination with hydrogen peroxide vapor, both relative humidity (RH) and relative saturation (RS) can be measured as a measure of quality control. During the process, the decontaminated air contains H_2O_2 that influences the total moisture level. It's important to understand that Relative humidity (RH) only gives the humidity value derived from water vapor. Whereas Relative Saturation (RS) measurement value includes both the humidity derived from water and H_2O_2 vapor. Thus, if you wish to know when the decontaminated air starts to condense (or reach dew point), you need to know RS.

A novel method for measuring vaporized hydrogen peroxide concentration, relative humidity, relative saturation and temperature for process control purposes has been developed. The new Vaisala PEROXCAP® sensor for vaporized hydrogen peroxide measurement contains two composite HUMICAP® sensors: One HUMICAP

sensor with a catalytic protection layer and the other one without the catalytic layer. A catalytic protection layer catalyzes hydrogen peroxide from the gas mixture allowing the HUMICAP sensor to only see water vapor; therefore the sensor measures partial water pressure, i.e. relative humidity. Another HUMICAP sensor without a catalytic layer senses the air mixture with the hydrogen peroxide vapor and water vapor. The difference between readings of the two sensors indicates the vapor concentration of H_2O_2.

Hydrogen peroxide is a “sticky” chemical; the vaporized version tends to easily absorb into a material. Once absorbed, aeration can be time consuming and affects overall bio-decontamination cycle times. When correct materials are chosen, materials absorb less hydrogen peroxide leading to shorter aeration times. On the other hand, hydrogen peroxide vapor can also easily decompose when in contact with suboptimal materials. Various materials can diminish hydrogen peroxide vapor concentration in the air and therefore weaken its effectiveness, or sterility assurance level (SAL). Material selection must be well understood when working with hydrogen peroxide vapor to ensure steady and repeatable bio-decontamination cycles. Unfortunately, the effect of material on hydrogen peroxide vapor concentration seems to be rarely discussed in scientific publications.

This presentation describes how to achieve repeatable vaporized hydrogen peroxide measurement that ensures successful bio-decontamination process. Repeatable measurement is maintained by selection of the correct measurement parameters and choosing the right materials for e.g. isolators.

Presenter’s biography

Irene Zakrzewski M.Sc. (Tech) is a Research Scientist in Vaisala’s Controlled Environment business area. In her current position, she develops devices for life science applications. During her studies, Irene was inspired by state-of-the-art measurement of environmental parameters. Upon completing her degree in 2011 with a specialty in electronics and sensor development, Irene began working in sensor development, focusing mainly on humidity measurement. Because the measurement of vaporized hydrogen peroxide is closely related technologically to the measurement of water vapor, moving from humidity to vaporized H_2O_2 has been a natural way for Irene to continue to delve the field that fascinates her. Her current challenge is to continuously increase her understanding of the true nature of different parameters and apply that knowledge to aiding the development of novel measurement techniques.