

Humidity Measurement in Hydrogen Peroxide Sterilization Process in Life Science Industry



Built-in value

- Vaisala HUMICAP® humidity sensors can measure the VHP saturation rate directly (0-100%)
- Humidity output can be used to control the VHP generator
- Catalytic filter available for saturated VHP to protect the sensor
- Vaisala sensor warming to prevent sensor and filter from getting wet
- Vaisala chemical purge feature to optimize long term sensor performance
- Reliable measurement instruments with global customer support

Maintaining contamination free areas is a must in life science industries and critical environments are also sterilized regularly. Some of these areas include small volume chambers like isolators and incubators and less often larger spaces like cleanrooms and processing lines. Vaporized hydrogen peroxide (VHP) is an effective agent for decontamination/sterilization when high enough VHP concentration and long enough exposure time are applied. Excessively high VHP concentration can result in unwanted saturation and surfaces wet with liquid hydrogen peroxide. Humidity measurement in VHP sterilization is an essential part of the procedure to control the VHP saturation level.

VHP Compliant Humidity Measurement Technology from Vaisala

Vaisala HUMICAP® Humidity measurement technology with thin film capacitive polymer sensors is capable of humidity measurements prior and during VHP exposure and in high and low VHP concentrations. The main advantage of the HUMICAP® sensor is that it is compatible with VHP even without any specific protection. In applications where saturation occurs a Vaisala protective catalytic filter is recommended.

Measure VHP Saturation Level

The ability to measure humidity directly in mixtures of VHP and air allows the user to follow the true saturation level of the gas mixture. Hydrogen peroxide and water are both polar molecules that change the polymer sensor capacitance. Because

Humidity Influences the VHP Saturation Level

Humidity levels have a direct correlation to temperatures at which the air containing VHP will saturate. When saturation conditions occur, condensate, including liquid hydrogen peroxide, will form on surfaces in the decontaminated space. The decontaminated space may be dried prior the VHP exposure to reach high enough VHP concentration

without saturation. The change of gas saturation rate is due to the molecular structure of hydrogen peroxide (H_2O_2) which is similar to water vapor (H_2O). The mixture of these two gases determines the saturation vapor pressure of the gas mixture. Hydrogen peroxide has relatively low saturation pressure which will increase the possibility of saturation of the air containing humidity.



The Vaisala VHP catalytic filter is available for a wide variety of humidity probes

the Vaisala HUMICAP® directly measures the true VHP saturation rate (0-100%), it can be used to control the sterilization process. Saturation level is highly valuable information especially when wet surfaces must be avoided.

Seven Good Reasons to Choose Vaisala HUMICAP® for the VHP Application

1. Durability for direct VHP exposure

The Vaisala HUMICAP® sensor is compatible with direct VHP exposure even at high concentrations and hundreds of VHP cycles up to saturation. The long term performance is very good at concentrations higher than typically used for sterilization. However, for the applications where full saturation is possible a Vaisala catalytic filter is recommended.

2. Catalytic VHP filter for saturated conditions

When VHP concentrations are high and condensation is expected, the Vaisala catalytic filter is used to generate additional protection for the humidity sensor. The catalytic filter is based on the generally known method where the H_2O_2 is split to H_2O and O_2 . The saturating VHP up to wet surfaces improves the decontamination effect but

may damage materials that are exposed to these conditions regularly. In this environment, sensor protection with a catalytic filter is recommended to protect the sensor and to extend the calibration interval.

3. Measure true saturation of the humid VHP gas

The similarity of the water vapor and vaporized hydrogen peroxide allows the capacitive HUMICAP® sensor to read the true saturation rate of a humid VHP gas. This is important in VHP applications where the gas concentration should be high enough to kill the living organisms, but should not saturate. This measured value shows how close the true saturation value is. If the saturation value is not required the catalytic VHP filter can be used in all VHP measurements.

Vaisala HUMICAP® sensors that are permanently installed to measure normal operating conditions need no additional protection beyond the catalytic filter.

4. Catalytic filter to read plain humidity in the VHP gas

If the pure humidity in VHP gas is needed, a normal way is to use a Vaisala catalytic filter that prevents the VHP from reaching the humidity sensor, but allows other gas components to be measured. When the humidity sensor is protected from VHP it responds to humidity only. The influence of the catalytic filter is about +1 %RH at 300 ppm VHP or +3 %RH at 900 ppm VHP (at 23°C).

5. Vaisala chemical purge to complete the long term stability

The chemical purge technology helps to correct the possible sensor long term drift and to extend the required calibration interval if VHP is measured without catalytic filter. Chemical purge automatically heats up the sensor in set intervals, evaporating the unwanted excess chemicals out of the sensor polymer. This returns the sensor performance back to the same level as used in normal chemical free air.

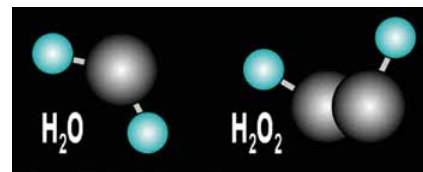
By utilizing the chemical purge with the HUMICAP® sensor the long term stability for measurement accuracy in VHP application will be excellent.

6. Vaisala sensor warming to keep sensor and filter dry in saturation

Under full saturation conditions, wet surfaces are not only problematic for materials, but also for humidity sensors. The humidity reading will stay at a 100% value until the sensor and filter have dried. Drying can take a long time depending on the flow and saturation rate of the surrounding air. To respond to real changes in the measured environment the HUMICAP® sensor is available with a sensor warming feature. Sensor warming keeps the sensor surface and filter temperature higher than the gas saturation point (dewpoint) and this helps to avoid saturation on the sensor and filter. Sensor warming is a proven Vaisala technology that is used widely when a risk of a wet sensor must be avoided.

7. Reliable humidity measurement

The HUMICAP® thin film capacitive sensor technology was invented and patented by Vaisala in the early 1970's. Since then Vaisala has been leading the way in humidity measurement in the most demanding applications. The latest HUMICAP® 180R humidity sensor version represents the highest humidity measurement performance for complex chemical environments. In VHP applications it performs with excellent durability and long term stability. This excellence combined with the Vaisala chemical purge and sensor warming technologies makes the measurement reliable and the HUMICAP® 180R sensor uniquely well suited to VHP applications.



Forms of Water and Hydrogen peroxide molecules

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