17.11.2020
Rotronic, Bassersdorf, Switzerland

Measurement of Relative Air Humidity in H_2O_2 Environments

Dear Customer / Partner,

Enclosed you will find a Statement on how the Rotronic Hydrogenperoxide Probe works, as well as a description of a sterilization process:

- The Rotronic HygroMer® HH-1 capacitive humidity sensor cannot provide a humidity-relevant measurement result in environments containing H_2O_2 and simultaneous condensation.
  In this case, the measurement signals present with condensation are only dependent on the H_2O_2 concentration secondarily.

- The humidity sensor itself is H_2O_2-resistant, i.e. the sensor delivers meaningful measurement results again before and after the end of the condensation phase ("in dry condition") when in adjusted condition.

- Correct measured values are shown again after the end of exposure to H_2O_2.

- In order to keep these condensation phases on the sensor element as short as possible, it is recommended to remove the protective filter on the sensor head permanently and to place the probe in a position favorable to the flow.

Situation Description: Sterilization Process with H_2O_2 and Measurement of Relative Humidity

The evaluation of the humidity probes and test results shows that during the injection phase in some process sequences in the sterilization chambers, rapid introduction of the generated hydrogen peroxide gas-water vapor mixture leads to condensation on the humidity probes.

This is caused by the fact that the probes are exposed to the normal ambient temperature of approx. 22 °C before evaporation of the H_2O_2. The injection phase is often very fast and ranges from approx. 28 - 30 °C. Due to the injection of H_2O_2, the relative humidity rises very quickly to values greater than 90 %RH. The thermal mass of the probes causes a delayed increase in the temperature of the probe head. At a very high relative humidity, this means a very small difference between the dew point and the probe head temperature. If the dew point temperature reaches the probe head temperature, condensation occurs on all surfaces that are colder than the dew point temperature. This means that a coating of micro droplets (water with H_2O_2) forms on the affected areas. The humidity sensor and its electrical connections are also affected by this. The probe then displays a measurement signal that is composed of the actual humidity signal and the additional influences (such as creeping currents in the

case of a condensation film (depending on the coat density and specific conductivity), individual drops on the sensor surface, cross influences due to the formation of galvanic cells in the case of condensation (electrochemical reaction), previous contamination (evaporation residues from previous charging cycles).

This additional contribution to the actual humidity signal is not constant and depends on the respective physical conditions at the time of measurement. Regarding the measurement signal during the injection and exposure phase, it should also be noted that H_2O_2 decomposes quickly at higher temperatures and in the case of condensation and this decomposition reaction produces additional water which, when evaporating or generated directly in the gaseous phase, generates an additional moisture content. This then leads to higher relative humidity values than would be expected. This condensation phase is maintained until it is physically possible for the water film to dry again. In dry state and during the ventilation phase, the humidity sensor then detects the amount of water vapor in the gaseous phase (standardized to relative humidity according to WMO) correctly again

Best regards,
ROTRONIC AG