OpreX™ Analyzers

Measuring Trace Moisture in Chlorine Production

Yokogawa Pre-Engineered Solution (YES) | Moisture in Chlorine

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Chlorine is used as an intermediate chemical in the production of high-demand products such as bleach, acids, and PVC.

To achieve the quality required for each product, chlorine manufacturers know the importance of measuring moisture levels in the chlorine gas at key points as it moves through the process toward liquefaction.

Electrolysis plants create hydrogen and chlorine from a brine solution. Chlorine gas generated from the anolyte of the electrolysis tank generally contains between 0.5 to 2.0 vol% H_2O (figure 1). The sample is then cooled and filtered to remove brine, subsequently emerging as wet chlorine gas. The wet gas flows to a drying tower where it is treated with sulfuric acid to reduce the moisture content down to ppm levels. Acid mist remaining in the dry chlorine gas flows to a dry chlorine tower where it is removed. The dry chlorine gas is then sent to a reciprocating compressor for liquefaction.

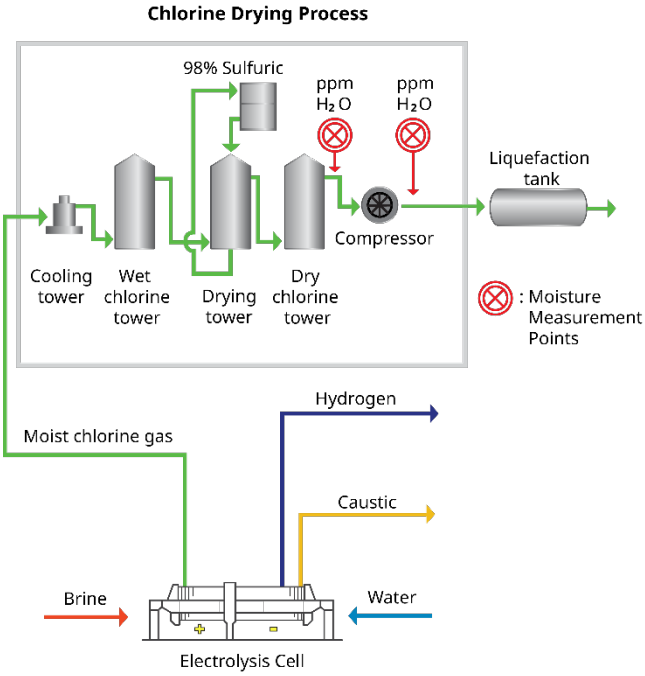


Figure 1. Trace moisture levels in the chlorine are monitored before and after the compressor.

Challenges

Learning immediately if there is ineffective drying or ingress of moisture into the process is critical to safe and smooth operation. For example, the presence of even trace levels of moisture after the dry chlorine tower causes corrosion of the chlorine compressor and contaminates the product with chlorine hydrate and hydrous iron chloride.

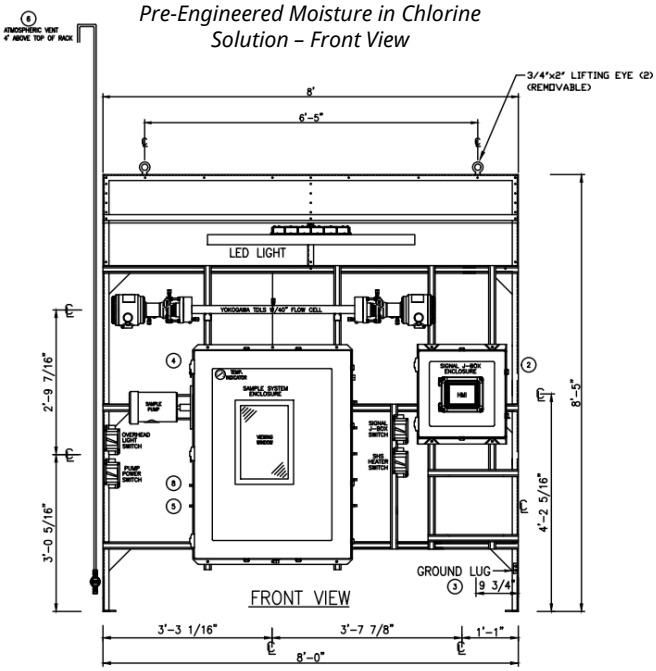
When a specified level of corrosion is detected, the process must be shut down to correct these issues.

Since manufacturers must respond rapidly to the presence of moisture, they rely on sensors for alerts. A conventional moisture sensor with a range of 1-5 ppm could have a T90 response time of an hour (note: T90 is the amount of time it takes for the sensor to measure 90% of the maximum analyte level).

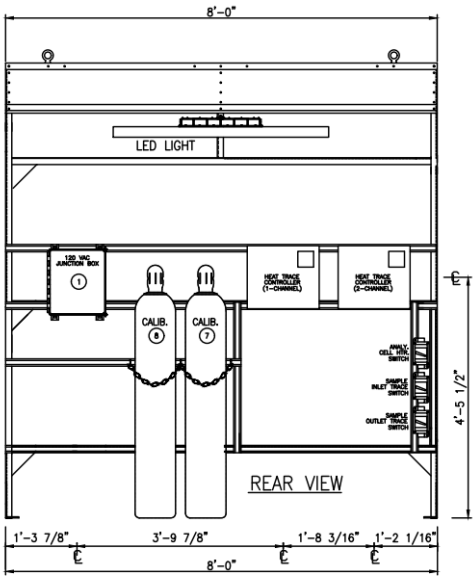
After measuring moisture in the process, the conventional sensor must recover quickly to allow it to recognize another event. Due to sensor saturation, recovery time from large concentration spikes of moisture can take more than 24 hours. A slow-recovery sensor could miss the presence of additional moisture and lead to further contamination and corrosion.

If a sensor is not operating, the manufacturer cannot detect moisture in the chlorine and must stop the process. Unfortunately, sensors can deteriorate and deliver inaccurate measurements due to contact with the process. This deterioration leads to maintenance costs that are associated with recalibrating or replacing the sensor.

Pre-Engineered Moisture in Chlorine Solution – Front View



Pre-Engineered Moisture in Chlorine Solution – Back View

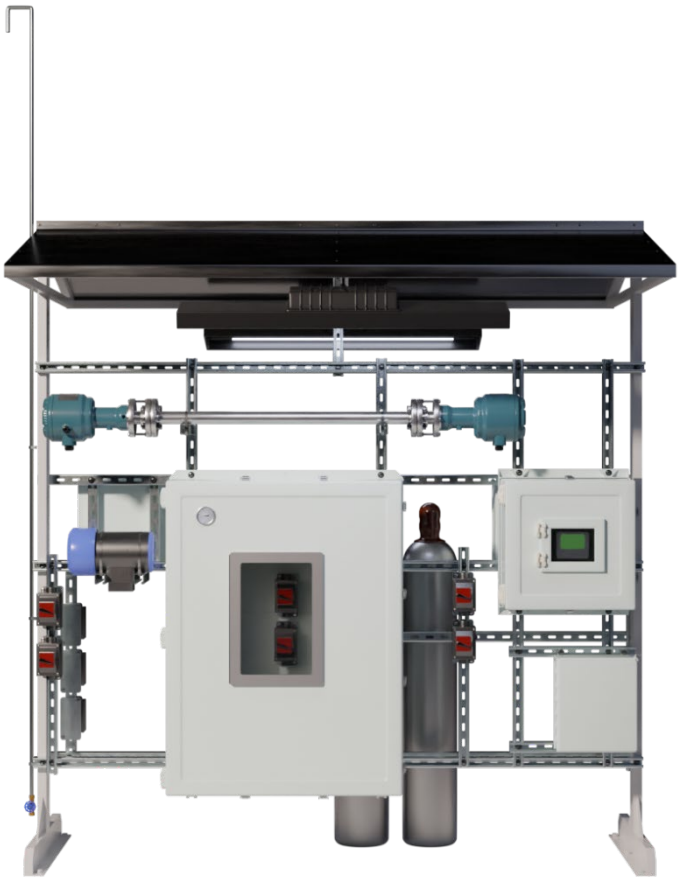


Solution

To maximize chlorine production, manufacturers need to prevent corrosion of equipment and increase the time between shutdowns. To support safe and continued chlorine production, the pre-engineered moisture in chlorine solution makes use of the advantages of Yokogawa's TDLS8000 laser analyzer in combination with Yokogawa's application expertise to provide a solution that avoids common pitfalls and design flaws common for this measurement.

The analyzer is mounted on a rack close to the sample take-off point to reduce sample lag time and associated engineering and design costs are minimized as this work has been done upfront with Yokogawa's Pre-Engineered Solutions (YES).

The YES responds to single-digit ppm step changes and recovers from the presence of moisture as fast as one second. Since the sensor does not contact the process, it does not degrade and will provide accurate readings over a longer period of time than conventional sensors; therefore, manufacturers are alerted more reliably to immediate potential issues.



Key Benefits

- **Minimized engineering and design costs**
- **Reduced sample lag time**
- **Response and recovery in seconds to ppm step changes and high-level breakthrough**

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