Marikka Nevamäki / Editor in Chief / Vaisala / Helsinki, Finland

Measuring process humidity for optimal product quality

Polyacrylamide drying is a complex process, which demands strictly regulated humidity and temperature conditions.

Kemira Oyj's paper chemicals plant in Vaasa, Finland, produces polyacrylamides for customers in global and domestic pulp and paper industry. Highly water-absorbent, polyacrylamides can be used as binders and retention aids for fibers, and to retain pigments on paper fibers.

The Vaasa plant has developed a highly sophisticated process for drying polyacrylamide, which is first produced at the plant as a gel consisting of 50% polyacrylamide and 50% water. After the drying process, the end-product resembles granulated sugar, and contains only 7% water.

"The drying process is very demanding, as excess heat ruins the product and makes it difficult to handle. Therefore the drying has to be carried out in phases. The whole process takes some eight hours," Technology Manager Jussi Nikkarinen explains.

The plant has four large dryers, each of them containing one to two tons of the product. The temperature in the dryers varies between 40-60 Celsius.

Challenges with product stability

"Initially, we were only able to control the process temperature, and the humidity conditions varied greatly. This made it challenging to produce a stable, high quality product. In 1999, we decided to install nine Vaisala humidity transmitters in the drying process," Nikkarinen recalls. The humidity transmitters incorporate patented Vaisala HUMICAP® capacitive thin-film polymer sensors.

Before getting started with the process improvement some ten years ago, Nikkarinen and his team researched drying processes used in industry, in order to find some good examples on how to proceed. However, as they wanted to measure humidity in the dryer air and not in the end-product, it was not an easy task.

"We couldn't find any best-practices, and had to go with our gut feeling. We installed the Vaisala transmitters ourselves. This was a relatively easy task. Cabling was more time consuming. The meters send all measurement data to a central data collection system, which enables us to monitor the whole drying process. Our chosen humidity measurement locations are air inlet and outlet channels. We also have one Vaisala handheld humidity probe for spot-checking and confirming the measurements produced by the fixed humidity transmitters," Development Technician Reino Paloniemi explains.

Surprising discovery led to corrective action

Part of the drying air is taken from outdoors, and part is redirected back from previous processes, after removing dust and other harmful particles. "Soon after we had installed the humidity transmitters, we realized that sometimes the air going in the dryers was more humid than the air coming out of the process. This is hardly the desired effect of a dryer. In other words, the drying process occasionally unintentionally turned into a moisturizing process," Nikkarinen smiles.

Corrective measures were taken as a result of this discovery. For example, the team installed a process

Kemira

Kemira specializes in water and fiber management chemistry. The company's customers are involved in pulp and paper making, municipal and industrial water treatment, and oil and mining. Kemira operates in 40 countries and has a staff of 10,000.

Jussi Nikkarinen (left) and Reino Paloniemi check the process is running smoothly in the control room.

Reino Paloniemi and Jussi Nikkarinen use a Vaisala handheld humidity probe for spot-checking and configuring the measurements produced by the fixed humidity transmitters.

air dryer. "The investment was easier to justify once we had the humidity data to back-up our argument," Paloniemi points out.

Clear benefits gained through humidity measurement

"Humidity measurement has brought clear benefits to our operations," Nikkarinen states. "For example, product quality has improved significantly, and our production capacity has increased. It has also improved our energy-efficiency, as now we don't have to heat the product too much." Humidity measurement has also increased the team members' understanding of the process, and removed most of the guesswork.

"We've been very impressed with the stability and reliability of the transmitters, which still work as new after ten years of use - despite all the dust and particles in the air," Paloniemi commends.

Further improvements possible

Kemira's polyacrylamide drying process could still be further developed, and some plans are already in place. The plant uses a central data collection system for overall process monitoring. This could be further enhanced with an automated control system, which could make the required adjustments automatically. "We could also introduce air flow measurement in the air channels," Nikkarinen adds.

The team at Vaasa has also cooperated with the Finnish Meteorological Institute, in order to find out the impacts of different weather conditions on the drying process. "We discovered that warm summer days are likely to cause most problems with their hot and humid conditions."

"It is important to remember that measurement alone is not enough. The information needs to be stored and presented in an accessible format. We have people working around the clock in three shifts. When you start your shift, it is very useful to be able to check what's been going on in the process during the previous shifts," Nikkarinen concludes.

Further information:
www.vaisala.com/humidity

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HUMICAP® sensor

Vaisala's relative humidity products incorporate a capacitive thin-film polymer sensor, Vaisala HUMICAP®. The HUMICAP® sensor features high accuracy, long-term stability and negligible hysteresis. It is insensitive to dust, particulate dirt and most chemicals.

All HUMICAP® products provide a full measurement range of relative humidity, 0 ... 100 % RH. In addition, depending on sensor model, the sensor is available with a chemical purge option, which maintains accuracy in environments with high concentrations of chemicals, or with a sensor preheat option that prevents condensation.

Operating principle

The thin-film polymer either absorbs or releases water vapor as the relative humidity of the ambient air rises or drops. The dielectric properties of the polymer film depend on the amount of water contained in it: as the relative humidity changes, the dielectric properties of the film change, and so the capacitance of the sensor changes. The electronics of the instrument measure the capacitance of the sensor and convert it into a humidity reading.