VAISALA / SUCCESS STORY

KEMET Electronics Optimize Their Manufacturing Process with Vaisala Dew Point Measurements

KEMET Electronics manufactures over 70 million solid insulator capacitors annually at their Suomussalmi facility in Finland. In order to improve their dryer capacity and reduce energy consumption while maintaining quality and yield, the KEMET team is now using dew point measurements in their vacuum dryers.

KEMET project team: Esa Matero, R&D Manager; Aaro Korhonen, R&D Engineer; and Harri Juntunen, Quality Engineer. The drying oven with a Vaisala DMT348 dew point transmitter installed on the vacuum pump connector is in the background.

A capacitor is a basic electronic component that is able to reserve electrical charge. Capacitors are used in filters, power supplies, oscillator circuits, and other electrical systems. A capacitor's operating principle is based on the accumulation of electrons on the surface of a conductive material. To facilitate this, a dielectric layer is located between the conductive layers. When electrostatic potential is applied over the terminals, the electrical field over the dielectric layer causes charge carriers to accumulate on the conductive surfaces. The amount of electrical current the capacitor can hold is called capacitance and is measured in the SI unit Farad [F]. The larger the surface area, and the smaller the distance between the conductors and the electrical permittivity of the dielectric, the higher the capacitance.

KEMET Electronics – Capacitor Specialists

KEMET Electronics, part of the KEMET Group, manufactures paper and polymer capacitors. "Humidity plays a crucial role in the manufacture of capacitors. Our

Challenge

- Capacitor paper has to be completely dry to ensure high quality and yield
- Over-drying limits the manufacturing capacity and affects energy consumption

Solution

- Vaisala DMT348 dew point transmitter installed at vacuum dryer exhaust for drying-oven control
- Vaisala MI70 handheld indicator together with HMP75 and DMP74A probes for overall process control
- Changing control strategy from one based on time to one based on measurement data

Benefits

- Improved yield at the vacuum deposit stage
- Increased drying capacity
- Shorter drying times
- Cost savings in the drying stage
- Improved control during the whole process

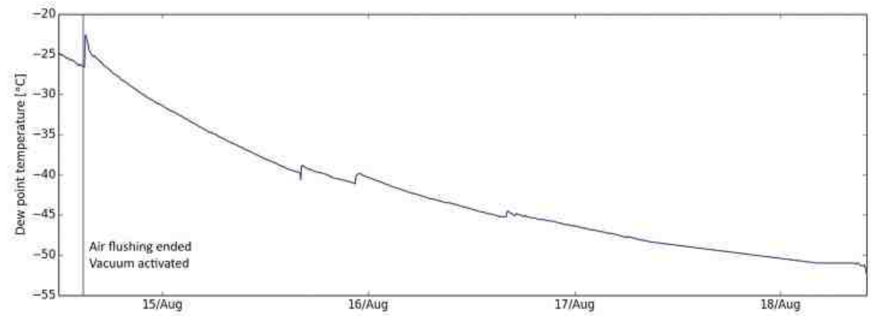
location in Finland is handy because the climate is naturally dry," Quality Engineer Harri Juntunen explains. "Seasonal variations in humidity still have an effect on our production process though."

In paper capacitor manufacturing, the capacitor paper rolls are heated in heating chambers and dried in vacuum driers. The dried paper is metallized in a vacuum deposition stage and then cut into strips, which are wound into radial capacitors. After this, the connector leads and protective epoxy are applied, followed by the final drying stage, electrical testing, and packaging.

Moisture Control in Paper Capacitor Manufacturing

Moisture control is essential in this process for many reasons. The metallization stage requires a high vacuum. If the paper is not dry enough during the vapor deposition stage, it is difficult to maintain a sufficiently high vacuum due to evaporating water vapor that increases vapor pressure and thus decreases vacuum. Because of variable humidity requirements, some parts of the manufacturing process take place in dry rooms, where air conditioning is used to maintain a stable environment.

Recently, KEMET installed a Vaisala DMT348 dew point transmitter into one of the dryers in order to monitor the drying process. Until now the dryers have been running on a timed program. "The paper-drying process typically takes six days in the vacuum chamber; two days for preheating and four for processing," says Juntunen. R&D Manager Esa



Changes in dew point temperature during the drying process in a test run. Knowing the optimum cut-off point helps to avoid over-drying while ensuring sufficient dryness and maintaining quality.

Matero adds, "Being able to monitor the conditions inside the dryer offers significant potential for developing various aspects of the process: increasing production capacity, reducing energy consumption, and improving the overall control of the process."

The vacuum drying takes place in two phases. Flushing, the first of these, involves heating the oven with hot water coils at up to +120 °C while applying a 10 mbar absolute vacuum by feeding a small supply of air into the vacuum chamber during the operation of the vacuum pump. The second phase, final drying, involves closing the air supply and maintaining approximately a 1 mbar absolute vacuum until the required dryness is achieved.

How DMT348 Optimized KEMET's Manufacturing Process

The DMT348 dew point transmitter was installed on the vacuum pump coupling. Despite the high temperature in the oven heating coils, the low heat conductance in a vacuum keeps the probe temperature within the measurable range. The heat is conducted into the probe mostly through the installation flange, meaning that the operating temperature for the measurement probe remains close to the surface temperature at the installation position.

The Vaisala DMT348 is suitable for installation in pressurized processes between 0 and 40 bars. It allows easy vapor-tight installation, making it ideal for vacuum drying applications. Encouraged by the success in the drying stage, KEMET's process development team has conducted dew point and humidity measurements with a Vaisala MI70 handheld indicator connected to HMP75 and DMP74A humidity and dew point probes. "Previously we didn't monitor humidity levels in all the relevant positions, partly due to limitations in the measurement range and operating temperatures of our existing equipment. We've now noticed that it's essential to study the conditions throughout the whole process," Juntunen concludes.

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