

Ceramic drying

Facts & figures:

The Space Shuttle's heat protection layer is mostly made from silica ceramic materials. This protects the spacecraft from the extreme 1,260 °C heat on re-entry into the Earth's orbit.

Hard ceramic materials such as titanium carbide achieve 93 hardness on the Rockwell scale. Diamonds are the hardest material on Earth with a Rockwell hardness of 100.



Venus of Dolní Věstonice

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Ceramic drying in general

The word ceramic comes from the ancient Greek word *Keramos* (κέραμος) which was the description for pottery made of burned clay mineral. The earliest ceramic object found, is the statue of "Venus of Dolní Věstonice" that was discovered in Brno, Czech Republic. This statue proves that even 27'000 years ago ceramic production was known to mankind.

Today, the term 'ceramic' has

became much wider and is now split into various types such as for example structural ceramics (e.g. bricks), white ware ceramics (e.g. tableware), refractory ceramics (e.g. kiln lining) and technical ceramics (e.g. insulators).

Ceramic is generally considered as an inorganic, fine grained non-metallic raw material that is mixed with water and shaped in moulds at room temperature. After the ceramic

(at that stage called 'green body'), has sufficiently dried it acquires its final properties during the burning process that generally takes place at 700 °C and above.

The first ceramics were simply dried outside and then burned in an open fire. These days, a variety of dryer types such as band, batch and tunnel dryers are used, together with electrical, microwave assisted and bottle kilns.



Why the need to measure humidity?

Drying is a critical stage in ceramic manufacture, according to ceramic experts. The drying process sometimes places more stress on the ceramic pieces than during firing because the drying needs to be done slowly, to prevent warping and cracking of the green body pieces. Yet, ceramic manufacturing companies need to get the time for this process down as much as possible for efficient production. Usually, the drying time without a commercial dryer can be between two days and a week. For larger, thicker pieces, it can even take up to two weeks. Drying clay properly is vital: if a clay piece is not

completely dry before the first firing, it will crack, warp or even explode, risking ruining not only that piece, but also other pieces in the kiln. On the other hand, if the clay has been dried too quickly in a drying chamber, cracks will form and the piece will be destroyed for certain during firing in the kiln.

So, there is a small margin between fast drying and ruining the ceramic material. The best and fastest drying results can only be achieved if the environment in the dryer is accurately controlled for temperature, humidity and also air velocity. These parameters



have a big influence on the rate of drying and therefore the drying quality.

A typical drying cycle varies from about 35 °C up to 120°C, starting with the low temperature and then slowly increasing as the green body gets drier. Simultaneously, precise measurement of the humidity inside the dryer helps to determine at what stage the drying process has reached.

What solution can Rotronic offer?

The heart of the latest humidity measurement products is the Rotronic capacitive sensor: HygroMer IN-1. This thick film sensor, with the best long term stability on the market is ideal for the

tough application of ceramic drying, where high temperatures and high humidity levels are present.



All products with this logo contain an AirChip3000.

AirChip3000 advantages:

- *Relative humidity, temperature and dew point outputs*
- *Can store 2'000 points*
- *Sensor self-test function*



HF 5 Wall mount transmitter
In combination with:

Rotronic products:

Humidity and temperature probes:

- **HC2-IM402**
-100...200 °C,
0...100 %rh,
Ø15 mm,
±0.8 %rh and ±0.1 K...
- **HC2-IC402**
-100...200 °C,
0...100 %rh,
Ø15 mm
±0.8 %rh and ±0.1K...
- **HC2-IC402-A**
-100...200 °C,
0...100 %rh,
Ø15/25 mm,
±0.8 %rh and ±0.1 K...

Transmitters:

- **HF5 series**
For interchangeable probes,
Various analogue and digital outputs, Display,
All psychrometric calculations available...
- **HF7 series**
Stainless steel probe,
-100...200 °C, 0...100 %rh
3/4 wire configuration,
Various analogue outputs,
Display...
- **HF8 series**
For 2 interchangeable probes,
Various analogue and digital outputs, Display, relay outputs.
All psychrometric calculations available...

Data loggers: (e.g. for solar dryer)

- **HL-NT range**
For interchangeable probes
(up to 7 probes with docking station)
32 MB flash card
Large LC display,
Conforms to FDA 21 CFR Part 11 and GAMP4...
- **LOG-HC2-RS**
Wireless logger with single interchangeable probe input.
Stores up to 500,000 data points. 6 Year battery lifetime
Range 100 m free field
Measurements: probe specific
Conforms to FDA 21 CFR Part 11 and GAMP4...



HC2-IC402 Probe HC2-IM402 Probe

Customer benefits:

Accuracy:

Choosing Rotronic products gives you the best accuracy on the market.

Precise humidity measurement enables the dryers to work at their maximum performance to dry the ceramic products as fast as possible, eliminating possible structural damage in the ceramic caused by rapid drying.

Communication:

Networking with Rotronic is

an easy affair! With the wide range of communication interfaces available, from conventional analogue output signals to USB, RS-485, Wireless and Ethernet RJ-45, Rotronic can provide the required interface to your drying control unit, or any third party monitoring system.

Long term stability:

With long term sensor stability of under 1 %rh per year (depending on the environ-

ment), Rotronic offers the possibility to "plug & play": install the device and leave it. We would recommend regular spot checks between multi-point calibrations.

Calibration:

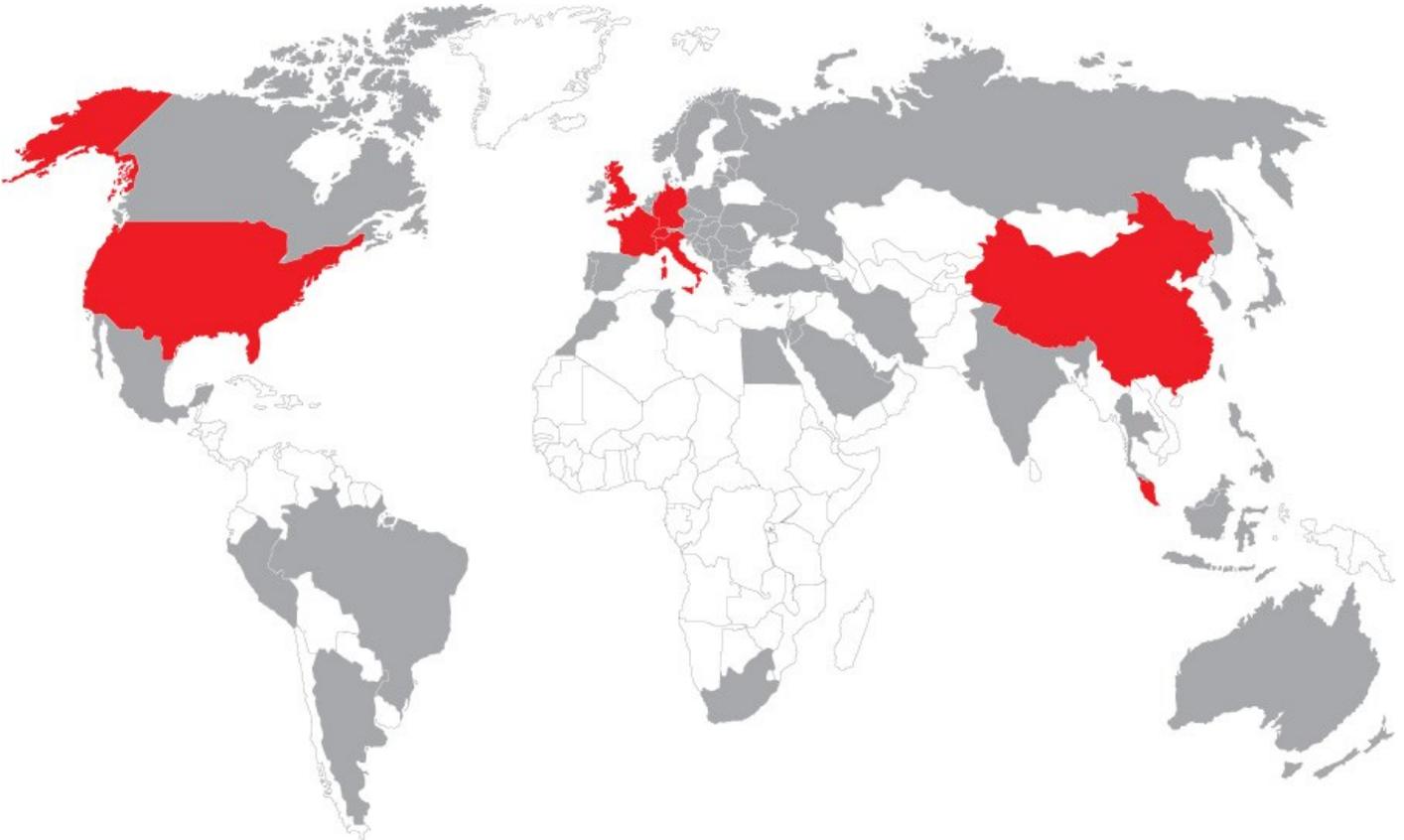
Rotronic offers a factory calibration certificate, and SCS certificate if required. The portable HygroGen temperature & humidity calibrator as well as unsaturated humidity salts are also available for on-site calibration.



HF7 Duct mount transmitter

Contact us:

Rotronic is represented in more than 40 countries around the world. An up-to-date list of all our partners is available at www.rotronic.com



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