How to Select, Install and Maintain A Dewpoint Sensor For Your Plastics Dryer

If you have sent for this information you are probably a little confused about measuring dewpoint. You are not alone! This subject is not taught in trade schools or even in engineering programs at universities. Vaisala has tried to pull together the most relevant information on this subject and explain it briefly – and simply.

We promised to answer five important questions about dewpoint measurement in plastics dryers. Below you will find the answers.

If you have questions after you review this information, you can call Vaisala directly and we'll answer your questions to the best of our ability.

Which Sensor Will Meet My Measurement Needs?

There are two basic types of sensors for measuring dewpoint in plastics dryers. One type is the polymer-based, relative humidity (RH) sensor. These devices measure RH and temperature and then calculate dewpoint. The other type is the oxide-based dewpoint sensor that directly responds to changes in dewpoint. Each of these sensors has their place, but neither one is appropriate for every measurement.

When you are defining your measurement requirements, there are three key things to keep in mind:

1. The expected range of dewpoint to be measured. *This is important because there is no single dewpoint sensor technology to cover the entire range of possible dewpoint conditions.*
2. Your accuracy requirements. *Usually accuracy of ±3 °C (± 5 °F) is adequate for monitoring or control of dryers.*
3. Maintenance requirements of the dewpoint sensor. *Some sensors require frequent recalibration.*

RH sensor based devices are useful for measuring dewpoint temperatures above -12 °C (10 °F). At lower dewpoints, RH sensors lack accuracy and stability (see the gray shaded text for an explanation of why this is true). This makes them useful for refrigerant type dryers, but questionable in most other dryer applications. If you select an RH sensor based device to measure a -40 °C (-40 °F) dewpoint, you will most likely not meet your own accuracy requirements.

The alternative to an RH sensor is a dewpoint sensor. Most of these sensors use aluminum oxide or silicon oxide as the sensing element. For measurements of very dry air (-73 °C (-100 °F) dewpoint), these sensors may be your best choice. Unfortunately, these sensors are inherently unstable, drifting rapidly from their calibration points. Most manufacturers suggest a six-month calibration interval. It is not surprising to see these sensors drift 10° or 20° in six months. Also, oxide sensors can be damaged by exposure to water or condensation. After such exposure, they may take as long as 24 hours to "dry down" to the real dewpoint temperature.

A third option is to consider the unique (and patented!). Vaisala DRYCAP® Dewpoint Sensor. This sensor works reliably for dewpoints down to --51 °C (60 °F), and in some cases down to -60 ° C (-76 °F). It easily withstands exposure to water, has a very fast response time (both for "dry down" and "wet up"), and has a suggested calibration interval of two years. A measurement accuracy of ±2 °C (± 4 °F) is the norm for DRYCAP® instruments. This sensor covers the ranges required for refrigerant dryers and many desiccant dryers. However, it is not suitable for ultra-dry conditions.

Vaisala DRYCAP® Hand-Held Dewpoint Meter DM70

Do I Need A Portable Device, Or A Permanent Device?

This depends on your specific needs, but a portable instrument is a great way to get started. If you have dewpoint instruments already permanently installed, the portable can be used to check their performance. If you have no instruments, or you suspect problems in your dry air system, a portable is ideal for identifying problems. Permanent instruments should be installed when you desire full-time monitoring of your dryers. Many people working with PET like to monitor their dryers all of the time. Permanent instruments can also be installed to control your dryer and reduce energy costs. We suggest that you contact your dryer manufacturer to better understand how you can improve dryer efficiency with good dewpoint measurement.

The Vaisala DM70 is currently the most sophisticated portable dewpoint instrument on the market. It is small (hand-held), easy-to-use, runs on rechargeable batteries, and offers two powerful features: graphic trending and data logging. Trending lets you watch the measurement session in real-time,

Why RH Sensors Lack Accuracy and Stability

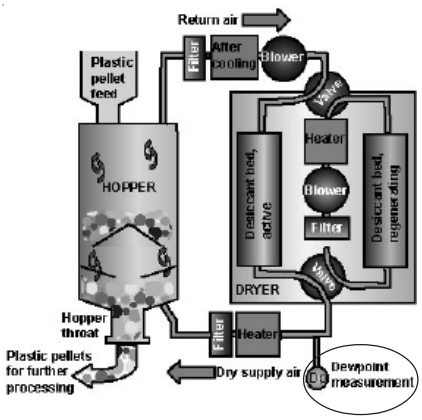
If your dewpoint temperature is lower than -12 °C (10 °F), RH sensor-based devices are undesirable. The problem is, as the dewpoint goes lower, so does the corresponding RH value. For dewpoints of -40 °C (-40 °F), the corresponding RH is less than 1%. Accuracy of RH sensors at this level is typically ± 2% RH, sometimes ± 1% RH.

The first problem is that accuracy of 2% is meaningless when the actual humidity level is 1%RH (you can't have -1% RH). The second problem is that small RH errors translate into large errors in the calculated dewpoint at this low RH range. For example, an RH sensor that reads just 0.9% RH low at 1% RH will have a calculated dewpoint error of 21 °C (37 °F), (reading -58 °C (-72 °F) when the real dewpoint is -37 °C (-35 °F)), and still be considered to be within specification. This level of accuracy is not acceptable for most applications.

showing any glitches or "spikes" that may occur as dryers cycle or demand on the system changes. Data logging lets you monitor the process for a longer period of time by recording and automatically saving the measurements; you select the interval and total recording time.

How Do I Install A Dewpoint Sensor For Best Results?

For plastics drying systems, the best place to measure dewpoint is after the dryer and before the heater. This



provides a direct indication of dryer performance. *See Figure 1.*

Fig. 1: The sample point for dewpoint measurement should be after the dryer and before the heater. A one meter (3') stainless steel sample line allows the sample to cool to ambient temperature.

We strongly recommend "sampling" the dry air to make your measurement. This means that you will tap off of your dryer system, typically with 6mm (¼") tubing, and bring a small stream of air to the sensor. This provides the essential function of cooling the dry air to ambient temperature before it reaches the dewpoint sensor.
Here are some additional benefits of sampling:

- The sample tubing can be routed to a convenient location.
- If you are using only one portable instrument, sample lines can be set up on multiple dryers with quick-connect fittings, making spot checks simple.

All of Vaisala's dewpoint sensors can be supplied with "sampling cells." The dewpoint sensor is inserted into the cell. The cell is connected to the 6mm (¼ inch) sample tubing using standard commercial fittings. The other end of the sample tube is connected to the dryer per *Figure 1.* Air in the drying system is usually under positive pressure, so it flows down the sample tube, past the dewpoint sensor, and exhausts to atmosphere. The required flow is only 1 slpm (2 scfh). Sample tubing should be clean stainless steel, and the tube should be at least three feet long to properly cool the sample air. Non-metallic tubing is undesirable and should be avoided.

You can make your own sample line from standard 6mm (¼ inch) SS tubing. If three feet of straight tubing is inconvenient, you can easily coil a straight piece of SS tubing by bending it around a piece of PVC pipe to form a coil. We use Swagelok or Parker fittings to connect the tubing at either end, as necessary.

For portable instruments, a convenient alternative to straight tubing is the flexible SS tubing offered by Swagelok. One end threads into the sample cell and the other is equipped as necessary to connect to your dryer. Quick connect fittings make it very easy to use a portable in multiple locations.

How Often Should the Sensor be Checked or Calibrated?

Follow the manufacturer's recommendation. Vaisala suggests a one or two year calibration interval, depending on the instrument. Sometimes a simple field check against a calibrated portable instrument is sufficient to verify correct operation of other instruments. Vaisala provides detailed calibration information in the User's Manual that is shipped with each instrument.

Any time that you have doubts about the performance of your dewpoint instruments, it is wise to check their calibration.

What Are the Tell-Tale Signs of a Malfunctioning Dewpoint Sensor?

- An instrument that displays one value all of the time, as if the output were locked.
- An instrument that is "bottomed out," always reading its lowest possible value.
- An instrument that is erratic, changing rapidly or randomly over a wide range of values.
- An instrument that displays impossibly dry or wet values.