Humidity School

Lesson 2

Measurement and Sampling Problems

STORK
INSTRUMENTS

1. Introduction

In general, humidity measurement is much more difficult to carry out properly than the measurement of other parameters such as temperature or pressure. Because any humidity sensor must be in intimate contact with the carrier gas (no shielding is possible as with a temperature sensor for example), it is much more vulnerable to contamination or physical damage. Considerably greater care must be taken in the siting and installation of humidity sensors. When measuring in the range below -20°C dewpoint, sampling systems have an increasing effect upon performance. Long sample lines and hygroscopic materials such as nylon or aluminum, coupled with low flow rates can introduce major errors and increase response time very significantly.

2. Sampling system and material of construction

One of the biggest challenges facing users of hygrometers is in the choice of sampling system and its material of construction. Many materials are hygroscopic by nature and retain within their walls significant quantities of water vapor, and adsorb or desorb moisture according to the water vapor pressure of the gas in which they are in contact. This has the effect of slowing down response time dramatically and in the case of very dry gases the effect can totally mask the true reading. Materials which minimize these effects must therefore be used.

For the same reason, upstream fittings such as valves and filters must be carefully chosen. In general, stainless steel and PTFE are the only satisfactory materials for sample lines. Filters and valves should be stainless steel if possible although for dewpoints wetter than about -40°C, aluminium or brass may be used. For dewpoints drier than -60°C, filters are best avoided altogether if response time is critical. In all cases sample line lengths and interconnections should be kept to a minimum and fittings should be good quality gas or vacuum type.

3. High and Low Temperature

The measurement of moisture at very high or very low temperatures is worth special mention. It is frequently not appreciated that although a gas may have a very high temperature (e.g. 2000°C as in a metal treatment furnace), its dewpoint temperature is still very low (e.g. -15°C dewpoint). It is therefore not necessary (indeed it is impossible) to measure moisture at the actual gas temperature. A very elegant solution in these cases is to cool the gas in a simple coiled stainless steel sample line. 3-4 meters of sample line in ambient air and with a flow rate of 0,5 liters per minute are sufficient to reduce the gas temperature to near ambient. The same solution in reverse may be applied in the case of refrigerated gases.

4. Above Ambient Dewpoints

In the case of dewpoints above ambient temperature it is necessary to protect the sample line so that its temperature does not fall below the dewpoint temperature, otherwise water will condense or ice will form in the line. This is important because although STORK sensors will not be damaged by condensation, water vapor in the sample gas will be lost to liquid water or ice and readings will be incorrect. Insulation or trace heating of the sample line will normally solve this problem.

5. Pressure and Vacuum

Measurements at up to 300 bar pressure and down to 10-5 millibar vacuum are possible. Pressure test certificates and helium leak tests for vacuum applications are available on request. Pressure limitations are given under the individual specifications for each instrument.