Monitoring moisture in metallurgical processes

A variety of metal treatment processes rely on controlled atmospheres to protect against oxidation, and to change or enhance the properties of the metals being treated. Many types of gas are used, from nitrogen and argon for protective atmospheres, to hydrogen and hydrocarbons for reactive atmospheres. Precision moisture measurement provides feedback on the chemistry of the atmosphere, and enables accurate gas mixing leading to improved finishes and savings on costs where gas usage and process temperatures are reduced.

Improving annealing processes through accurate moisture measurement

Annealing is a relatively simple process carried out in a furnace to soften metal, increase ductility and reduce internal material stresses. The material is heated to just above its critical temperature, then held at a lower temperature for a number of hours before being cooled. The process is carried out in a controlled atmosphere, where monitoring of conditions is critical to ensure the best finishing of the end product.

The two types of atmosphere used can be classified as reactive or protective. A protective atmosphere does not interact with the metal being treated and is used to prevent changes happening on the surface of the metal, such as oxidation or decarburization. Reactive atmospheres can be reducing or oxidizing. Reducing atmospheres are most common, made up a mixture of hydrogen and nitrogen. The hydrogen reacts with the metal oxides on the surface of the finished piece, giving a clean finish.

Measuring the dew point of the annealing furnace gives a vital indication of how reducing or oxidizing the atmosphere is during the heating stages. This allows the furnace operator to accurately control the gas mixture to manipulate the atmosphere to give the best results. Accurate determination of the furnace atmosphere conditions leads to better finishes, reduced gas usage and can enable the annealing process to be carried out at lower temperatures, resulting in lower operating costs.

The dew point of the furnace atmosphere should be measured continuously. The sample would be extracted from the furnace and passed through a cooling coil in order to bring it back down to ambient temperature for safe measurement. Lower dew points mean the reducing potential of the atmosphere is increased, with typical desirable dew points of a reducing atmosphere below -50°C or -70°C depending on the type of metal being treated. This is well within the measurement range of Michell Instruments precision cooled mirror hygrometers.

Controlled atmospheres for sintering processes

Sintered parts are made in a conveyer furnace by heating powdered metal that has been pressed into the desired shape. In the first stage of the process the parts are preheated to remove the lubricant used when the parts are pressed to shape. This stage is normally carried out under a slightly oxidizing atmosphere.

Controlled atmospheres for sintering processes (cont.)

The second stage is the high heat stage used to sinter the parts, and is typically carried out under a reducing atmosphere made up of a mixture of nitrogen and hydrogen. The hydrogen reacts with the oxygen and metal oxides within the pressed metal, forming water. It is necessary to measure the moisture content in this stage order to accurately calculate the correct concentration of hydrogen required to maintain the reducing atmosphere. A lower dew point increases the reducing potential of the atmosphere and can allow the furnace to be run at lower temperatures.

Michell Instruments offers a range of chilled mirror hygrometers, which measure a primary characteristic of moisture – the temperature at which condensation forms on a surface. This means that chilled mirror instruments provide drift free measurements and are inherently repeatable, giving reliable results every time. The S8000 RS is the ideal measurement instrument for these tasks.

S8000 RS

The S8000 RS is the ideal measurement instrument for this task. The rate of formation of frost on the mirror surface can be slow at low levels of moisture content. An accurate and reliable measurement with a non-fundamental hygrometer can be difficult to perform. The S8000 RS utilises a unique advanced dual optics system to detect very small changes in moisture condensed on the mirror surface, resulting in very high sensitivity and fast response when making measurements at low levels of moisture content.

The S8000RS uses a fundamental cooled mirror measurement technique that is dependable, reliable and highly accurate. Measurements are repeatable, and drift free. The S8000 RS comes with a modern HMI, many user selectable measurement units and a generous number of outputs. Other features include datalogging and Ethernet communications. The instrument is supplied with a traceable calibration as standard, but an optional UKAS accredited calibration is also available.

Key Features

Measurement Range	RS80: -80 to +20°C dew point RS90: -90 to +20°C dew point	**HMI**	5.7” Resistive Touch Screen
Measurement Units	**Moisture:** °C/°F dp, %RH, g/m3, ppmv, ppmw (SF6) **Pressure:** barg, psig, kPa, MPa	**Data Logging**	SD Card, 32GB Max 560 days at 2 second interval
Accuracy	±0.1°C	**Outputs**	**Analogue:** 3x User selectable, 0/4-20mA, or 0-1V **Digital:** USB or Ethernet (Modbus TCP) **Alarms:** 1x Process, 1x Fault
Repeatability	±0.05°C	**Additional Features**	Integrated flow sensor, remote temperature probe, optional integrated pressure sensor.

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