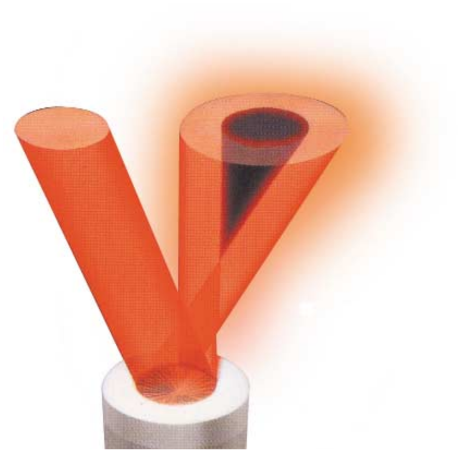
Hydrocarbon Dew Point

Technology

Fundamental, automatic 'dark spot' principle giving high accuracy, drift-free operation and reliability for hydrocarbon dew point detection

- Automatic Optical Detection Technique
- Intrinsically Safe
- Flow de-coupled measurement
- Accurate and repeatable
- Allows phase envelope determination



Background

The condensation temperature of heavy hydrocarbon components in gas - commonly known as the hydrocarbon dew point - is a complex and difficult parameter to measure. Traditionally this measurement has been made using a manual optical technique based on the cooling of a mirrored surface in contact with the hydrocarbon gas mixture. Whilst it is possible, with experience and application, to obtain repeatable results with a manual dew-point hygrometer, the subjective nature of this technique yields it ever less applicable in today's de-regulated gas markets where continuous and precise measurement of this critical parameter are demanded. Michell's automated Dark Spot Technology provides the ideal solution.

Hydrocarbon Dew Point - The Science

Natural gas is made up of a large number of discrete components, from hydrogen to complex long chain hydrocarbons. Each component will have its own particular dew point, effectively defined by its concentration and vapour pressure. Therefore, as a sample of natural gas is cooled, each component will begin to condense as it becomes saturated at a particular temperature. Heavy hydrocarbons will be the first to condense, but in small quantity as they are normally the trace components in the gas mixture. Therefore, unlike for instance water dew point in an air system, the hydrocarbon dew point in natural gas is a non-distinct parameter that can be changed dramatically by small changes in gas composition or pressure. To complicate matters further, component molecules can interact and even form weak bonds together at higher pressures and therefore the phase relationship of natural gas follows a completely different pattern to that of simple gas mixtures. Indeed, the phase envelope folds back on itself at higher pressures, so effectively the hydrocarbon dew point reaches a peak (normally at about 27 bar g) and then reduces. See graph 1. A final physical point of note is that hydrocarbon condensates have an extremely low surface tension compared, for example, to that of water. Therefore, as condensation forms on a surface, it will tend to form a film rather than discrete droplets, rendering detection by traditional optical means far more difficult than the detection of water dew points. This factor is a major reason for the difficulty in applying manual, visual techniques such as described above.

It is therefore vital that any technology used for the measurement of the effective hydrocarbon dew point of natural gas is extremely sensitive, repeatable and able to operate over a range of system pressures. The Dark Spot Technology has been designed to satisfy all these requirements and provide continuous, real time analysis.

MICHELL Instruments

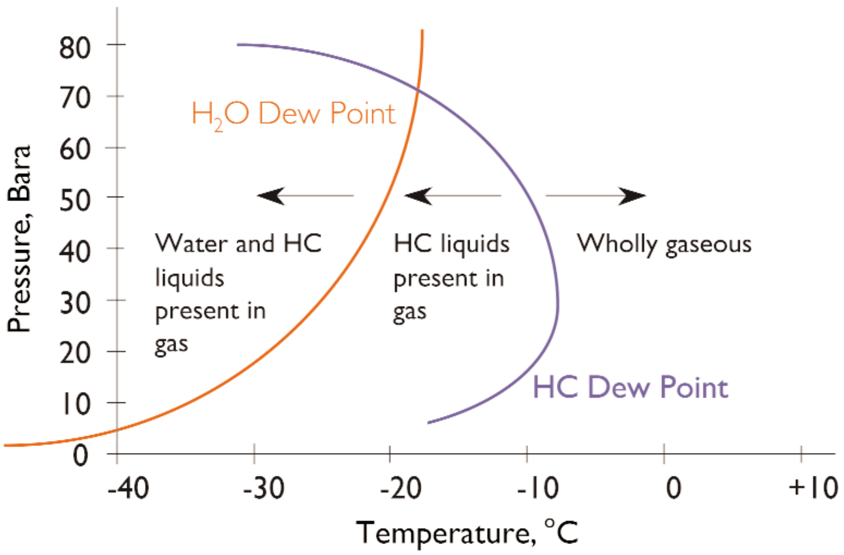
The Dark Spot Principle

The Dark Spot optical principle utilised in Michell's Condumax Hydrocarbon Dewpoint Analyser is radically different from that of any other chilled mirror instrument. Sensitivity of the order of 1ppm (molar) of condensate enables the analyser to detect the almost invisible films of condensate that are characteristic of hydrocarbon gases at dew point, due to their low surface tension.

The optical surface is the key element of the sensor cell and comprises an acid etched, semi-matt surface with a central conical shaped depression. A well collimated beam of visible red light is focused onto the central region of the optical surface. In the dry condition most of the incident light beam is reflected from the optical surface to form an annulus ring of light. Optical detection is made of light dispersed. As hydrocarbon condensates form on the optical surface during a measurement cycle its optical properties are modified - the reflected light intensity of the annulus ring increases and there is a dramatic reduction in the scattered light intensity within the dark spot region. It is this secondary effect that is monitored and interpreted. Hence, the Dark Spot Detection Technique makes use of the physical characteristic of hydrocarbon condensate that makes it so difficult to detect in a manual system. When a pre-determined layer of condensate has been detected the instrument electronics records the temperature of the optical surface as the hydrocarbon dew point and then initiates a recovery cycle whereby the optical surface is actively heated to evaporate the condensates back into the flowing gas sample. The whole process takes no more than a few minutes under complete computer control.

Flow De-coupling

In order to achieve maximum accuracy in this difficult measurement, a flow de-coupling method is used. Discrete measurement cycles, at user definable intervals, lock a fixed sample of the hydrocarbon gas mixture into the measurement cell. As the optical surface is cooled, sequential condensation of hydrocarbon components occurs until the pre-selected optical trip level is reached that signals the effective hydrocarbon dew point temperature of the gas. The fixed sample means that there is representative condensation of all the hydrocarbon components and prevents preferential condensation of heavy ends that might occur with a flowing sample - this could lead to a falsely high indication of the hydrocarbon dew point.



Graph 1: Retrograde Phase Envelope

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