

# Measuring Hydrocarbon Dew Point for Natural Gas Processors & Pipeline Operators using Automatic Hydrocarbon Hygrometers

## Application Background

When natural gas is extracted from a field, it requires processing before it can be sold as pipeline gas. In order to make the gas suitable for sale and use, the heavier components must be removed. A common way to remove heavy gas components is to chill the gas so the heavy components condense and drain away. This chilling is facilitated by expanding the gas, the drop in pressure corresponding to the drop in temperature. This has cost implications related to running the compressors, as the gas requires re-pressurisation before transmission.

The composition of the pipeline gas produced is related primarily to the markets for the gas itself, and for the condensates (referred to as Natural Gas Liquids, or NGL) which are removed from it. In a situation where the market for NGL is particularly strong, the gas will be heavily processed, and the majority of the NGL will be removed and sold. This makes the gas leaner, lowering its calorific value.



As a result of this, many users will set contractual specifications regarding gas quality. This can be defined in a number of ways, and is frequently related to a minimum calorific value of the gas - important when a loss of gas quality would mean a drop in operating capacity. It will also be related to the hydrocarbon dew point of the gas; for example - as gas turbines in power plants are susceptible to damage by liquids, the formation of condensates in the gas could have severe financial repercussions in terms of damage repairs. This also applies to pipeline operators, as collections of liquid, particularly in the low points in the pipe, can restrict gas flow.

So it is important for gas processors to be very aware of the hydrocarbon dew point of their product, as, if it is too high, the pipeline operator or end user could refuse to accept the gas. If it is too low, resources will have been wasted in over-processing, there could also be a penalty clause from the user - if the required energy value of the gas was previously stipulated.

## Measurement Techniques

There are a number of different accepted methods for measuring HCDP, the original technique being to use a cooled mirror dewscope. This requires a skilled operator to view a mirror over which the sample is flowed. The mirror is then cooled, and the temperature at which the first drops of condensation are viewed is noted.

For:

- ✓ Widely used industry standard measurement technique
- ✓ Low capital investment

Against:

- × Periodic spot checking only
- × 'Subjective', operator dependant measurement of variable sensitive and repeatability
- × Labour intensive, therefore high running costs

Another method of determining the HCDP is by means of a gas chromatograph (GC), this method determines the concentrations of each hydrocarbon element (up to C12 in most cases). Through an equation of state calculation, the condensing points of the quantities of each component present are identified and calculated to give a hydrocarbon dew point for the complete mixture. However due to the limitations of the device when analysing heavy hydrocarbon molecules, the calculations of the HCDP can frequently be quite inaccurate, suggesting that the HCDP is drier than the actual value.

For:

- ✓ Potential to combine a number of gas quality/tariff parameters into one analyzer
- ✓ The components contributing to a high dew-point level may be identified and so help to determine the reason/source
- ✓ Possibility to provide a theoretical phase envelope curve

Against:

- × Accuracy of analysis, and thus hydrocarbon dew-point calculation, is dependent on correct and regular use of specialist reference gases
- × An indirect method of determining hydrocarbon dew point, relying on the correct application and suitability of the equation of state being used
- × Susceptible to measurement errors due to limit of analysis sensitivity and composition changes
- × Specialist staff required to operate/maintain performance
- × Very high initial outlay, including installation costs (analyzer house) and running costs (personnel and reference gases)

The alternative is to use an automatic, optical condensation hygrometer, such as the Michell Instruments Condumax II. The Condumax II functions in a similar manner to the Cooled mirror dewscope. The cell has an etched optical surface with a central conical depression which normally refracts light unevenly. An LED shines at this surface and a photo-detector looks at an image of the light shining back, which in dry conditions, appears as a ring of light. The photo-detector is focussed on the light scattered into the centre of the ring. A thermoelectric peltier device cools the surface until condensates begin to appear. The condensates alter the reflective properties of the surface, with the circle of light around the perimeter



Condumax II Installed in outside Analyser house

intensifying, and the scattered light in the centre dispersing according to the amount of condensate on the mirror. The exact signal level can be accurately monitored by looking at the signal from the photodetector. The mirror temperature is recorded when the desired level of condensates are deposited. The factory setting of the Condumax II gives readings which are comparable to readings obtained by an experienced dewscope operator.

For:

- ✓ Direct fundamental 'objective' measurement of high sensitivity and repeatability
- ✓ Stand alone operation - In-built verification routines
- ✓ Sensitivity may be adjusted to conform with measurement techniques agreed between gas supplier and receiver
- ✓ No specialist operation/maintenance staff requirements
- ✓ Ability to produce phase envelopes through direct measurement rather than theoretical estimation

Against:

- × Significant initial investment, though low installation and running costs



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