Application of oil absorption in case of measurements of temperature of a dew point on moisture of natural gases.

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Annotation.

In the report the reasons demanding to carry out control of moisture content in natural gas on objects of the gas industry are specified. The principles and methods of measurement of humidity and temperature of a dew point of gases are considered. It is told about the devices realizing a condensation method of measurement of a dew point and merits and demerits inherent in this method. Process of oil absorption is considered. Also results of test of the made absorber capable to considerably reduce shortcomings inherent in the analyzers and hygrometers realizing a condensation method of measurement of temperature of a dew point of natural gases are given yielded.

Report.

Introduction.

Among the known complex of the natural minerals relating to fuel and energy group, one of the main on use in the national economy is occupied by natural combustible gases. Natural gas is one of the best types of fuel. It is distinguished completeness of combustion without smoke and a soot, lack of ashes after combustion, by ease of ignition and regulation of process of burning. It is also a raw materials source for the chemical industry.

In the course of production, the natural gas arriving from a well, as a rule, is saturated with water and heavy hydrocarbons. Therefore, even before transfer it shall be drained to a certain level in order to avoid corrosion of pipelines and formation of the hydrates destroying an armature and other elements of a pipeline system. Besides transfer of water on thousands of kilometers is simply unprofitable. For this reason such parameter as humidity of gas is one of the main in case of production, transportation and conversion of natural gas. Reliable and exact measurement of this parameter is required at all stages - from a well to gas processing plant, and significantly influences profitability and process performance.

Temperature of a dew point of natural gas.

In the gas industry, for determination of humidity of gas its temperature of a dew point on moisture (DPW) which is strictly normalized by regulating documents is taken. Gas dew point temperature on moisture is a value of temperature of gas in case of which the water vapor containing in the gas cooled isobaric becomes saturated over a flat surface of water, in other words there is a transition of vapors of water to the condensed condition (liquid or hoarfrost). If necessary dew point temperature on moisture can be counted in moisture content according to the tables ASTM, ISO and GOST. Also It should be noted that from the technological point of view not absolute value of amount of moisture in gas, and degree of proximity of the current thermodynamic status of this water vapor to a saturated condition in case of which, actually, and there is a moisture condensation is important. Therefore the most acceptable characteristic is dew point temperature on moisture.

For natural gas there are one more temperatures of a dew point — a dew point on hydrocarbons (DPHC). It is temperature at which of gas liquid hydrocarbons begin to be condensed. These liquid hydrocarbons represent gas components with higher molecular weight — usually butane and heavier. This parameter, as well as in a case with a dew point on moisture, requires to itself attention and is normalized by regulating documents.

The devices used for determination of temperature of a dew point of gas.

Special devices – hygrometers or analyzers which operation is based on various principles of measurement are used to measurement temperature of a dew point of gases.

From all set of the devices intended for measurement of temperature of a dew point it is possible to allocate two primary groups of the analyzers which are most often used and realizing different methods of measurement:

1. The analyzers realizing a dew point method (a condensation method) which is based on determination of temperature at which gas becomes saturated the moisture which is in it

or hydrocarbons. This temperature is determined at first condensation of water vapor or hydrocarbons on a condensation surface which temperature can be established by any in the range of temperatures of work of a hygrometer.

2. Analyzers which operation is the cornerstone sorption methods. Essence of sorption methods is absorption of vapors of water from natural gas hygroscopic material (sorbent) of the sensor of the sorption hygrometer which is in a gas flow with the subsequent measurement of any physical quantity pro rata to amount of sorbed water. Value of the measured physical quantity is recalculated in mass concentration of vapors of water. The greatest distribution was gained by dielkometrichesky, coulometric, piezoelectric and interferential methods.

Both groups of analyzers have as the advantages and shortcomings. But the unique analyzers which are realizing a direct method of measurement and directly determining DP are devices the measurements relating to the first group and realizing a condensation method. All other types of analyzers realize an indirect method of measurement, and for recalculation of output parameter in units of DP the special tables ASTM, ISO or GOST are used. Reliability of these tabular data raises doubts because, for example, the same results when using formulas of recalculation of ASTM D1142-95 and according to ISO 18453:2004 disperse by 10-15 degrees. The existing dependences receive, as a rule, on artificial mix of water vapor in nitrogen therefore they strongly differ from data for water in methane in specific operating conditions.

At the analyzers relating to the first group also other essential advantages in comparison with devices from other groups are had, namely:

- a possibility of measurement of temperature of a dew point not only on moisture but also on hydrocarbons,
- with a pressure close to atmospheric the error of measurement is determined only by an error of determination of temperature (a thermometer error),
- a part of analyzers has a possibility of visual observation of moisture condensation process what allows to exclude mistakes in case of measurement in case of loss of condensate of other components containing in gas (heavy hydrocarbons, etc.).

All listed benefits of the analyzers realizing a condensation method of measurement promoted that they gained the greatest distribution now.

<u>The difficulties arising at measurement of temperature of a dew point of gas on moisture the devices realizing a condensation method of measurement.</u>

As the analyzers realizing a dew point method (a condensation method) have a condensation surface which is washed by the researched gas that on it in the basis also other components containing in gas on by waters which can be accepted for moisture can be condensed. The glycols getting to gas in case of its drying and hydrocarbons with higher molecular weight (heavy hydrocarbons) belong to such components.

Availability, in a significant amount, heavy hydrocarbons and glycol in the researched gas leads to misstatement of true values of temperature of a dew point on moisture or do not possible its determination at all by the device of this type as they with a high probability will be condensed on the condensation surface of the device in case of more high temperature, than water. That is in a case with heavy hydrocarbons it hi to growth of a dew point on hydrocarbons to the value exceeding a dew point on water.

From above told it is possible to draw a conclusion to perform exact measurements of temperature of a dew point on water in natural gas the device of condensation type it is necessary to remove or bring to acceptable values amount of heavy hydrocarbons and glycol in this gas.

For removal from gas of the listed components the special filter is included in the package of analyzers. The cartridge the filled sorbent which is the modified absorbent carbon forms a basis of such filter.

The modified absorbent carbon has properties to well absorb the glycols couples and heavy hydrocarbons. However, it also has serious side effects, being the effective dehumidifier capable to absorb also moisture and consequently, to cause considerable changes of moisture content in test. So if the researched gas becomes to the land, absorbent carbon will give water, doing the gas arriving in the analyzer to more damp and if test becomes more damp, coal will dry up it therefore the device will begin to show lower

humidity, than actually. This effect will manifest itself until in the coal will not come to equilibrium with the moisture, then the moisture content in the sample will be unchanged.

Thus overall performance of coal will be high in it so far there won't come the equilibrium condition on glycols and heavy hydrocarbons but already came on moisture. That is coal still absorbs glycols and heavy hydrocarbons but doesn't absorb moisture any more.

It should be noted that the greatest possible concentration of vapors of glycols in natural gas is as a rule rather low, in comparison with concentration of moisture, and the modified absorbent carbon on this component can effectively work rather long time.

Availability in gas of a large amount of heavy hydrocarbons leads to growth of a dew point on them. Operating time of the modified absorbent carbon on this component decreases as on it and on water the equilibrium condition in coal will be established practically at the same time.

From stated it is possible to draw a conclusion that for carrying out the correct and long measurements of temperature of a dew point on moisture in natural gas, in a case when dew point temperature on hydrocarbons is higher than it, it is necessary to use the effective filter of heavy hydrocarbons.

Such filter was made and tested in laboratory of department "Metrology and Analytical Devices" branch "Engineering Technical Center" of JSC «Intergas Central Asia».

Oil absorber.

The oil filter - an absorber is intended for removal from test of gas of vapors of hydrocarbons generally propane - butane group. It can be applied in case of measurements of temperature of a dew point on moisture condensation analyzers and hygrometers in cases when gas contains a large amount of the hydrocarbons which are condensed before moisture that complicates or does not possible carrying out measurements.

The principle of operation of the filter is based on use of process of oil absorption which cornerstone the mass exchange, i.e. transition of substance from a gaseous phase in a liquid phase is (in absorbent or an absorber). Dissolution of gas in absorbent depends on pressure and temperature in an absorber, and also the molecular mass of absorbent. As absorbent (an absorber of hydrocarbons from gas) usually apply light oils. Use of oil as absorbent also doesn't promote change of moisture content in gas test as water in oil is practically not dissolved and consequently it doesn't lead to misstatement of results of measurement.

Structurally the absorber is a hermetic vessel of high pressure in amount 1 liter. In the lower part of a vessel the union for supply of the researched gas, and in the upper part the union for removal of the filtered gas supplied to the analyzer or a hygrometer is established. The vessel, on a half, is filled with the absorbent which is the dehydrated transformer oil through which there passes the researched gas and filtering is reached due to absorption of vapors of hydrocarbons by oil.

The filter described above was made and put on comprehensive trials. Testing consisted in a transmission of gas through it having a certain value of temperature of a dew point on moisture of the GVG-2M gas generated by the generator of humidity, and then a transmission through it natural gas in which dew point temperature on hydrocarbons considerably exceeded value of temperature of a dew point on moisture. In the first case influence of absorbent on moisture content in test of the researched gas, and in the second efficiency of its work on decrease in temperature of a dew point on hydrocarbons was established. Results of testing for the first case are given in table 1, and for the second in table 2.

As control devices analyzers of a dew point of condensation type were used: Chandler of model 13-075 of production of "Chandler Engineering", USA with a margin error measurements of temperature of a dew point ±0,5 ºC and "Hygrovision – BL" made by LLC "SPA Vympel", Russia with a margin error of measurement of temperature of a dew point ±1ºC

Table 1.

generated DPW, GVG-2M ,ºC.	measured DPW, Chandler 13-075,ºC.	measured DPW, Hygrovision-BL,ºC.
20	19,8	20,1
0	0,1	0
-20	-20,1	-19,7

Table 2.

	measured DPHC gas, ºC.	measured DPW gas, ºC.	measured DPHC gas, ºC.	measured DPW gas, ºC.
	without absorber		with an absorber	
Chandler 13-075	14,8	condensation of hydrocarbons (HC)	-17,2	-16,3
Hygrovision – BL	15,5	condensation of hydrocarbons (HC)	-16,8	-16,5

Conclusion.

Testing of the made sample of an absorber showed its efficiency during removal of hydrocarbons from the researched natural gas. Also lack of influence of the filter on moisture content in test of the researched gas was established.

Filters, similar to it, can be used with success together with analyzers and hygrometers of condensation type without worsening their metrological characteristics, and in certain cases doing application of the last without them at all not possible.

Literature.

1. GOST R 53763 - 2009 "Natural combustible gases. Determination of water dew point temperature.", Moscow, Standartinform, 2010.

2. GOST R 53762 - 2009 "Natural combustible gases. Determination of hydrocarbon dew point temperature.", Moscow, Standartinform, 2010.

3. Prakhova M. U., Krasnov A. N., Nagumanov H. G. " Measurements of moisture content in the natural gas for field conditions: some problems.", Modern scientific research and innovations, No. 7 2015.