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On the Basic Parameters of Pipe Measuring Device

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Abstract

Developed a system for measuring the amount of extracted from the bowels of oil and petroleum gas, based on the volumetric method of measurement, and made of pipes. A technique to determine the water content of the hydrostatic pressure drop, which takes into account the presence in the crude oil dissolved gas. The theoretical results are confirmed in the experimental field tests of pipe measuring setup.

Key words: Measurement; Well; Quantity; Oil; Gas; Water cut; Pipe

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To organize reliable through each well control and the accounting of production which is a basis of all system of rational subsurface use[1,2], it is impossible when using the existing group of well measuring units (GMS).

Their basic disadvantages are:

(a)Insufficient accuracy, non-operability and not ensuring the reliability of the results-in fact they are flat and not measuring units[2-6];

(b) Relative measurement error of the flow rate of any well Bush is always more than passport error of installation[5,6];

(c) It cannot be used on single well and for the measurement of high-viscosity oils;

(d) The moving parts;

(e) The tank requires registration as the vessel working under pressure;

(f) The bottom of the tank during filling works as oil-water separator, while discharging at first water flows, then the emulsion (with decreasing water content) and finally the oil, which does not allow to measure with installed on the discharge line hygrometer real cut of wells.

Thus in the range of changes in the water content of 70% - 100%, which is typical for most developed fields of Russia, basic absolute error watering for moisture meters PVN-615M and VNP-100 is respectively +/-1.4 and +/-4%. Measured the local and not the integrated water content.

Let the Bush has the N producing wells. Each i-th hole ($i=\overline{1,N}$) is characterized by the amount of produced crude oil $q_{l,i}$, water content of $n_{w,i}$, and gas factor $\tilde{A}_{f,i}$. Time of measurement of flow rate each one using GMS $\tau_{GMS,i}=v_{GMS}/q_{l,i}$. It is easy to estimate that at the rate of 50 m^3/day, the separation tank with a capacity of v_{GMS} = 2.5 m^3 completely filled with liquid during 1 - 2 o'clock. All this time the separation tank works as oil-water separator - top will be collected oil, then emulsion with changing the height of the cut, and below water. The moisture meter is installed on the discharge line. Therefore, the discharge of first water flows, venture emulsion with decreasing water content, and in the end-oil, that is, watering becomes variable. In this thread the hygrometer will -give testimony with great accuracy. Additionally separation tank requires registration as a vessel operating under pressure.

Measurement range GMS q_{GMS} is chosen so that it was more debit any of the well of Bush, that is, the condition $\delta_{GMS}>\delta_i$ $\left(i=\overline{1,N}\right)$. When relative error (as in the passport) δ_{GMS} absolute error is $\Delta_{GMS}=q_{GMS}\delta_{GMS}$. Debit Bush is determined as the sum of the rates of its wells. When progressively metering of well production Bush relative measurement error, it will be Equation (1).

$$\delta_c = N\delta_{GMS} \Big/ \sum_{i=1}^{N} q_{l,i} / q_{GMS} \quad (1)$$

From (1) that the relative error of measurement of the flow rate of the well cluster is always greater relative (as in the passport) errors GMS, since the condition $q_{l,i}/q_{GMS} < 1 \quad \left(i = \overline{1,N}\right)$. From (1) we get that by using GMS-400 with a relative error of 2.5% on the Bush of 8 wells with an average rate of 50 m^3/day. the relative error in the determination of the rate of well cluster will be 20 %.

To address these shortcomings there developed a measuring pipe plant (MPD - the measuring pipe device), which has:

(a) a relative measurment error of the amount of fluid is constant and does not depend on the flow rate;

(b) the relatively small size (due to the lack of capacity - separator);

(c) provides for the use on a single wells and well pads;

(d) defines integrated water content, and basic absolute error watering constant, regardless of flow rate;

(e) piping does not require registration as a vessel operating under pressure;

(f) a small time interval measurements allows to measure the flow rate all wells at the Bush, when completed PSM, during the day several times;

(g) no moving parts.

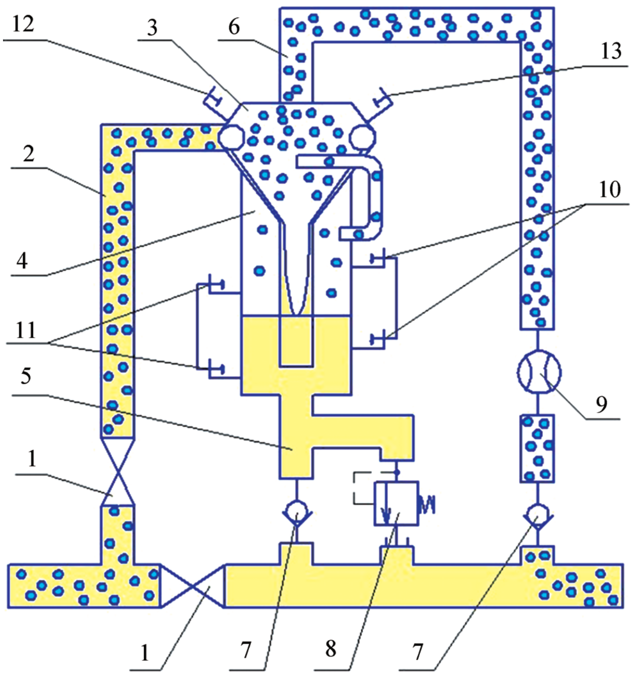

Figure 1
The Cheapest in the Production and in Use the Option MPD (1 - Valve; 2 - Supply Pipe Production Wells; 3 - Separation Unit; 4 - Column; 5 - Liquid Withdrawal Conduit; 6 - Exhaust Gas Conduit; 7 - Solenoid Valve; 8 - Safety Valve; 9 - Gas Flowmeter; 10 - Liquid Level Sensors; 11 - Hydrostatic Pressure Differential Sensor; 12 - Pressure Sensor; 13 - Temperature Sensor)

The cheapest in the production and in use the option MPD is shown in Figure 1. In the pipe of exhaust emulsion there must be set a solenoid valve (valve). The Volume flow of emulsion is determined according the time of filling of the measuring device, located at the bottom of the column. Then the solenoid valve opens and the liquid is discharged into the pipeline for production of wells. You can install the solenoid valve on the gas line. In case of significant flushing the lower part of the column is equipped with the socket that allows you to collect almost all the resulting foam, thereby eliminating its influence on the measurement result. The outcoming emulsion is evenly distributed over the separation device, forming a film flowing down. The Time of runoff should be far greater than the ascent time of gas bubbles from the film. As it is measured the filling time, the installation works in any watering with sufficient accuracy, and it can be improved by increasing the height of the measuring volume. The Height of measuring device h_m depends on the relative error δ_l measuring the amount of produced fluid and absolute error of level sensors $\Delta_ó$:

$$\delta_l = \Delta_ó \sqrt{2} \big/ h_i \quad (2)$$

If the density of oil ρ_o and water ρ_w are not less than 10 %, then the integral degassed water content of crude oil can be defined by the difference of its hydrostatic pressure ΔP_l:

$$n_w = \frac{\Delta P_l / g h_m - \rho_o}{\rho_w - \rho_o} \quad (3)$$

From (3) we see that the main absolute error of watering is constant, regardless of flow rate, and it can be reduced by increasing the height of the measuring device. It should be noted that unlike hygrometer, which determines the cut in a small Bush, MPD defines the integrated water content of crude oil, located in a measuring part. The cost of the gauge hydrostatic pressure drop is much lower than the hygrometer.

Calculated from (2) the error of the water content is about 1 %[7,8] when the following values of parameters: h_i= 1.3 m; ρ_w= 1,000…1,200 kg/m^3; ρ_o= 800…920 kg/m^3 and the relative error of measurement of hydrostatic pressure drop is of 0.1% (Metran-100-DI-1162).

If crude oil has the dissolved gas, then the method of determining the water content by hydrostatic pressure drop is complemented by its accounting. Molar mass of the gas M_G is determined by the 6-component composition and the Molar mass of the component $M_{g,i}$ and their concentration $k_{g,i}$:

$$M_G = \left(\sum_{i=1}^{6} \frac{k_{g,i}}{M_{g,i}} \right)^{-1}; \qquad \sum_{i=1}^{6} k_{г,i} = 1. \quad (4)$$

The relation (3) is used in equation of Mendeleev-Clapeyron when determining the volume fraction of dissolved gas α_g in crude oil.

After performances there obtained the expression for determination of the water content of crude oil with the dissolved gas.

$$n_w = \frac{\Delta P_l / g h_m - \rho_o + \alpha_g (\rho_o - \rho_g)}{(1 - \alpha_g)(\rho_w - \rho_o)} \quad (5)$$

While $\alpha_g = 0$ the Equation (4) is transformed into (2).

An important parameter is the frequency of measurements. It is determined with account of the sampling theorem: if there is a signal with a certain range of frequencies, in order to restore it with any accuracy, there should be a discrete measure at least 2 times more often than the frequency of the signal. For the time selected τ^* the ascent well production from the pump intake to the mouth of the well. Then periodicity of measurement of production wells should be $\tau < \tau^*/2$.

Taking the above into account, there was developed and tested MPD, the General view of which during the field testing is shown in Figure 2.

Figure 2
The General View MPD of Which During the Field Testing

REFERENCES

[1] Sokolov, S. M., Gorbatikov, V. A., Tarasov, M., & Fakhretdinov, I. Z. (2009). About modernization of old oil fields of Western Siberia and the integrated design of their development and construction. *The Oil Industry*, *11*, 120-123.

[2] Shayakberov, V. F., Ismagilov, R. R., & Latypov, I. A. (2010). New technologies of modernization of arrangement of old oil fields. *Scientific-Technical Bulletin of JSC "NK Rosneft"*, *1*, 8-11.

[3] Sokolov, S. M., & Gorbatikov, V. A. (2001). Development of oil fields in Western Siberia: from principles of arrangement to the problems of upgrading. *Oil Industry*, *5*, 22-24.

[4] Abramov, G. S. (2012). What begins bore. *Kipinfo*, *1*, 8-12.

[5] Shayakberov, V. F. (2012). Test units for measurements of the quantity of petroleum and petroleum gas for wells and well clusters. *Measurement Technique*, *54*(11), 1249-1255.

[6] Shayakberov, V. F. (2013). Error of calculation of water when using a pipe installation for measurement of the quantity of crude oil and gas. *Measurement Techniques*, *2*, 25-26.