

## **AUTOMATED GROUP UNIT FOR MEASURING DEBIT OF OIL WELL ON BASIS OF PIEZOMETRIC METHOD**

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One of the major parameters of work an oil layer is daily average production on which the technological rules-mode of selection on well is established. Only the exact knowledge of this size on each concrete well will allow to execute the conclusion about correct work of system « a layer-well - producing equipment », to do{make} forecasts and to plan necessary preventive works which will allow to avoid in the further emergencies, and, hence, expensive repairs and a stop of an oil recovery. Definition of productivity (oil and gas rate) oil and gas wells while in exploration oil and oil-and-gas field is one of the most difficult and actual problems of maintenance of development of fields.

Traditional means of definition production of wells are separation measuring unit with preliminary separation of production and the subsequent definition of its quantity through measuring unit, measuring separators, Group Measuring Unit (GMU) type of "SPUTNIK", trap, batchbox and etc. Measurements with their helps allow to determine separately a liquid and gas flow. For measurement production of the wells it is most effective application group measuring unit included in system of the centralized control. Developed in NIPI «NEFTEKHIMAVTOMAT» the centralized monitoring system of production oil wells of type AGM most full met the requirements of a petroleum industry. System AGM is intended for automatic telemeasurement production oil wells separately on water and on oil on group measuring unit of the closed system of collect and transport of oil. Each complete set of system AGM-3 allows to capture the centralized control of 192 wells. System AGM-3 represents system of the centralized collection of the information with condensation of a liaison channel and the flexible central program. The system consists of the dispatching board and the automatic registrar, placed on dispatching board of the production area, and twelve half-set equipments of executive points, located on automated measuring units.

By system AGM are achieved:

- Automatic switching a well from the collector to the measuring unit (MU) and back after the program of gauging;
- Filling batchbox in time, set by the dispatcher (it is determined by character of a well);
- Automatic measurement production of wells separately on oil and on water with transfer of results of gauging on dispatching board for its registration on the form;
- The automatic control of a condition batchbox and equipments on a measuring unit;
- Automatic preparation batchbox to gauging.

The dispatching board is connected with all of executive points by means of one two-wire air-line of communication on which commands and signals are transferred.

In such a way one of the board serves up to twelve measured installations, to each of which is connected sixteen wells [2, p.191; 3, p.66].

System AGM-3 is developed in 60th years of the last century and with small modernizations till now is maintained in some oil fields of Azerbaijan. However it is necessary to note, that the means of automation installed on this technological scheme and measuring technics have morally become outdated, their spare parts for a long time are not issued by the industry. On the other hand operation float systems of measurement is very inconvenient that it is placed inside of capacity and directly contacts to a measured liquid. Sticking on floats of paraffin, pitches sometimes and sand, forces metrological characteristics of this way. Therefore

very often it is necessary to stop AGMU for labour-consuming preventive works or it will be limited to rough measurement of quantity only the general liquid.(not separately oil and water).

Considering above mentioned to support **AGM-3** in the operating condition practically it is very inconvenient. As a result or the craft remains without gauging automatic or existing group measuring units give a greater error of measurements, especially at small production wells.

In a direction of modernization AGMU it is necessary to note achievements of Joint-stock company OZNA.

Developed by them automated group measuring units equipped modern equipments of measuring technics and information technology have improved on comparison with their predecessor metrological characteristics [4]. However they very expensive and economically their application in conditions of Azerbaijan is unprofitable as much more cheaply to modernize technological schemes AGM-3 , which are available on production areas on the basis of modern means of automatics of measuring techniques and information technologies.

The work, measurements increasing accuracy production is an actual problem. There is the variant of measurement of quantity of the general liquid (weight in capacity by piezometric way, volume through the flowmeter) and definition of quantity of oil and water by calculation in the given report. The technological scheme automated group measuring units on the basis of piezometric way of measurement of a column of a liquid is resulted on figure 1.

It provides modernizations existing on production areas AGM-3 and differs that system of measurement of floats type U6-M is changed to measuring instruments of the flow meter 6, pressure 7, pressure difference 8 and temperature 9, and the device of management GZU "Trap" including controller "Trap" and a gas flowmeter is developed on the basis of modern microcontrollers.

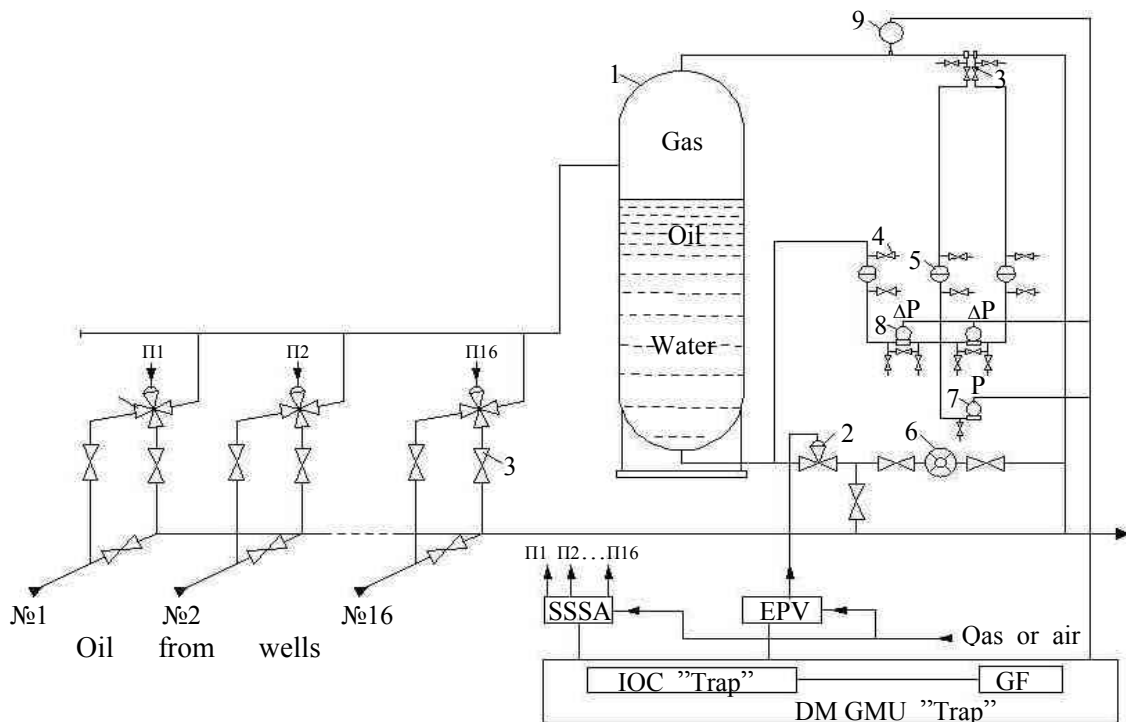


Figure 1. The Technological scheme automated group measuring unit on the basis of piezometric way.

1 - trap; 2 - operating valve; 3 - shutoff valve; 4 - blow-off valve; 5 - settling vessels; 6 - flowmeter; 7 - converter of pressure with valve block; 8 - converter of pressure difference with valve block; 9 - converter of temperature.

SSSA - the switch of the step-by-step allocator; IOC - intellectual operating controller "Trap"; GFM - a gas flowmeter; DM GMU - the device of management GMU "Trap"; EPV - electropneumatic valve.

AGMU carries out gauging production of the wells, connecting them serially to measuring capacities. Each well depending on in advance certain production has time of gauging. At connection of a concrete well to measuring capacities the controller starts the timer of time of gauging. It is measured pressure difference ( $\Delta Pf$ ) on an output of the gauge and the weight of a liquid is calculated under the formula:

$$G_{fi} = S \cdot \Delta Pf_i \quad (1)$$

where  $S$  is the area of cross-section section measuring capacities,  $\text{cm}^2$ . Height of a column of a liquid under the formula:

$$G_{fi} = S \cdot \Delta P \rho_{fj0} \quad (2)$$

where  $\rho_{fj0}$  is the focused density of a liquid

Calculation under formulas (1) and (2) proceeds before achievement  $\tau_j \geq \tau_{j\text{lim}}$  or  $H_{fi} \geq H_{\text{lim}}$ . At achievement of one of conditions  $G_{fi} = G_{fj}$  switching-off of a well from measuring batchbox is accepted and carried out. Electropneumatic valve EPV for a devastation of capacity opens. Thus the sanction to summation of impulses of a flowmeter is given, i.e. the volume of a liquid  $V_f$  is defined. After known temperature correction:

$$V_{fT} = V_f (1 - \alpha T) \quad (3)$$

The density of a liquid of the given well is defined as:

$$P_{fj} = \frac{G_{fj}}{V_{fT}} \quad (4)$$

It is known, that at displacement of two liquids the density of a mix submits to the additive law, in view of it, the share of oil in a liquid will be defined:

$$K_0 = \frac{\rho_w - \rho_{fj}}{\rho_w - \rho_0} \quad (5)$$

Then the weight of oil and water will be accordingly certain:

$$G_{0j} = G_{fj} \cdot K_0 \quad (6)$$

$$G_{wj} = G_{fj} (1 - K) \quad (7)$$

The production of oil and water in an hour and for a day in tons accordingly:

$$G_{oj/h} = \frac{G_o}{\tau_j} \cdot \frac{\text{tonne}}{\text{hour}} \quad (8)$$

$$G_{wj/h} = \frac{G_w}{\tau_j} \cdot \frac{\text{tonne}}{\text{hour}} \quad (9)$$

$$G_{oj/day} = 24 \cdot G_{oj/hour} \quad (10)$$

$$G_{wj/day} = 24 \cdot G_{wj/hour} \quad (11)$$

This process cyclically proceeds for all wells connected to AGMU serially in an automatic mode.

Application of piezometric method of measurement of a column of a liquid in measuring capacity in comparison with floating method of measurement gives capacity AGMU following advantages:

All measuring devices are installed outside of capacity that facilitates operation of measuring devices:

-after filling capacity time of a sediment for division «oil - water» is not required and due to reduction of time of a sediment frequency of measuring of wells increases, that in integrated value of measuring of wells improves accuracy of measurement.

During time of accumulation of capacity there is an opportunity of measurement of quantity of a liquid through the certain intervals of time and to construct characteristic  $G_f = f(t)$  that in turn characterizes submission of the deep pump in time.

### References

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