UDC 622.692.4

SELECTION OF TECHNICAL AND TECHNOLOGICAL PARAMETERS OF PUMPDOWN PRODUCT FROM THE CAVITY PLOT OF OIL PIPELINE

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Abstract. *The calculation formulas for determination of operating efficiency of product removal from pipe-line cavity by pump exhausting depending on section area and pressure head of a relieved pipe line so as to provide maximum possible operating efficiency of product removal from the pipe line. The obtained results can be used for breakdown maintenance of oil-trunk pipelines and overhaul of oil-products pipelines.*

Keywords: *oil-trunk pipeline, operating efficiency of product removal from pipe line cavity, emergency blowout, gravity-flowing discharge*

Repair of main pipelines with pipe replacement, and their disassembly associated with the pumpdown of oil from the cavity plot of the pipeline [1]. With the planned works discharge product from section of the pipeline is pumping out the pumps.

In the process of pumping oil to the place of evacuation, depending on the elevation of the site and the place emptied pump can come from two sides or one side only. In this case, the resistance to movement of oil depends on the length and diameter of the pipeline through which at present takes place within the product and the state of the cavity pipeline in terms of resistance to movement of fluid. Specified pressure and the resistance movement, the maximum rate of oil flow in the cavity of the pipeline to the place of evacuation. To ensure the efficient operation of drain pumps requires that the amount of oil flowing to the pump per unit time was equal or close to the total productivity drain pumps. It should also be taken into account, during the discharge is reduced geodetic benchmark crude oil in the pipeline, which reduces the pressure, under which there is fluid motion. Decreases the length of the site, which contains oil, moving to a place of evacuation. Reduce the pressure and the length of the site with the oil changes the rate of oil flow in the cavity of the pipeline during pumping.

Total output of oil pump depends on the characteristics emptied part of the pipeline, pump characteristics and number of interconnected for parallel operation, as well as the diameter and length of pipeline connecting the pump with a hollow pipe.

Taking into account the recommendations of [2], based on analysis of collaborative drain pumps and empties the oil pipeline section we have obtained the formulas for calculating the performance product removal from the cavity of the pipeline pumping pumps in the form

$$Q_H = \overline{Q}_H \cdot F_{CB} \cdot (2\,gH)^{0,5}\,, \qquad (1)$$

where F_{CB} – sectional area of the released oil; g – acceleration due to gravity; H – pressure, under which there is a movement of the product to the place of evacuation;

$\overline{Q}_H$ – dimensionless flow rate, which is determined depending on the parameters characterizing the head loss in the process of emptying, specifications, and the number of parallel drain pumps.

To determine $\overline{Q}_H$ analytical expressions for possible cases of oil revenues to the place of evacuation – from both sides of the pipeline (concerning the place of pump-down) and only one side. For example, admission to the place of pumping oil from one side only, for $\overline{Q}_H$:

$$\overline{Q}_H = \left[h + \frac{h_B}{\left(\eta_B^2 n\right)^2} \right]^{-0,5}, \tag{2}$$

where h, h_B – dimensionless parameters of the head loss in the liberated oil pipeline, and pipelines connecting the oil pump with a cavity defined by the recommendations [3]; n – number of parallel pumps; $\eta_B^2 = \frac{f_{CB}}{F_{CB}}$; f_{CB} – cross-sectional area in the world connecting pipelines.

Increase h and h_B consistent increase in the length and decreasing diameter pipelines.

The analysis of the effect of parameters influencing the performance of product removal from the cavity section of the pipeline in order to select the most efficient technical and technological parameters of release. Analysis of our analytical relationships to determine Q_H and $\overline{Q}_H$ showed that the parameters that affect significantly the productivity drain and which can be selected in preparation for an evacuation option $\eta_B^2 n$. Calculations showed that an increase to a certain parameter $\eta_B^2 n$ there is an increase $\overline{Q}_H$ and flow Q_H. Increase $\eta_B^2 n$ increase Q_H is slightly. Value $\left(\eta_B^2 n\right)_0$, with an increase of which significantly reduce the influence $\eta_B^2 n$ performance Q, will be rational. Studies have shown that the rational values $\left(\eta_B^2 n\right)_0$ depend on the parameter of loss of pressure in the pipeline emptied h. Increase h option $\eta_B^2 n$ reduced. This shows that at high resistance to movement of fluid in the cavity of the pipeline increases $\eta_B^2 n$ does not lead to substantial improvements in productivity Q. Note that the increase $\eta_B^2 n$ associated with an increased diameter of the pipes and the number of parallel drain pumps. In the range of possible values loss in the connecting piping option h_B value $\left(\eta_B^2 n\right)_0$ virtually no effect.

To determine $\left(\eta_B^2 n\right)_0$ analytical expressions for admissions to the place of pumping oil from both sides and only one side. For example, the case proceeds to a place of pumping oil from one side only

$$\left(\eta_B^2 n\right)_0 = \left(\frac{9,15}{h}\right)^{0,5}. \tag{3}$$

Equation (3) allows you to find the diameter of the connecting pipes d_0 for given h и n or to determine the amount of drain pumps n for given h and d_0, which provide the best performance possible release of the oral section of the pipeline from oil. From (3),

$$n=\left(\frac{D}{d_0}\right)^2\cdot\left(\frac{9{,}15}{h}\right)^{0{,}5}, \qquad (4)$$

where D – inner diameter of the pipeline.

For example, for the pipeline with a diameter of 1020 mm length emptied area 8.5 km (length 8.5 km corresponds to $h=300{,}0$) at $\frac{d_0}{D}=0{,}25$ and $n=3$ ensured the highest possible performance product removal from the cavity of the pipeline is determined from the equation (1).

Accidental rupture of pipes of main oil pipelines to install drain pumps are gravity flow through an emergency evacuation of the gap [4]. As a result of the analysis we derive an analytic expression for the flow of oil through an emergency pipe rupture oil pipeline in the form (1). We also obtain formulas for calculating the dimensionless parameters of flow through the gap – $\overline{Q}_P$ for admissions of the product to the place of the gap on both sides and one side only. Options $\overline{Q}_P$ depend on the area of discontinuity and its hydraulic resistance of the expiration of the liquid. Calculations showed that there is such a marginal area of the gap $F_{ПР}$, which more consumption of the product through the gap with the increase of its area is practically not increased.

We obtained the formulas for calculating the marginal area of the gap for the admissions of the product to the place of the gap on both sides and one side only. For example, when you receive a product with only one hand

$$F_{ПР}=F_{СВ}=\left(\frac{26{,}01}{h}\right)^{0{,}5}. \qquad (5)$$

As an example, consider emptying flow through the gap section of the pipeline with a diameter of 1020 mm, a length of 8.5 km section emptied and $h=3000{,}0$. Area limit break $F_{ПР}=0{,}2944=F_{СВ}$ or $F_{ПР}=2310$ см^2.

Thus we have obtained analytical expressions allow a choice of technical and technological parameters of the liberation of the cavity area from the main pipeline products that deliver the best possible performance from the disposal of the product pipeline.

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