MOVEMENT OF THE CLAY SOLUTION IN THE BORING PIPE AND DEFINITION OF CRITICAL SPEED OF THE SUSPENSION OF THE FIRM PARTICLE AT HORIZONTAL DRILLING

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The summary: *In this article an attempt is made to theoretically determine the rate of wool in relation with horizontal drilling. Conducted a special experiment for the theoretical and experimental determination of the viscosity and the coefficient of the interaction between the particles contribute to a deeper physical phenomenon is determined if the movement of a drilling mud.*

Keywords: *hydraulics, sedimentation, firm particles, the stream expense, speed of a current, horizontal drilling, the rotary moment, factor, resistance of pressure, a turbulent stream, conditional viscosity of a chisel solution, a clay solution.*

Now the increasing urgencies gets drilling - the directed and horizontal chinks. It is connected with necessity of increase of productivity and decrease times of recovery of outlay building of chinks. Besides, detection the areas under agricultural objects, territories and the reserves, the limited space on to placing chinks with the maximum compactness and without decrease potential.

The solution expense is regulated for protection of a core and achievement of the maximum volume of selection. The solution washes out and cools a chisel, providing high speed and extending chisel service life. Too big expense washes away a core. Too low expense - cannot clear effectively enough a chisel and it leads to reduction of speed.

Speed of rotation steals up so that to provide peak efficiency of selection of a core, optimization of speed and the maximum service life of a debt. It is defined by properties of breed. At definition of optimum speed of rotation, loading on a chisel and the solution expense are supported by constants.

In soft breeds speed of rotation should be less for improvement of process of selection of a core. Abrasive breeds demand smaller speed of rotation on conditions of prevention of premature deterioration of a chisel of selection of a core.

One of problems at drilling of the naklonno-directed and horizontal chinks is insufficient clearing of a chink which leads to variety of complications and lengthening of terms of building of chinks.

Perfection of methods of clearing is conducted in several directions: improvement parameters liquids, perfection of hydrodynamics of washing. It is connected with necessity of increase of productivity and decrease in times of recovery of outlay of building of chinks.

The purpose of the given work is the experimental and theoretical research of hydrodynamic processes on experimental modeling installation for revealing of law of structure non-uniform environments and realization of power saving up structure of a current of a mix at horizontal drilling of chinks, also definition of law of sedimentation during rotation and without rotation of an internal pipe in space, and also influence of a mode of a current.

In the last time processes of transportation of particles in a clay solution with reference to drilling the horizontal chinks are studied. Studying of processes of transportation mountain reeds or firm particles and definition optimum, parameters providing without sedimentation of firm particles in a pipe is a paramount problem during drilling of chinks. These factors leads to increase of efficiency of clearing of a horizontal trunk of a chink from breeds [4].

And also experimentally investigated hydrodynamic processes of a current of mixes at circular pipe section on modeling installation. Besides studied modes of a current of mixes in circular pipe section providing reduction of sedimentation of firm particles by a pipe wall.

Without looking these researches of processes of transportation or firm particles in the basic size subject thus to definition, critical speed usually is or firm particles at horizontal drilling which firm particles remain in weighed a condition.

In work as [1] authors are considered theoretical ways of definition of the critical speed providing a suspension of a single firm particle in limited area of a stream. Resistance of pressure and a friction, gravity (body weight), carrying power, the rotary moment of a firm particle for a horizontal current a liquid + a firm particle are considered.

$$\upsilon_{\text{ж}} = \sqrt{\frac{2 \cdot V \cdot g \cdot (\rho_m - \rho_{\text{ж}})}{C_y \cdot \omega \cdot \rho_{\text{ж}}}} \quad (1)$$

Where the C_y - the factor of resistance considering force of a friction at lifting of a particle; ρ_m - density of a firm particle; $\rho_{\text{ж}}$ - liquid density; V - body volume; ω - characteristic (миделевая) the particle area.

From the formula (1) follows that with increase in concentration of firm particles or solution weighting critical speed decreases. Hence, at the same value of critical speed bodies of the critical size will be kept in a suspension.

Non-uniformity of distribution of speeds definitely affects carrying out process breeds during horizontal drilling also on stream section. The great bulk of particles is usually taken out by the central part of a stream having the greatest speed, and the small speeds which have got to a zone (an interface - walls) cannot be taken out. Therefore the most perfect washing of chinks occurs at a turbulent mode of a current. By authors in work [1] it is noticed that at a turbulent mode of a suspension can be considered as a dysphasic solution. Taking into account degree of demanded accuracy of calculations for practical purposes at a turbulent mode fictitious viscosity of a firm phase [2] can be used.

$$\mu_2 = -\mu_1 \frac{Q_1}{Q_2} + \left(-\frac{\partial P}{\partial X}\right)\frac{\pi R^4}{8Q_2}, \quad (2)$$

Where μ_1 - dynamic factor of viscosity of a liquid phase, will usually be applied to a clay solution kinematic viscosity $v_1 = \mu_1/\rho_{\text{ж}}$; Q_1, Q_2 - volume expenses of the first and second phase accordingly; $\frac{\partial P}{\partial X}$ - a pressure gradient; R - pipe radius.

The formula is received, using expressions of expenses of the dysphasic environment, moving in a round cylindrical pipe.

$$Q_1 = U_{1cp} f_1 \pi R^2 \;; \qquad Q_2 = U_{2cp} f_2 \pi R^2, \quad (3)$$

Where U_1, U_2 - average speeds for dysphasic environments I will have the following appearance [2]:

$$U_{1cp} = -\frac{2\frac{\partial P}{\partial X}}{m^2 R}\left[\frac{n_1 I_1(mR)}{m I_0(mR)} + \left(\frac{kR^2}{8 f_1\mu_1 f_2\mu_2} - n_1\right)\frac{R}{2}\right] \quad (4)$$

$$U_{2cp} = -\frac{2\frac{\partial P}{\partial X}}{m^2 R}\left[\frac{n_1 I_1(mR)}{m I_0(mR)} + \left(\frac{kR^2}{8 f_1\mu_1 f_2\mu_2} - n_2\right)\frac{R}{2}\right], \quad (5)$$

where

$$n_1 = \frac{1}{f_1\mu_1} + f_2\mu_2 - \frac{1}{\mu_1};$$

$$n_2 = \frac{1}{f_1\mu_1} + f_2\mu_2 - \frac{1}{\mu_2};$$

(6)

$$m = \sqrt{k\left(\frac{1}{f_1\mu_1} + \frac{1}{f_2\mu_2}\right)}$$

Other designations in formulas (4-5) correspond designations in the literature [2, 3]. Having excluded from expressions (3), (4), (5), $\frac{I_1(mR)}{I_0(mR)}$ we will receive for conditional viscosity of the second phase. On the basis of the formula (2) the factor of dynamic viscosity μ_2 depending on firm particles is investigated and is proved that with increase homogeneous particles increases μ_2. Applying theoretical techniques of definition of factor of interaction between particles - *k* and conditional viscosity μ_2, conducted special research on experimental installation of type of Reynolds, especially used in a course hydraulics in vitro at definition of a mode of a current, and also factor of a hydraulic friction λ a stream.

Experimental installation consists of the amalgamator (a pressure head tank), a glass tube, the pump and connecting tubes.

The length of glass pipeline *L*=135 cm, internal diameter *d*=0,9 cm the Entrance part of a pipe has the conic form. Besides, in a working site of a pipe unions for measurement of pressure difference along a stream are built in. The investigated mix consisted from (a firm particle) and waters. Prepared it as follows. Water some time maintained in a special tank for allocation of vials of air, then added necessary volume of rosin. Largeness grains rosin made 0,4 mm which have been received by a method. At first experiences spent with pure water.

After continuous hashing an investigated mix by means of the rotary crane passed from the amalgamator in a pressure head tank through speeds. A pressure head tank filled to the necessary level which strictly supported and kept till the end of one series of experiences. A constancy of level of a liquid provided by means of a drain pipe for what in a tank the special equipment has been built in.

In the course of experiences measured sizes of expenses of the first and second phases necessary for calculations, pressure difference along a current, concentration, and also mix temperature. After movement was established, pressure drop on a considered site of the pipeline measured, connected to the union a rubber tube.

The mix expense at an exit from a pipe defined a set of tests. Weight maintenances of each component accordingly are equal in the selected test

$$Q_1\gamma_1 t = G_2 - G_3 \;;$$
$$Q_2\gamma_2 t = G_3 - G_1 \;, \quad (7)$$

where Q_1, Q_2 - volume expenses of the first and second phases; γ_1, γ_2 - relative density of water and rosin; G_1, G_2, G_3 - weight of a vessel, a mix and a firm body accordingly; t - time.

Defined the general test weight:

$$(Q_1\gamma_1 + Q_2\gamma_2)t = G_1 \quad (8)$$

The water expense in a mix

$$Q_1 = \frac{G_2 - G_3}{\gamma_1 t} \quad (9)$$

The rosin expense

$$Q_2 = \frac{G_3 - G_1}{\gamma_2 t} \quad (10)$$

Using the data on parameters $\boldsymbol{Q_1}$ and $\boldsymbol{Q_2}$ from $\boldsymbol{\Delta P}$ from experiment, defined factors of conditional viscosity of a firm particle under the formula (2). On values $\boldsymbol{\mu_2}$, $\boldsymbol{f_2}$ calculated percentage of average relative speed to average speed of the first phase:

$$\frac{U_{1cp} - U_{2cp}}{U_{1cp}} \cdot 100\% \quad (11)$$

Under formulas (5) and (6) we will find average speeds of environments, knowing Q_1 and Q_2 from experiment. Under this data, having calculated the relation (11) and having postponed it for axes of ordinates, we will establish corresponding value on axes of the abscises, representing experimental value of factor of interaction - $\boldsymbol{k}$. Factors $\boldsymbol{k}$ and $\boldsymbol{\mu_2}$ for other experimental points are similarly defined.

In tab. 1 values of skilled sizes and results of calculations are resulted at the volume maintenance of a firm material for f_2=0,2 and f_2=0,3 differences between the speeds of environments depending on pressure difference and reaching of 20 % from average speed are shown.

The conditional factor of viscosity of a firm material with pressure drop growth almost constant, and interaction factor increases slightly. At change ***ΔP*** on 45 %, ***k*** will change on 12 %. Hence, in certain cases movements of particles rosin at $\boldsymbol{k_{cp}}$=483 kg·s/m^4 it is possible to make concrete calculations (tab. 1).

Tab. 1. Result of calculations of movement of a clay solution in a boring pipe at horizontal drilling

Pressure gradient $\frac{1}{\gamma_1}\left(-\frac{\partial P}{\partial X}\right)$	The expense water $Q_1,\left(\frac{см^3}{с}\right)$	The expense rosin $Q_2,\left(\frac{см^3}{с}\right)$	Conditional viscosity $\mu_2\cdot 10^4,\left(\frac{кг\cdot с}{м^2}\right)$	Experimental factor $k,\left(\frac{кг\cdot с}{м^4}\right)$
for ***f₂*=0,2**				
0,03	18,8	3,0	14,3	373
0,04	22,6	4,9	14,2	370
0,05	26,5	5,6	14,5	343
0,06	30,2	6,3	14,6	340
0,07	34,0	7,1	14,5	333
			$\mu_{2cp}=14{,}4$	$k_{cp}=351$
for ***f₂*=0,3**				
0,04	13,0	4,7	13,0	457
0,05	15,6	5,7	13,0	462
0,06	18,3	6,7	12,9	477
0,06	20,9	7,6	12,8	497
0,07	23,6	8,8	12,7	520
			$\mu_{2cp}=12{,}8$	$k_{cp}=483$

Thus, the offered theoretic-experimental methods of definition of factors of interaction between phases and conditional viscosity of a firm phase of a mix promote the further development of calculation of transportation of a particle without sedimentation in tubes of horizontal drilling. Under settlement formulas the finding of factors ***k*** and $\boldsymbol{\mu_2}$ is reduced to experimental definition of expenses of the first and second phases, concentration and pressure drop along a mix current (a clay solution) in a pipe.

The received results, allow to plan a circle of the basic perspective problems of the hydromechanics which studying will promote deeper explanation of physics of the phenomena at a current of a clay solution in horizontal drilling. Research of improvement of transportation of a clay solution at horizontal drilling of oil and gas chinks is a part of performance of the plan of dissertational work.

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