RESERCH OF THE ELECTRIC POWER CONSUMPTION WITH THE PURPOSE OF ITS ECONOMY AT OIL TRANSPORTATION

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ABSTRACT
In the article it is considered the problem of improving in discounting and normalization of power consumption in oil transportation which is very actual in oil industry as in most power-consuming industry.

Keywords: electric power, consumption, transportation, turbulence, temperature.

I. INTRODUCTION

Speed of laminar current of a viscous liquid on a cylindrical pipe is given by the formula (1):

$$v = \frac{P_1 - P_0}{4\eta l}(a^2 - r^2) \qquad (1)$$

Where: $v \frac{M}{C}$ - speed of a liquid current ;

$(P_1 - P_0)\Pi_a = \frac{H}{M^2}$ - difference of pressure on the ends of a pipe;

(l) m - length of a pipe;

$(\eta)\Pi_a c \frac{нс}{м^2}$ - viscosity;

(r) m - current radius of a pipe;

- (a) m - radius of a pipe.

At increasing of speed up to critical $\mathbf{v_{cr}}$ it happens a sharp change of a stream character . Values of both speed and pressure in that case will not be constant during a time and there will be fluctuations of speed and pressure about their average values.
At critical speeds of current continuous mixing and circulation of a liquid which occur in all points of a stream, result in substantial growth of hydraulic resistance, and it, in turn - increases a specific power consumption during transportation of liquids (oil) on pipes.

II. MAIN PART

Thus, at critical speeds a laminar current is replaced by turbulent current that causes change of character of a liquid's (oil) current on pipes and results in increasing of the specific consumption of the electric power during transportation.
As it is known the occurrence of turbulence is determined by critical value of a dimensionless value - Reynolds's number which for a pipe with round section of radius is determined by the formula (2):

$$R_e = \frac{2\rho a v}{\eta} \qquad (2)$$

Where $(\rho)\frac{\kappa g}{m^3}$ - density.

Critical value of Reynolds's number depends on a condition of surface of pipes, a geometrical configuration of the pipeline and varies within a wide range of (3) Re=1200÷2200.
From expression of Reynolds's number it is possible to determine critical value of speed

$$v_{cr} = \frac{R_e \eta}{2\rho a} \qquad (3)$$

Having accepted the critical value of speed which equal to its average value we shall receive:

$$v_{aver} = v_{cr} = v_{r=a/2} = \frac{3a^2(p_1 - p_0)}{16\eta l} \qquad (4)$$

And from (4)

$$\Delta P = (P_1 - P_0) = R_e \frac{8l}{3\rho a^3}\eta^2 = M\eta^2 \qquad (5)$$

Where $$M = R_e \frac{8l}{3\rho a^3}$$

Thus, for keeping the laminar of a oil liquid current on pipes it is necessary that the difference of nominal values of pressure on an output and an input would be less, than DP

$$\Delta P_H < \Delta P = M\eta^2$$

The dependence of viscosity of oil on temperature can be determined by the empirical formula:

$$\eta = \eta_0 e^{-\alpha\theta} \qquad (6)$$

Where factors α and h can be determined according to the tables and monograph (4).

Using the formula (2)

$$W = W_{01} + W_0 e^{-k\theta} \qquad (7)$$

and having determined the nominal specific consumption of electric power corresponding to the nominal value of temperature θ_H (2) , we shall receive:

$$\theta_0 = \frac{1}{\kappa} l_н \frac{W_0}{W_н - W_{01}} \qquad (8)$$

and the viscosity corresponding to θ_H

$$\eta_H = \eta_0 e^{-\alpha\theta_H} = \eta_0 e^{-\alpha\frac{\ln W_0}{k(W_H - W_{01})}} = \eta_0 e^{l_n\left(\frac{W_H - W_{01}}{W_0}\right)^{\alpha/k}}$$

$$\eta_H = \eta_0\left(\frac{W_H - W_{01}}{W_0}\right)^{\alpha/\kappa} \qquad (9)$$

Comparing the expressions of a nominal difference of liquid's (oil) pressure on an input and an output of the pipeline with the expression of nominal viscosity at nominal temperature, we shall receive:

$$\Delta P_H < M\eta_H^2 = M\eta_0^2\left(\frac{W_H - W_{01}}{W_0}\right)^{2\alpha/k} \qquad (10)$$

III.CONCLUSION

The nominal mode of oil transportation can be obtained by changing DP or by defining the specific consumption of electric power or by changing and regulating of temperature of transporting oil.

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