COMPARATIVE ANALYSIS OF THE PROPERTIES OF THE HYDRAULIC CYLINDER FLUID WHEN USING A SEAL

Rakhmatova Fotima Muzaffar kizi
student of the Department of "Mining Electromechanics" of the Navoi State Mining and Technological University in Navoi
Rakhmatova Zukhra Muzaffar kizi
student of the Department of "Mining Electromechanics" of the Navoi State Mining and Technological University in Navoi
Ruzikulova Sevinch Ahmed kizi
student of the Department of "Mining Electromechanics" of the Navoi State Mining and Technological University in Navoi
Aslanov Aslbek Hasan ugli
student of the Department of "Mining Electromechanics" of the Navoi State Mining and Technological University in Navoi

If dirt gets into the hydraulic cylinder, it primarily affects the viscosity of the liquid, which leads to a pressure and temperature drop in the hydraulic cylinder.

Viscosity is a property of a liquid that resists shear or relative displacement of layers [1]. The shear resistance force is called the internal friction force.

The center of the stem axis is located along the Oh axis. Then the resistance force of the liquid in the cylinder will have the form:

$$F = \pm\mu S\frac{du}{dx}, \text{ Pa·s,} \qquad (1)$$

where μ – viscosity, Pa·s;

S – cross-sectional area, mm^2;

$\frac{du}{dx}$ – fluid flow velocity, mm/s.

The fluid pressure in the hydraulic cylinder is expressed by the formula

$$p = \frac{F}{S} \text{ (or } F = pS\text{), Pa.} \qquad (2)$$

From formulas (1) and (2) we get:

$$pS = \pm\mu S\frac{du}{dx}.$$

Shortening by S we have:

$$p = \pm\mu\frac{du}{dx}, \text{ Pa.} \qquad (3)$$

From equality (3) we determine the viscosity of the liquid:

$$\mu = \frac{p}{\frac{du}{dx}}, \text{ Pa·s.} \qquad (4)$$

Fluid fluidity is the inverse property of viscosity. Denoting it by $\sigma_т$, we get:

$$\sigma_т = \frac{1}{\mu} = \frac{\frac{du}{dx}}{p}, \frac{1}{\text{Pa·s}}. \qquad (5)$$

If from equation (3) we express the velocity of fluid movement along the hydraulic cylinder, then it has the following form:

$$\frac{du}{dx} = \frac{p}{\mu}. \qquad (6)$$

This means that the fluid velocity is constant.

Equation (6) is a first-order differential equation with separable variables.

Solving equation (6), we obtain

$$u = \frac{p}{\mu}x + C, \qquad (7)$$

where C is an integral constant.

The integral constant C can be found using the initial conditions $u = u_0$ by $x = 0$ (here $0 \leq x \leq l$, $l-$ stem length). Substituting these expressions into the equation (7), we find C:

$u_0 = 0 + C$, where from $C = u_0$.

Then $u = \frac{p}{\mu}x + u_0$. (8)

It follows from this that the velocity function is a linear function. In this case, we conclude that the plot (trajectory) of the velocity function is a straight line.

Since the velocity of the fluid is constant, the acceleration will be zero, i.e.$\frac{d^2u}{dx^2} = \left(\frac{p}{\mu}\right)' = 0$.

Now that the expression for determining the viscosity (4) has been obtained, then using data on the pressure and velocity of the liquid, it is possible to calculate its value when the liquid meets the technical requirements. Using the obtained experimental data for pressure $p = 38\ MPa$, $l_{\text{max}} = 2120\ mm$ (stem length), calculate the viscosity value μ.

Taking into account the time of movement of the rod along the hydraulic cylinder (forward or backward), we get the velocity of the fluid:

$$\frac{du}{dx} = \frac{l}{t} = \frac{2120\ mm}{4\ s} = \frac{2{,}12\ \text{м}}{4\ s} = 0{,}53\ m/s.$$

Then

$$\mu = \frac{p}{\frac{du}{dx}} = \frac{38\ MPa}{0{,}53\ m/s} = 7{,}17\ MPa * s/m. \qquad (9)$$

Considering the above and using experimental data, it is possible to calculate the viscosity, fluidity and pressure of the liquid when using a sealing protective ring and without it. As a result, comparing the results obtained in all cases, it is possible to draw final conclusions. [2-19]

It should be noted that in the future, when using the amount of pollutants in calculations $G_{\text{загр}}$, note that $G_{\text{загр}}$ it consists of total pollutants consisting of silicon $G_{\text{кр}}$, sodium $G_{\text{нр}}$, potassium $G_{\text{к}}$, water $G_{\text{в}}$ and other types of pollutants that appear depending on weather conditions, geographical location of the deposit, climatic conditions, etc. We denote it in the form:

$$G_{\text{загр}} = G_{\text{кр}} + G_{\text{нр}} + G_{\text{к}} + G_{\text{в}} + \cdots + G_n.$$

Reasoning that if dirt gets into the liquid, then it becomes more viscous, we come to the conclusion that the proportionality of viscosity and contamination, and it is linear.

In this case, the mathematical model, based on (3), has the following form:

$$p \cdot G_{загр} = p\left(G_{кр} + G_{нр} + G_{к} + G_{в} + \cdots + G_{n}\right) = \mu \frac{du}{dx}. \qquad (10)$$

From here we determine the pressure of the liquid taking into account pollutants:

$$p = \frac{\mu \cdot \frac{du}{dx}}{G_{загр}} = \frac{\mu \cdot \frac{du}{dx}}{\left(G_{кр}+G_{нр}+G_{к}+G_{в}+\cdots+G_{n}\right)}, \text{ Pa.} \qquad (11)$$

Taking into account the expression (3.25), we obtain the formula for determining the viscosity:

$$\mu = \frac{p \cdot G_{загр}}{\frac{du}{dx}} = \frac{p\left(G_{кр}+G_{нр}+G_{к}+G_{в}+\cdots+G_{n}\right)}{\frac{du}{dx}}, \text{ Pa·s.} \qquad (12)$$

Considering that $\mu = 7{,}17\ MPa * s/m$, $G_{загр} = 68{,}71\ mg/kg$ – total amount of pollutants without the use of a protective ring, $G_{загр} = 30{,}2\ mg/kg$– when using a protective ring and u=0.53 m/s fluid velocity can be determined by the pressure, viscosity and fluidity of the fluid.

LIST OF USED LITERATURE

1. Abduazizov N.A., Toshov J.B. Analysis of the influence of the temperature of the operating liquid on the performance of hydraulic excavators // "GORNIY VESTNIK UZBEKISTANA", 2019, №3 (78) pp. 89-91

2. Abduazizov N.A., Muzaffarov A., Toshov J.B. "A complex of methods for analyzing the working fluid of a hydrostatic power plant for hydraulic mining machines." // International Journal of Advanced Science and Technology. – India, 2020. – Vol. 29. – No5. – P. 852-855. (No3. Scopus; No 41. SCImago, impact factor – SJR 2019: 0,11).

3. Азаматович Н. и др. ИССЛЕДОВАНИЕ ВЛИЯНИЯ ВЕЛИЧИНЫ ЗАГРЯЗНЕНИЯ РАБОЧЕЙ ЖИДКОСТИ НА НАДЕЖНОСТЬ ГОРНЫХ МАШИН //RESEARCH AND EDUCATION. – 2022. – Т. 1. – №. 8. – С. 95-103.

4. Абдуазизов Н.А., Алиев Т.Б. и др. ИК-спектроскопический анализ загрязненности гидравлической жидкости гидрофицированных горных машин // Universum: технические науки. – Москва, 2019. – №8. – С. 35-39.

5. Абдуазизов Н. А., Жураев А. Ш. Исследование физико-химического состава загрязняющих веществ рабочей жидкости гидравлических экскаваторов, эксплуатируемых в Кызылкумском регионе //Universum: технические науки. – 2021. – №. 6-2 (87). – С. 20-23.

6. Абдуазизов Н.А. Разработка методов повышения эффективности карьерных гидрофицированных экскаваторов на основе оптимизации их гидравлических систем Узбекистан // Дисс. док. техн. наук. – Алмалык, 2020. – 200 с.

7. Абдуазизов Н. А. Обоснование и выбор параметров системы «гидробак-охладитель» гидрообъемной силовой установки карьерного комбайна //Канд. дисс., М., МГГУ. – 2008.

8. Замышляев В. Ф. и др. Сравнительный анализ результатов аналитических и экспериментальных исследо ваний момента сопротивления вращению шнеко-фрезерного рабочего орга на карьерного комбайна //Горный информационно-аналитический бюллетень (научно-технический журнал). – 2007. – №. 11. – С. 15-23.

9. Абдуазизов Н. А. Повышение эффективности гидравлической системы карьерных экскаваторов //Монография.-Навои. – 2020.

10.Jurayev A. S., Raxmatova Z., Raxmatova F. GIDRAVLIK KONCHILIK MASHINALARNING GIDRAVLIK TIZIMIDAGI ULANISH QISIMLARIDA BOSIM YO'QOTILISHLARNING TAHLILI //Journal of Integrated Education and Research. – 2022. – Т. 1. – №. 4. – С. 377-383.

11. Raxmatova Z., Raxmatova F., Jurayev A. GIDRAVLIK TIZIMLARNING EKSPLUATATSIYASI GIDRAVLIK EKSKAVATORINING UMUMIY ISHLASHIGA TA'SIRINI O'RGANISH //Zamonaviy dunyoda pedagogika va psixologiya: Nazariy va amaliy izlanishlar. – 2022. – Т. 2. – №. 17. – С. 1-6.

12.Raxmatova F., Jurayev A. GIDRAVLIK EKSKAVATORNING GIDRAVLIK TIZIMIDAGI BOSIM YO'QOTILISHLARNING NAZARIY TAXLILI //Zamonaviy dunyoda pedagogika va psixologiya: Nazariy va amaliy izlanishlar. – 2022. – Т. 2. – №. 17. – С. 7-14.

13.Jurayev A. S., Raxmatova Z. M. Q., Raxmatova F. M. Q. KONCHILIK MASHINALARINI GIDRAVLIK TIZIMDAGI ISHCHI SUYUQLIGINI TOZALASH UCHUN G'OVAKLI FILTRNING TAYORLASH METODIKASI //Academic research in educational sciences. – 2022. – Т. 3. – №. 4. – С. 1000-1005.

14.Турдиев С. А., Жураев А. Ш. Исследование влияния абразивного изнашивания зуба ковша экскаватора на величину сопротивления копанию грунта //Academic research in educational sciences. – 2022. – Т. 3. – №. 3. – С. 105-110.

15.Shavkatovich Z. A. Study Of The Effect Of Hydraulic Systems Operation On The General Performance Of A Hydraulic Excavator //The American Journal of Engineering and Technology. – 2021. – Т. 3. – №. 10. – С. 36-42.

16.Жураев А. Ш. АНАЛИЗ СОСТОЯНИЯ ЭКСПЛУАТАЦИИ ГИДРАВЛИЧЕСКИХ ЭКСКАВАТОРОВ НА ЦЕНТРАЛЬНЫХ КЫЗЫЛКУМСКИХ МЕСТОРОЖДЕНИЯХ //The 4 th International scientific and practical conference—Achievements and prospects of modern scientific research‖(March 7-9, 2021) Editorial EDULCP, Buenos Aires, Argentina. 2021. 306 p. – 2021. – С. 160.

17.Jurayev A. S. et al. ZAMONAVIY DVIGATEL AGREGATINI YARATISH IMKONIYATLARINI TADQIQOT QILISH //ТЕХНИЧЕСКИЕ НАУКИ: ПРОБЛЕМЫ И РЕШЕНИЯ. – 2021. – С. 49-53.

18.Jurayev A. S. GIDRAVLIK EKSKAVATORLARNI RIVOJLANISHINI TAHLIL QILISH //Academic research in educational sciences. – 2021. – Т. 2. – №. 8. – С. 286-294.

19.Муратов Г. Г. и др. Исследование применяемых в крановом электроприводе тиристорных систем //Вестник науки и образования. – 2019. – №. 4-2 (58). – С. 16-20.