FUNDAMENTALS OF EXTERNAL NETWORK CHARACTERISTICS OF HYDRAULIC SYSTEM

Turdiyev Sardorjon Abdumuminovich
Navoi State University of Mining and Technologies, associate professor of the "Mining Electrical Mechanics" department, PhD.
E-mail: sardor_kem@mail.ru

Akhmedov Sahib Tojiboyevich
Assistant of the Department of "Mining Electrical Mechanics" of the Navoi State University of Mining and Technologies.

ABSTRACT

Nowadays, a number of machines and equipment with a hydraulic system are widely used in mining, construction and agriculture. In order to increase the stable and reliable operation of the hydraulic systems of these machines, it is important to construct the descriptions of their external networks, and the basics of calculating the regulation of hydraulic processes are considered in this article.

Keywords: throttle, hydraulic drive, spool, switchgear, auxiliary device, flow, load, dependence.

INTRODUCTION

Hydraulic drive is a set of hydraulic machines, hydraulic equipment, hydraulic lines (pipes) and auxiliary devices, and it is called a hydraulic system designed to transfer energy and convert movement through a fluid [1]. At the same time, it is possible to regulate and reverse the speed of the output device, as well as to transfer one type of movement to another at the same time.

The hydraulic machines that are part of the hydraulic system are pumps and hydraulic motors, and they can be several [2].

Hydraulic devices are devices for controlling hydraulic operation, with the help of which it is regulated, as well as means of protecting it from high and low pressures of the liquid. Hydraulic equipment includes throttles, valves for various purposes, and distribution devices for changing the direction of hydraulic fluid flow [3,4].

LITERATURE ANALYSIS AND METHODOLOGY

Auxiliary devices are called conditioners of the working fluid, which serve to ensure its quality and condition. These are various particle separators (filters), heat exchangers (heaters and coolers), hydraulic tanks and accumulators [5,6].

The calculation of hydraulic operations is now necessary and important, and includes the following:

- drawing up the principle scheme of the hydraulic drive, choosing the speed control method at the output link;
- choosing a hydraulic engine and determining its parameters;
- selection of the pump, selection of hydraulic equipment and calculation of hydraulic system pipes;
- hydraulic calculation of systems;
- construction and calculation of the external network description of the hydraulic system.

RESULTS

The external network characteristic of the hydraulic system (Fig. 1) is the dependence of the speed of movement on the output link on the external load and has the form [7]:

• for hydromotives:

$$n_m = f\,(M)$$

• for pouring hydraulic cylinders:

$$\upsilon = f\,(F)$$

• momently for hydraulic cylinders:

$$\omega = f\,(M)$$

The characteristic of the external network can be rigid (if the movement speed is almost constant in the range of load changes) and non-rigid [8].

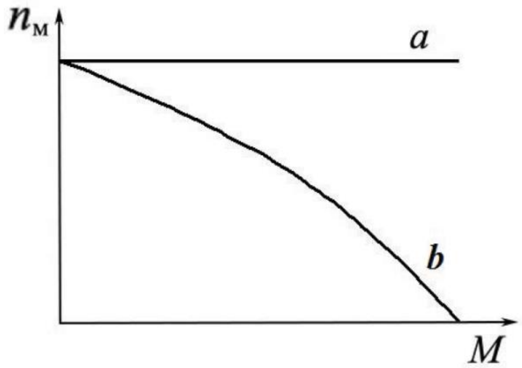

Figure 1. External network description of hydraulic drive: a-hard; b-not hard

With volumetric regulation of hydraulic drive, the characteristic of the external network is rigid. Determined taking into account volumetric losses in terms of nominal operating volumes in the pump and hydraulic engine [9,10]:

$$n_m q_{mn} = n_n q_{nn} - K_{Q_n}\, p\, K_{Q_m}\, p\,, \quad (1)$$

indicators here:

$$K_{Q_n} = \frac{(1-\eta_{Q_n}) q_{nn} n_{nn}}{p_{nn}}\;; \quad (2)$$

$$K_{Q_m} = \frac{(1-\eta_{Q_m}) q_{mn} n_{mn}}{p_{mn}}\;; \quad (3)$$

K_{Q_n} and K_{Q_m}these are calculated as coefficients that determine the rigidity of the characteristics of the pump and hydraulic engine.

P the amount of magnitude of the load pressure is determined by the external torque [11]:

$$p = \frac{2\pi M}{q_{mn}}.$$

When used as a hydromotor, the calculation of the external network characteristic is carried out in the form of a table according to the formula presented below [12,13]:

$$n_m = n_n \frac{q_{nn}}{q_{mn}} - \frac{2\pi}{q_{mn}^2}\left(K_{Q_n} - K_{Q_m}\right)M\ .$$

When using a power hydraulic cylinder as a hydraulic engine, the calculation of the external network characteristic is carried out according to the following formula [14]:

$$v = n_n \frac{q_{nn}}{F} - \frac{K_{Q_n} + K_{Q_S}}{F^2} R\ ; \quad (4)$$

for moment hydrosylindres:

$$\omega = \frac{2\pi}{z}\left[\frac{n_n q_{nn}}{q_0} - \frac{2\pi}{q_0^2}\left(K_{Q_n} + K_{Q_s}\right)M\right]\ . \quad (5)$$

The coefficient in (4) and (5) photmules is as follows:

$K_{Q_s} = \frac{(1-\eta_{Q_s})Q_{dqs}}{p_{hay}}$, bu yerda, here, the efficiency of the volumetric useful work coefficient of the hydraulic cylinder can be taken as $\eta_{Q_s} = 0{,}9$.

The characteristic is calculated using the formula for determining the current consumption through an adjustable throttle:

$Q_{dr} = \mu\psi F_{dr_0}\sqrt{\frac{2\Delta p_{dr}}{\rho}}$, (6) here, μ is the consumption coefficient flowing through the throttle (it is assumed that μ =0.62 in the calculation); Ψ - relative opening of the throttle (calculated as Ψ =1); F_{dr_0} - cross section area with the throttle fully closed: F_{dr_0}=$\pi dyx;$ dy - conditional transition; x = 0,02dydu – throttle gap passage; Δp_{dr} - pressure difference in the throttle.

DISCUSSION

The calculation of the description of the external network is carried out in the form of a table according to the formulas:

a) for series throttle control:

- hydro motors:

$$n_m = \frac{Q_{dr}}{q_{mn}} = \frac{\mu\psi F_{dr_0}}{q_{mn}}\sqrt{\frac{2}{\rho}(p_{nn} - p_{sl} - \frac{2\pi M}{q_{mn}})} \quad (7)$$

- for pouring hydraulic cylinders:

$$v = \frac{Q_{dr}}{F} = \frac{\mu\psi F_{dr_0}}{F}\sqrt{\frac{2}{\rho}(p_{nn} - p_{sl} - \frac{2\pi M}{F})} \quad (8)$$

- for torque hydraulic cylinders:

$$v = \frac{2\pi Q_{dr}}{zq_0} = \frac{2\pi\mu\psi F_{dr_0}}{zq_0}\sqrt{\frac{2}{\rho}(p_{nn} - p_{sl} - \frac{2\pi M}{zq_0})} \quad (9)$$

CONCLUSION

To obtain a tight external network characteristic, special throttle regulators are connected to the circuit under series throttle control, where the pressure difference does not depend on the external load. In this case, the calculation of the characteristics of the external network is carried out according to the following formulas:

- hydro motors:

$$n_m = \frac{\mu\psi F_{dr_0}}{q_{mn}} \sqrt{\frac{2(p_{nn} - \Delta p)}{\rho}} - \frac{2\pi}{q_{mn}^2}(K_{Q_n} + K_{Q_m})M \,; \quad (13)$$

- for pouring hydraulic cylinders:

$$v = \frac{\mu\psi F_{dr_0}}{F} \sqrt{\frac{2(p_{nn} - \Delta p)}{\rho}} - \frac{K_{Q_n} + K_{Q_s}}{F} R \,; \quad (14)$$

- for torque hydraulic cylinders:

$$\omega = \frac{2\pi}{z} \left[\frac{\mu\psi F_{dr_0}}{q_0} \sqrt{\frac{2(p_{nn} - \Delta p)}{\rho}} - \frac{2\pi}{q_0^2}(K_{Q_n} + K_{Q_s})M \right] ; \quad (15)$$

here, Δp - $Q = Q_{nom}$ loss of pressure in the throttle.

When calculating the external network characteristic, it is determined by five to six values of the external load in the range of $0 \div R_{max}$ or $0 \div M_{max}$, and formulas (13) - (15) determine the values of the relevant parameters. According to the calculation results, the following related graphs are created:

$$n_M = f(M); \quad \upsilon = f(R); \quad \omega = f(M).$$

We can see that the hydraulic system depends on a number of indicators, which will be necessary in the creation of the description of the external network based on the above structured relationships. On the basis of the above results, the description of the external network of volumetric hydraulic treatment will be built, and through this external network, it will be possible to determine the optimal performance of the hydraulic treatment.

ADABIYOTLAR RO‘YXATI

1. Azamatovich, A. N., Shavkatovich, Z. A., Abdumuminovich, T. S., & Xusniddinovich, A. S. (2005). Simulation of the Motion of Dusted Air Flows Inside the Air Filter of a Hydraulic System of a Quarry Excavator. International Journal of Grid and Distributed Computing (IJGDC), ISSN, 4262, 11-18.

2. Turdiyev, S. A., and Jurayev A. Sh. "Study of the effect of excavator bucket tooth abrasion on digging resistance." Academic Research in Education Sciences 3.3 (2022): 105-110.

3. Абдуазизов, Набижон Азаматович. "Турдиев Сардоржон Абдумуминович Жураев Акбар Шавкатович. Разработка математическая модель тепловых процессов в регулирующем контуре гидрообъемной силовой установки карьерного комбайна (44-47)." Евразийский Союз Ученых. Технические науки 62.1 (2019): 44-47.

4. Djuraev, R. U., and S. A. Turdiyev. "Mathematical modeling of the wear of cutting elements on quarry excavators." International journal of advanced research in science, engineering and technology (IJARSET)–India 9.3 (2022): 19074-19080.

5. Мустафаев О. Б., Турдиев С. А. ДИНАМИЧЕСКОЕ ВОЗДЕЙСТВИЕ РЕЗЦОВ ИНСТРУМЕНТАМИ РЕЖУЩЕ-СКАЛЫВАЮЩЕГО ДЕЙСТВИЯ.

6. Azamatovich, A. N., Shavkatovich, Z. A., Abdumuminovich, T., & Khusniddinovich, A. (2005). Modeling the movement of dusty air flows inside the air filter of the hydraulic system of a mining excavator. International Journal of Grid and Distributed Computing (IJGDC), ISSN, 4262, 11-18.

7. Abdumuminovich T. S., Tojiboyevich A. S. ANALYSIS OF EFFICIENCY OF CONTROL METHODS OF HYDRAULIC DRIVE MOTORS //RESEARCH AND EDUCATION. – 2023. – Т. 2. – №. 2. – С. 109-115.

8. Abduazizov N. A. et al. Gidroekskavatorning gidrobakdagi havo filtrining ichida changlangan havo oqimlari harakatini modellashtirish //Academic research in educational sciences. – 2021. – Т. 2. – №. 3. – С. 294-304.

9. Abdumuminovich T. S., Tojiboyevich A. S. GIDRAVLIK YURITMALARNI TARTIBGA SOLISH USULLARI SAMARADORLIGINI OSHIRISH //Journal of Integrated Education and Research. – 2023. – Т. 2. – №. 2. – С. 8-14.

10. Raykhanova G. Y., Djuraev R. U., Turdiyev S. A. DEVELOPMENT AND EXPERIMENTAL RESULTS OF A NEW CONSTRUCTION OF THE ELEMENT OF PROTECTION OF THE BASE OF THE JAVE PART OF QUARRY EXCAVATORS //The American Journal of Engineering and Technology. – 2022. – Т. 4. – №. 04. – С. 58-67.

11. Turdiyev S. A., Djuraev R. U. Experimental results on the effectiveness of an improved excavator bucket tooth design //The American Journal of Engineering and Technology. – 2022. – Т. 4. – №. 03. – С. 1-13.

12. Turdiyev S. A. et al. Experimental and test study of the effectiveness of the improved design of the excavator bucket jaw plate //Central Asian Research Journal for Interdisciplinary Studies (CARJIS). – 2022. – Т. 2. – №. 3. – С. 214-223.

13. Кахаров С. К., Турдиев С. А., Аблакулов С. Б. Увеличение ресурса бурового оборудования, за счет применение структурно-функциональной схемы ремонта взаимосвязанных элементов //Современные научные исследования и разработки. – 2018. – Т. 1. – №. 5. – С. 329-332.

14. Xalilov S., Raxmatova Z., Raxmatova F. GIDRAVLIK EKSKAVATORNING EKSPLUATATSION XARAJATLARINI TAHLILI //Zamonaviy dunyoda pedagogika va psixologiya: Nazariy va amaliy izlanishlar. – 2022. – T. 1. – №. 26. – C. 34-39.

15. Abdullayev, S. H. ., Turdiyev, S. A. ., Raxmatova , Z., & Raxmatova , F. . (2022). KON MASHINALARI GIDRAVLIK TIZIMINING HAVO FILTRINI TAKOMILLASHTIRISH. Journal of Integrated Education and Research, 1(4), 417–423.

16. Raykhanova G. Y., Djuraev R. U., Turdiyev S. A. DEVELOPMENT AND EXPERIMENTAL RESULTS OF A NEW CONSTRUCTION OF THE ELEMENT OF PROTECTION OF THE BASE OF THE JAVE PART OF QUARRY EXCAVATORS //The American Journal of Engineering and Technology. – 2022. – T. 4. – №. 04. – C. 58-67.

17. Raykhanova G. Y., Dzhuraev R. U., Turdiyev S. A. STUDY OF THE LOADS ON BUCKETS AND CUTTING ELEMENTS OF QUARRY EXCAVATORS DURING DIGGING AND CUTTING //Academic research in educational sciences. – 2022. – T. 3. – №. 4. – C. 1123-1132.