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AXIAL-PISTON HYDRAULIC MACHINES - FIELD OF APPLICATION AND PERFORMANCE INDICATORS

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Quantitative characteristics of one or more properties, in relation to certain conditions of creation and operation of machines, are called machine quality indicators. One of the most important generalizing properties of machines is reliability. With regard to agricultural, construction and road machines, reliability can be characterized as the ability to maintain within a certain time the values of all parameters that characterize the machine's ability to perform the necessary functions under the specified modes and conditions of use, maintenance, storage and transportation. Being a complex property, reliability, depending on the purpose of mobile machines (construction, road, agricultural) and their operating conditions, may include reliability, durability, maintainability and preservation or certain combinations of these properties. Construction and road machines include motor graders, bulldozers, excavators, scrapers, specialized vehicles, agricultural forage and grain harvesters, etc. In their design, due to its advantages, a hydraulic drive has found wide application. More than 90% of single-bucket excavators produced in the country have a hydraulic drive, and 100% of motor graders. The share of means of mechanization of construction with a hydraulic drive exceeds 50%. In mobile agricultural machines 100% hydraulic drive of the working equipment is used, and in almost all combines of both domestic and foreign production, hydraulic transmission is used. This is confirmed by the analysis of literary sources [1, 2], which showed that modern grain harvesters DON-1500/1500B/1500M/2600/091, Yenisei-1200/950/960/9, forage harvesters KSK-100, DON -750/680/680M, Polissya-250, DON-800 mowers and flatteners, KPS-5G, RKM-4, RKM-6, KS-6B root and brush harvesters, SB-92B/159B/172-1/237 concrete trucks , SMB-060, as well as foreign machinery of John Deere, Claas, Case, Massey Ferguson and others, equipped with various hydraulic systems, which include a volumetric hydrostatic transmission drive (HST).

The developer of the volume hydraulic drive (HST) is the Sauer company, which was founded in 1946 in Germany. Over the years, the company has developed and produced axial-piston pumps and hydraulic motors of the 15, 20, 40, 42, 51, 70, 90 series. In 1978, the production of GST-90 volumetric hydraulic drives with a working volume of 89 cm^3 was mastered at the Kirovohrad plant "Hidrosila" (Ukraine, Kirovohrad) [2].

GST-90 is an analogue of the 20th series of axial-piston pumps and hydraulic motors and is the most popular in our country and the countries of the near abroad. The volumetric hydraulic drive GST-90 includes an axial-plunger pump with an adjustable working volume, an unregulated axial-plunger hydraulic motor, a tank for the working fluid, a heat exchanger, a fine filter with a vacuum gauge, pipelines and hoses [4].

An axial-piston pump converts the mechanical energy of the engine into hydraulic energy, creating a flow of working fluid, an axial-piston hydraulic motor, on the contrary, converts the hydraulic energy of the working fluid into mechanical energy.

Axial-piston hydraulic machines (pump and hydraulic motor) are interconnected by two hydraulic lines. On one of them, the flow of working fluid is supplied by the pump to the hydraulic motor under pressure up to P_h = 34,3 MPa, on the second - it returns from the hydraulic motor to the pump under pressure P_b = 1,17 MPa [3].

Thus, in the "pump-hydromotor" system of the GST-90 hydraulic drive, there is a closed circulation of the working fluid. The working fluid that has leaked through the conjugation of the parts of the hydraulic units enters their internal cavity, from there it flows into the tank through the heat exchanger through the drainage pipeline system. The design features of axial-piston hydraulic machines include the presence of a power supply system, a working volume control system (hydraulic control distributor and servo piston with a cradle) and a hydraulic motor of the valve box in the main pump [4]. According to the manufacturing plant of the open joint-stock company "Hydrosila", the criterion for the limit state of the GST-90 volumetric hydraulic drive is a decrease in the volumetric efficiency of the pump at nominal modes by no more than 20% [4, 5].

Figure 1 shows the results of statistical processing of the average seasonal performance of KSK-100 combines depending on the service life [4, 5].

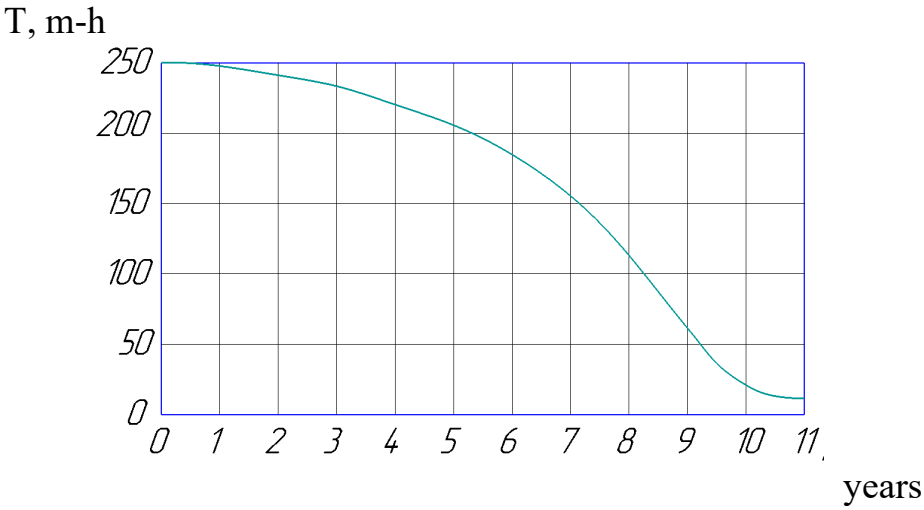

Fig. 1. The curve of the reduction of earnings before the failure of the harvester KSK-100 from the term of service

Gamma-percentage resource ($\gamma = 90\%$) of GST-90 before the first overhaul is 4000 m-h, and gamma-percentage working time to failure ($\gamma = 95\%$) is equal to 1800 m-h. [6,7].

Fig. 1.2 shows that the seasonal performance of the harvester is in the range of $T_c = 47 - 253$ m-h, with the average seasonal performance $\overline{T}_{av}$ = 170,6 m-h. Thus, failures of the second and third complexity groups occur after 3 – 4 years of machine operation.

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