

**RESULTS OF THE RESEARCH ANALYSIS OF THE INFLUENCE
OF CONTAMINATION OF THE WORKING FLUID ON THE
RELIABILITY OF THE HYDRAULIC DRIVE**

Viunyk O., engineer, sin. teacher,
Khokhlov D., student

*Dmytro Motorny iTavria state agrotechnological university, Zaporozhye,
Ukraine.*

The main source of power losses in the hydraulic pump is the technical condition of the couplings of the parts of the pumping assembly. The increased concentration of mechanical impurities in the working fluid accelerates the wear of friction surfaces. The study of the dependence of the wear of gear pumps of the GP-2 type on the concentration of mechanical impurities was carried out by the method of accelerated tests. The pumps were tested in the nominal mode on the working fluid purified by an 8...12 μm filter. Then this liquid was contaminated with grinding powder. When the working fluid was contaminated with M-20 grinding powder with a mass concentration of 0.005%, the volumetric efficiency decreased by 17% in 138 hours. The decrease in volume efficiency by such a value on purified oil occurred in 1200 hours. When the working fluid was contaminated with M-4 grinding powder with a concentration by mass of 0.025%, after 5.5 hours the volumetric efficiency of the pump decreased to almost zero. Japanese experts believe [1] that the intensity of wear increases sharply when the concentration of pollutants increases to 0.15...0.2%. Specialists of the Ministry of Defense of Great Britain, the corporation "Witland Helicopter", the Imperial College and Research Institute (Navy) of the United States believe that a significant increase in the service life of hydraulic units is achieved in purity classes no lower than 14/11. The service life is doubled if the pollution level is reduced from 21/13 to 17/14 according to ISO44061 classification.

The effect of contamination of the working fluid on the reliability of the hydraulic drive of construction and road machines was studied in Khadi [2]. Examination of hydraulic excavators, bulldozers and mobile cranes that were in real operation conditions showed that the purity of working fluids on excavators and bulldozers is at the level of 16...17 classes, and that of mobile cranes is at the level of 15...16 classes. When refueling the machines with a working fluid with a purity of class 15, the maximum working time to the set values of the purity of the working fluid was 240 and 480 hours, respectively. It was found that particles with a size of 5...25 μm are dangerous for excavators, and 10-40 μm for bulldozers and truck cranes.

The study of the size distribution of particles made it possible to

establish that the share of dangerous particles in their total number reaches 95% for excavators, and 30-33% for truck cranes and bulldozers.

When the temperature of the working fluid rises above 80 C and its contamination is at the level of the 75th class, the plunger of the hydraulic distributor jams, which leads to unstable operation of the hydraulic system, and the pump operates with increased noise characteristics. Bench tests of hydraulic pumps 210.25 and 223.25 showed that cleaning the working fluid from mechanical impurities allows to increase the performance of pumps for excavators by an average of 2.8 times, for truck cranes by 1.7 times. Simultaneous cleaning of mechanical impurities and water increases the service life of excavator pumps by 3.9 times, truck cranes by 1.9 times [1].

Research works [2] and other scientists have shown that intense wear is caused by particles whose size is proportional to the gap in the friction pairs. If the size of the particles is smaller than the gap, then the part of impurities in the liquid flow passes freely through it without causing damage. Particles of pollution, the size of which is much larger than the size of the gap, do not penetrate into it, but can cause partial blockage of the gap from the outside. Large particles can be broken into small ones. Contaminant particles, the size of which is close to the size of the gap, are the most dangerous, especially when their hardness exceeds the hardness of the material of the parts. Penetration of larger particles into the gap is possible only after its increase as a result of the abrasive effect of small particles or as a result of distortion of parts under load. Once in the gap, the particle of contamination moves relative to the working surfaces with sliding, resulting in scratches on the surfaces of the contacting parts. The effect of particles on the surface is, as a rule, multiple. Difficult working conditions of agricultural, construction and road machinery (high dustiness, temperature fluctuations, humidity) lead to increased wear of hydraulic units and, as a result, to a high percentage of failures in work. Wear of hydraulic units of machines is determined by the presence of mechanical impurities in the working fluid and is mainly caused by hard abrasive particles. Hydraulic units that contain plunger pairs - hydraulic pumps, hydraulic motors, distributors - have the highest failure rate.

The topic of further research will be the analysis of methods of cleaning the working fluid from mechanical impurities.

References

1. Журавель Д.П. Забезпечення надійності гідросистем сільськогосподарської техніки шляхом очищення робочих рідин. Науковий вісник ТДАТУ.2020. Вип. 10, т.2 Режим доступу <http://elar.tsatu.edu.ua/handle/123456789/12947>

2. Бондар А.М. Технічний сервіс мехатронних систем: навчально-методичний посібник до самостійної роботи. Мелітополь: ВПЦ «Люкс», 2021. 141.