Analysis of the Impact of Hydraulic System Fluid Quality on the Efficient Operation of Universal-Type Tractors

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ABSTRACT

The article discusses the analysis of the share of faults associated with the contamination of fluids in the hydraulic system of Universal-type tractors and the impact of fluid quality on the coefficient of technical readiness.

Keywords: Universal tractor, hydraulic system, operational reliability, failure.

Introduction

The main characteristics of hydraulic system reliability are durability and uninterrupted operation, depending on the level of purity of the working fluid, the first applies only to units with complex mechanisms, the second to systems and machines.

The main part

The controlled operation of the hydraulic system of universal-type tractors has shown that the proportion of faults associated with the contamination of the fluids used is 79% of the total faults, including:

1) Defects caused by abrasive, solid particles or fragments, failure and compression as a result of erosion (erosion) - 59%;

2) malfunctions as a result of congestion - 14%;

3) erosion as a result of irrigation - 6%.

In the hydraulic system of universal-type tractors, the average contamination of the fluid is assumed to be 14-15 classes, and for mining equipment classes 16-17 are accepted. The percentage of downtime due to contamination of the working fluid in the hydraulic systems of various machines is shown in Figure 1.
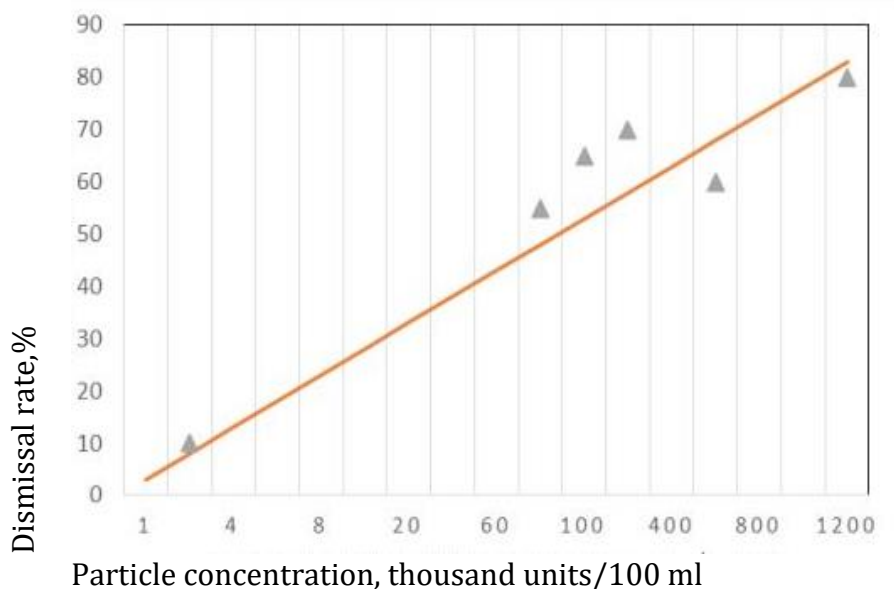
Figure 1. Failure rate due to contamination of the working fluid in the hydraulic systems of various machines.

With the change in the composition of the failures, the proportion of failures in hydraulic machines, aggregates and other extension joints, including fine friction pairs, is significantly reduced. This has a positive effect on all parameters of reliability, for example, the coefficient of technical readiness, because such faults lead to a lot of time spent on repairs and, accordingly, equipment failure. In practice, the task of determining susceptibility to pollution leads to the search for the following category of dependencies:

$$Pa = kcs * f\left(Cj\right), мкм,$$

(1)

where *Pa* is the critical characteristic of the equipment; *kcs* - coefficient of sensitivity to pollution; *f(Cj) – j –* is the algebraic function of the pollution concentration of the j-dimensional group.

In other words, the time at which the critical output characteristic reaches the minimum allowable value (PaCR), the time between the continuous operation of the source or the source of the aggregate is of interest:

$$Taf = T\left(PaCR\right), ч·мкм.$$

(2)

Sometimes, the critical property may not be related to the functional properties of the equipment as a system or machine element, and as *Pa*, any measurement parameters that reflect changes in the composition of product properties under the influence of contamination may be used. For example, the absolute value of the failure of a part is unquestionably proven from the point of view of the manufacturer of the unit. However, it is unlikely that this approach is convenient for the designer or user of the machine transmission, as it does not allow a direct assessment of the impact on the reliability properties of mechanical compounds and therefore the appropriateness of spending on filtration.
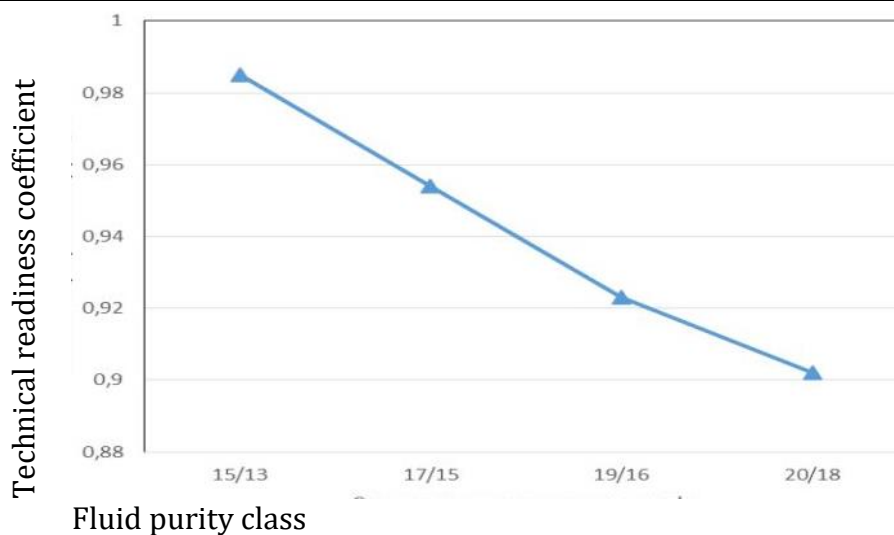
Figure 2. The coefficient of technical readiness of the universal-mower tractor depends on the purity class of the fluid M-10G2K (data on controlled control for 2872 working hours).

Figure 2 shows the complete unit of operating costs and general indicators of use of universal-mowing tractors on the example of MTZ 80 tractors from universal mowers. Determining the required level of fluid purity according to the criterion of minimum operating costs for the consumer is the same as for universal-type tractors. As an example, the choice of universal-type tractors is determined by the availability of appropriate operational data.

Economically, the best cleanliness class is 15/13, but it has been found that excavator manufacturers recommend grades 17/15 and 18/16. It is important that the optimal level of purity improves over time, which is explained by the high results in the field of filtration technologies and the relative reduction in the cost of efficient materials for filtration. To determine the effect of contamination of the working fluid on the reliability and durability of the elements of the hydraulic systems of universal-type tractors, the condition of the elements of the hydraulic systems of the MTZ 80 tractor was studied and the fluid operating in these systems was analyzed.

Conclusion
The study of the impact of the quality of hydraulic oils on the performance of hydraulic universal-type tractors allowed determining the impact of contamination of the working fluid on the reliability and durability of units, as well as optimal parameters of contamination,

abrasion and cleanliness of hydraulic systems of MTZ 80 tractors. The results of the study of the effect of working fluid on the reliability and durability of hydraulic system elements confirmed that the hydraulic system units and elements of universal-running tractors working with contaminated working fluids are unreliable and often fail due to malfunctions.

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