

# ANALYSIS OF RESEARCH RESULTS OF THE FLOW IN THE WATER PASSAGE OF THE REVERSIBLE HYDRAULIC MACHINE IN THE PUMPING OPERATION MODE

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For high-quality forecasting of energy characteristics, it is necessary in the research of the working process of a reversible hydraulic machine to compile an energy balance not only in the turbine, but also in the pump mode.

The method of averaged dimensionless parameters is used for determination of the hydraulic losses in the pump mode in the elements of the water passage in the initial stages of its design. This method does not allow to separate losses in the spiral casing, stator columns and wicket gate, therefore balance losses in these elements are summarized.

In the fig. 1 there are research results of ORO500. Calculations were performed at a constant value of  $n = 1000$  rpm, the rate value varied in range from 30 to 70 l/sec, opening of the wicket gate vanes ( $a_0$ ) is 13 mm for the runner model diameter that equals 350 mm.

The graph shows that the minimum values of losses at the rate 51 l/sec. With increasing rate through the reversible hydraulic machine losses in the supply monotonically increase, in the optimum they reach about 1.5 %. Runner losses at rate values  $Q < Q_{opt}$  and  $Q > Q_{opt}$  increase. This is due to the fact that there are shock losses on the suction edges of the runner at rates that differ from the optimal value. Losses in the runner at the optimal value of the rate reach about 3 %.

Essentially the change in hydraulic losses in the water passage is significantly affected by losses in the outlet. The presence of wicket gate vanes is a feature of a reversible hydraulic machine in comparison with centrifugal pumps. It is in wicket gate that the greatest losses are noted. The maximum losses are in the zone of small values of rate. At  $Q = Q_{opt}$   $h_{outlet} = 8.5$  %.

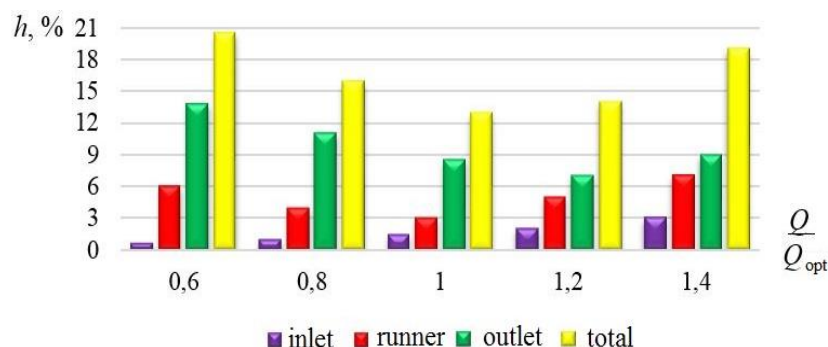


Figure 1 – Energy losses in the parts of water passage ORO500 in the pump mode