

# DETERMINATION OF THE HYDRODYNAMIC PARAMETERS OF A REVERSIBLE HYDRAULIC MACHINE WITH HEAD OF 500 M

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For given the operating conditions of the power system, *PSPPs* operate in pumping mode for more hours than in turbine mode, and the design heads in pumping mode are higher than in turbine mode, so when selecting the design parameters of a reversible hydraulic machine, start from the pumping mode of operation.

In order to ensure the required parameters in the pumping mode  $H_p$  and  $N_p$  and to obtain the suction height  $H_s$ , it is necessary to start from the optimum specific speed  $n_{sp}$ , which takes into account the required hydrodynamic parameters of the water passage of the reversible hydraulic machine. In the absence of an extended nomenclature of reversible hydraulic machines that does not cover this head range, the specific speed is found on the basis of statistical data of existing reversible units

that correspond to the proposed reliability factor which for the current level of manufacturability is  $K = 2000-2500$ .

$$n_{sp} = \frac{K}{\sqrt{H_p}}$$

The suction height is determined by the formula proposed by Prof. Aleksapolskiy D.Y. for high-pressure reversible hydraulic machines and pumps

$H_s = (n_{sp}/4080) H_p - 10$  or based on statistical processing of existing units *PSPPs*  $H_s = 10 - 4,97 \cdot (n_{sp}/3,65)^{0,93} \cdot 10^{-3} H_p$ . The value of the circumferential velocity coefficient is approximated by the dependence  $K_{u2} = 0,895 + 1,07 \cdot 10^{-3} \cdot n_{sp}$  based on statistical processing of data from existing *PSPPs* hydraulic units.

Based on the selected parameters, it is possible to determine, as a first approximation, the synchronous speed  $n_s$ , the suction height  $H_s$ , and the runner sizes  $D_2$ ,  $b_2$ ,  $D_0$  the blade angle at the runner pressure edge  $\beta_2$  and other parameters that determine the steepness  $\gamma$  - the angle of inclination of the theoretical pressure characteristic  $Q-H$ . The hydrodynamic parameters of runner in the function  $n_{sp}$  are given in Table 1.

Table 1: Main parameters of the reversible hydraulic machine *RFr500*

$n_{sp}$	$n_s, rpm$	$K_{u2}$	$D_2, m$	$H_s, m$	$b_2/D_2$	$D_0/D_2$	$\beta_2^\circ$	$\gamma^\circ$
90	375	0,99	5,1	-40,1	0,065	0,49	20	31
100	428,6	1,003	4,5	-46	0,077	0,5	19	33
110	500	1,011	3,9	-51,7	0,085	0,55	18	33,5

The obtained parameters of the reversible hydraulic machine must be refined through numerical studies and targeted modifications of the water passage elements to obtain the specified characteristics.