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PARAMETRIC TESTING OF UNITS OF OLOT PUMPING STATION.

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Annotation. This article provides information on parametric testing of pumping stations. The types and conditions of testing are explained. The results and conclusions of the tests conducted at the Olot pumping station are presented.

Key words. Pump station, unit, parametric test, pressure, relative error.

The main type of full-scale testing of pump units under operating conditions is control tests, in which the actual parameters of the units are determined at the operating point of the characteristic. According to the results of the control tests, a conclusion is made about the compliance of the actual operating parameters of the units with the factory and design parameters, the energy efficiency of the equipment is determined, the effect of existing deviations from the nominal conditions, prevention and repair of the operation of the pump units the effectiveness of their work is evaluated.

At the Olot pumping station, seven units of the same type are subjected to control tests in two variants of the speed of the working wheels.

All units have separate pressure pipes and vacuum break valves at the siphon water outlet.

The essence of control tests is to simultaneously measure and register the following parameters in the selected mode:

- pump water consumption;
- pump pressure;
- electric motor power;

- the water level of the lower and upper pools.

Accuracy of measurements, transfer of results, design and evaluation procedure, control tests were carried out in accordance with the requirements of SUST 6134-87.

The following measuring devices were used during the tests:

1. A universal flowmeter with clamp-on ultrasonic transducers of the PT-878 type from PANAMETRICS with a relative error of 1%, the amount of solid inclusions (sediment) is up to 10% by volume.

2. Model MO-160 type manometer measuring limit 1.6 kg/cm2, accuracy class 0.4.

3. K 505 electric measuring set, direct current measurement limit is up to 10A, accuracy class is 0.5, it is the NS routine of the secondary control circuit. connected through measuring transformers.

The rules for using the devices are specified in the manufacturer's description and instructions.

The principle of operation of the flow meter is based on the measurement of the ultrasonic speed along and against the flow of water in the pipeline.

In this case, the flow meter is automatically adjusted depending on the diameter and wall thickness of the pipeline, temperature and the type of medium to be measured. The deviation range of the sound speed was additionally set to 20% of the actual one to exclude the influence of the suspension medium inhomogeneity and random, non-systematic errors on the sound speed. Measurements outside the range are ignored by the device.

During the measurements, the readings of the device were recorded using an integrated circuit for 5 minutes with an interval between measurements of 10 s, that is, each value is the average of eight consecutive measurements.

Preparations were made before the start of the tests:

- connecting hydrometric rails;

- installation of three-way taps to select the pressure in the pipeline;

- selection and preparation of the measurement range for installation of clamp transducers of the flow meter; to determine the actual area of the inside of the pipeline at the point of flow measurement.

The main conditions of the test are as follows:

- records of instrument indicators are made only in the steady state of the pump;

- reports on instrument indicators for each test mode are carried out at the same time;

- all the values measured during the tests and the calculated parameters are recorded in the protocol with a description of the experimental conditions.

When processing the results and calculating the parameters, the flow was obtained directly from the readings of the flow meter.

According to GOST 6134-87, the developed pressure for a pump with a bent elbow suction pipe was determined by the following formula:

$$\boldsymbol{H=P_m * 10^4/\gamma + V^2/2q + Z_m} \qquad (1)$$

where: H is the total power of the pump, m; P_m - pressure according to the manometer kgf / cm^2; **γ** – specific gravity of water, 1000 kg/m^3; V - water velocity in the pressure pipe at the cross section of the pressure gauge connection, m / s; Z_m - pressure gauge installation height, m.

The relative error in pressure measurement with a pressure gauge of accuracy class 0.4 with a measurement limit of 1.6 kgf/sm^2 and a design pressure of 0.6 kgf / cm^2:

$$\delta P = 0,4 * 1,6/0,6 = 1,0\ \%$$

The relative error in the pressure calculation is the sum of the errors in the measurement of the pressure, water density, velocity head, height position of the manometer and is found by the formula.

$$\delta H = \frac{1}{H}\left[\left(\frac{P_n * \delta_n}{\gamma}\right)^2 + (2*0.083)^2\frac{\vartheta^4\delta\vartheta^2}{d^4} + (4*0.083)^2\frac{\delta d^2\vartheta^4}{d^8} + \frac{P_m\delta\gamma^2}{\gamma} + (9.81*Zm)\delta Z_m^2\right]^{1/2};\%$$

where: H and ϑ - passport pressure and pump flow at the operating point, m and m^3/s; R_p is the limit of the pressure gauge scale, kgf/cm^2; δ_p - accuracy class of the pressure gauge, %; γ - specific gravity of water, 1000 kg/m^3 is accepted; $\delta\vartheta$ - relative error of the flow meter, %; d - internal diameter of the pipeline, m; δ_d - relative measurement error of pipeline diameter, %; P_m - pressure on the manometer, H=6 m, P_m=0.6 kgf/cm^2; $\delta\gamma$ is the error of measuring the specific gravity of water, % (measurements were not carried out, the error was taken from the table difference in the specific gravity of water at 4°C and 20°C):

$$(1000 – 999,800) *100 /1000 =0,2 \%;$$

δZ_m - measurement error of the height position of the pressure gauge relative to the tail water level, %. The absolute error of the hydrometric rod in one division of the scale (1 cm) with the arrow mark of the pressure gauge pin is 188.9 m, the level of downstream is 187.5 m:

$$\delta Z_m = 1 / (188.9-187.5) = 0,7 \%$$

After the change:

$$\delta H = \frac{1}{8}\left[\left(\frac{1,6*10^4*0,4}{1000}\right)^2 + (2*0,083)^2\frac{5^4*1^2}{2,0^4} + (4*0,083)^2\frac{1^2*5^4}{2,0^8} + \frac{0,8*10^4*0,2^2}{1000} + (9,8*1,4)^2*0,7^2\right]^{1/2} =$$

$$= 0,125[41+1+0,81+0,32+188*0,49]^{1/2} = 0,125*[137]^{1/2} = 1,5\%$$

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