Modern Journal of Social Sciences and Humanities
ISSN: 2795-4846 Volume 15 (Apr-2023)
Available online: https://mjssh.academicjournal.io

Studying the Wear of Working Parts of Centrifugal and Positive Pressure Pumps in A Natural Way and Preventing their Wear

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Annotation: In the article, we will consider the study of the working details of centrifugal and rotary pumps during the practice of using irrigation pumping stations in natural conditions.

Keywords: Centrifugal pump, vane pump, impeller, pump station, pump, suction pipe, vane chamber, water intake unit, sludge particles, flow rate, water driving, hydraulic resistance, cavitation.

The entrance. The experience of using centrifugal and reading pumps has shown that their service life between repairs is determined in one irrigation season. One of the main reasons for the decrease in the operating parameters of centrifugal pumps is the hydroabrasive rapid erosion of the blades of their working wheels and the sealing gaps. In order to have practical information in this regard, the erosion of the details of the following centrifugal pumps during one irrigation season was studied. D6300-80 ("Asaka-adir" NS), the pumps selected for the experiment were partially disassembled before commissioning, and the initial thicknesses of the inlet and outlet edges of the impeller blades and discs were measured at predetermined points. The thickness of the shovels was measured in 6 sections at 5 points using a specially made indicator plug. Impeller sealing ring and disc diameters. It is in place (two mutually perpendicular circular diameters) in size.

The results of micrometering of the erosion of the working parts of the pumps showed that the working wheel blades were worn unevenly both in length and in shape. After 26 years of operation of the pump, the wear of the vanes at the entrance to the impeller was small, i.e. 0.3-0.5 mm. In the output part, the erosion of the blades of the working wheel made a considerable amount, i.e. 2.6-2.86 mm.

This can be explained by the increase in the kinetic energy of solid mud particles and their concentration on the blade surface as a result of the increase in the amount of Coriolis forces from the center and along the radius of the impeller. A row of grooves with a depth of up to 0.5 mm is observed in the exit zones of the working surface of the shovels, which is the result of the nature of grinding hard abrasive particles contained in water. There are significant wear marks on the backs of the shovels.

In the pumps of the pumping station "M-2-1", the exit edges of the blades had a saw-like appearance slightly smoothed by abrasive particles over their entire width. This point can be explained by the fact that large-sized sediment particles also fall into water supply pipes in rainy weather.

The main part. The inner sides of the impeller discs are unevenly curved both in radius and in width. The largest amount of wear on the discs (2.17 mm) was in the part of the working surface of the shovels near the exit points.

The maximum hydroabrasive erosion in the spiral intake was at the junction with the diffuser, i.e. in the "tongue" area, and along the length of its walls, in the form of fish scales. This increase in surface roughness as a result of erosion in the removal device increases the hydraulic resistance in its flow section, which in turn causes a decrease in pump pressure.

The protective bushings on the ground where the coolers are located are also subject to considerable erosion. Although the erosion of protective bushings does not affect the working characteristics of the pump, it causes the loss of a large amount of metal mass and the need to replace them with new ones.

The amount of shear between the sealing ring and the outer circumference of the impeller has a significant effect on the performance of centrifugal pumps. As a result of the erosion of the densifying rock surfaces, uneven undulations and fish scales have appeared. The greatest erosion of the working surface of the condensing ring took place at the end of it at the corner of the flow and had a groove-like shape on the radius.

The reason for this may be that the flow is compressed when it enters the slot, and it increases the local velocity and reduces the pressure to critical points. This leads to the formation of cavitation grooves in the gap and, as a result, increases the rate of wear at the end of the sealing ring surface. In addition, as a result of the rotation of the disk, the current creates a lump-like motion, and in this case, it is considered an additional source of erosion.

The expansion of the gap under the influence of cavitation-abrasive flow in the gap corresponds to the initial periods of the use of the pump. After 2000 hours of operation of the pump, the maximum amount of the notch was 3.1...3.3 mm.

Results and suggestions. The results show that the pressure change during the irrigation season was insignificant, i.e. 3.5-4.2 m. The water flow calculated by determining the average speed of the flow of the pump in the pipe using the Pitot tube was initially 1.5 m3/s, but by the end of the irrigation season it was 1.42 m3/s, that is, it decreased by 80 m/s. This is a result of the widening of the impeller compression slots and is reported in the literature. It is also determined by calculations performed according to the style.

In the first pump, the area near the outer edge of the shovel inlet suffered the most erosion. In addition, cavitation erosion is more on the back side of the second pump blade. As a result of the analysis of their usage periods, it was found that the first pump was used more in spring-summer water turbidity, and the second one was used when the level and turbidity of the water source decreased. So, the first pump was exposed to more hydroabrasive wear, while the second one was more cavitation wear.

In positive pumps, the impeller chamber is also subject to significant wear. The most rapid expansion of the slit under the influence of the slit flow with turbidity corresponds to the initial periods of pump operation. The main role in the expansion of the crack is played by the pressure of the pumps. For example, in the OP-193 pump with a pressure of N=17 m, the crack expansion occurs faster than in the OP5-110 pump with a pressure of N=8.5 m. Calculations performed using the data showed that the crack expansion depends on 1.5-1.2 levels of pump pressure. If the amount of clearance S increases, the volumetric efficiency of the pump and the water flow decrease.

In conclusion. We can say that according to the calculations, the water flow of the OP5-110 pump decreased by 0.35 m3/s, and the water flow of the OP11-193 pump decreased by 1.1 m3/s.

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