ISSN 2181-9408

Scientific and technical journal

Sustainable Agriculture

№1(17).2023

ARCHITECTURE. LANDSCAPE ARCHITECTURE

POWER ENGINEERING, ELECTRICAL ENGINEERING, AUTOMATICS. COMPUTING TECHNOLOGY.

AGRICULTURE, WATER MANAGEMENT, FORESTRY, AND FISHERIES. AQUACULTURE

ECONOMY. ECONOMIC SCIENCE. OTHER BRANCHES OF THE ECONOMY.

IMPROVING THE EFFICIENCY OF ELECTRICITY CONSUMPTION AT PUMPING STATIONS

R.J.Baratov – associate professor, Ya.E. Chulliev– assistant, I.X.Yaxshimurodov – master student
"Tashkent Institute of Irrigation and Agricultural Mechanization Engineers" National Research University

Abstract

This article analyzes the technical characteristics of pumping units, technical processes in the suction pipeline. As a result of the conducted research, the issues of developing an intelligent water supply and power supply system by introducing sensors with wireless communication. As a result of the conducted research, the issues of developing an intelligent water supply and power supply system by introducing sensors with wireless communication with aim of saving resources and using them effectively.

Keywords: pump, measure, static pressure, surface, sensor.

Introduction. Nowadays, irrigation systems in Uzbekistan have more than 1,600 medium-sized and more than 30,000 small pumping stations. The annual volume of electricity consumed by pumping stations is 7-7.5 billion.kWh is 23% of the total amount of electricity generated in our country[7,8]. But the need for the amount of water consumed in such quantity has no scientific justification.

One of the main reasons leading to an increase in electricity consumption and a decrease in the useful operating coefficient in existing high-power pumping units is the cavitation process. Consequently, when using intelligent sensors to measure and control the cavitation process, including the amount of electricity consumed in the start-up and load modes in pumping units, is saved. At the same time, the normal operating modes of frequency-regulating devices are established and electric drives are installed. The failure of electrical equipment is prevented and the efficiency of operation is increased [9,11]:.

In the case when N pumping units are installed at the pumping station, in this case the efficiency of the pumping units is the same, the control range should be as follows [12,18,19]:

$$\Delta Q = Q_1 = Q_2 \ldots\ldots Q_n \qquad (2.4)$$

Currently, all types of pumps are aggregates:

$$\Delta Q = Q_{n\,(max)} \qquad (2.5)$$

Consequently, the water flow in the suction pipe requires monitoring of ΔQ, high-precision intelligent sensors. The water flow rate Q should be uniform in all intermediate zones of pumping units. the effect of the level of change in the water level at the inlet on the performance of the pumping unit is shown in Figure 1.

It is customary to install the same electric motors and pumps of the same type at each pumping station, in addition, the number of pumping units varies from 2 to 16, depending on the accepted size and the number of spare units. Pumping stations differ depending on the installed number of pumping units or the degree of separation of the total capacity into 1/2-1/5 parts, where one number is the total capacity of the pumping station [13,16].

This leads to a gradual reduction in water and electricity consumption [10,13,14,16,17,18]. In addition, by changing the rotation frequency of the pumping unit, the electricity consumption of pumping units in the irrigation system is reduced, and the control range can also be determined by raw materials. This will be as shown in Figure 2 below. If the characteristic of the pressure sensor pipe (N pressure sensor pipe) is known, it is possible to find out the operation of the pump how mode or conditions. If the characteristics of the pressure transmission pipe (N pressure transmission pipe) are known, it is possible to find out in which mode or conditions the pump will operate.

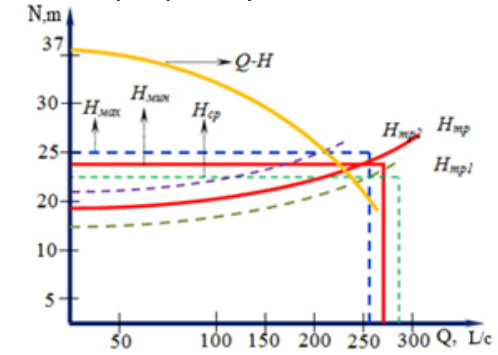

Figure 1. The effect of changes in the water level at the inlet on the performance of the pumping unit.

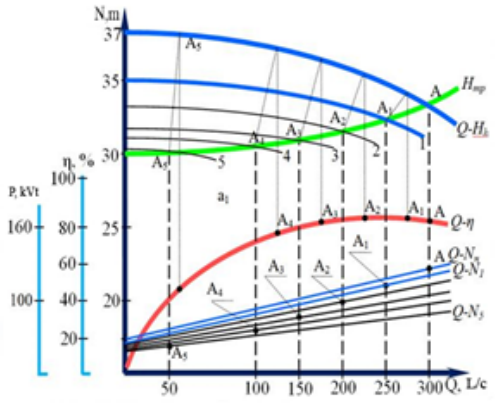

Figure 2. Control by changing the engine speed

The design of pumping units, taking into account their technical and economic indicators, is in various manifestations, depending on the flow coefficient, pressure, geometric parameters of the pressure transmission pipe.

Each pumping unit operates on one pressure sensor pipe, or several of them are combined into a common pressure sensor pipe. Such generalized pumping units operate in parallel in a common pressure sensor pipeline. An example of the operation of pumping stations for a separate pressure transmission pipeline is the John Door-1 pumping station, which is at the disposal of the Abu-Bukhara machine channel, and other pumping stations can be cited [6,7,8,9,20].

The analysis shows that, from a practical point of view,

the joint operation of pipes for transmitting the total pressure of pumps is widely used and designed at pumping stations in the irrigation system [1,2,3,15].

At the same time, the operating modes of pumping stations in irrigation systems are determined by many other parameters, which can be distinguished as constructive, technological and electrical.

The arrangement of the pipeline devices for the transmission of pressure, the angle of rotation of the passage and other devices is constructive. If these parameters work according to nominal values, they cannot be controlled [1, 2, 3, 20].

The technological parameters include the following values, namely the pump pressure in the inlet and outlet pipelines (R) and the nominal capacity (Q nominal capacity), the water level in the channels (Q lower, Q upper) and the water flow tables (Qt = Qp) [9,10,19].

Electrical parameters include the following values, i.e. the number of revolutions and rated power of the circuit, transformer power, motor output voltage (U output), frequency of the power supply, active and reactive power, load factor (**γ** download), power indicators (n, $\cos\phi$) and other electrical parameters [16,17,18,20].

All this together determines the modes of operation of pumping stations in the irrigation system.

The analysis shows that it is impossible to achieve control and rational use of electricity at a pumping station during water transmission, regulation of pumping stations in accordance with the required irrigation water consumption can only be carried out by changing some technological and electrical parameters.

References:

1. Baratov R.J., Jalilov A.U. Issues of developing intelligent sensors for control objects of irrigation and drainage systems. Collection of articles II International scientific and technical conference dedicated to the 90th anniversary of the birth of Professor Zaripov Madiyar Fakhritdinovich "Problems of obtaining, processing and transmitting measurement information", USATU, Ufa, Russia. - September 19-20, 2019. - P.223-227. ISBN 978-5-4221-1298-2.
2. Energy and ThermoFluids Engineering, CSIRO Manufacturing and Infrastructure Technology, P.O. Box 56, Highett, VIC 3190, Melbourne, Australia.
3. Baratov R.J., Djalilov A.U., Chulliyev Y.E. Low Power Smart System Development for Water Flow Measurement and Level Controls in Open Canals, 6(12), (2019).
4. R. J. Baratov., Ya. E. Cho'lliyev., F. Murtazaeva. Algorithm for ensuring the energy-efficient operation mode of pumping units// "Uzbekhydroenergetics" scientific and technical journal, 2022*№1 (13).
5. R.Baratov, T. Bon, Y.Chulliyev, Yu.Shoyimov, M.Abdullayev. Modeling and simulation of water levels control in open canals using Simulink// IOP Conf. Series: Earth and Environmental Science 939 (2021) 012028, doi:10.1088/1755-1315/939/1/012028.
6. Baratov RJ, Chulliyev YE, Ruziyev S 2021 Smart system for water level and flow measurement and control in open canals E3S Web of Conferences 264,
04082, https://doi.org/10.1051/e3sconf/202126404082.
7. W.E. Asher, L.M. Karle, B.J. Higgins, P.J. Farley, I. Leifer, E.C.Manahan, The influence of bubble plumes on air–seawater gastransfer velocities, J. Geophys. Res. 101C (1996) 1207–12041.
8. V. Khokhlov. Energy saving at pumping stations. and. Uzbekistan kishlok khujaligi. 2005, No. 6, -36 pp.
9. H. Medwin, N.D. Breitz, Ambient and transient bubble spectraldensities in quiescent seas and under spilling breakers, J. Geophys.Res. 94C (1989) 12571–12759.
10. R. Manasseh, Y. Yoshida, M. Rudman, Bubble formationprocesses and bubble acoustic signals, in: Third InternationalConference on Multiphase Flow, Lyon, France, June 1998, p. 426.
11. Glovatsky O.Ya., Nosirov F.Zh., Sharipov Sh.M., Saparov A.B. Study of the influence of cavitation on the pressure pulsation behind the impeller of pumping units // Collection of scientific articles of the XV scientific-practical conference of young scientists and masters "Modern problems in agriculture and water management", "Qishlok va suv khzhaliging zamonaviy muammolari" - Tashkent, 2016. - 425 -430 s.
12. Steven R. Evett,R. Troy Petersand Terry A.“Controlling water use effiency with Irrigation Automation: cases from drip and center pivot Irrigation of Cornand Soybean” Howell Southern Conservation SystemsConference, Amarillo TX, June 26-28, 2006 57.
13. Bram Verhaagen, David Fernandez Rivas, 2016 Measuring cavitation and its cleaning effect, UltrasonicsSonochemistry29 (2016) pp619-628.
14. M.R.Haider, M.R.Mahfouz, S.K.Islam, S.A.Eliza, W.Qu, E.Pritchard. 2008A low-power Capacitance measurement Circuit with High Resolution and High Degree of Linearity, IEEE, Circuits and Systems, Sep. pp.261-264.
15. I.S.Pearsall. 1966Acoustic detection of cavitation,Proceedings of the Institution of Mechanical Engineers Conference(MECH ’66), vol.181, 3A, 14.
16. Y.Wang,H.L.Liu,S.Q.Yuan,D.LiuandJ.Wang, 2013Characteristics of cavitation vibration and noise in centrifugal pumps with different vane wrap angles,Journal of Drainage and Irrigation Machinery Engineering, vol.31,5,390–400.
17. X. Duan, Y. Wang, and Y. Su, “Features combined classification of cavitation in waterjet pumps,”Journal of ShanghaiJiaotong University, vol. 45, no. 9, pp. 1322–1326, 2011.
18. Microcontroller based drip irrigation, technical paper on Drip Irrigation www.engineers .com, April 30, 2010.