NEW WELL ELECTRIC WATER PUMPS

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Introduction. In recent years, Ukraine's infrastructure has suffered significant damage to key facilities, including its industrial and domestic water-supply systems. At the same time, meeting the growing demand for high-quality process and drinking water in municipal, industrial, and agricultural sectors has become an urgent challenge. Subsurface water sources – exploited via intake wells fitted with submersible electric pumps – play a leading role in addressing this need.

Today, standard induction motors are almost universally employed as the pump's drive units. One promising route to substantially improve the energy efficiency and reduce the size and weight of existing water-production systems is to replace these asynchronous motors with more powerful, compact synchronous magneto-electric motors [1].

Research Objective. To develop an advanced hydraulic system with high mass–energy performance by replacing the conventional asynchronous drive with a high-speed magneto-electric motor.

Materials and Research Results. Domestic manufacturers have developed advanced hydraulic systems with exceptional energy performance. Drawing on global experience in submersible pump design and our own techno-economic analyses, we set out to create high-capacity electric-pump units sized to fit smaller-diameter casing strings than those currently in production [2].

Preliminary cost estimates show that substituting the standard ECV 8-65-110 pump for the ECV 10-63-110 model reduces specific capital investment for outfitting an 8″ well by 11 % compared to a 10″ installation. Likewise, operating and maintenance expenses – including depreciation provisions for renovation – are 10 % lower for the 8″ configuration [3, 4].

The first unit of this new series, the ECV 8-65-110, shown on Figure 1, has now entered serial production. Performance tests on the production prototype demonstrate a hydraulic efficiency (η) of 76 %, versus just 70 % for the ECV 10-63-110. This improvement is attributable to the use of "pot-type" impeller stages with mixed-flow (axial-radial) blades and non-pressure-compensated runner wheels.

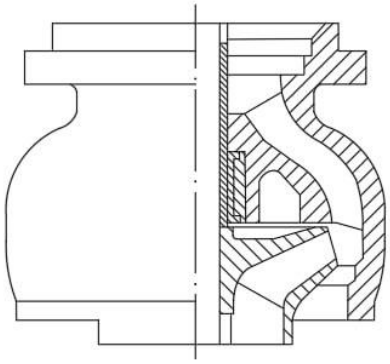

Figure 1 – The working stage of the ECV 8-65-110G unit

The ECV 8-65-110 unit is presently coupled with a DAP 32-180 electric motor, manufactured by the Sumy Machine-Building Plant [5]. The plant plans to introduce a new base-model motor in the 32–37 kW class, also developed in-house. This upgraded motor offers several advantages over its predecessor: higher efficiency, reduced mass and material content, and greater tolerance for stator-winding overheating owing to the substitution of PVDL winding wire with PETV-100 wire.

Notably, this is the first time that the motor's mounting dimensions conform to the NEMA international standard, enabling full interchangeability across all motors of this frame size. The rapid development cycle is also significant: design and fabrication of complex casting tools, trial casting of components, and assembly of a pilot batch of pumps were completed in under one year.

Sumy Machine-Building Plant, in collaboration with its partners, is now developing the ECV 8-65-180 pump equipped with a 45 kW motor. At the same time, a horizontal-operation submersible pump design is under way. Parallel efforts focus on reinforcing high-wear components to enhance the overall reliability of the assemblies [6, 7].

The development portfolio includes high-efficiency pump stages of the following capacities: 8″ frame: 100 m³/h, 10″ frame: 120 m³/h and 160 m³/h and 6″ frame: 25 m³/h.

This study underscores the importance of advancing submersible pump technology to ensure both economic efficiency and operational reliability in water supply systems. One promising modernization avenue involves the use of novel materials – particularly polymer composites with enhanced wear resistance – for manufacturing pump components.

Another key direction is the integration of real-time condition-monitoring systems based on sensor networks that track operating parameters such as temperature, vibration, and pressure [8]. Such diagnostic functionality enables early detection of deviations from normal operating regimes and helps prevent catastrophic failures.

We also carried out finite-element modeling of several magneto-electric motor designs using the Simcentre MotorSolve software. Figure 2 presents the main performance curves for the motor under study, and Table 1 summarizes the computed key parameters for six different motor variants, while Figure 3 show operation characteristics of the electric motor.

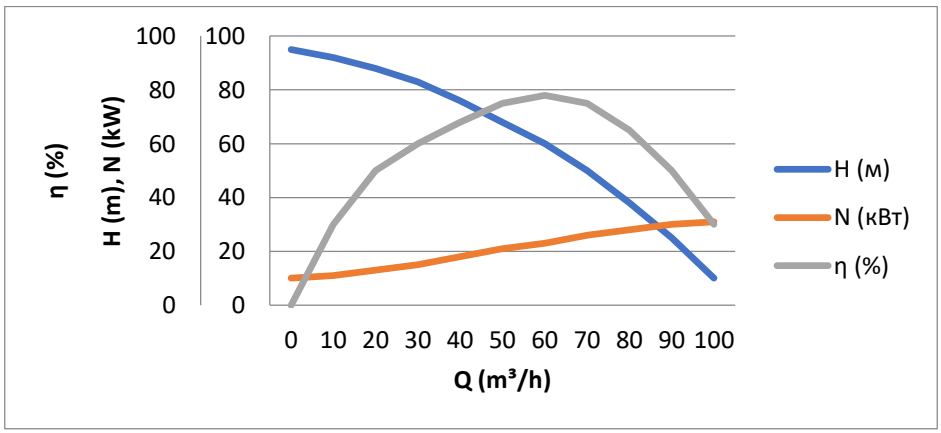

Figure 2 – Performance characteristics of the ECV 8-65-110G unit

Table 1 – Characteristics of the ECV 8-65-110G Unit Driven by an Asynchronous Motor (A) versus a Magneto-Electric Synchronous Motor (B)

A	B	A	B	A	B	A	B
Q (m³/h)		H (m)		N (kW)		η (%)	
0		95		10	2	0	0
10		92		11	18	30	36
20		88		13	21	50	58
30		83		15		60	70.2
40		76		18		68	79.56
50		68		21		75	86.4
60		60		23		78	91.26
70		50		26		75	85
80		38		28		65	76
90		25		30		50	57
100		10		31		30	35

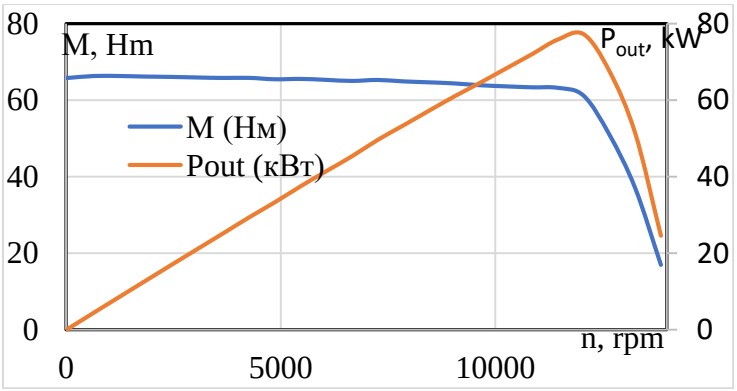

Figure 3 – Operating characteristics of the electric motor

Conclusions. A medium-power permanent-magnet synchronous motor has been designed and optimized to replace the existing asynchronous drive in submersible pump applications. The new motor delivers higher overall efficiency, improved operational stability, and enhanced reliability of the well pump compared to the baseline asynchronous design. This successful upgrade represents an effective solution for reliable water supply across a wide range of field conditions.

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