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NEW TREND IN THE IMPROVEMENT OF TECHNOLOGY OF PIPELESS WATER LIFTING FROM WELLSWITH SUBMERSIBLE MOTOR PUMP IN THE WATER SUPPLY AND IRRIGATION IN KAZAKHSTAN

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Abstract

A brief analytical review of researches and developments in the technology of pipeless water lift from wells by electric submersible pumps, including in Kazakhstan, is given. Researches in KazNAU on improvement of the technology of pipeless water lift to improve the efficiency of groundwater use in the water supply and land reclamation system using in the technological process of water lift a new type – packer hydraulic device with ejector, increasing water withdrawal from the well and increasing the efficiency of submersible electric pump by 20-30% and reducing metal consumption per one pump unit in 2-3 times are presented. A new direction in improving the technology of pipeless water lifting - methodological basis for the development of necessary standard sizes of packer hydraulic devices, allowing to solve the problem of effective use of promising developments in the water supply and land reclamation system of Kazakhstan – has been proposed.

Keywords: Analytical review pipeless water lifting technology, underground water, deep well, submersible motor pump, the hydraulic packer unit, ejector, water, land reclamation, construction diagram, a theoretical study.

НОВОЕ НАПРАВЛЕНИЕ В СОВЕРШЕНСТВОВАНИИ ТЕХНОЛОГИИ БЕСТРУБНОГО ВОДОПОДЪЁМА ИЗ СКВАЖИН ПОГРУЖНЫМИ ЭЛЕКТРОНАСОСАМИ В СИСТЕМЕ ВОДОСНАБЖЕНИЯ И МЕЛИОРАЦИИ КАЗАХСТАНА

Н. Ильясова, Ж. Жакупова, О. Мешик, А. Яковлев, Е. Саркынов

Аннотация

Дан краткий аналитический обзор выполненных исследований и разработок по технологии беструбного водоподъёма из скважин погружными электронасосами, в том числе в Казахстане. Приведены исследования в КазНАУ по усовершенствованию технологии беструбного водоподъема для повышения эффективности использования подземных вод в системе водоснабжения и мелиорации с использованием в технологическом процессе водоподъема нового типа – пакерного гидравлического устройства с эжектором, увеличивая водозабор из скважины и повышая КПД погружного электронасоса на 20–30% и снижая металлоёмкость на один насосный агрегат в 2–3 раза. Предложено новое направление в совершенствовании технологии беструбного водоподъёма – методические основы разработки необходимых типоразмеров пакерных гидравлических устройств, позволяющих решить проблему эффективного использования перспективных разработок в системе водоснабжения и мелиорации Казахстана.

Ключевые слова: аналитический обзор, технология беструбного водоподъема, подземная вода, скважина, погружной электронасос, пакерное гидравлическое устройство, эжектор, водоснабжение, мелиорация, конструктивная схема, теоретическое исследование, обоснование, экспериментальное исследование, насосная установка.

Introduction. At present, in Kazakhstan, especially in the southern regions, agricultural production is developed mainly on irrigated lands using surface water, but in arid zones, due to the lack of surface water and their remoteness from irrigated lands, groundwater from constructed wells with the use of submersible electric pumps for water intake is used for irrigation and general water supply.

According to the existing traditional technology of water extraction from wells, water-lifting pipes, the weight of which per one pumping unit is 500-1000 kg and requires large operating costs for installation and dismantling works, are required.

The use of progressive technology of pipeless water-lifting (through the well casing) with the use of packer devices of various designs installed on the discharge nozzle of the pump, separating the suction part of the pump from the discharge part in the well, allows to reduce metal intensity by 2 - 3 times, improve energy performance of the pump unit, reduce significantly the operating costs of installation and dismantling works, increase the service life of casing pipes, eliminate water pollution and clogging of wells.

However, the implementation of tubeless water lifting technology in water supply and land reclamation is restrained due to the lack of necessary packer sizes for electric submersible pumps in the market, due to the insufficiency of conducted methodical research in this direction. Therefore, methodological basis of development of necessary standard sizes of packer hydraulic devices for submersible electric pumps for the technology of pipeless water lifting in water supply and land reclamation, is a topical problem.

In CIS countries, including Kazakhstan, there are positive developments in effective use of pipeless water extraction from groundwater wells by means of electric submersible pumps and packer devices in water supply and land reclamation systems.

Research was aimed at studying the technology of pipeless water lift using mainly submersible electric pumps and their own packer device designs for justification of parameters of necessary standard sizes for conventional well diameters of 5, 6, 8, 10 and 12 inches. However, there were no researches on methodical bases of development of necessary standard sizes of packer hydraulic devices for electric submersible pumps for technology of pipeless water lift in water supply and land reclamation, with the purpose of their effective introduction in conditions of pasture and general water supply and land reclamation.

Main part. A brief review of the works performed in the direction of research. Development of designs, theoretical and experimental studies on the water lift from wells with packer device are devoted domestic and foreign works, the authors of which are: Lugovskoy M. V., Kashekov L. Ya. (1966-1977) [1, 2], Zhelobovsky A. G., Usenko V. S., Gurinovich A. D., Gladkov V. D, M. A. Lavrov (1975–1990) [3–7], A. I. Fabrikov, A. A. Silchenko, V. M. Kostyukevich, R. S. Ariel (1982–1985) [8, 9], V. N. Fisenko, M. M. Trusov, V.Y. Wright (1985-1994) [10–12], S. V. Murozov, Pevzner A. A., Kalmykov Y. P., Kolodyuk L. A., Poleshchuk S. S. (1986–1990) [13], Yakovlev A. A., Konyrbaev A. B. [14–17], V. D. Krapivin [18], E. Sarkynov, Zhakupova J. Z. [19–21] and others. In 1976–77, Russia [1, 2] researches of tubeless water-lift technology with development of packer devices (self-sealing casing) for water-jet pumping units of two standard sizes for a well of 150–154 and 100–104 mm inner diameter were conducted in the Institute of Water Chemistry, the results are positive. In 1975-95 in CNIIKIVR (Minsk, Belarus) [3–7], in Soyuzgiprovodkhoz (Moscow) and YuzhNIIGiM (Novocherkassk, Russia) [9] there was carried out a great work on investigation and creation of packer devices for submersible electric pumps for pipeless water rise from 6 ISSN 2224-526X Series of Agrarian Sciences. № 3. 2016 wells of conditional diameter of 8, 10 and 12 inches. The packer devices were made mainly with self-sealing rubber sleeves (Figure 2, a and b). The locking mechanism was in the form of slats with tapered grooves, which were driven mechanically by means of rods, on which packer device with a submersible electric pump was lowered. Prototypes of three sizes were manufactured, test results were positive.

In the Kazakh Research Institute of Water Economy (1980–2000, Kazakhstan) [10–12] technologies of pipeless water lifting were investigated and packer devices for submersible Three standard sizes of packer devices for 8, 10 and 12 inch diameter wells with flow rates of flow rates of 10 dm3 /s and more with the

use in the reclamation system. The packer device (figure 2, c) was made of a body in the form of a pipe connected to the pump discharge which has a fixing mechanism made of sliding wedges and a sealing collar, flanged to the pipe and placed in a cylindrical cage that slides over the pipe.

The packer is mechanically secured and pre-sealed inside the well by means of rods, on which the packer with a submersible pump is lowered down into the well with a submersible pump. The development was completed with the production of a pilot batch of packer devices implemented with positive results in the reclamation system of Kazakhstan.

In 1986–90 at the Research Institute of Rovno State Pedagogical Institute (Rivne) [13] on contractual terms with Gosagroprom of Kazakhstan researches were carried out and packer device for submersible electric pump "Horyn" was developed (figure 2, a) for lifting water through casing pipes of 6 inch diameter (inner diameter 150–154 mm). The sealing part of the device was adopted the same design of the Kazakh Research Institute of Water Economy - in the form of a sealing collar, flange mounted with the body-pipe of the packer and placed in a cylindrical glass, moved on the pipe. However, elements of novelty were introduced, aimed at facilitating dismantling operations (reduction of the collar breakaway force) by making the side wall of the cup, in contact with the collar, of variable height along the length of its circumference. An experimental sample was made, and the results are positive.

In the Scientific and Production Association "Kazselkhozmekhanizatsiya" (KazNIIM ESKh) (1986–2000, Kazakhstan) [15–17] researches of tubeless water-lifting with development of three standard sizes of packer devices of hydraulic type for electric submersible pumps of ECV type for wells of conventional diameter of 5, 6, 8 duimeters for pasture water supply conditions were conducted.

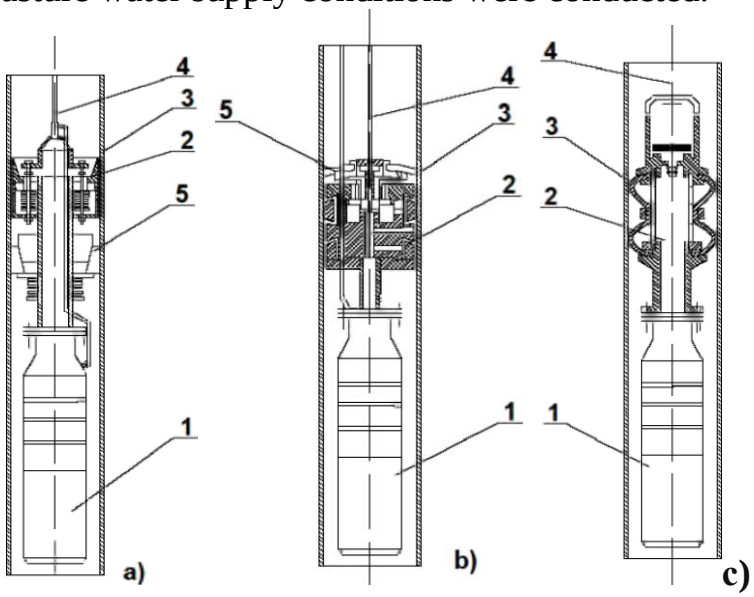

Figure 1 – Schematics of known packer devices for pipeless water lift to submersible electric pumps: 1 - pump; 2 - packer device; 3 - well casing; 4, 5 - down-lifting and fixing mechanisms. a) design of NIS of Rovno Pedagogical Institute; b) design of NGO "Kazselkhomehanizatsiya";c) design of V.D.Krapivin

A distinctive feature of the packer design (Figure 1, b) is the sealing part in the form of two alternately working sealing sleeves, installed in the housing with an axial

hole, which is attached to the discharge nozzle of the pump. The packer unit has locking, anti-twisting and tripping mechanisms, interconnected with each other and a sealed wellhead with a discharge branch pipe.

The work was completed with development of prototypes, conducting state acceptance tests in 1997 with UG G-168M standard size for 6 inch wells with a recommendation to put it into production. The inflatable packer, designed by V. Krapivin, is of interest among other packer designs [18] (Fig.1, c), designed according to the USSR datasheet ¹ 252867, but there is no information about its development.

The purpose of the work of the new direction is to substantiate the methodological basis and develop a methodology for the calculation of the required sizes of packer hydraulic devices with an ejector for submersible electric pumps for the technology of pipeless water lift from wells in the water supply and land reclamation system, increasing the flow and efficiency of the pumping unit by 20-30 %.

Main objectives of the work: - Justification of a new type of hydraulic packer with an ejector to a submersible electric pump in the technology of pipeless water lift from wells in the water supply and land reclamation system; - Development of theoretical framework for the technology of pipeless water lift using a new type of hydraulic packer with an ejector; - Justification of methodological principles and development of methods for calculating the necessary dimensions of hydraulic packer devices with an ejector to submersible electric pumps for technological and industrial applications.

The object of research are: a new type of packer hydraulic device with ejector, technology of pipeless water lift from wells in water supply and land reclamation system, submersible electric pump, well with sealed head, branch pipe, gate valve and pipeline.

Conclusions:

1. On the basis of the performed applied research a brief analytical review of the performed works on the technology of pipeless water lift from wells by submersible pumps, including in Kazakhstan, and the improved technology of pipeless water lift to increase the efficiency of groundwater use in the water supply and land reclamation system using in the technological process of water lift a new type of packer hydraulic device with ejector, which increases water intake from the well and increases the efficiency of submersible pump.

2. A new direction in the improvement of the technology of water lifting is proposed, i.e. methodical basis for the development of necessary standard sizes of packer hydraulic devices, allowing to solve the problem of effective use of promising resource-saving developments in the water supply and land reclamation system of Kazakhstan.

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УДК [574+ 594]

ЭФФЕКТИВНОСТЬ КРЕПЛЕНИЙ СООРУЖЕНИЙ ИНЖЕНЕРНОЙ ЗАЩИТЫ ОТКОСНОГО ТИПА

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Аннотация

В представленной работе приведены результаты технико-экономической оценки эффективности различных типов крепления откосов дамб и плотин, используемых на водохранилищах Беларуси.

Ключевые слова: водохранилище, сооружения, эффективность, стоимость.

EFFICIENCY OF FASTENING STRUCTURES OF ENGINEERING PROTECTION OF SLOPE TYPE

V. E. Levkevich

Abstract

The presented work presents the results of a feasibility study of the effectiveness of various types of dam and dam slope support used in reservoirs in Belarus.

Keywords: reservoir, facilities, efficiency, cost.

Введение. Общая длина укрепленных берегов и берегоукрепительных сооружений на водохранилищах Беларуси составляет около 250 км. Длина поврежденных и разрушенных берегоукрепительных конструкций и сооружений по данным натурных обследований, проведенных в период 2013–2021 гг., оценивается в пределах 120 км, что составляет около 50 % протяженности всех креплений на водохранилищах.