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Feasibility Studies of the Blinded Technology for Rehabilitation of the Wells with Low Flow Rates in Areas with Hot and Dry Climatic Conditions

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ABSTRACT : Relatively long time operation of the wells and poor groundwater quality, mainly high rigidity, is the result of the salt depositions and filter corrosion producs in the pores of the near-filter zone and on the surface of filters, which leads to decreasing in the productivity of wells. An efficient technology is proposed for processing and recovering the flow rate of artesian wells. This article is devoted to the feasibility study of this technology.

KEY WORDS: water, water wells, flow rate, clogging deposits, filters, flow rate rehabilitation technology, economic feasibility study, sustainable operation of water wells.

I. INTRODUCTION

In hot and dry climates, the hardness of groundwater is relatively high and the level of mineralization is high and this is the main reason for the formation of solid colmatants/clogging deposits. In areas with long-term operation and low groundwater quality, i.e., high hardness, there is a decrease in well flow due to sedimentation and corrosion in the well filter and pre-filtration area. An effective technology for recovering flow by processing artesian wells operating in hot and dry climate conditions is proposed. This article is devoted to the feasibility study of this technology.

II. RESEARCH, METHODOLOGY AND ANALYSIS

It is known that in most cases artesian wells are used to extract groundwater. Due to the influence of local climate on groundwater quality and water hardness, it accelerates the formation of salt deposits in the filter and pre-filtration area of wells. As a result, a decrease in the filtration coefficient leads to a sharp decrease in well efficiency. This does not ensure the stable operation of the well. This, in turn, increases the cost of unstable wells. The funds spent on them are mainly spent on the repair of fast-burning pumping units, the cost of their installation and dismantling, the consumption of large amounts of electricity and low water consumption increase the cost of water supplied to the consumer. This is one side of the issue. Second, the low efficiency of water intake wells, which are the starting point of the entire water supply system, causes the operation of all elements of the system to be unstable, unreliable, and intermittent. In this article, we will focus on the feasibility of the proposed technological solution to ensure the stable operation of wells.

To prevent or eliminate the above causes and their negative consequences, technical and technological solutions are required to ensure the smooth, reliable, efficient and stable operation of wells in dry and hot climates. The UZWATER National Research Center at the Department of Water Supply, Sewerage and Water Resources Protection of the Samarkand State Architectural and Civil Engineering institute has developed specific proposals for solving this problem. The essence of this proposal is as follows:

• The efficiency or flow of artesian wells in areas with hot and dry climatic conditions due to the specificity of these areas, as a result of water quality indicators, there is a sharp decline in well flow rates in 5-7 years, which leads to a sharp increase in costs;

• Expenditures for the well are mainly characterized by an increase in pump unit repairs, high electricity consumption, and other operating costs;

• High costs and low water supply lead to an increase in the cost of water and, as a result, to legitimate complaints from consumers about the operation of the water supply system;

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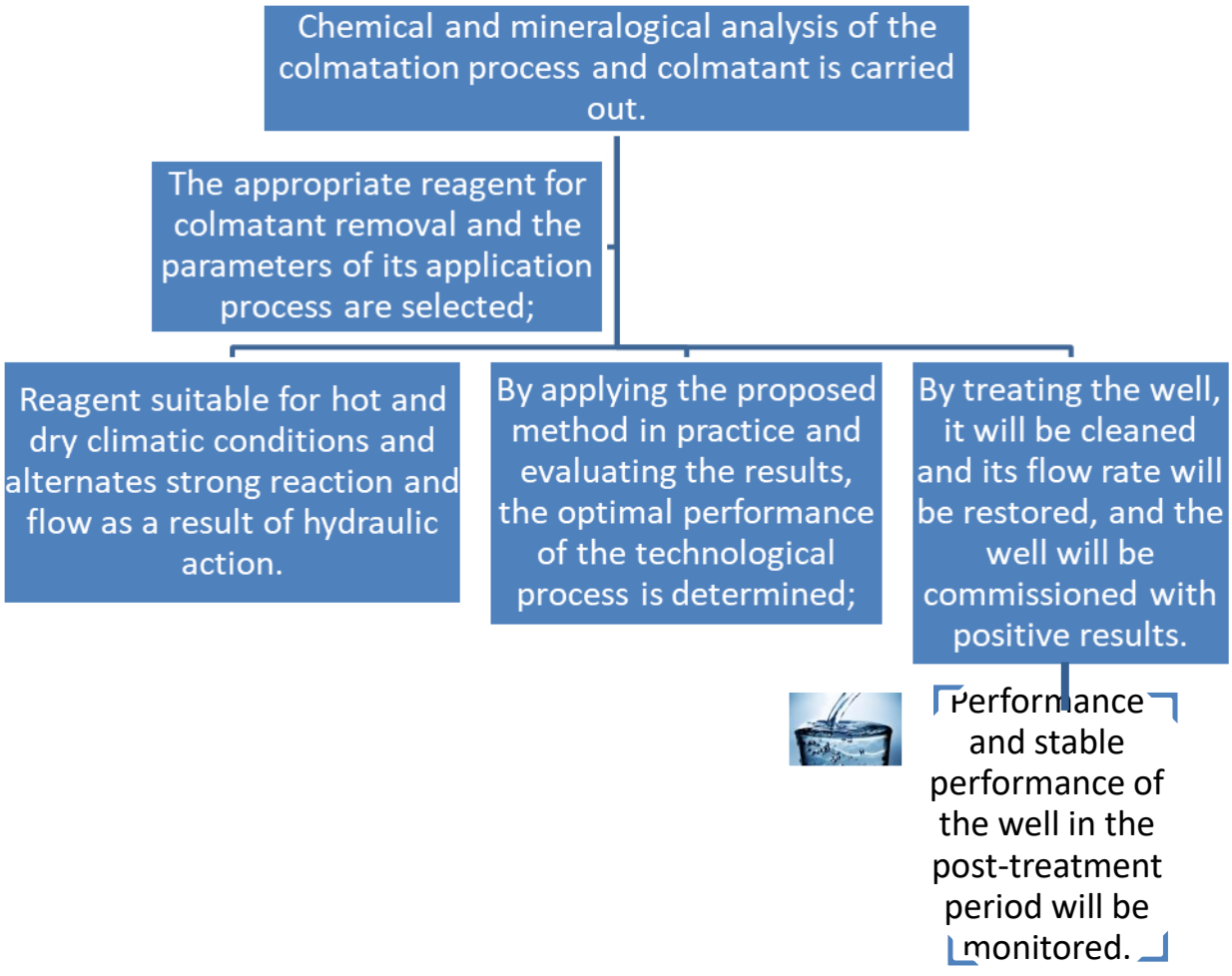
• Typically, the solution to such a problem is to abandon the use of wells and choose a relatively expensive engineering solution related to the design, drilling, construction, equipping and commissioning of a new well, which will reduce the financial performance of the system through water costs and leads to consumer objections;
• We have developed a blended technology for the recovery of the flow of artesian wells operating in hot and dry climates, and its effectiveness has been tested in practice;
• The proposed technology will dramatically increase the efficiency of the entire water supply system through the stable operation of wells, reducing the cost of produced water and, most importantly, the reliability, stability, continuity of wells.

Below we will discuss in detail the generalized method of re-filling the well efficiency and its technical and economic indicators. The proposed technology to ensure the stable operation of artesian wells has been patented and the invention is dedicated to ensuring the stable operation of artesian wells operating in hot and dry climates. The main purpose of applying this technology in practice is to provide a cheap, convenient and environmentally safe engineering technological solution that ensures the stable operation of wells that have been operating for a long time in dry and hot climates. To achieve this goal, a series of technical solutions and technological processes are proposed to eliminate sediments in the well filter and pre-filter area and prevent their re-formation.

The main cause of the problem is a solid sediment, which is a combination of salt depositions, aquafire particles and filter corrosion products from the groundwater. When the clogging deposition/colmatant, which is the result of the colmatization of salts in the groundwater stream, is cleaned by other known methods, its residues formation of the new centers for crystallization and accelerate the process of re-drying. If the colmatant is removed fully as easily as possible and the groundwater filtration rate is increased, the water supply efficiency of the well will be increased and operational stability will be ensured. The proposed technological sequence of processing the well and restoring its flow rate is shown in the diagram below.



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The distinctive features of the proposed engineering-technological solution differ sharply from other methods used in the treatment of wells, and it has its own advantages. This technological solution is distinguished by its convenience, compactness, low cost, environmental safety. For hot and dry climates, there is no such technology that ensures the stable operation of wells by decollecting them. Of course there are analogues and their shortcomings are given in the initial analysis of the study. We will list the main and important aspects of some of them. Modern technologies of water treatment have studied the crushing or mechanical removal of sediments in one way or another. Their disadvantages are that they do not combine a sequence of technological processes that can be re-melted in hot and dry climates, do not sink and are easily removed. The proposed technology is based on the development of a technological sequence of simultaneous melting, crushing of colmatant, formation of complexes that do not sink in solution and easy removal of processed products as a complex process and their application for hot and dry climates.

The effectiveness of the proposed generalized technology is based on the following formula:

$$\Delta Q = (Q_2 - Q_1) \cdot T_{year}., m^3$$

Where: Q_1 - until the well is processed, i.e. decreased flow rate, m^3/h;

Q_2 - post-treatment of the well, i.e restored flow rate, m^3/h;

T_{year} - the number of hours the well operates during the year, hours;

ΔQ - growth rate of well flow as a result of application of the proposed technology, m^3/year

Note: The change in well debit and all its parameters are determined in accordance with the same decrease in the static level of water in the well.

III. RESULTS, RECOMMENDATIONS AND CONCLUSIONS

Technological solutions and scientific recommendations were tested in water wells of Kyzyltepa of Navoi region and Gijduvan and Shafirkan districts of Bukhara region. The results showed that their use in wells where the flow rate decreased as a result of collimation increased their flow rate by 3-3.5 times. The current tests of the proposed technology are based on the following calculations:

$$\Delta Q = (Q_2 - Q_1) \cdot T_{year}$$

where: Q_1 - before the development of the well, ie reduced flow rate - 10.0 m^3/h;

Q_2 - post-treatment of the well, i.e. regenerated flow rate - 33.0 m^3/h;

The operation of the well is uninterrupted throughout the day, i.e. T = 24 hours.

Hence, the annual rate of well flow rate growth as a result of the application of the proposed generalized technology is ΔQ:

$$\Delta Q = (Q_2 - Q_1) \cdot T_{year} = (33{,}0 - 10{,}0) \cdot 24 \cdot 365 = 201480\ m^3;$$

If we take into account that one well gives Q = 201480 m^3 of excess water per year, its efficiency can be seen to increase dramatically. This is especially effective when using a group of wells, namely:

$$\Sigma\Delta Q = \Delta Q \cdot N$$

is defined in the view. Here N - the number of treated wells in the group. This means that when a group of wells is operating, the increase in their total debit is N times. The proposed generalized technology will further increase the efficiency in the areas where the well group operates.

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