Recommendations for reducing sanding process in water wells

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Abstract. The history of vertical drainage wells began in 1923 in the United States of America and since 1950 in Uzbekistan. Such scientific researchers as N. Reshetkina, Kh. Yakubov, A Umarov, Z. Pushkarev, N. Nasonov, I. Akhmedov, and other scientists worked on designing and constructing vertical drainage wells. The study aims to develop recommendations for improving the sustainable operation of vertical drainage wells based on their design and construction, considering natural and economic conditions. The relevance of the work lies in the fact that stable operation of wells without sanding will provide: an increase in the duration of good operation without repair, an improvement in water supply in the reclaimed area, drainage of the area suspended on the well, and an increase in economic efficiency.
The place of research work is the Syrdarya and Fergana regions of the Republic of Uzbekistan, as well as the Kyzylorda region of the Republic of Kazakhstan. The design of vertical drainage wells differs significantly from water wells (for water supply) in that vertical drainage wells are drilled with a large diameter (800-1260mm) and equipped with gravel filters. They have a shallow depth (35-80m) and large diameters of the filter frame and casing pipe (300-426mm), which significantly affect their costs and determine the territory's drainage area, which is the main task of this type of well. Such wells are operated in the study areas. The article presents data that is the basis for developing recommendations for improving the sustainable operation of a vertical drainage well. Recommendations are given to eliminate the problems of vertical drainage wells.

1 Introduction

Depending on the function and purpose, water wells are: drinking, irrigation, vertical drainage wells, and monitoring groundwater (geological and hydrogeological). Also, in practice, there are drop wells. All these perform tasks to achieve the goals of the people's interests. The results of our practical observations in Uzbekistan, South Kazakhstan, and

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Tajikistan showed that, theoretically, the need for water is a problem inextricably linked with human existence. The original wells were built for groundwater abstraction but not of an engineering or industrial type. An example is a 57 m deep well built by Babur (1547) in India (Red Court) and wells of the Khorezm Khanate (Khiva). They are designed for water intake without pipes and filter cages. They are designed for water intake without pipes and filter cages.

Modern wells at the engineering level, that is, casing with a filter frame, were put into operation on the territory of the United States of America in 1923-1925. (vertical drainage) and on the territory of Uzbekistan since the 1950s[1,2,5,9]. Due to the high-water consumption in modern wells, the mode of use, due to the structure of structures and construction technologies, is a characteristic process of reducing water consumption. Next comes the process of filling the cavity of the well filter with sand (soil).

Many scientists have contributed to science and were engaged in draining land and installing and using vertical drainage wells. These include such scientists as S. Averyanov, A. Mikhaltsevich, A. Eskov, A. Yangol, and N. Reshetkina. In Uzbekistan, a special place is occupied by scientists in the operation of vertical drainage wells, as well as the restoration of flow rates of vertical drainage wells M. Yakubov, A. Abirov, A Umarov, Z. Pushkarev, V. Nasonov, I. Akhmedov, Z. Mirkhasilova, A.Khojiyev, R.Muradov and others [1,2,3,4,11,12].

2 Materials and methods

Our studies include the method of measuring the flow rates of vertical drainage wells using the SANIIIRI (PKR 219-100) Flow Meter equipment. The device was used during field studies. The proportion of sanding was carried out by "weight" methods, using a drying oven and electronic scales. An "electronic depth gauge" was used to measure the well's depth. The physical and chemical properties of the selected soil samples by the depth of the wells during the drilling process were determined in the chemical laboratory by the method "Determination of the chemical composition of the water extract of soils", according to V.S. Volobuev. The alkalinity and redox potential of water were determined using a special device. Graphs and formulas were calculated using computer technology, the Excel program. The graph in Figure 3 was built based on two stages. The first step is to change the depth of the sanding measurement in the well, and the second step is to measure the sand content.

3 Results and Discussions

Scientific research on vertical drainage wells was conducted in the Syrdarya and Fergana regions of the Republic of Uzbekistan and the Kyzylorda region of the Republic of Kazakhstan. When designing water wells, their designs are mainly exemplary, mainly steel pipes and floats are used as materials, and in recent years, aggressive plastic, polymer, and fiberglass structures have been used.

In areas where irrigated agriculture is practiced, irrigation wells and vertical wells are mainly used to regulate water, salt, air, and soil heat. Their structure is somewhat different from drinking water wells. The difference is that the depth of these wells is mainly 35-80 (vertical drainage), 50-200 (irrigation) mm, and the diameter is 320-426 mm. The filter frame and surrounding pipe are surrounded by a gravel (natural) as a natural filter. The depth of wells with drinking water is not limited; it depends on the depth of the aquifer, in which a gravel (natural) filter is not formed (Figure 1).

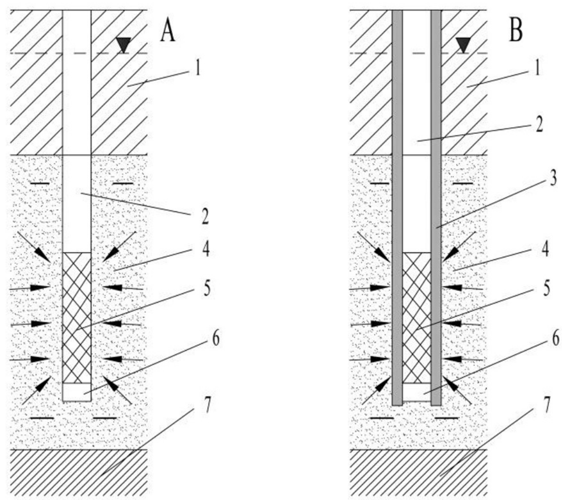

Fig 1. Construction of water wells

A is drinking water and B is wells of vertical drainage. 1 is surface layer of the earth; 2 is well casing; 3 is gravel filter; 4 is aquifer of the earth; 5 is filter; 6 is well sump; 7 is waterproof ground layer

The data in the figure (Fig. 1 and 2) shows that all wells have a rectangular section of the filter frame [22].

In vertical drainage wells and water wells, a gravel filter is created with a thickness that differs from the thickness of a drinking water well, a good diameter (ro), and this causes a large consumption of well water.

Well water consumption is calculated by the formula

$$Q = \pi k \frac{H^2 - h_0^2}{ln\frac{R}{r_0}} \tag{1}$$

Where in the formula

k is the filtration coefficient of the aquifer,

H,h are the dynamic and static water levels,

R,r are the radius of the depression curve that occurs during the well's operation and the well's radius (conditionally, the drilling radius).

Many factors influence the decrease in well water consumption: geological changes in the territory, construction technology, well design, well operation mode, characteristics of the aquifer, etc.

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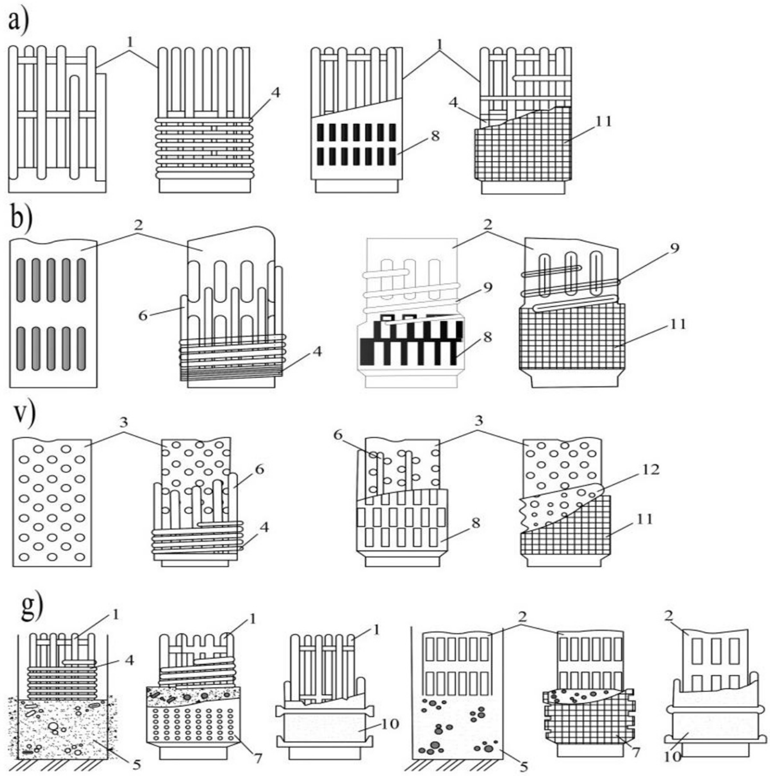

Fig. 2. Water well designs: a, b, c are filters with round and slotted holes based on a rod frame; d is gravel filter: 1 is rod frame with support ring; 2 is tubular frame with slots (slit); 3 is tubular frame with a round hole; 4 is stainless steel wire; 5 is loose sprinkling; 6 is sheet and support posts made of spiral wire; 7 is gravel casing; 8 is stamped stainless steel sheet; 9 is support for winding the spiral; 10 is gravel block; 11 is stainless steel or brass mesh; 12 is lining mesh.

The results of our practical studies carried out in the Syrdarya basin (Fergana Valley, Hungry Steppe, South Kazakhstan, and Kyzylorda regions) showed that the sanding process is typical for vertical drainage wells and "on water", but not for all of them [6-10].

Along the length of the filter (filter frame), sanding wells are covered with soil by 20-80 percent, depending on the amount of silting and the service life. The process of sanding water wells is a problem in different areas in different parts of the world [13-16].

On the territory of Russia, Belarus, and other countries, work has been organized to clean wells from silting, and the necessary mechanisms and technologies have been developed. This requires the development of new, improved technologies in this area. Our practical research and analysis of available sources show that the water formation rate in water wells obeys the law of arithmetic progression along the length of the filter. In this case, the flow rate in the filter increases from bottom to top [17,18,19,20,21]. Depending on the particle size distribution, the soil particles are also lifted up and removed with the water due to the speed of the water. Relatively large rocks remain in the filter cavity and cause siltation of the well. (Figure 3).

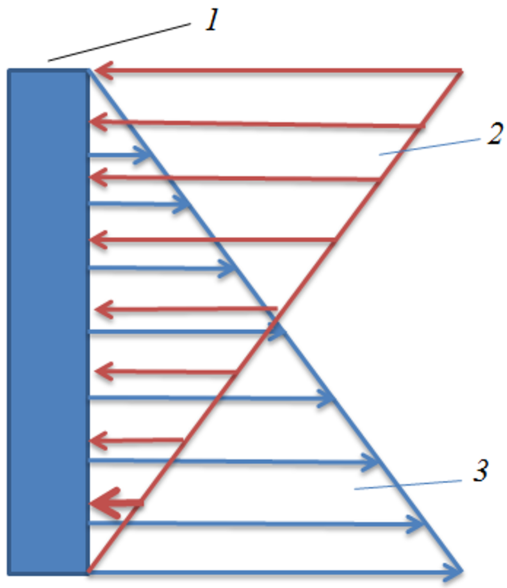

Fig.3. Graph of water formation rate and sedimentation of sand particles in water well: 1 is well frame; 2 is scheme of water formation in the mesh filter; 3 is diagram of well siltation process.

Many researchers have conducted field studies with vertical drainage wells, but the topic of sanding in wells has not been thoroughly studied. Therefore, in our research, we consider ways to improve the performance of vertical drainage wells without sanding. Also, increasing the duration of good operation without repair, improving water supply in the reclaimed area, draining the area suspended on the well, and increasing economic efficiency.

4 Conclusions

The control and measurement work carried out by us at water wells showed that wells "for irrigation" do not differ from vertical drainage wells in terms of construction technology and design; their flow rate is 20-105 l / s.

The frames of these filters are made in the conditions of Uzbekistan with a diameter of 320-426 mm. Considering the water flow rate of wells and their design, the speed of water movement in the filter zone varies over a wide range (approximately 0.1-3.0 m/s) along the length (height); that is, it increases with height. At the bottom of the filter, it is the minimum speed. In this case, even the smallest particles are deposited in the water, accumulating over time and making the well ineffective.

Based on the information above, the following is recommended to fix the issue:

- It is necessary to design, manufacture and use types of water well designs that ensure a uniform flow of water.
- The design of water wells should be designed and equipped, taking into account water consumption. In this case, it is advisable to calculate the dimensions of the filter frames according to the water flow rate.
- It is desirable to introduce developments and technologies with replaceable filter frames in constructing water wells, especially vertical drainage, and wells "for irrigation".

- It is desirable to increase the efficiency of wells by introducing a control system that provides a high mode of operation of water wells in the basins.

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