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SOME ISSUES OF RE-UTILIZATION OF CASING STRINGS, UNUSED WATER WELLS (ON THE EXAMPLE OF SOME COUNTRIES OF THE SOUTH-WESTERN SAHEL)

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Annotation
The article discusses some of the issues of recovery and reuse of casing strings of unused wells in tropical countries. The results of experimental-production work to solve the above issue are presented. In particular, it is noted that the consistency of liquefied clay rocks located in the annulus of wells, which in turn depends on the equipment of the columns with drainage pipes, significantly affects the success of the extraction of casing pipes. Optimal schemes for equipping casing strings with small-diameter drainage pipes and standard sizes of holes were established. Possibilities of applying the results of these works in other regions with similar characteristics are indicated.

Keywords: well, column, pipe, consistency, drainage, rock, clay, sandstone, lens, hose, diameter, limit, plasticity, water resistance.

Introduction

The territory of the countries bordering the South-Western part of the Sahara Desert (Senegal, Guinea Bissau, Republic of Guinea, Mali, Niger, etc.) is characterized by a dry and hot climate. In these vast territories, the population density is extremely low, and they are inhabited by nomadic tribes engaged in animal husbandry (mainly sheep breeding). These nomadic tribes constantly migrate with their herd in search of pastures and water sources. It often happens that there is grass, but there is no water and its

INNOVATIVE TECHNOLOGICA
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ISSN: 2776-0987 Volume 2, Issue 12, Dec., 2021

natural sources are far away. The existing wells are currently not able to meet the needs of people and herds [12,3,4]. In recent years, with the development of mobile drilling equipment, in regions with abundant grass stands for the needs of people and livestock breeding, they began to drill water wells into the horizons of groundwater. From these wells, unstable low flow rates were obtained in the range of 1.5-5.0 m^3 / day. and after 4-6 days some of them dried up, forcing people to look for other pastures and drill new wells.

The Main Part

In the geological structure of this region, the overlying rocks of the earth's crust are composed of clayey-sandy rocks of the Quaternary age. Among clayey rocks, there are sandy interlayers with a lenticular structure, which hydrogeological serve as natural reservoirs of groundwater. These interlayers are limited both in thickness and in area, which leads to a low production rate of drilled wells and their rapid depletion in a relatively short period of time (Fig. 1).

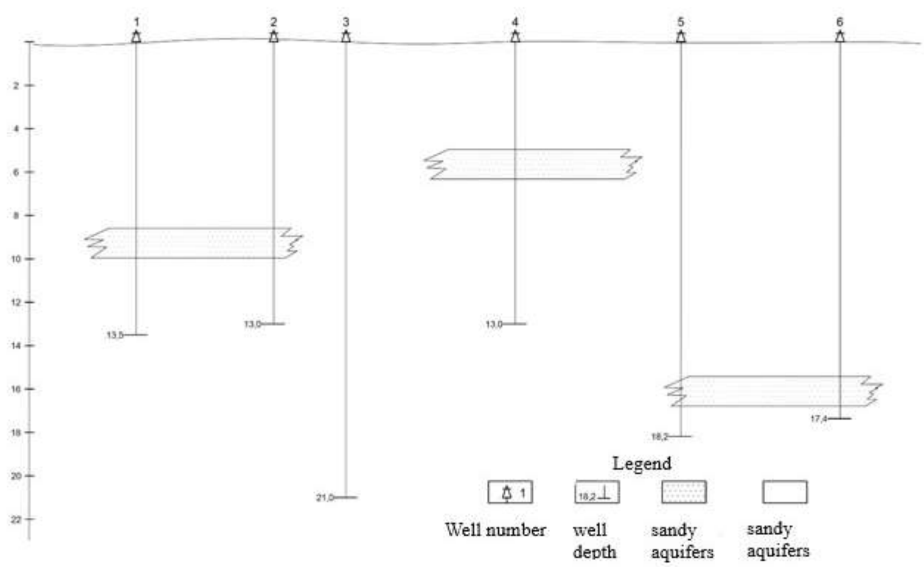

Fig. 1. Well geological section (Kayes Province, western Mali)

As can be seen from this figure, the aquifers are discontinuous and do not have a hydraulic connection with each other. In some cases, this is confirmed by the results of the chemical analysis of groundwater carried out by a mobile field laboratory. The

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chemical composition of groundwater, according to the degree of mineralization, is classified as low-mineralized and soft waters that meet the requirements of the WHO (World Health Organization) and are suitable for drinking. The location of the water wells is sometimes determined by geophysical studies (depending on the financial condition of the customer), but most often it is determined at random (depending on the reserves of the fodder base).

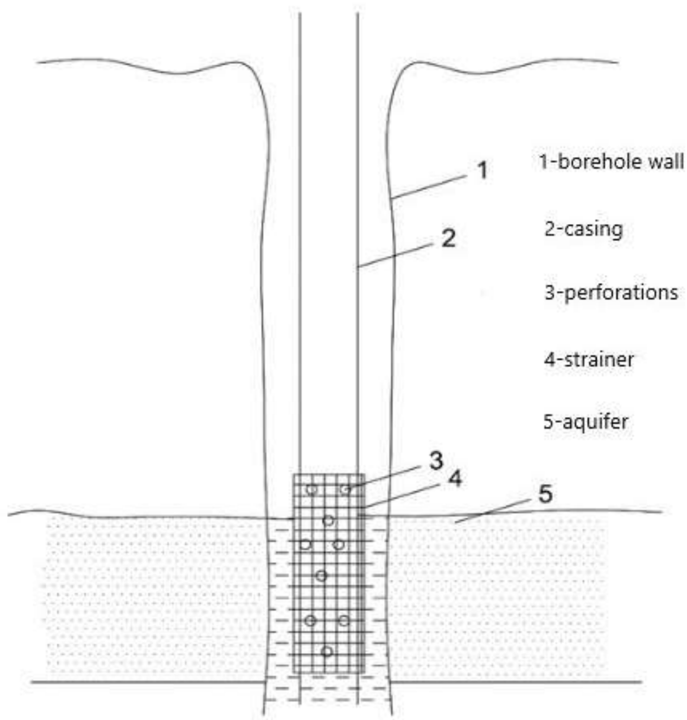

Fig. 2. Typical design of water supply wells.

Wells are drilled with mobile wheeled drilling rigs equipped with a set of equipment, including pipes for securing the walls of the well from landslides. Since the 90s of the last century, in order to reduce the cost of water wells, attempts have been made to fix the walls of the wells with PVC plastic pipes. However, the viscoplastic properties of the clays composing the geological section caused the collapse of the columns and blocked the passage of the riser pipes, which was the reason for the rejection of the further use of plastic pipes. Instead, they began to use conventional steel pipes coated with a corrosion-resistant protective layer based on synthetic resins.

All wells were drilled rotary by blowing air (dry season).

During the rainy season - flushing with water with the addition of foragon to the drilling fluid in order to avoid clogging of the aquifer of the well. Then the casing pipes were

INNOVATIVE TECHNOLOGICA
METHODICAL RESEARCH JOURNAL
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run, in the lower part of which there are round holes that play the role of a filter. A plastic mesh was wound on the outer part to retain sand particles entering the well along with water. After running the casing into the well, the aquifer interval was filled with quartz sand with a diameter of 2-4 mm to create a natural filter (Fig. 2). The annular space between the outer wall of the pipes and the surrounding rocks, according to the Rock Management Rules, was filled with drill cuttings consisting of clay rocks. The wells were operated either with a bailer or submersible electric pumps for several days (weeks) until the reserves of grasses and water were depleted. After the herd was moved to other pastures, the wells remained ownerless and lost. Arriving at new pastures, farmers were forced to order the drilling of new expensive water wells in search of new sources of water. The most valuable element of the abandoned wells is the steel casing. There have been attempts to reuse them, but they were unsuccessful. When lifting the casing pipes due to the tightness of the clay material in the annulus and corrosion, there were cases of pipe breakdown, violation of their integrity, and lack of lifting equipment power, which led to the stoppage of such work.

To solve this problem, the author of this article, who has worked in the Sahel countries for many years, proposed to gird the casing strings before running into the well with perforated steel pipes of small diameter (d = 10.2-15 mm) attached to the body of the latter. Water is pumped into the well, where it is planned to raise the casing strings, into the annulus through drainage pipes (most often, water is supplied by gravity from a container installed at the wellhead) [5-8]. At the same time, water leaving the holes wets the clay material of the annular space, transforming their pasty consistency, depending on the duration of the water injection time (Fig. 3).

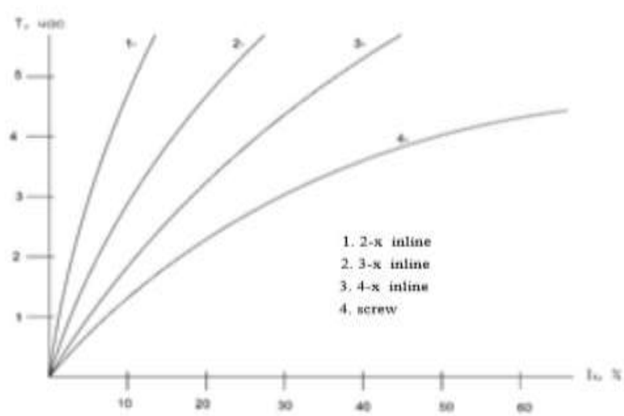

Fig. 3. Dependence of the consistency index on the time of water injectionю

INNOVATIVE TECHNOLOGICA
METHODICAL RESEARCH JOURNAL
ISSN: 2776-0987 Volume 2, Issue 12, Dec., 2021

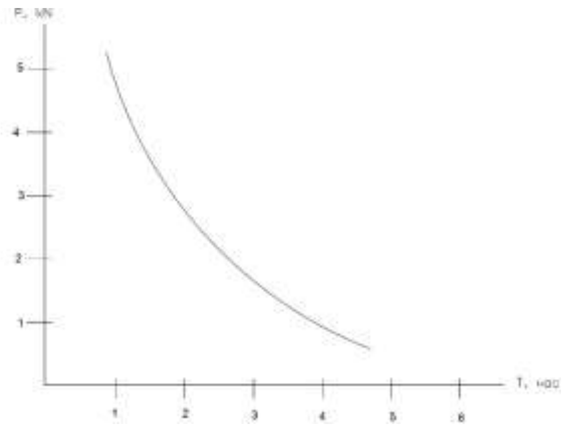

Fig. 4. The dependence of the weight of the casing on the duration of water supply to the wells.

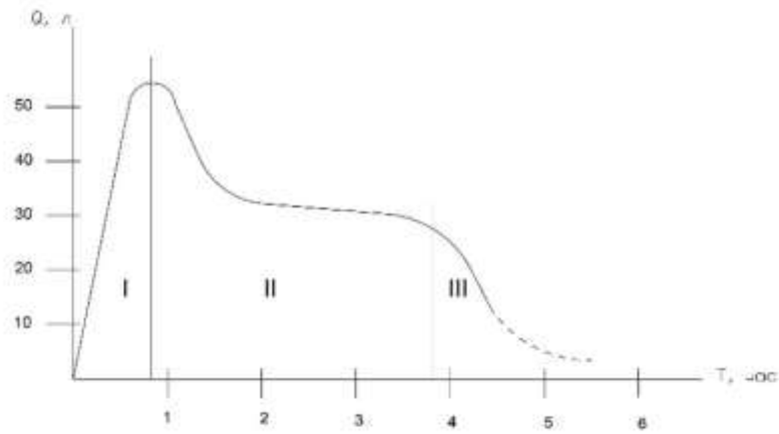

Fig. 5. The dependence of the flow rate of injected water on time

This proposal was based on changing the Utterberg limit [1], which depends on the water content in clay rocks (clay, loam) and covers two states:

- ✓ Plastic limit WP, water content separating plastic and fluid state;
- ✓ Consistency index I_c.

These limits, in turn, determine:

a) Plasticity index I_p

$$I_p = W_L - W_P$$

б) Consistency index I_c

$$I_c = \frac{W_L - W}{W_L - W_P}$$

where W - water content in clays in natural conditions.

W_L - water content in liquid clays.

Lithological analysis of drill cuttings showed that the upper part of the geological section consists mainly of clay, as it deepens, it is replaced by loam, then by sandy loam and sand (aquifer). Laboratory studies carried out by us at the Mining and Geological Institute (Boke) to determine the water-resistance of rocks showed that the rocks of the lower part of the section (loam and sandy loam) are less resistant to water and are easily destroyed. In other words, we can say that the rocks in the lower part of the section quickly lose their consistency in water and become fluid. It is this circumstance that allowed us to propose a scheme for casing strings fastening to further extract them from idle wells. It should be noted that in the conditions of remote desert-steppe areas, the price of casing pipes is 50-60% of the total cost of the well.

According to the proposed scheme, metal pipes with a diameter of 10.2 mm with pre-drilled holes on the body, the diameter of which is from 2.0 to 5.0 mm, were mounted on the outer wall of the casing pipes (Fig. 6). Moreover, small holes are located at the bottom and as the depth of the well decreases, the diameter of the holes is made larger. This placement of holes is done to evenly distribute the injected water along the wellbore.

For each running meter of pipe, 10 rows of holes are drilled. Each row has 3 holes located at an angle of 90º and covering an angle of 180º (Fig. 7).

It should be noted the arrangement of the holes is in the following order: sandy loam d = 2.0 mm, loam d = 3-4 mm and clay d = 4-5mm.

Were used 2, 3, 4 in-line and screw-shaped (distance between screw pitches 20 cm) fastening of small pipes to the casing. (fig. 6).

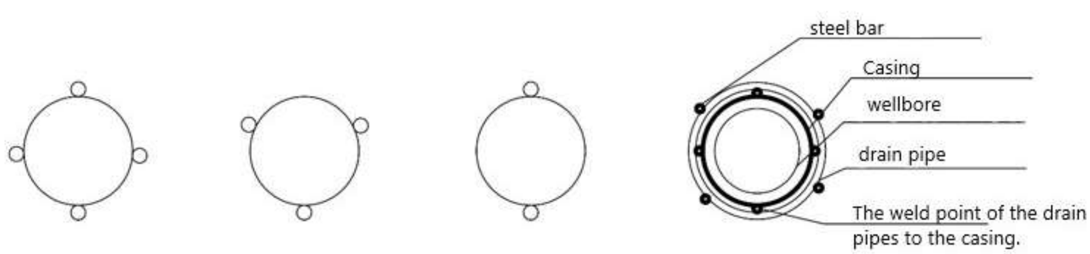

Fig. 6. Installation diagram of the drainage pipe to the casing.

Analysis of the results of casing extraction from abandoned wells showed that among all 4 schemes, despite the increased consumption of small pipes, 4 turned out to be the

ISSN: 2776-0987 Volume 2, Issue 12, Dec., 2021

most successful scheme. (Fig. 7). Of the 27 cases of lifting, there was not a single case of damage to the raised pipes, despite the relatively large depth of the wells (from 17 to 36 m). In our opinion, this is due to the wetting of the clay material in the annular space by the injected water and the formation of a liquid consistency, which has little shear resistance and has a little obstacle to pipe lifting. It should be noted that the use of the 4th scheme in three cases was marked by the failure of small pipes from the casing, which was caused by the unevenness of the wellbore. To eliminate this problem, welding (outside of small pipes) of steel rods (d = 7-9 mm) was proposed, which subsequently eliminated all complications when lifting the casing strings.

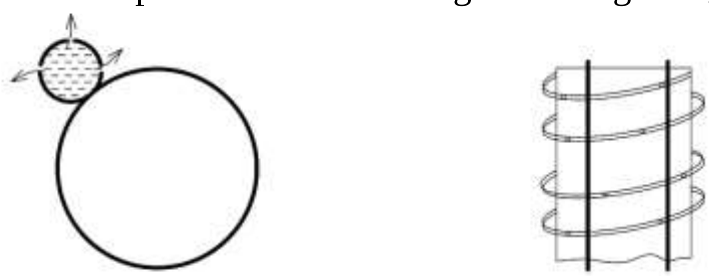

Fig. 7. Diagram of the location of the drain holes in the drain pipe.

The connection of the drain pipes is carried out as the casing strings are built up in the well. At the same time, the casing pipe, which is in a hanging position, by light rotation brings the joint of the drainage pipe closer, then, in the end, the latter is put on rubber-plastic pipes, securing them with metal clamps. When lifting the column, these pipes are again freed from the clamps for their further use. In order to determine the effect of the rate of liquefaction of clay material filling the annular space of the wells on the energy consumption of pipe lifting, a number of experiments were carried out in laboratory-field conditions, the results of which are presented in the form of graphs (Fig. 5).

It can be seen from the graph that the yield stress of the clay material in the well depends, along with the wetting time, also on the scheme of equipping the casing strings with drainage pipes, i.e., the greater the drainage coverage, the greater the wetting. With the vertical arrangement of the drain pipes, due to the gravity of the water, the water coming out of the holes is predominantly filtered in the vertical direction, delaying the wetting time. With a screw arrangement of drainage pipes, the coverage of the rocks located between the two rows of the spiral is carried out by the incoming water from

ISSN: 2776-0987 Volume 2, Issue 12, Dec., 2021

the holes located above, providing a relatively wide coverage, in a relatively short period of time. The increase in the consistency index, influencing the improvement of the rheological properties of the clay material, contributed to a decrease in the weight of the casing pipes, due to the manifestation of Archimedean forces [5], which further contributed to the choice of lifting equipment with the appropriate characteristics. The works described in the article were carried out in 7 countries from 1996 to 2017 in the countries of the Sahel, West Africa, Mali, Niger, Senegal, Guinea Bissau, the Republic of Guinea, Liberia, Sierra Leone with the direct participation of the author (Table 1). In this way. work on the extraction of casing pipes from abandoned water wells proved to be effective given the fact that farmers' base points are not constant in search of new pastures. This allowed farmers to avoid the cost of purchasing pipes when drilling new water wells. It should be noted that part of the territory of Uzbekistan is desert-steppe regions with an analogous geological characteristic and the use of such a practice would save a lot of money in the construction of shallow drainage and other water wells.

Conclusions

1. The consistency of the clay filler located between the casing and the surrounding rocks depends on the mineralogical composition of the rocks and the holding time of the water supplied to the wells. In order to obtain optimal consistency, the time of continuous water supply to the wells should be at least 4 hours.
2. For successful lifting of casing strings from wells, the outer part of the latter should be equipped with perforated drain pipes with a diameter of 10.2 mm. Moreover, the diameter of the perforated holes from bottom to top should increase.
3. Some information about the lifting of casing pipes in individual countries of the Sahel (according to [3])

INNOVATIVE TECHNOLOGICA
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Table 1. Some information about the lifting of casing pipes in individual countries of the Sahel (according to [3])

Country	Number of wells with pipe lifting	Average well depth, m	Number of wells		Pipe length, m	
			With a damaged column	With an intact column	damaged	without damage
Mali	87	12-45	9	78	120	1802
Niger	64	15-40	7	57	77	1500
Senegal	53	15-30	4	29	60	520
Guinea Bissau	22	16-32	-	22	-	560
Republic of Guinea	36	12-25	2	34	27	602
Liberia	18	12-20	1	17	14	296
Sierra-leone	15	15-20	-	15	-	268

References

1. Schlosser, F. (1983). Eléments de mécanique des sols.
2. Bogomolov, G. (1986). Hydrogéologie et notion de géologie d'ingénieur Edition de la Paix. Moscou, p. 279.
3. Odyl Kayumov. (2016). Mamady Keita Réuttilisation des chaînes de tubage des forages hydrauliques Compte – rendu d'un contrat économique. Fond de la bibliothéque de l'ISMGB, Boké, p. 96.
4. Пашков, Н. Н., & Долгачев, Ф. М. (1977). Гидравлика. Основы гидрологии. М.: Энергия.
5. Khakimova, K. R., Holmatova, D. B., & Abdusalomov, A. A. (2020). Basics of atlas mapping optimization in the ferghana region. ACADEMICIA: An International Multidisciplinary Research Journal, 10(5), 613-617.
6. Abdukadirova, M. A., & Mirzakarimova, G. M. (2020). Value of geodetic works in construction of hydrotechnical structures. ACADEMICIA: An International Multidisciplinary Research Journal, 10(6), 1307-1312.
7. Xakimova, K. R., Abdukadirova, M. A., & Abduxalilov, B. K. (2019). Development of innovative methods in cartographical description of ecological status. Actual Science, (11), 34-38.
8. Abdukadirova, M. A., & Mirzakarimova, G. M. (2021). The importance of installation of base gps stations in permanent activity in Fergana region. Asian Journal of Multidimensional Research, 10(9), 483-488.