

A.Ya. Margaryan, D.H. Grigoryan, A.A. Vartanyan, E.V. Avanesyan, G.H. Martirosyan, V.H.Tokmajyan

**HYDRAULIC CALCULATION OF ARTESIAN BASIN WATER RESOURCES
ARTIFICIAL RECHARGE IN MOUNTAIN RELIEF CONDITIONS**

UDC – 626.816:556

**HYDRAULIC CALCULATION OF ARTESIAN BASIN WATER RESOURCES
ARTIFICIAL RECHARGE IN MOUNTAIN RELIEF CONDITIONS**

Albert Ya. Margaryan

Institute of Water Problems and Hydro-Engineering
Named After I.V. Yeghiazarov
125, Armenakyan St., 0011, Yerevan
e-mail: albertmargaryan39@gmail.com
ORCID iD: 0000-0002-3846-0657
Republic of Armenia

Davit H. Grigoryan

National University of Architecture and
Construction of Armenia
105, Teryan St. 0009, Yerevan
e-mail: davit-grigoryan@yandex.com
ORCID iD: 0009-0004-9081-3204
Republic of Armenia

Arevshad A. Vartanyan

M.V. Lomonosov Moscow State University
1, Kolmogorov str. 119991, Moscow
e-mail: arevshad@mail.ru
ORCID iD: 0000-0002-0317-7296
Russian Federation

Eleonora V. Avanesyan

National University of Architecture and
Construction of Armenia
105, Teryan St. 0009, Yerevan
e-mail: avanesyane@rambler.ru
ORCID iD: 0000-0002-4443-2353
Republic of Armenia

Gagik H. Martirosyan

Institute of Water Problems and Hydro-Engineering
Named After I.V. Yeghiazarov
125/3 Armenakyan St., 0011, Yerevan
e-mail: gagik.martirosyan1@yandex.ru
ORCID iD: 0009-0007-2546-7167
Republic of Armenia

Vache H. Tokmajyan

Institute of Water Problems and Hydro-Engineering
Named After I.V. Yeghiazarov
125 Armenakyan St., 0011, Yerevan
e-mail: tokmajyanv@gmail.com
ORCID iD: 0000-0001-8096-064X
Republic of Armenia

<https://doi.org/10.56243/18294898-2025.2-27>

A.Ya. Margaryan, D.H. Grigoryan, A.A. Vartanyan, E.V. Avanesyan, G.H. Martirosyan, V.H. Tokmajyan

**HYDRAULIC CALCULATION OF ARTESIAN BASIN WATER RESOURCES
ARTIFICIAL RECHARGE IN MOUNTAIN RELIEF CONDITIONS**

Abstract

River water flowing in mountainous areas are characterized by significant seasonal changes due to spring and autumn floods, making their efficient use difficult. Fountain wells increase total water consumption by providing water not only for irrigation but also for drinking and household needs. It is known that in many countries the use of water comes from groundwater basins, into which, in addition to atmospheric precipitation, river runoff is forcibly directed. In flat places, these activities require large financial costs both for water purification and for injection into underground reservoirs. Mountainous areas have high water quality indicators. In addition, natural relief differences make it possible to pump large volumes of fresh water into the underground basin without the use of pumping stations. The volume of water injected into underground aquifers is determined by the pipeline's water pressure, the filtration properties of the aquifers, the number of wells, the distance between them, and other factors. Based on comparisons of the calculated data on water consumption according to different empirical formulas, which showed close results, the mentioned researchers were given reason to believe that these formulas can be trusted. The authors of this paper consider the use of empirical formulae for calculating the replenishment flow rate of an artesian basin is inappropriate, because of the large risk of distorting the real picture. Based on the fundamentals of technical hydromechanics a method for hydraulic calculation of the distribution of flow rates in absorbing wells has been proposed

Keywords: underground water basin, artificial recharge, absorbing borehole, river streams regulation, reservoir

Introduction

Accumulation of significant volumes of water runoff in reservoirs in complex hydrogeological conditions requires not only large investments in construction, but also in water transportation to the consumer, which is fraught with significant filtration losses. Tatevik Yedoyan et al. show that artificial replenishment of the Ararat artesian basin with water in an underground basin is possible and profitable [1].

The global freshwater deficit is expanding faster than predicted at the turn of the century. Water scarcity has already become an urgent issue for more than 40% of the world's population. There is a good chance that the situation will deteriorate. Currently, 1.7 billion people live in river basins where the demand for water far outstrips the river's ability to purify itself. resource and the inefficiency with which it is used [2, 3]. More than 80 percent of the world's wastewater is discharged untreated into rivers or seas. Ensuring sanitation, hygiene and a sustainable supply of clean drinking water has become imperative in the fight against the COVID-19 pandemic. Regular hand washing is one of the most effective actions a person can take to reduce the spread of germs and prevent infections. When discussing the issues of water resource management, it should also be taken into account that significant climate changes are also already present in the South Caucasus region. In particular, the average annual temperature increase in the eastern regions of Armenia during the last 50 years was 1.3°C, and the average monthly temperature increase reaches 3.2°C [4, 5]. In many countries of the world, these indicators are much more worrying. Because the existence of both human society and flora and fauna is dependent on this

A.Ya. Margaryan, D.H. Grigoryan, A.A. Vartanyan, E.V. Avanesyan, G.H. Martirosyan, V.H. Tokmajyan

**HYDRAULIC CALCULATION OF ARTESIAN BASIN WATER RESOURCES
ARTIFICIAL RECHARGE IN MOUNTAIN RELIEF CONDITIONS**

unique resource, fresh water has become a symbol of the concept of "life" in the modern world. However, as a study of indicators of fresh water resource use in individual countries and regions of the world reveals, the specific volumes of water use vary greatly, indicating a lack of socioeconomic tools for this resource and a low efficiency of its use [1, 2].

During periods of low water demand, there is a problem of storage of excess fresh water, which during the last two centuries has been mainly done by \$3.5. It is not possible to effectively solve the issue of filtration prevention in many reservoir bowls. Although a number of effective technologies for implementing anti-filtration measures have been developed in recent years, their widespread application necessitates long-term experimental research, and the problem will remain unresolved for a long time [6, 7].

In addition to these open water ecosystems, there is a decrease in the amount of stored water due to evaporation. The construction of reservoirs also raises a number of other problems: seismic risks increase, the consequences of a possible collapse of the dam can lead to major humanitarian disasters. It should also be noted that over the years, the reservoirs are filled with sediments, which, mainly being installed in the useful volume, continuously reduce the possibility of regularization of the structure [8].

The possibility of storing storm water in underground basins has received a lot of attention in recent years. In a number of countries, where reservoir construction is technically difficult and inefficient, and the hydraulic structure system lacks the capacity to store the required water, special wells are built for this purpose, primarily in decommissioned mines. Tests of constructed wells have shown that there are large differences in the hydraulic parameters of the well between pumping and recharging wells, because such wells are frequently blocked [9].

Recharge schemes for the various managed deep aquifers are varied. They are mainly used in developed countries for various purposes, but until now there is no systematic classification and collection of data about them [10].

The goals of underground water artificial storage are the following [11]:

- to increase the usable water balance;
- improve water quality in aquifers;
- use aquifers for seasonal storage;
- store excess water during periods of low water demand.

Studies show that in wells where water is injected from aquifer-rich coastal aquifers, absorption capacity drops by up to one-third during the season. Experiments have shown that dual-purpose wells work more efficiently than single-purpose injection wells because it is relatively easy to wash wells of solid and organic contaminants in dual-purpose wells.

However, the main disadvantage of using wells for water storage is the low injection rate and the need for multiple recharge wells when the total volume of water to be injected is large. However, it should also be noted that interest in artificial storage of water in underground basins has increased in response to a decrease in the level of groundwater, an increase in the pollution and vulnerability of surface water, the opposition of a number of environmental factors to dependence on surface water resources, and other reasons [10, 12, 13].

Artificial storage of water in underground basins also requires that there is a flow in the aquifer or that it has a sufficiently large volume [14].

A.Ya. Margaryan, D.H. Grigoryan, A.A. Vartanyan, E.V. Avanesyan, G.H. Martirosyan, V.H. Tokmajyan

**HYDRAULIC CALCULATION OF ARTESIAN BASIN WATER RESOURCES
ARTIFICIAL RECHARGE IN MOUNTAIN RELIEF CONDITIONS**

During the artificial storage of water in underground basins, water quality deterioration may also occur, affecting the quality recovery processes of the injected water [15]. In this regard, for artificial storage of water in underground basins, it is preferable to use those boreholes that have been used for irrigation, fish farming or other purposes of groundwater abstraction. There are many such preserved or partially used boreholes in Armenia, particularly in the Ararat Plain.

Conflict setting

The purpose of this work is to develop a universal hydraulic system providing the transfer of storm water to underground basins, and in the period of water shortage, to the water intake through the existing deep wells.

Using the methods of technical hydromechanics, the problem is to obtain a calculation scheme for the determination of flows transported by deep wells to underground basins.

Research Results

Consider the calculation schemes for two and three absorption wells to obtain a theoretical general solution. The first calculation scheme consists of an above-ground basin, a main pipeline AB, a distribution pipe BC, units B and C, and a number of two vertical pipes that supply water to the underground artesian basin (Fig.1).

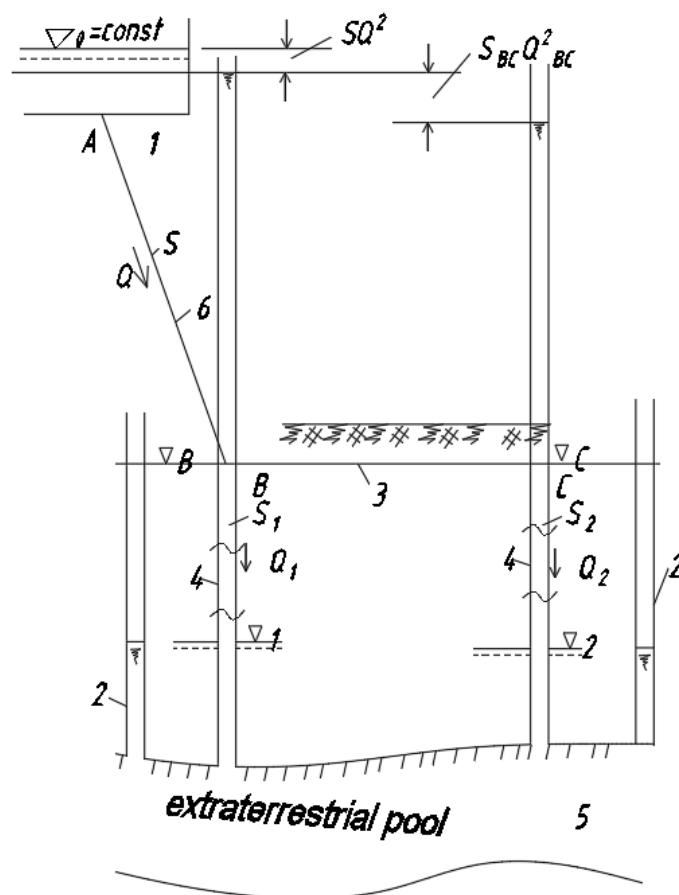


Fig. 1 Calculation scheme of two absorption wells

1 – ground basin, 2 – piezometer, 3 – distribution pipe,
4 – deep well, 5 – underground basin, 6 – highway pipe

A.Ya. Margaryan, D.H. Grigoryan, A.A. Vartanyan, E.V. Avanesyan, G.H. Martirosyan, V.H. Tokmajyan

**HYDRAULIC CALCULATION OF ARTESIAN BASIN WATER RESOURCES
ARTIFICIAL RECHARGE IN MOUNTAIN RELIEF CONDITIONS**

Piezometers are placed at the unit points, which determine the pressure levels in the underground basin. The energy losses in the above-ground pool, main pipe, distribution pipe and delivery pipe system are determined by the well-known Shezi formula: Piezometers are placed at the unit points, which determine the pressure levels in the underground basin. The energy losses in the above-ground pool, main pipe, distribution pipe and delivery pipe system are determined by the well-known Shezi formula: $h_w = SQ^2$.

The pressure at unit B will be

$$y_B = \nabla_0 - \nabla_B - SQ^2, \quad (1)$$

where S is the hydraulic resistance of the pipe AB, which is determined depending on the length and diameter of the pipe, Q is the discharge established in the pipe AB, ∇_0, ∇_B are the geometric characters of the above-ground reservoir and unit B, respectively, y_B - where B is the pressure at the unit.

In the underground basin, let's denote the mark of piezometric height in the vertical pipe descending from unit B as ∇_1 , the flow: Q_1 , the hydraulic resistance of the pipe S_1 . For the pipe descending from unit C, these parameters will be: ∇_2, Q_2, S_2 , respectively.

The flow Q_1 in the vertical pipe descending from unit B will be determined by the following formula

$$y_B + \nabla_B - \nabla_1 = S_1 Q_1^2, \quad (2)$$

The pressure at unit C will be:

$$y_C = y_B - (\nabla_C - \nabla_B) - S_{BC} Q_{BC}^2, \quad (3)$$

where S_{BC} is the hydraulic resistance in the pipe BC, Q_{BC} is the flow through the pipe BC, ∇_C is the geometric character of the unit C, y_C is the pressure at the unit C which will be less than the pressure at the unit B $S_{BC} Q_{BC}^2$ in size.

If the system consists of two branches, the flow from the external pool will be equal to the sum of the flow rates Q_1 and Q_2 in the vertical pipe descending from units B and C

$$Q_{BC} = Q_2 = Q - Q_1 \quad (4)$$

The flow Q_2 in the vertical pipe descending from unit C will be determined from the following equation

$$y_C + \nabla_C - \nabla_2 = S_2 Q_2^2. \quad (5)$$

Thus, the system of equations (1)...(5) is closed, and the unknowns Q, Q_1, Q_2, y_B, y_C are determined uniformly.

Suppose B unit feeds three deep wells (Fig.2).

A.Ya. Margaryan, D.H. Grigoryan, A.A. Vartanyan, E.V. Avanesyan, G.H. Martirosyan, V.H. Tokmajyan

**HYDRAULIC CALCULATION OF ARTESIAN BASIN WATER RESOURCES
ARTIFICIAL RECHARGE IN MOUNTAIN RELIEF CONDITIONS**

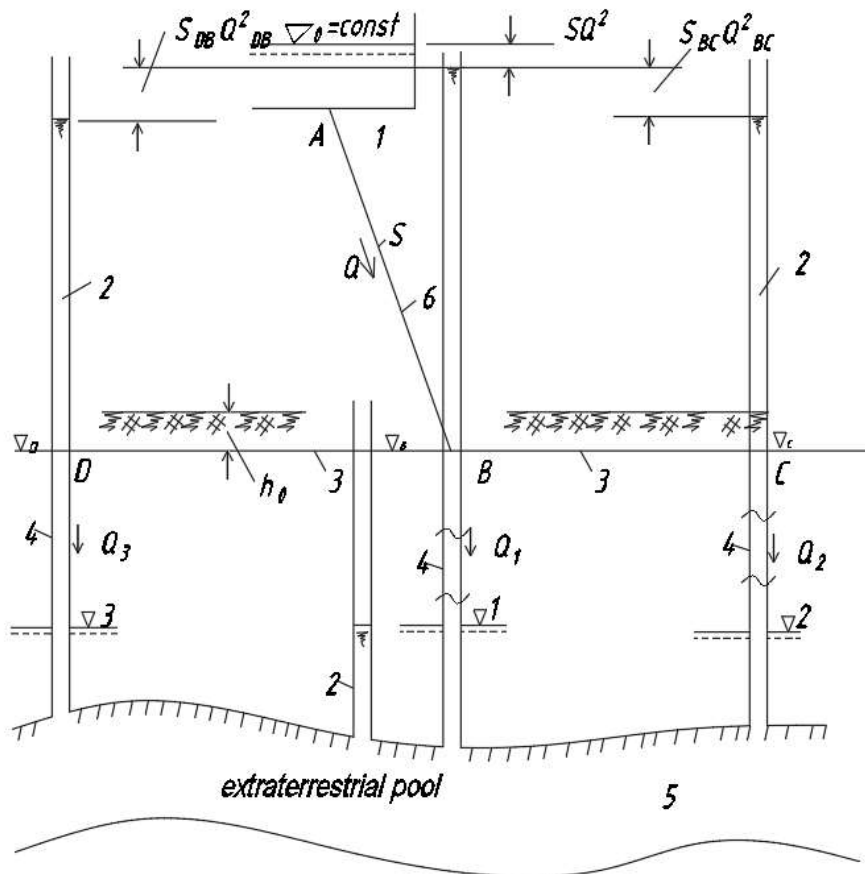


Fig. 2 Calculation scheme of the three absorbing wells

In this case, the calculation equation system consists of seven equations.

$$\left\{ \begin{array}{l} y_B = \nabla_0 - \nabla_B - S Q^2, \\ y_B + \nabla_B - \nabla_1 = S_1 Q_1^2 \\ y_C = y_B - (\nabla_C - \nabla_B) - S_{BC} Q_{BC}^2 \\ y_C = (\nabla_2 - \nabla_C) + S_2 Q_2^2 \\ y_C = (\nabla_2 - \nabla_C) + S_2 Q_2^2 \\ y_D = (\nabla_3 - \nabla_D) + S_3 Q_3^2 \\ Q = Q_1 + Q_2 + Q_3 \end{array} \right. \quad (6)$$

System blockages may necessitate the need to protect pipelines from short-term impact forces caused by non-stationary hydraulic regimes. It is proposed that the distribution pipes be equipped with a vent and a universal ventilation device to establish an accounting mode in the system. The system of equations contains $2n+1$ equations if the surface basin is fed by n wells, each with its own distribution pipe (Fig.3).

A.Ya. Margaryan, D.H. Grigoryan, A.A. Vartanyan, E.V. Avanesyan, G.H. Martirosyan, V.H.Tokmajyan

**HYDRAULIC CALCULATION OF ARTESIAN BASIN WATER RESOURCES
ARTIFICIAL RECHARGE IN MOUNTAIN RELIEF CONDITIONS**

It is recommended that the discharge from the catch basin to the underground basin be distributed from a single unit (for example, unit B). Water is supplied from the selected unit to existing deep wells that have been decommissioned or are partially operational via pipes buried deeper than the freezing mark.

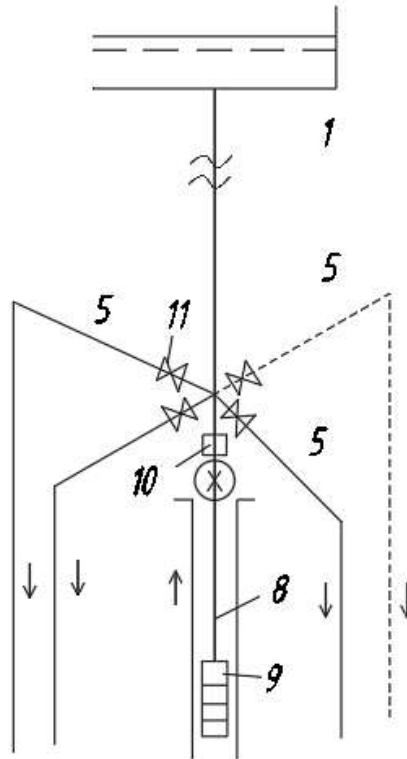


Fig. 3 Calculation scheme of the absorption well with n number

1-7 appointments see in Fig.1, 8- water collection well,
9- submersible pump, 10- revers, 11 – valve

It is recommended that the discharge from the catch basin to the underground basin be distributed from a single unit (for example, unit B). Water is supplied from the selected unit to existing deep wells that have been decommissioned or are partially operational via pipes buried deeper than the freezing mark.

The proposed outlet distribution scheme allows for the storage of abundant spring flows through a deep well in the underground basin and the use of the accumulated water in times of water scarcity. In other words, the deep well serves two purposes throughout the year: first as an accumulator, then as a feeder.

Conclusions

1. The magnitudes of flow transported by deep wells to underground basins are determined by the surface basin's character, the underground basin's piezometric heights, and the geometric and hydraulic parameters of the pipelines.
2. The proposed hydraulic system assumes underground basin storage during periods of flooding and water intake during periods of water deficit.

A.Ya. Margaryan, D.H. Grigoryan, A.A. Vartanyan, E.V. Avanesyan, G.H. Martirosyan, V.H. Tokmajyan

**HYDRAULIC CALCULATION OF ARTESIAN BASIN WATER RESOURCES
ARTIFICIAL RECHARGE IN MOUNTAIN RELIEF CONDITIONS**

3. In order to put these conclusions into action, at least one nearby well must be outfitted with a submersible pump. The water will be pumped into the above-ground basin in this manner using the same delivery main pipe. At the same time, all distribution pipe inlet valves are closed, with the exception of the valve on the distribution pipe of the pump equipped with a pump. To prevent reverse water movement in the event of an emergency power failure of the pump's electric motor, the given push pipe is equipped with a reverse valve.

References

1. Sahakyan, S., Sarukhanyan, A., Yedoyan, T., Vartanyan, A. and Avanesyan, E. 2023. Restoration Peculiarities of Ground Water Basins in the Mountainous Relief Regions. Journal of Architectural and Engineering Research. 5, (Nov. 2023), 19–32. DOI:<https://doi.org/10.54338/27382656-2023.5-003>
2. Markosyan, A. Kh., Matevosyan, E.N., Tokmajyan, S.H., Avanesyan, E.V., 2021. The Supplies of Fresh Water and Main Indicators of Their Utilization in the World. Bulletin of High Technology, Stepanakert, N1 (15), 66-77.
3. Markosyan, A.Kh., Matevosyan, E.N., Tokmajyan, S.H., Avanesyan, E.V., 2021. Comparative Research of Indicators of Fresh Water Utilization Assessed in Different Countries and Regions. Bulletin of High Technology, Stepanakert, N2 (16), 71-84.
4. Avanesyan, E.V., 2021. Some Problems on Enhancing the Efficiency of Water Utilization in a Climate Change in the Republics of Armenia and Artsakh. Bulletin of High Technology, Stepanakert, N2 (16), 3-14.
5. Paris Agreement, 2015. – UNFCCC
https://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf
6. Tokmajyan, Vache, Vardanyan, Arevshad et. Al.. 2020. The application of anti-filtering polymer mass to solve the water storage problem in highland regions. Budownictwo o Zoptymalizowanym Potencjale Energetycznym. 10. 17-22.
doi.org/10.17512/bozpe.2020.2.02.
7. Vartanyan, A.H., Shakhnazarov, A.A., Tokmajyan, V.H., Sarukhanyan, A.A., 2020. Increase of Soil Moisture Content by Applying Polymer-Mineral Material. Bulletin of High Technology, Shushi, N1 (11), 3-10.
8. Baljyan, P.H., Kelejian, H.G., Avanesyan. E. V., Tokmajyan, V.H., 2021. Evaluation of the Actual State of the Mataghis Reservoir, W-H Characteristics and Forecasting of Future Changes. Bulletin of High Technology, Stepanakert, N3 (17), 14-22.
9. Guttman, J., Negev, I., Rubin, G., 2017. Design and Testing of Recharge Wells in a Coastal Aquifer: Summary of Field Scale Pilot Tests. Water, 9, 53.
doi.org/10.3390/w9010053
10. Sprenger, C., Hartog, N., Hernández, M. et al., 2017. Inventory of managed aquifer recharge sites in Europe: historical development, current situation and perspectives. Hydrogeol J 25, 1909–1922. doi.org/10.1007/s10040-017-1554-8
11. Dillon, P., 2005. Future management of aquifer recharge. Hydrogeol J 13, 313–316.
<https://doi.org/10.1007/s10040-004-0413-6>

A.Ya. Margaryan, D.H. Grigoryan, A.A. Vartanyan, E.V. Avanesyan, G.H. Martirosyan, V.H. Tokmajyan

HYDRAULIC CALCULATION OF ARTESIAN BASIN WATER RESOURCES
ARTIFICIAL RECHARGE IN MOUNTAIN RELIEF CONDITIONS

12. Kurtzman, D., Netzer, L., Weisbrod, N., Nasser, A., Graber, E. R., and Ronen, D., 2012. Characterization of deep aquifer dynamics using principal component analysis of sequential multilevel data, Hydrol. Earth Syst. Sci., 16, 761–771, <https://doi.org/10.5194/hess-16-761-2012>, 2012.
13. Pyne, R.D.G., 1995. Groundwater Recharge and Wells: A Guide to Aquifer Storage Recovery (1st ed.). CRC Press. <https://doi.org/10.1201/9780203719718>
14. Bouwer, H., 2002. Artificial recharge of groundwater: hydrogeology and engineering. Hydrogeology Journal 10, 121–142. <https://doi.org/10.1007/s10040-001-0182-4>
15. Antoniou, E.A., Hartog, N., Van Breukelen, B.M., Stuyfzand, P.J.. 2014. Aquifer pre-oxidation using permanganate to mitigate water quality deterioration during aquifer storage and recovery. Applied Geochemistry, Vol. 50, November 2014, 25-36. <https://doi.org/10.1016/j.apgeochem.2014.08.006>

**ԼԵՈՆԱՅԻՆ ՌԵԼԻԵՖԻ ՊԱՅՄԱՆՆԵՐՈՒՄ ԱՐՏԵՐՅԱՆ ԱՎԱԶԱՆԻ ԶՐԱՅԻՆ
ՌԵՍՈՒՐՍՆԵՐԻ ԱՐՇԵՍՏԱԿԱՆ ԼԻՑՔԱՎՈՐՄԱՆ ՀԻԴՐԱՎԼԻԿԱԿԱՆ ՀԱՇՎԱՐԿԸ**

**Ա.Յա. Մարգարյան¹, Դ.Հ. Գրիգորյան², Ա.Ա. Վարտանյան³,
Է.Վ. Ավանեսյան², Գ.Հ. Մարտիրոսյան¹, Վ.Հ. Թոքմաջյան¹**

¹Ակադեմիկոս Ի.Վ. Եղիազարովի անվան ջրային հիմնահարցերի և հիդրոտեխնիկայի ինստիտուտ

² Ճարտարապետության և շինարարության Հայաստանի ազգային համալսարան

³Լոմոնոսովի անվան Մոսկվայի պետական համալսարան

Լեռնային տարածքներում գետերի հոսքը բնութագրվում է գարնանային և աշնանային հոսքերի հետ կապված զգալի սեզոնային փոփոխություններով, ինչը դժվարացնում է դրա արդյունավետ օգտագործումը: Շատրվանային հորերի առկայությունը մեծացնում է ջրի ընդհանուր սպառումը՝ ապահովելով ջուր ոչ միայն ոռոգման, այլև խմելու և կենցաղային կարիքների համար: Հայտնի է, որ շատ երկրներում ջուրն օգտագործվում է ստորգետնյա ավազաններից, որտեղ, տեղումներից բացի, հարկադրաբար ուղղորդվում է գետերի հոսքը: Հարթ տարածքներում այս աշխատանքները պահանջում են մեծ ֆինանսական ծախսեր ինչպես ջրի մաքրման, այնպես էլ այն ստորգետնյա ավազաններ մղելու համար:

Լեռնային տարածքները բնութագրվում են ջրի բարձր որակի ցուցանիշներով: Բացի այդ, ռելիեֆի նիշերի տարբերությունները հնարավորություն են տալիս մեծ քանակությամբ քաղցրահամ ջուր մղել ստորգետնյա ավազան՝ առանց պոմպակայաններ օգտագործելու: Ստորգետնյա ջրատար հորիզոններ մղվող ջրի ծավալը որոշվում է խողովակաշարում ջրի ճնշմամբ, ջրատար հորիզոնների ֆիլտրացիոն հատկություններով, հորատանցքերի քանակով, դրանց միջև հեռավորությամբ և այլ գործոններով:

Հոդվածի հեղինակները արտեզյան ավազանի համալրման հոսքի արագության հաշվարկման համար էմպիրիկ բանաձևերի կիրառումը համարում են անտեղի՝ իրական

A.Ya. Margaryan, D.H. Grigoryan, A.A. Vartanyan, E.V. Avanesyan, G.H. Martirosyan, V.H. Tokmajyan

**HYDRAULIC CALCULATION OF ARTESIAN BASIN WATER RESOURCES
ARTIFICIAL RECHARGE IN MOUNTAIN RELIEF CONDITIONS**

պատկերը խեղաթյուրելու բարձր ռիսկի պատճառով: Տեխնիկական հիդրոմեխանիկայի տեսության հիման վրա առաջարկվում է կլանման հորատանցքերում հոսքի արագությունների բաշխման հիդրավլիկ հաշվարկի մեթոդ:

Բանալի բառեր. ստորգետնյա ջրավազան, արհեստական լրացում, կլանող հորատանցք, գետային հոսքերի կարգավորում, ջրամբար:

**ГИДРАВЛИЧЕСКИЙ РАСЧЕТ ИСКУССТВЕННОГО ПОПОЛНЕНИЯ ВОДНЫХ
РЕСУРСОВ АРТЕЗИАНСКОГО БАССЕЙНА В УСЛОВИЯХ ГОРНОГО РЕЛЬЕФА**

А.Я. Маргарян¹, Д.Г. Григорян², А.А. Вартанян³

Э.В. Аванесян², Г.А. Мартиросян¹, В.О. Токмаджян¹

¹Институт водных проблем и гидротехники им. акад. И.В.Егiazарова

²Национальный университет архитектуры и строительства Армении

³Московский государственный университет им. М.Ломоносова

Речной сток в горных районах характеризуется значительными сезонными изменениями, связанными с весенними и осенними паводками, что затрудняет его эффективное использование. Наличие фонтанных скважин увеличивает общее водопотребление, обеспечивая водой не только орошение, но и питьевые и хозяйственно-бытовые нужды. Известно, что во многих странах вода используется из подземных бассейнов, куда, помимо атмосферных осадков, принудительно направляется речной сток. На равнинных участках эти работы требуют больших финансовых затрат как на очистку воды, так и на закачку в подземные резервуары. Горные районы характеризуются высокими показателями качества воды. Кроме того, естественные различия отметок рельефа позволяют закачивать большие объемы пресной воды в подземный бассейн без использования насосных станций. Объем воды, закачиваемой в подземные водоносные горизонты, определяется напором воды в трубопроводе, фильтрационными свойствами водоносных горизонтов, количеством скважин, расстоянием между ними и другими факторами. Сравнение расчетных данных по различным эмпирическим формулам, показавшее близкие результаты, дало упомянутым исследователям основания полагать, что этим формулам можно доверять. Авторы статьи считают использование эмпирических формул для расчета дебита восполнения артезианского бассейна нецелесообразным ввиду большого риска искажения реальной картины. На основе теории технической гидромеханики предложен метод гидравлического расчета распределения дебитов в поглощающих скважинах.

Ключевые слова: подземный бассейн, искусственное пополнение, поглощающая скважина, регулирование речных потоков, водохранилище.

Submitted on 23.02.2025

Sent for review on 26.02.2025

Guaranteed for printing on 29.07.2025