

G.L. Hayriyan

NEW TECHNOLOGY FOR REPAIRING WASHOUTS IN EARTH DAMS USING POLYMER-MINERAL MATERIAL
(ON THE EXAMPLE OF THE DAM OF THE RESERVOIR «GEGHARKUNIK 2»)

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Georgi L. Hayriyan

Institute of Water Problems and Hydro-Engineering
Named After I.V. Yeghiazarov
125/3, Armenakyan st., 0011, Yerevan
e-mail: hayriyangeorge@gmail.com
ORCID iD: 0000-0002-6828-9010
Republic of Armenia

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Abstract

A new technology for eliminating leaks in an earthen dam has been proposed. This technology involves the use of a modified polymer-mineral material «PMM». To eliminate leaks in an earthen dam, this material should be installed in a ratio of 7.5 kg/m².

Keywords: water, soil, filtration, polymer-mineral material, sand clay

Introduction

In many hydraulic structures, including reservoir bowls, it is not possible to effectively mitigate the problem of filtration. Although a number of effective technological solutions for implementing anti-filtration measures have been developed in this direction in recent years, their mass application implies long-term experimental research and the issue is unlikely to be solved in the near future [1, 2, 3].

The "PMM" material is developed at the Institute of Mechanics of Moscow State University after Lomonosov, by employees of the laboratory of natural processes. Over the past four years, scientists from the Moscow State University and the Shushi Technological University have been conducting research on the use of the PMM material in order to develop technologies for its use in urban planning, water management, waste disposal, agriculture and other sectors of the economy [4]. The modified PMM material undergoes multiple cycles of swelling and drying, and It does not decompose under soil, biological and atmospheric influences and is environmentally friendly and safe. Depending on its concentration, it can maintain a water pressure of tens of atmospheres along with clay.

Conflict Setting

The problem is to develop technology to eliminate leakages and prevent filtration losses in the reservoir dam «Gegharkunik 2».

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The Gegharkunik 2 reservoir is located within the land boundaries of the settlement of the same name, 900 m southeast of the village cemetery, on the elevation of the northeastern slope of the Geghama ridge, at an altitude of about 2220 m (Fig. 1).



Fig. 1 Reservoir «Gegharkunik 2»

The reservoir is fed by a canal connecting the river "Gegharkunik Djur". It stores about 325 thousand cubic meters of water. The surface of the water mirror of the reservoir is two hectares, the water is used for irrigation, through a canal with a capacity of about 400 l/s. The length of the homogeneous earth dam is about 240 m, and the maximum height exceeds 20 m.

The water in the bowl doesn't stay for long. Studies have shown that most of the water loss happens at the lower part of the dam, where there are many washouts. (Fig. 2). This means the reservoir not only fails to serve its main purpose but also poses a significant threat to the Gegharkunik community if the dam were to fail.

On July 5, 2020, on the right slope of the reservoir and part of the dam body (it is located almost in front of the first bend to the right of the dam), a washout with a water swirl was noticed (Fig. 3). To eliminate the accident, several trucks of sand and gravel were poured into the mine, but it was quickly washed away by the flow of water and carried away to deeper horizons. The gully was closed by gradually filling and compacting several truckloads of clay material brought from a sandy loam deposit located on the right slope of the reservoir into the pit.

To combat water loss from the erosion zone, in addition to sand-clay material, it is recommended to use the polymer mining material «Modernized PMM». The material «Modernized PMM» has the property of multiple cyclic swelling and drying, does not deteriorate under soil, biological and atmospheric influences, is environmentally friendly and safe, and is capable of performing waterproofing functions together with clay under pressure of tens of atmospheres (depending on concentration).

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Fig. 2 Washouts on the dam body

Laboratory tests of the polymer-mineral material "Modernized PMM" were carried out by specialists from the Institute of Mechanics of Moscow State University named after M.V. Lomonosov and the Institute of Water Problems and Hydraulic Engineering named after academician I.V. Yegiazarov.



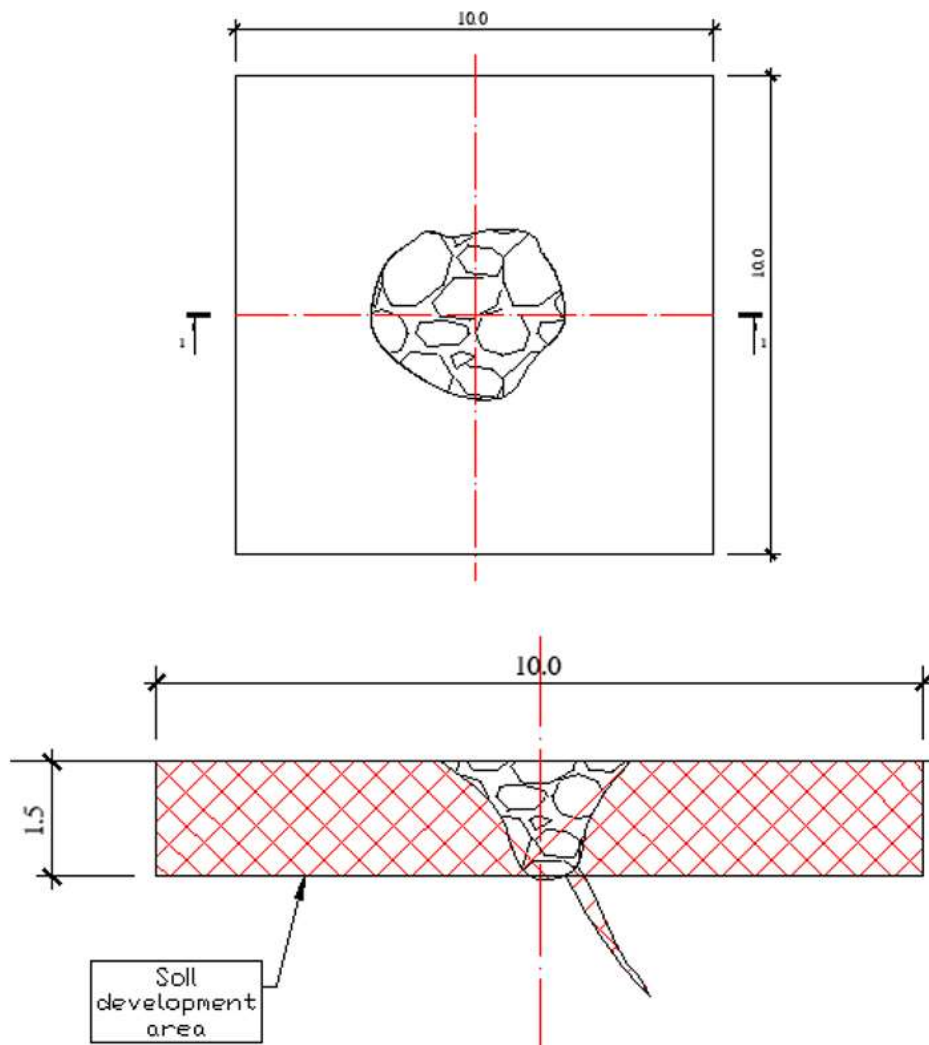
Fig. 3 Washout zone

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The following technology is proposed for eliminating gullies (Fig. 4):

1. Dig a hole in the washout area measuring 10x10x1.5m. Level and compact the bottom of the hole.
2. Pour gravel $d=40-50$ mm, thickness $h=150$ mm onto the bottom and compact it.
3. Pour medium-grained sand $h=100$ mm onto the gravel layer and compact it.
4. Place clay $h=700$ mm thick on the sand layer. Place the clay in 100 mm thick layers, having previously moistened and compacted it.
5. On the leveled and compacted clay layer, lay a compacted layer of clay and PMM polymer mixture 7.5 kg/m^2 in a ratio of 1:5.
6. Place a compacted layer of clay 250 mm thick on top of the polymer mixture.
7. Place a protective layer of medium-grained sand 150 mm thick on top of the clay layer.



**Fig. 4 Soil development area - developed pit
in the erosion zone measuring 10x10x1.5m**

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The layout of the gully 1 is shown in Fig. 5.

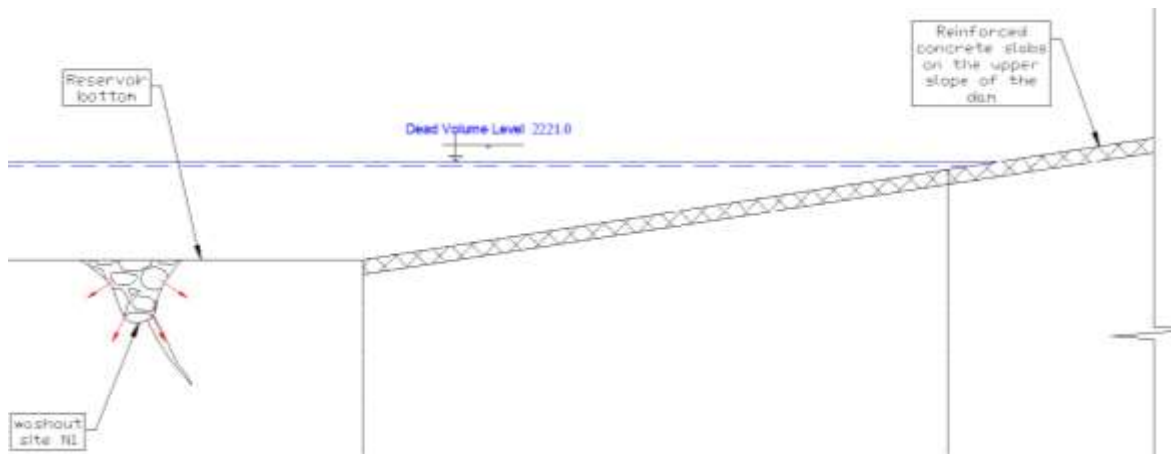


Fig. 5 Location diagram of gully 5

The layout of the gully 2 is shown in Fig. 6.

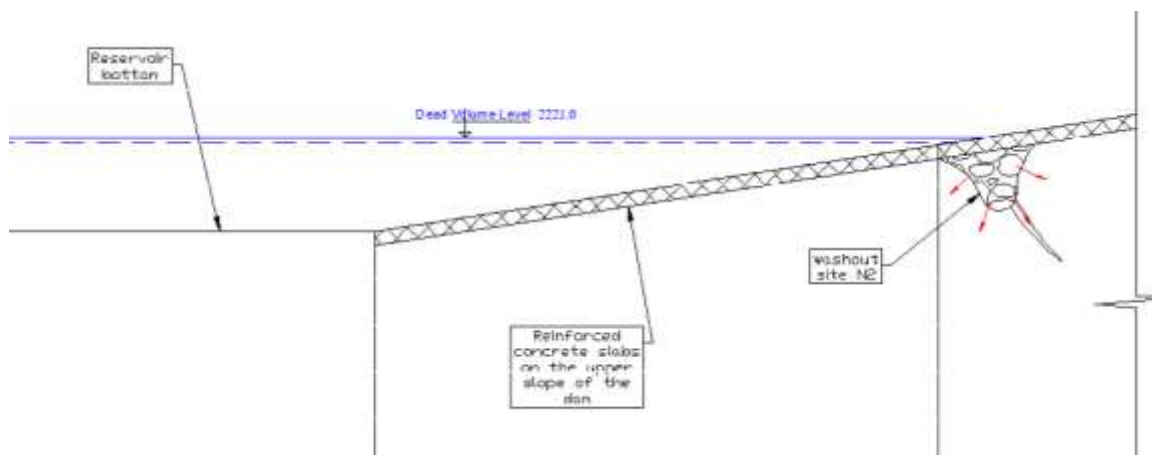


Fig. 6 Location diagram of gully 2

The clay used must be homogeneous, without large grains and stones.

Conclusion

1. To combat flushing losses (washout), in addition to compacted clay, it is recommended to use the polymer-mineral material «PMM Modernized».
2. If gullies appear in new places (the probability of which is extremely high), it is recommended to use the technology for their elimination indicated above.

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References

1. Hayriyan G.L. The Possibility of Repairing Washouts in Dams Using Polymer-Mineral Material (A Case Study of Tsakhkashen Reservoir Dam) //Bulletin Of High Technology, N 2 (30) 2024.-pp. 3-10.
2. Mikayelyan N.A., Tokmajyan V.H., Vartanyan A.A., Galstyan A.G., Experimental research on the filtration properties of an untamped mixture with "PMM" polymer mineral material, Construction of Optimized Energy Potential (CoOEP), Vol. 12, 2023, 17-24, DOI: 10.17512/bozpe.2023.12.02
3. Tokmajyan V., Vartanyan, A., Mikayelyan, N. Construction of reservoirs using polymermineral materials M1 and PMM //Construction of Optimized Energy Potential, 2021. N10(2), 31-38.
4. Tokmajyan V., Vardanyan, A., Galstyanh, A., Mikayelyan, N. The application of anti-filtrating polymer mass to solve the water storage problem in highland regions. Construction of Optimized Energy Potential, 2020, N 9(2), 17-22.

**ՊՈԼԻՄԵՐԱՀԱՆՔԱՅԻՆ ՆՅՈՒԹԻ ՕԳՏԱԳՈՐԾՄԱՄԲ ԳՐՈՒՆՏԱՅԻՆ
ՊԱՏՎԱՐՆԵՐՈՒՄ ԼՎԱՑԱԿՈՐՈՒՍՆԵՐԻ ՆՈՐՈԳՄԱՆ ՆՈՐ ՏԵԽՆՈԼՈԳԻԱ
(«ԳԵՂԱՐՔՈՒՆԻՔ 2» ԶՐԱՄԲԱՐԻ ՊԱՏՎԱՐԻ ՕՐԻՆԱԿՈՎ)**

Գ.Լ. Հայրիյան

Ակադեմիկոս Ի.Վ. եղիազարովի անվան ջրային հիմնահարցերի և հիդրոտեխնիկայի ինստիտուտ

Առաջարկվում է նոր տեխնոլոգիա, որը թույլ է կտա փակել «Գեղարքունիք 2» ջրամբարի պատվարի մարմնում լվացակորուստները և կանխել ֆիլտրացիոն ելքերը: Տեխնոլոգիան հիմնված է «PMM» մոդիֆիկացված պոլիմերահանքային նյութի կիրառման վրա: «Գեղարքունիք 2» ջրամբարի պատվարի լվացակորուստներից ազատվելու համար առաջարկվում է այդ նյութը տեղադրել $7,5 \text{ կգ/մ}^2$ համամասնությամբ:

Բանալի բառեր. ջուր, գրունտ, ֆիլտրացիա, պոլիմերահանքային նյութ, ավազակավ

**НОВАЯ ТЕХНОЛОГИЯ РЕМОНТА ПРОМОИН ГРУНТОВЫХ ПЛОТИН С
ИСПОЛЬЗОВАНИЕМ ПОЛИМЕРНО-МИНЕРАЛЬНОГО МАТЕРИАЛА
(НА ПРИМЕРЕ ПЛОТИНЫ ВОДОХРАНИЛИЩА «ГЕГАРКУНИК 2»)**

Г.Л. Айриян

Институт водных проблем и гидротехники им. академика И.В.Егизарова

Предложена новая технология, которая позволит закрыть промывные потери в теле плотины Цахкашенского водохранилища и предотвратить фильтрационные расходы. Технология основана на использовании модифицированного полимеро-

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минерального материала «ПММ». Чтобы избавиться от фильтрационных потерь грунтовой плотины водохранилища «Гегаркуник 2», рекомендуется устанавливать этот материал в пропорции 7,5 кг/м².

Ключевые слова: вода, грунт, филцтрция, полимеро-минерального материал, глина.

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