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FEATURES OF OPERATION OF THE «HERMON-ELPIN» PRESSURE SYSTEM

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

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

Davit V. Madoyan
Institute of Water Problems and Hydro-Engineering
Named After I.V. Yeghiazarov,
125 Armenakyan St., 0011, Yerevan,
e-mail: davmadoyan95@gmail.com
ORCID iD: 0009-0005-0775-1821
Republic of Armenia

Hovhannes V. Tokmajyan
Institute of Water Problems and Hydro-Engineering
Named After I.V. Yeghiazarov
125 Armenakyan St., 0011, Yerevan
tokmajyan.hovhannes@gmail.com
ORCID iD: 0000-0002-2315-7233
Republic of Armenia

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A.Ya. Margaryan, V.H. Tokmajyan, G.H. Martirosyan, D.V. Madoyan, H.V. Tokmajyan
FEATURES OF OPERATION OF THE «HERMON-ELPIN» PRESSURE SYSTEM

Abstract

Gravity canals have their own operation peculiarities. A gravity main canal is usually several times longer than the cumulative length of pumping pipelines of pump stations being replaced. Two important features of gravity channels are considered: establishing a hydraulic regime and removing air from the pipeline.

Keywords: river, undissolved air, dissolved air, design flow.

Introduction

There is a undissolved air in the form of blisters as well as dissolved air. It is known that the amount of dissolved air is in direct proportion to the pressure. Hence, when water flows from the lower point of the pipeline to the upper point, then the dissolved air gradually is separated in the form of blisters and is entrained upwards by the flow thus accumulating air in the nearest upper segment of the duct. The air continuously accumulated here creates so called an air cushion, which begins to gradually decrease the live section of the fluid flow, accompanied by increase in the average velocity of that section.

To escape dangerous effects, air outlet devices of automatic action are placed in all high points of the pipeline.

After operation of the Hermon-Yelpin gravity two-line water pipeline (2007), the lands of Areni and Rind settlements fell under the service of this (Hermon-Yelpin) water pipeline, which eliminated the need to mechanically pump water through the right-hand branch of the Areni pumping station. Currently, the irrigation water supply of Khachik settlement lands is carried out by the 2nd and 3rd level pumping stations of the left side branch of the Areni pumping station. Many years of operation of high-pressure branch water pipelines built in mountainous terrain show that they do not produce their design output. The elevated land areas of Vernashen, Gladzor, Aghavnadzor, Rind and Yelpin settlements are under the service of the Hermon-Yelpin high-pressure highway complex pipeline [1, 2].

The Hermon-Elpin gravity hydraulic junction is a complex engineering structure. The receiving basin of the edge of the Hermon-Yelpin gravity aqueduct is located in the lower area of Aghavnadzor village. The high pressure water line has 2 branches: Aghavnadzor-Chiva and Aghavnadzor upper part (Fig.1).

The main water pipeline includes two pipelines 30 km long, with a diameter of 1000 mm and 1200 mm respectively, laid in one trench. The hydroelectric complex has two main water intakes located 4 km apart. The 1st intake was built on the right bank of the embankment of the head of «Elegis-7» small HPP, from which the high-pressure pipeline with a diameter of 1000 mm begins. The second head gate was built at a distance of about 100 m from the machine room of the Elegis-7 hydroelectric power station in order to turn on the flow of water from the hydroelectric power station in the water conduit.

After the first operation of the water pipelines, it was established that they did not produce the estimated productivity. This circumstance is connected with the complex relief of the mountainous area.

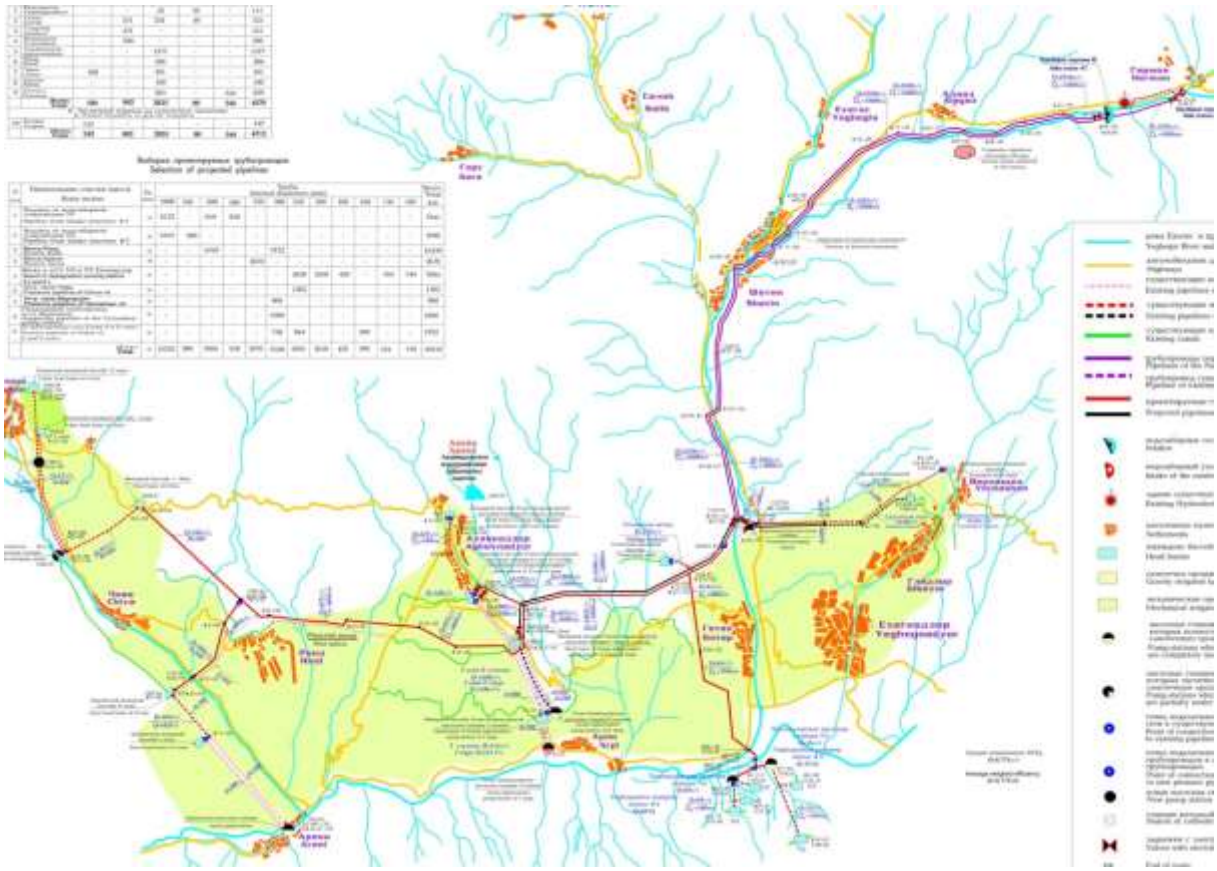

Fig. 1 Map of the Hermon-Elpin water conduit

Conflict Setting

The irrigation pressure water pipelines are periodically filled and emptied. This process should be performed by a definite sequence of actions for the transition effects underway in the pipeline not to harm the firmness of the pipeline. During filling and emptying the pipeline, it is necessary to create an opportunity for free outlet and entrance of the air.

The purpose of establishing a hydraulic regime is to ensure the necessary pressure at key points of the main pipeline and to ensure a minimum pressure at the upper points so as not to disrupt the required volume of water supply and to prevent dangerous vacuum in the upper parts of the pipeline.

Research Results

The Hermon-Elpin pressure pipeline consists of 29 siphon sections, each of which has 1 manual and 1 automatic air removal device. The latter quickly went out of order and became the cause of air accumulation in pipelines.

Increasing the velocity in the water pipeline leads to increase in air entraining capacity of water flow, as a consequence of which some volume of the air cushion is entrained by the flow thus freeing space for the air continuously coming from below. Ultimately a balance is created between the entrained and the coming air volumes. This balance is very unstable since any outside irritation can violate it. As a result of all this, the outlet becomes smaller and

along the entire pipe elastic fluctuations of the fluid column occur, which can cause decomposition of the pipeline.

Comprehensive measures for protection against water hammer of pressure pipelines are given in [3].

Three branches connected to the Hermon-Yelpin water pipeline have absolute terrain marks. These are the Aghavnadzor, Vernashensky and Yelpinsky pressure basins. To establish the calculated water flow rate, it is necessary to throttle (towards closing) the pressure steel valves installed on the main water supply (with a pressure of 50 ATM), which is accompanied by a dangerous increase in pressure with the possible occurrence of a hydraulic shock.

Laboratory studies of the Aghavnadzor section of the «Hermon-Elpin» pressure system were conducted at the I.V. Egiazarov Institute of Water Problems and Hydraulic Engineering (Fig. 2).

There is a large accumulation of air in this section, which leads to a pressure drop of tens of meters during operation of the water pipeline. Due to the lack of intermediate air removal devices, it is impossible to remove a large accumulation of air using a device installed at the top of the siphon, which significantly reduces the water consumption.

Fig. 2 Model of hydraulic studies of air accumulation area

The most dangerous section of the pipeline is the 7 km long siphon section, which runs between the upper part of the village of Shatin and the section of the water supply valve, where the excess pressure in the event of the upper branch of Aghavnadzor being triggered is 50 ATM.

Before the Aghavnadzor pressure basin, the pipeline has well-defined siphon sections with a large descending and small ascending wing.

Establishing the calculated hydraulic regime in the water pipeline is significantly complicated by the presence of small hydroelectric power plants located above the head of the hydraulic structure, which do not have spillways for idle modes. For this reason, the flow rate supplied to the main water pipeline is often less than the calculated value, resulting in air freely entering the pipeline through the inlet section over a distance of several kilometers.

Conclusion

1. The «Hermon-Elpin» high-pressure water pipeline is heavily overloaded, and the Elegis River at its source does not provide the design flow. With the launch of the first stage of the Khachik pumping station, it will be possible to relieve the high-pressure water pipeline of the Hermon-Elpin water supply system by 200...250 l/s, which will create favorable conditions for the water supply of the settlements of Vernashen, Gladzor, Getap, Arpi, Aghavnadzor, Chiva, Areni and Elpin. At the same time, reducing the speed of water movement in a high-pressure water supply system helps to mitigate hydraulic shocks that occur when throttling valves, which is one of the main guarantees of ensuring the safe operation of the water supply system.
2. It is necessary to equip the siphon units of the Hermon-Elpin water pipeline with highly efficient devices for air removal and automatic control.

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«ՀԵՐՄՈՆ-ԵԼՓԻՆ» ՃՆՇՈՒՄԱՅԻՆ ՀԱՄԱԿԱՐԳԻ ՇԱՀԱԳՈՐԾՄԱՆ ԱՌԱՆՁՆԱՀԱՏԿՈՒԹՅՈՒՆՆԵՐԸ

Ա.Յա. Մարգարյան, **Վ.Հ.Թոքմաջյան**, **Գ.Հ. Մարտիրոսյան**, **Դ.Վ. Մադոյան**, **Հ.Վ. Թոքմաջյան**
Ակադեմիկոս Ի.Վ. եղիազարովի անվան ջրային հիմնահարցերի և հիդրոտեխնիկայի ինստիտուտ

Հերմոն-Ելփին ջրատարի բարձր ճնշման ջրագիծը խիստ ծանրաբեռնված է, իսկ դրա գլխամասում էլեգիս գետը չի ապահովում հաշվային ելքը: Խաչիկի պոմպակայանի

առաջին աստիճանի վերագործարկումով հնարավորություն կստողծվի Հերմոն-Ելփին ջրատարի բարձր ճնշման ջրագիծը 200…250 լ/վ ելքով բեռնաթափել, որը նպաստավոր պայմանների երաշխիք կստեղծի Վերնաշեն, Գլաձոր, Գետափ, Արփի, Աղավնաձոր, Չիվա, Արենի ու Ելփին բնակավայրերի ջրամատակարարման համար:

Խաչիկի պոմպակայանի վերագործարկումով Հերմոն-Ելփին բարձր ճնշման ջրագծի խողովակում շարժման արագության նվազեցումը նպաստում է փականների դրոսելացումից առաջացող հիդրավլիկական հարվածների մեղմմանը, որը ջրային համակարգերի անվտանգության ապահովման հիմնական երաշխիքներից է:

Բանալի բառեր. գետ, չլուծված օդ, լուծված օդ, հաշվային ելք:

ОСОБЕННОСТИ ЭКСПЛУАТАЦИИ НАПОРНОЙ СИСТЕМЫ «ЭЕРМОН-ЕЛПИН»

А.Я. Маргарян, В.О. Токмаджян, Г.А. Мартиросян, Д.В. Мадоян, О.В. Токмаджян
Институт водных проблем и гидротехники им. академика И.В.Егиазарова

Высоконапорный водопровод «Эрмон-Ельпин» сильно перегружен, а река Элегис в его истоке не обеспечивает расчетный расход. С вводом в эксплуатацию первой очереди насосной станции «Хачик» появится возможность разгрузить высоконапорный водовод водопровода «Эрмон-Елпин» на 200...250 л/с, что создаст благоприятные условия для водоснабжения населенных пунктов Вернашен, Гладзор, Гетап, Арпи, Агавнадзор, Чива, Арени и Елпин. При этом, снижение скорости движения воды в высоконапорном водопроводе способствует смягчению гидравлических ударов, возникающих при дросселировании задвижек, что является одной из главных гарантий обеспечения безопасности эксплуатации водовода.

Ключевые слова: река, нерастворенный воздух, растворенный воздух, расчетный расход.

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