



## Microbiological Specification of The Araz River

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### Abstract

For any state or region, the availability of an optimal amount of local water is of great importance. Since the local drain is a kind of its own wealth of the state and in this regard, its use and protection does not depend on other states. Rich in many natural resources, water in Azerbaijan is a scarce resource. The main reason for this is due to the fact that Azerbaijan is located in the arid zone of the South Caucasus and here the moisture content is 2.7-3 times less than evaporation. The situation is aggravated by the fact that more than 70% of Azerbaijan's water resources are transboundary sources, mainly the Kura and Araz rivers, the basin of which is connected by the territories of 4 border states - Turkey, Armenia, Georgia and Iran.

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### INTRODUCTION

As the main tributary of the Kura river and the second largest water content in the Caucasus, the Araz starts from the Bingol mountainous areas in Turkey. In the upper reaches it shares borders with the Euphrates basin [8]. The catchment area of the Araz is 102 thousand km<sup>2</sup>, which is 54.2% of the Kura basin area and connected to the territories of Turkey, Islamic Republic of Iran, Armenia and Azerbaijan. Of the total length of 1072 km, 357 km of length is in Turkey, which is 2 times bigger than the length of the Kura in Turkey. Long-term, repeated studies have found that on the territory of Turkey and Islamic Republic of Iran, consisting of mountain ranges, the Araz almost managed to avoid human impacts, and to gipersaprobnosti polluted in the territory of Armenia [9]. It stands to mention that the whole territory of Armenia belongs to the catchment area of the Araz and all industrial and domestic waste water is spewed directly or by the local left-bank tributaries of the Araz. The second source poisoning the water in the Araz is Okhchuchay river that carries hundreds of tons of heavy metals, thousands of cubic meters of concentrated acids of metalobogatitelyh industrial facilities, Kaphan, Kajaran and mine waters concentration of which is hundreds of times higher than the maximum permissible concentration of these pollutants.

### MATERIALS AND STUDYING METHODS

Araz River is the main branch of the Kura and the second largest river of Transcaucasia. It also starts from the mountain ranges Bingol in Turkey. The length of the Araz is 1072 km and a catchment area is 102 km<sup>2</sup>. The length of the upper part of the river is more than 370 km and runs inside the foothills of Turkey. Starting from the point of junction of Araz with Western Arpacay serves as the border with Armenia, in the exit area from the city of Igdir. At a distance of 12 km area is considered to be the border with Azerbaijan (Nakhchivan Autonomous Republic). The Araz from the earliest times is the border between Turkey and Armenia, Iran, Azerbaijan and Armenia. Microbiological, hydrochemical and hydrobiological studies of the Araz outside Azerbaijan were carried out in stages at different times. Unlike the Kura our proposal for a joint study of the catchment area of the Araz in collaboration with the experts of the Academy of Sciences of Armenia in the 70s was refused. In spite of this, knowing that the whole territory of Armenia belongs to the catchment area, all major cities and towns spew disposed waters through a special collector into the river at the border zone with the Nakhchivan Autonomous Republic, in 1966, 1976, 1983, 1987 we were carrying out studies in the river itself and in the main branches within the Ararat plain.

And once the USSR collapsed within the period from 2005 to 2013 the Araz was studied 8 times on

the territory of Turkey, including the border zones with Armenia. Collection of the material and seasonal observations in duplicate were carried out on 16 stations, 5 of which have been determinate in the border zones with Armenia. Samples of water and soil were taken aseptically using bottled bathometer of Yu.I.Sorokin [11] and a GOIN small tube. The total number of microorganisms determined by the method of A.S.Razumov [5], saprophytic, coliform and physiological groups of bacteria were taken by plating on selection soils the compositions of which are provided in laboratory manuals by V.I.Romanenko, S.I.Kuznetsova [8], and A.G.Rodinoy [6]. The volume of degradation of the organic matter, as one of the reliable indicators of the degree of self-cleaning is taken into account according to G.G.Vinberga [2]. To find quantitative and qualitative composition of existing organic matter in the water, decay depth and the extent of saprobity of water in the Araz there were used the calculations of the ratio of the number of saprophytic bacteria with the total number by count up [3; 7].

## RESULTS AND DISCUSSION

The study of the concentration of biogenic elements consisting of a nitrate-nitrite and phosphate in the water of the Araz in Turkey and in the border zone of Armenia showed that in the

area of Tekman and Kerpikoy nitrogen and phosphorous mineral salts constitute, on average, 0.5 and 0.07 mg/l, respectively. At the same time, these indicators in the Araz after junction with Arpacay receiving waste waters of Gyumri increase by 6 and 13 times, respectively. Main and a large-scale pollution of the Araz takes place in the Ararat plain area, where large cities and industrial centers of Armenia, including Yerevan, Abovyan, Masis, Echmiadzin, Oktamberyana etc are situated. The Araz is being polluted by waters from the left bank branches - Hrazdan, Sevdzhyur, Pambak, Getap and others carrying huge weights of untreated industrial and domestic wastewaters of Sevan, Tsarentsavan, Arzni. If in the areas of peripheral cities main pollution caused by the production of agricultural, food, dairy industry and household waste, in cities such as Yerevan, Abovyan, Vanadzor, Tumanyan, Alaverdi and others there are concentrated chemical, metallurgy, synthetic and plastic industry, highly poisonous waste waters of which are transported by a special collector to the border zone with the Nakhchivan Autonomous Republic of Azerbaijan. It is also specific that our first studies conducted 40 years ago (1966) showed that the number of coliform bacteria in the Hrazdan water are ten times higher than sanitary standards; back then the bacteria tended to increase according to the flow and time (Table 1).

**Table 1: A number of (thousand/ml) saprophytic and coliform bacteria in the Hrazdan waters (average in summer)**

Cities	Saprophytic bacteria			Coliform bacteria		
	1966	1976	1987	1966	1976	1987
Sevan	3,6	7,6	14,8	1,2	3,1	4,1
Charentsavan	9,8	14,8	21,3	3,4	6,6	11,4
Hrazdan	16,2	21,9	39,6	5,4	8,7	13,6
Abovyan	30,0	38,4	51,3	9,3	17,4	26,3
Yerevan (bridge)	44,0	64,2	86,8	14,6	22,6	37,9
Masis	70,0	90,4	126,0	21,3	19,4	28,6
Magnifying power	19,4	12,0	8,5	18,0	6,3	7,0

Especially river Araz is being poisoned by pesticides, salts of heavy metals, oil products, phenols and other pollutants of copper-molybdenum processing plants of Kajaran, Kapan, mine waters of numerous groves of metals by runoff of the Ohchichay which has no fauna and flora till junction with the Araz [4]. Poisoning by the waters of Ohchichay of vegetation, trees and even livestock and birds in the villages-settlements was noted at the early 60s of the last century [5]. It is known that in the technology of enrichment of the molybdenum ores, copper and other heavy metals and sulfur concentrated sulphuric and hydrochloric acid is used. According S.N.Aliev [1]

only in 1974 by the runoff of the Ohchichay to the Araz came over 940 m<sup>3</sup> of acid solution. The results of M. Salmanov's study carried out in 1978 showed that following the junction of the water of the Ohchichay with the Araz water, at a distance of 25 km downstream the number of saprophytic bacteria was reduced by 60% [4]. Conducted monitoring of the character of water in the border areas of the Araz and some transboundary rivers by the Weather Service of the Ministry of Ecology and Natural Resources of Azerbaijan indicate the excess of a great number of pollutants in these rivers (Table 2).

**Table 2: Annual average maximum permissible concentration of hydrochemical ingredients in the waters of the Ohchichay in the Shayfly village on Armenia`s border**

Year	Copper <sup>1</sup>	Molybdenum	Iron	O <sub>2</sub>	pH
1987	710-810	120-140	16-17	0	2.10
1988	19-22	25-30	8-10	0	2.20
1989	25-30	200-240	30-40	0	2.20
1990	130-180	260	29	0	2.40
1991	890	1290	46	0	3.40
1992	980	2500	38	0	2.30
1993	950	2100	50	0	2.20

Note: 1. maximum permissible concentration: Copper – 0,001; molybdenum – 0,004; iron – 0,005 mg/l.

The problem of ecological safety of the water of the Araz is compounded by the entering to it of the wastewaters from the Metsamor NPP. Microbiological study of the river Araz within the territory of the Republic of Turkey was made for the first time seasonally in 2005-2006.

It should be emphasized that most of the catchment area of the river Araz in Turkey is relatively flat, has poor vegetation, especially forested area is really poor. Stoke and branches of the river are used by the local population more frequently than the upper Kura basin. On the catchment area of the Araz there are more settlements with a large number of residents. At the same time the Araz is not directly contaminated by the wastewaters of cities such as

Igdir, Sarikamis, Kars, Pasinlyar, Kagzman. It is also specific that the wastewaters undergo biological treatment by the method of irrigation and filtration for further usage in the agricultural sector. The results on the number of saprophytes, groups of coliform bacteria and the total number of microorganisms are given in the table 3, which shows that all indicators before the water of Arpacay came from the territory of Armenia match the group of mesosaprobic pond.

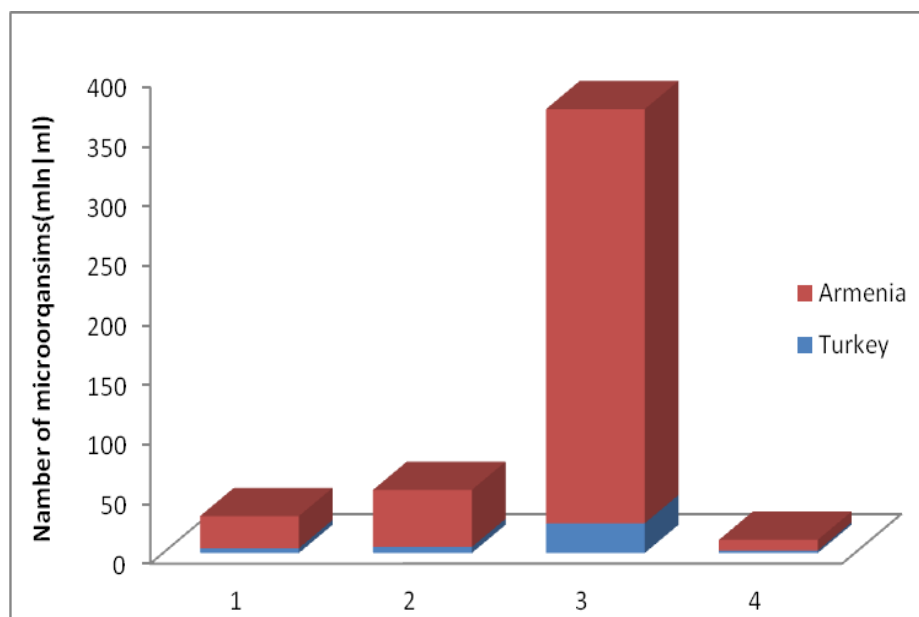
It should be noted that compared to the water of the Kura the water of the Araks in Turkey is much muddier. Despite this, the intense increase of microbiota of allochthonous and soil origin was not established. At some settlements, for example near Pasinlyar, Sarikamis, Karschay and Khorasan were noted a local water pollution. At the same time as in the top of the Kura, where the river at a distance of 15-22 km.

**Table 3: Total number of microorganisms (10<sup>6</sup>KFU/ml), number of saprophytic (10<sup>5</sup> KFU /ml) and coliform bacteria(KFU /ml) in the water of the Araz (average in summer)**

Settlements	Total number of microorganisms	Number of saprophytic bacteria	Total number of coliform bacteria
Pasinlyar	4,5	4,8	160
Kerpikoy	4,1	2,8	90
Dalidara	5,6	4,8	240
Bulanygsu	3,8	1,1	26
Karagurt	4,4	2,1	38
Sarikamis	5,6	1,1	20
Kars Chai	7,9	13,2	130
Kağızman	6,3	9,8	290
Arpaçay	9,8	24,6	360
Buzludja	12,6	36,8	680
Sadarak	19,7	46,3	800

The ecosystem of the river regains its stability in water and bottom sediments of the physiological groups of bacteria as free nitrogen fixing, cellulose-destructive, sulfate-reducing, denitrifiers are quite underdeveloped and unidentified in individual taxa. Indicators of biological consumption of oxygen are also rather small, but the increase in water samples taken below the junction of river Arpacay shall be noted. Therefore

it can be assumed that the enrichment of water within Armenia by allochthonous organic matter related to the receipt of waste water. In summer 2007, we carried out special studies on an equal number of settlements on the Araz in Armenia and Turkey, thanks to which we managed to define the total number of microorganisms, the number of saprophytic and coliform bacteria and the daily water consumption of oxygen for BOD (Fig.).



**Fig. 1. The total number of microorganisms(1), the number of saprophytic(2) and coliform(3) bacteria and biological consumption of oxygen( mg/l)(4).**

As can be seen, the total number of microorganisms in the water samples taken at five settlements of Armenia superior to those taken in Turkey by 70 times, if we are taking about saprophytic it is 114 times, and as to coliform it is 12 times, and as to oxygen consumption it is 6 times.

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