

# Impact of Municipal Wastewater of the Dilijan City on the Hydrochemical Indicators of Water of the Agstev River

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Brief Review

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**Abstract** The paper discusses that outside the city of Dilijan, the hydrochemical parameters of the Agstev River increase 1.3-2.6 times. This fact can be explained as the city wastewater of Dilijan enters the river without treatment. Discusses that the pollution of household wastewater is mainly due to the flushing of toilets, kitchen and cleaning water polluted with bacteria, viruses, washing and cleaning agents including dirt and rests of food. The amount of pollutants from the municipal wastewater of the city of Dilijan, which gets into the Agstev River per day, has been calculated. The calculation shows that the concentrations of phosphates, ammonium nitrogen, total nitrogen, BOD5 value are close to its real value. It was found that the amount of Suspended substances is less than the real values, which is caused by the pollution of the river by surface waters coming from fields outside the city of Dilijan.

**Keywords:** Municipal Wastewater, River Agstev, Dilijan, Armenia

## 1. Introduction

Water resources play a vital role in various sectors of economy, such as industrial activities, agriculture, forestry, fisheries, hydropower, and other creative activities [1-3]. Municipal wastewater is defined as wastewater from households or a mixture of wastewater from households and of industrial origin as well as precipitation water.

Households may produce wastewater from flush toilets, sinks, dishwashers, washing machines, bath tubs, and showers. Municipal wastewater mainly comprises water with relatively small concentrations of suspended and dissolved organic and inorganic solids. Organic substances include carbohydrates, lignin, fats, soaps, synthetic detergents, proteins, and their decomposition products, as well as various natural and synthetic organic chemicals from the process industries. Typical domestic wastewater can be classified as strong, medium, or weak, depending on the concentration of the major constituents. Municipal wastewater also contains a variety of inorganic substances, including heavy metals, phosphates, ammonium nitrogen, total nitrogen [4,5].

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The purpose of the work is to quantitatively show the impact of domestic wastewater in the city of Dilijan on the water quality of the Agstev River.

## 2. Study area

1. River Agstev is right tributary of the Kura. Agstev is 133 kilometres long

with a drainage basin of 2,589 square kilometres [6,7]. It rises in the territory of Armenia, on the northwest slope of Mount Tezher. The following takes place in a wider valley. The largest tributaries are Bldan, Voskepar, Getik. Two monitoring posts located on the river Aghstev: number 15–1,2 km above the city of Dilijan, number 16–0,5 km below the city of Dilijan, number 17–1,0 km above the city of Ijevan, number 18–8 km below the city of Ijevan.

2. Dilijan city is a spa town and urban municipal community in the Tavush Province of Armenia. Usually called Armenian Switzerland or Little Switzerland by the locals, it is one of the most important resorts of Armenia, situated within the Dilijan National Park[8].

### 3. Results and Discussion

Table 1 shows some hydrochemical indicators of water at hydrological posts - river Agstev [9]. As follows from Table 1, after the city of Dilijan all hydrochemical indicators of the river Aghstev increases by 1.3-2.6 times, which can be explained by the influence of untreated or insufficiently treated domestic wastewater of the city of Dilijan.

Table 1. Some hydrochemical indicators of the river Agstev

Indicators	№ 15	№16	Estimated
Mineralization, mg / L	150.8	191.9	-
Nitrate nitrogen, mg / L	1,22	1.94	-
Nitrite nitrogen, mg / L	0,0157	0,0354	-
Ammonium nitrogen, mg / L	0,2318	0.5910	0.57
Total nitrogen, mg / L	1.4675	2.5664	2.64
Phosphates, mg / L	0,176	0,337	0.32
Suspended substances, mg / L	38.0	64.9	38.5
BOD <sub>5</sub> , mg / L	2.63	2.65	2.55

The volume of domestic wastewater is almost equal to the volume of drinking water consumed in the village. The general average water consumption rate in the cities of Armenia is 200 liters per day for one person [5]. Considering that the average amount of pollutants from one resident entering the city's sewer network during the day is more or less constant [5], as well as the fact that the population of Dilijan is 17,712 people [8], the amount of pollutants entering the Aghstev River with the municipal waste water of the city of Dilijan for 1 day was calculated (Table 2).

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Table 2. Amount of pollutants entering the sewerage network of Dilijan city.

Polluting substances	The amount of pollutants per person, g	Total amount of pollutants for Dilijan city, kg / day
Total nitrogen	28	438.4
Ammonia nitrogen	8	109.6
Phosphates	2,8	43.84
Suspended substances	22	344.4
Surfactant	2,5	39.1
Petroleum products	0,2	3.1
Fats	8	125.2

For 1 day 3542 m<sup>3</sup> of untreated domestic wastewater from the Dilijan city, which contains 43.84 kg of total phosphorus, gets into the Aghstev River. Hence, the calculated value of the concentration of total phosphate in wastewater is 12.375 mg / L. Since the waters of the river Agstev (water flow at post No. 15 is 3.61 m<sup>3</sup> / s, the concentration of total phosphate is 0.176 mg / L) is mixed with waste water from Dilijan (waste water flow is 0.041 m<sup>3</sup> / s) [5], the concentration of river water changes. Below, using the example of total phosphate, this value is calculated after mixing river and waste water:

a) the total water flow is  $3.61 + 0.041 = 3.641$  m<sup>3</sup> / s.

b) concentration  $P_{tot} = (3.61 \times 0.176 + 0.041 \times 12.375) / 3.641 = 0.32$  mg / L.

Using the same equation, we calculate the amounts of total nitrogen and ammonium nitrogen that are close to the true values.

It is known from the literature that the BOD<sub>5</sub> of domestic wastewater in the city of Dilijan is 112 mg / L, and the amount of suspended solids is 90 mg / L [5]. From this data, we have calculated the amount of BOD<sub>5</sub>, suspension materials. Table 2 shows that the actual estimated values of BOD<sub>5</sub>, are quite close to each other, and the calculated data for the suspension

materials are significantly smaller than the actual data. This last fact tells about that the suspension materials penetrate into the river mainly through the rainwater of Dilijan city.

## 4. Conclusions

Thus, it is shown that the pollution of household wastewater is mainly due to the flushing of toilets, kitchen and cleaning water polluted with bacteria, viruses, washing and cleaning agents including dirt and rests of food. It was found that outside the city of Dilijan, the hydrochemical parameters of the Aghstev River increase, which can be explained by the fact that the city wastewater of Dilijan enters the river without treatment. The calculation shows that the amount of suspended solids is less than the real values, and the concentration of phosphates, ammonium nitrogen, total nitrogen, BOD<sub>5</sub> value are close to its real value. In fact, the great importance of the actual amount of suspended solids can be explained by the pollution of the river by surface streams coming from the territory of the city of Dilijan.

## Conflicts of interest

The authors declare no relevant financial or other conflict of interest or disclosures in relation to this paper.

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