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TREATMENT OF WASTEWATER IN PRILEP FROM A PUBLIC HEALTH ASPECT

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Abstract

Wastewater is any water that has changed its original physicochemical and microbiological characteristics due to its use in settlements, industry, street washing, washing of agricultural lands and from atmospheric precipitation. All municipal wastewater in Prilep is collected through a partially separated sewage network (fecal and atmospheric) and discharged into the recipient Prilep river through a common main collector. Due to wastewater pollution and potential public health risk as well as according to a feasibility study, the construction of UWWTP Prilep (Urban Wastewater Treatment Plant) (purification station for communal wastewater) was required.

In the period 2018-2022, to assess public health risk the Prilep Public Health Center took wastewater samples before treatment and after treatment for physico-chemical and microbiological analysis.

The purification process in PSKOV Prilep of municipal wastewater takes place in 3 consecutive steps: pre-treatment, primary treatment and secondary treatment of wastewater. In the period 2018-2022, 80 physicochemical and microbiological analyses of municipal wastewater were performed at the Public Health Center-Prilep.

The findings have indicated that after treatment, municipal wastewater meets the criteria of the Rulebook on the conditions, method and emission limit values for wastewater discharge after its treatment, the method of their calculation, taking into account the special requirements for the protection zones (Official Gazette of the Republic of North Macedonia no. 81/2011).

Keywords: municipal wastewater, municipal wastewater treatment plant, purification, physicochemical and microbiological analysis, public health

Introduction

It is easy to take water for granted. Clean water comes out of a tap, we use it and then as "dirty" water disappears down the drain. In this way, the water that leaves our homes, schools and workplaces is contaminated. In most European countries, such wastewater is collected, transported and then treated in an urban wastewater treatment plant, to remove components harmful to the environment and human health, before the water is returned to nature (EEA, 2018). The importance of access to clean water and sanitation is embedded in

Goal 6 of the United Nations' Sustainable Development Goals (UN, n.d). Supplying clean water and collecting waste water has required huge investment across Europe in recent decades[1].

Wastewater or so-called liquid waste is any water which original physicochemical and microbiological characteristics have changed due to use in settlements, industry, road washing and the use of agricultural land and rainwater[2].

There are three types of wastewater, or sewage: domestic sewage, industrial sewage, and storm sewage. Domestic sewage carries used water from houses and apartments; it is also called sanitary sewage. Industrial sewage is used water from manufacturing or chemical processes. Storm sewage, or storm water originates from precipitation that is collected in a system of pipes or open channels[3].

In Prilep, there is a Central Disposition of Wastewater - Sewerage, which is a partially separated sewerage network. These are two parallel networks, one collects storm water and street washing water, and the other wastewater from households, public facilities and industry. The capacity of the sewage system depends on:

- The number of inhabitants in the settlement and the expected increase in the next 20-30 years,
- The maximum amounts of atmospheric inputs over the last 50 years,
- The amount of industrial wastewater and the possibility of its increase in the next 20-30 years,
- Existence of facilities that are major consumers of water (hospitals, public laundries, swimming pools, etc.)[2].

More than 80% of the world's wastewater flows back into the environment without being treated or reused[4].

To protect the water receiver used for irrigation, drinking, recreation, in industry and land (groundwater) from pollution, its purification is necessary, especially if the ratio between the amount of wastewater and the receiver is unfavorable, below 1:30.

Industrial wastewater that contains harmful, toxic and radioactive substances, then organic pollution and substances that will harm the self-purification process of the recipient, needs to be purified before being discharged into the city sewer[2].

Prilep has the most modern and one of the largest sewage treatment plants in the Balkans, the construction of which required almost four years of intensive construction work. The implementation period began on June 23, 2014, and construction ended and was officially put into use on May 31, 2018. The capacity of the treatment plant is 95.000 equivalent inhabitants and it covers an area of 7 hectares[5].

The technological process in UWWTP-Prilep is divided into several segments, interconnected and dependent on each other:

- Pre-treatment, which physically removes large objects like rags and plastics, and smaller objects like grit from the wastewater. This prevents damage to the equipment further along the treatment process.
- Primary treatment, which removes fine particles. Wastewater is held in a tank where heavier solids can settle to the bottom, while any lighter solids and fat float to the surface. The settled and floating materials are separated, while the remaining liquid proceeds to secondary treatment or is discharged to the environment.
- Secondary treatment, also known as biological treatment, removes the remaining organic matter, suspended solids and some of the bacteria, viruses and parasites, and to some extent nutrients and chemical substances.

More stringent treatment is applied to remove the remaining nutrients when discharging into sensitive waters. Specific treatment techniques, such as disinfection, can be

used to further remove bacteria, viruses and parasites harmful to public health, or any remaining chemicals and harmful substances[1,6].

Material and methods

In the UWWTP laboratory, tests are continuously carried out on the wastewater that enters the treatment plant (they take samples and monitor the parameters that affect the technological process) and test the water that, after treatment, is released into the city river as purified.

- input parameters: t°, pH, TSS (total suspended solids), TDS (total dissolved solids), COD (chemical oxygen demand), BOD (biological oxygen demand)
- output parameters: t°, pH, TSS, TDS, COD, BOD

According to the Annual National Program for public health in the Republic of North Macedonia in the period 2018-2022, 80 physicochemical and microbiological analyses of municipal wastewater were performed in the Public Health Center - Prilep[7].

Results

Physicochemical and microbiological analyses were performed in the laboratory in the period from 2018-2022. The following vapors were measured at the inlet and outlet: temperature, pH acidity, total suspended solids, total dissolved solids, chemical oxygen consumption, biological oxygen consumption, total nitrogen, ammonia, phosphorus, nitrates, nitrites, nickel, zinc, copper, iron, chromium for chemical analysis and for microbiological analysis, thermotolerant coliform bacteria, coliform bacteria originating from feces and *Escherichia coli* were examined. The results obtained are given in tables.

Table 1 shows temperature results in the period 2018-2022 for each month. According to the Rulebook on the conditions, method and limit values of emission for wastewater discharge after its purification, the method of their calculation, taking into account the special requirements for the protection zones (Official Gazette of the Republic of North Macedonia No. 81/2011) the limit value of temperature for discharges to surface water was 30°C. There were no deviations from the limit value.

Table 1. Temperature limit value for discharges into surface water was 30°C

Year	2018		2019		2020		2021		2022	
Month	Influent average	Effluent average	Influent average	Effluent average	Influent average	Effluent average	Influent average	Effluent average	Influent average	Effluent average
January	/	/	9.3	8.9	10.3	10.8	10.6	11.0	9.7	11.0
February	/	/	10.2	10.8	10.7	11.8	10.7	11.5	10.3	11.5
Mart	/	/	11.9	12.9	11.4	12.2	10.8	11.8	10.5	11.8
April	/	/	13.6	14.5	12.9	13.5	13.2	14.0	13.1	14.0
May	/	/	15.2	16.7	16.0	17.0	16.3	17.4	16.6	17.4
June	/	/	18.4	20.2	17.6	18.9	18.3	19.7	19.5	19.7
July	/	/	19.5	21.2	20.1	21.3	20.6	22.0	20.6	22.0
August	19.4	20.7	20.6	21.9	19.7	21.1	21.1	22.3	20.8	22.3
September	18.7	19.3	20.3	20.9	19.2	20.3	18.6	19.9	19.0	19.9
October	17.1	17.2	17.9	18.7	16.7	17.7	15.1	16.1	16.2	16.1
November	14.2	14.7	16.3	16.8	14.4	15.4	14.0	14.6	15.3	14.6
December	11.7	11.6	12.6	13.6	12.4	13.2	11.6	11.5	/	/
Average	16.2	16.7	15.5	16.4	15.1	16.1	15.1	16.0	15.6	16.4

Table 2 presents the results of pH in the period 2018-2022 for each month. According to the Rulebook on the conditions, method and limit values of emission for wastewater discharge after its purification, the method of their calculation, taking into account the special requirements for the protection zones (Official Gazette of the Republic of North Macedonia

No. 81/2011) the limit value of pH for discharges into surface waters is 6.5-9.0. There were no deviations from the limit value.

Table 2. pH limit value for discharges into surface waters was 6.5-9.0

Year	2018		2019		2020		2021		2022	
Month	Influent average	Effluent average	Influent average	Effluent average	Influent average	Effluent average	Influent average	Effluent average	Influent average	Effluent average
January	/	/	8.23	7.42	8.27	7.19	7.92	7.02	8.80	7.20
February	/	/	8.30	7.23	8.02	6.95	7.15	6.82	8.53	7.29
Mart	/	/	8.30	7.23	8.21	7.18	8.01	7.16	8.27	7.30
April	/	/	8.26	7.39	8.28	7.35	8.35	7.13	8.39	7.24
May	/	/	8.38	7.54	8.49	7.47	8.28	7.04	8.47	7.19
June	/	/	8.33	7.54	8.36	7.27	8.30	7.08	8.14	7.21
July	8.44	/	8.34	7.57	7.82	7.09	7.99	7.04	8.10	7.15
August	8.63	7.38	8.62	7.89	7.84	6.81	7.88	6.95	8.19	7.14
September	8.50	7.53	8.49	7.88	7.64	6.70	7.75	6.84	8.17	7.19
October	8.46	7.38	8.09	7.66	7.96	7.14	7.66	6.77	8.12	7.24
November	8.23	7.21	8.03	7.24	8.18	7.50	8.13	7.01	8.09	7.11
December	8.25	7.24	7.93	7.19	8.32	7.56	8.29	7.27	/	/
Average	8.42	7.35	8.28	7.48	8.12	7.18	7.98	7.01	8.30	7.21

Table 3 shows the results of total suspended substances in the period 2018-2022 for each month. According to the Rulebook on the conditions, method and limit values of emission for wastewater discharge after its purification, the method of their calculation, taking into account the special requirements for the protection zones (Official Gazette of the Republic of North Macedonia No. 81/2011) the limit value of total suspended substances for discharges into surface waters was 35 mg/l. It can be seen that the monthly averages were above the limit value in some months of 2020, 2021 and 2022, but the annual averages were within normal limits. Wastewater Treatment Plant had a very high percentage of removal of TSS (total suspended substances) during the investigated period (range from 84-95%).

Table 4 shows the results of total dissolved substances in the period 2018-2022 for each month. According to the Rulebook on the conditions, method and limit values of emission for wastewater discharge after its purification, the method of their calculation, taking into account the special requirements for the protection zones (Official Gazette of the Republic of North Macedonia No. 81/2011) the limit value for total solutes was not set.

Table 5 shows the results of chemical consumption of oxygen in the period 2018-2022 for each month. According to the Rulebook on the conditions, method and limit values of emission for wastewater discharge after its purification, the method of their calculation, taking into account the special requirements for the protection zones (Official Gazette of Republic of North Macedonia No. 81/2011) the limit value for chemical consumption of oxygen for discharges into surface waters was 125 mg/l. Table 5 shows that, except in August 2019, there was no deviation from the limit value.

Table 6 shows the results of biological oxygen consumption in the period 2018-2022 for each month. According to the Rulebook on the conditions, method and limit values of emission for wastewater discharge after its purification, the method of their calculation, taking into account the special requirements for the protection zones (Official Gazette of Republic of North Macedonia No. 81/2011) the limit value for biological consumption of oxygen for discharges into surface water was 25 mg/l. The first three years of operation of UWWTP, the values of BOD were above the limit value, but in the following two years, those values were normalized, except for some months.

Table 3. Total suspended substances (TSS) limit value for discharges into surface waters is 35 mg/l

Year	2018			2019			2020			2021			2022		
Month	**Influent average**	**Effluent average**	**Average % of removal**	**Influent average**	**Effluent average**	**Average % of removal**	**Influent average**	**Effluent average**	**Average % of removal**	**Influent average**	**Effluent average**	**Average % of removal**	**Influent average**	**Effluent average**	**Average % of removal**
January	/	/	/	146.54	10.81	93	215.0	6.5	97	297.9	51.2	83	179.1	5.2	97
February	/	/	/	190.36	15.75	92	249.0	5.4	98	278.8	7.31	97	149.6	5.7	96
Mart	/	/	/	223.9	14.85	93.5	339.0	12.0	96	142.6	7.84	95	500.2	36.0	93
April	/	/	/	275.4	22.5	91.83	260.0	8.2	97	233.7	8.23	96	198.8	7.4	96
May	/	/	/	202	8.5	95.44	337.2	8.1	98	165.5	47.7	71	292.3	5.2	98
June	/	/	/	195	4.8	97.11	373.3	10.7	97	141.5	13.38	91	170.9	5.8	97
July	/	/	/	235	9.8	95.82	484.1	15.9	97	128.6	6.57	95	307.2	6.9	98
August	154.05	16.04	89	413	23	94.43	364.0	7.0	98	119.0	7.48	94	310.2	8.8	97
September	139.73	5.92	95	343	14	91.05	382.0	16.9	96	163.0	37.8	77	585.7	6.6	99
October	173.75	9.8	93	244	5	97.56	477.9	49.8	90	164.4	136.0	17	381.4	23.1	94
November	169.22	11.9	93	192	5.4	96.81	361.9	61.3	83	264.0	7.40	97	206.0	52.2	75
December	168.31	5.94	96	193	7	96.04	306.5	12.9	96	131.5	6.80	95	/	/	/
Average	161.01	9.92	93.2	237.77	11.78	94.54	345.8	17.9	95	185.9	26.04	84	298.3	14.8	95

Table 4. Total dissolved solids (TDS) limit value for discharges to surface water is 500 in mg/l

Year	2018			2019			2020			2021			2022		
Month	**Influent average**	**Effluent average**	**Average % of removal**	**Influent average**	**Effluent average**	**Average % of removal**	**Influent average**	**Effluent average**	**Average % of removal**	**Influent average**	**Effluent average**	**Average % of removal**	**Influent average**	**Effluent average**	**Average % of removal**
January	/	/	/	364	299	18	364	299.0	18	318.4	249.2	22	405.0	297.9	26
February	/	/	/	361	310	14	361	310.0	14	360.4	298.5	17	399.3	313.4	22
Mart	/	/	/	660	302	54	660	302.0	54	381.1	312.8	18	405.0	335.0	17
April	/	/	/	333	301	10	333	301.0	10	389.9	327.0	16	398.1	320.8	19
May	/	/	/	362	381	-5	389.2	331.3	15	431.8	307.3	29	420.9	317.3	25
June	/	/	/	357	351	2	431.9	348.0	19	392.9	297.7	24	403.5	309.5	23
July	/	/	/	396	326	18	374.7	360.8	4	372.1	321.4	14	419.8	299.7	29
August	438	341	22	400	381	5	360.8	312.0	14	359.9	306.5	15	407.0	290.6	29
September	379	396	-4	438	388	11	397.8	340.7	14	361.0	292.2	19	493.5	305.9	38
October	379	388	-2	507	460	9	409.5	326.9	20	326.7	281.8	14	445.8	310.4	30
November	368	349	5	428	390	9	462.2	402.3	13	406.6	308.3	24	429.8	317.4	26
December	356	349	2	374	312	17	434.9	375.2	14	362.5	287.3	21	/	/	/
Average	384	364.6	4	415	350	13	414.9	334.1	17	372.0	299.2	19	420.7	310.7	26

Table 5. Chemical oxygen demand (COD) limit value for discharges into surface waters was 125 mg/l

Year	2018			2019			2020			2021			2022		
Month	**Influent average**	**Effluent average**	**Average % of removal**	**Influent average**	**Effluent average**	**Average % of removal**	**Influent average**	**Effluent average**	**Average % of removal**	**Influent average**	**Effluent average**	**Average % of removal**	**Influent average**	**Effluent average**	**Average % of removal**
January	/	/	/	395.0	40.5	89.7	545.5	83.9	85	/	/	/	430.0	12.6	97
February	/	/	/	456.7	40.0	91.2	569.4	45.4	92	322.50	32.80	90	385.7	23.3	94
Mart	/	/	/	510.5	31.1	93.9	209.4	3.0	99	321.40	47.74	85	612.3	103.6	83
April	/	/	/	461.8	51.5	88.9	306.7	2.0	99	324.83	62.37	81	792.4	42.1	95
May	/	/	/	450.2	63.2	86.0	/	/	/	394.86	88.64	78	617.8	21.1	97
June	/	/	/	482.3	74.3	84.6	/	/	/	436.00	63.23	85	530.7	23.9	95
July	417.8	4.55	98.90	508.1	104.2	79.5	/	/	/	528.63	39.95	92	473.6	12.2	97
August	402.8	42.01	89.57	604.0	172.4	71.5	/	/	/	535.43	54.64	90	349.2	85.5	76
September	727.66	59.83	91.77	/	/	/	/	/	/	383.00	29.67	92	402.5	24.8	94
October	570.22	82.28	85.57	522.8	92.6	82.3	/	/	/	317.00	20.10	94	453.8	50.4	89
November	441.66	102.4	76.80	473.3	61.6	87.0	/	/	/	/	29.10	/	403.0	27.6	93
December	385	77.15	79.96	442.3	57.9	86.9	/	/	/	/	23.50	/	/	/	/
Average	490.85	61.4	87.09	482.5	71.8	85.6	407.8	33.6	94	446.8	44.7	89	495.5	38.8	92

Table 6. Biochemical oxygen demand (BOD) limit value for discharges into surface water was 25 mg/l

Year	2018			2019			2020			2021			2022		
Month	**Influent average**	**Effluent average**	**Average % of removal**	**Influent average**	**Effluent average**	**Average % of removal**	**Influent average**	**Effluent average**	**Average % of removal**	**Influent average**	**Effluent average**	**Average % of removal**	**Influent average**	**Effluent average**	**Average % of removal**
January	/	/	/	170.0	37.9	77.7	287.6	65.4	77	254.5	65.4	74	194.4	15.6	92
February	/	/	/	215.5	26.0	88.0	260.1	35.0	87	209.4	11.4	95	175.1	16.4	91
Mart	/	/	/	260.3	32.9	87.8	250.4	27.2	89	206.5	30.4	85	217.7	32.0	85
April	/	/	/	218.6	43.2	78.2	251.9	18.3	93	224.4	36.0	84	294.5	24.6	92
May	/	/	/	206.5	52.4	87.9	253.4	21.4	92	205.3	41.5	80	452.0	19.9	96
June	/	/	/	230.4	56.9	75.3	254.3	17.6	93	295.3	20.5	93	281.7	22.8	92
July	233	/	/	260.6	93.3	64.2	257.9	31.1	88	269.7	18.8	93	259.6	14.6	94
August	266	38.5	85.52	309.5	143.3	53.7	250.6	21.4	91	332.8	33.6	90	176.1	71.2	60
September	232.4	57.92	75.1	/	/	/	251.2	9.7	96	223.4	22.6	90	206.3	21.0	90
October	300.22	68.45	77.2	275.8	73.3	73.4	260.6	34.1	87	170.2	12.9	92	255.1	44.1	83
November	262.66	75.16	71.38	252.6	50.3	80.1	256.4	35.0	86	214.6	22.7	89	236.4	23.8	90
December	197.33	64.16	67.48	226.8	48.1	78.7	256.7	14.0	95	168.8	11.2	93	/	/	/
Average	248.6	60.83	75.33	238.8	59.8	76.8	257.6	27.5	89	231.2	27.3	88	249.9	27.8	88

Table 7 shows the results of total nitrogen in the period 2018-2022 for each month. According to the Rulebook on the conditions, method and limit values of emission for wastewater discharge after its purification, the method of their calculation, taking into account the special requirements for the protection zones (Official Gazette of Republic of North Macedonia No. 81/2011) the limit value for total N for discharges to surface water was 10 mg/l. Table 7 shows that the limit value of total nitrogen exceeded in the winter months.

Table 8 shows ammonia results in the period 2018-2022 for each month. According to the Rulebook on the conditions, method and limit values of emission for wastewater discharge after its purification, the method of their calculation, taking into account the special requirements for the protection zones (Official Gazette of Republic of North Macedonia No. 81/2011) the limit value for NH_4 for discharges into surface water was 10 mg/l. Table 8 shows that, except for the first months of 2019, ammonia values were within the limit value.

Table 9 shows phosphorus results in the period from 2018-2022 for each month. According to the Rulebook on the conditions, method and limit values of emission for wastewater discharge after its purification, the method of their calculation, taking into account the special requirements for the protection zones (Official Gazette of Republic of North Macedonia No. 81/2011) the limit value for P for discharges into surface waters was 2 mg/l. Table 9 shows that in 2021 there were deviations from the limit value.

Table 10 shows the results of nitrates, nitrites, nickel and zinc in 2021 for each month. According to the Rulebook on the conditions, method and limit values of emission for wastewater discharge after its purification, the method of their calculation, taking into account the special requirements for the protection zones (Official Gazette of Republic of North Macedonia No. 81/2011) the limit value for discharges to surface water: NO_3 was 2 mg/l, NO_2 was 1 mg/l, Ni was 0.5 mg/l, Zn was 2 mg/l. The results for nitrates, nitrites, nickel and zinc were within the limit value.

Table 11 shows the results of copper, iron, lead and chromium in 2021 for each month. According to the Rulebook on the conditions, method and limit values of emission for wastewater discharge after its purification, the method of their calculation, taking into account the special requirements for the protection zones (Official Gazette of Republic of North Macedonia No. 81/2011) the limit value for discharges into surface waters: Cu was 0.5 mg/l, Fe was 2 mg/l, Pb was 0.5 mg/l, Cr was 0.1 mg/l. The results for copper, iron, lead and chromium were within the limit value.

Table 7. Total N limit value for discharges to surface water was 10 mg/l

Year	2018			2019			2021			2022		
Month	**Influent average**	**Effluent average**	**Average % of removal**	**Influent average**	**Effluent average**	**Average % of removal**	**Influent average**	**Effluent average**	**Average % of removal**	**Influent average**	**Effluent average**	**Average % of removal**
January	/	/	/	54.7	21.4	60.9	/	/	/	64.38	17.2	73
February	/	/	/	45.1	20.4	54.7	/	2.1	/	34.98	7.31	79
Mart	/	/	/	48.2	18.9	60.8	42.3	8.4	80	34.10	13.2	61
April	/	/	/	50.2	22.0	56.2	39.7	16.1	59	52.07	9.89	81
May	/	/	/	/	/	/	47.7	15.4	68	35.40	7.62	78
June	/	/	/	/	/	/	41.6	8.4	80	39.60	6.185	84
July	/	/	/	/	/	/	33.2	7.2	78	54.00	21.7	60
August	/	/	/	/	/	/	32.5	7.6	77	33.65	14	58
September	/	17.1	/	/	/	/	37.5	7.3	81	/	/	/
October	/	/	/	/	10.1	/	29.6	11.4	61	/	/	/
November	45.9	20.6	54.46	/	7.06	/	38.5	10.2	74	43.60	23.3	47
December	57	18.15	68.15	/	/	/	29.5	9.0	69	/	/	/
Average	51.45	18.62	61.3	49.54	16.65	58.1	37.2	9.4	75	43.5	13.4	69

Table 8. NH_4 limit value for releases in surface water was 10 mg/l

Year	2018			2019			2020			2021			2022		
Month	**Influent average**	**Effluent average**	**Average % of removal**	**Influent average**	**Effluent average**	**Average % of removal**	**Influent average**	**Effluent average**	**Average % of removal**	**Influent average**	**Effluent average**	**Average % of removal**	**Influent average**	**Effluent average**	**Average % of removal**
January	/	/	/	25.5	19.2	24.7	/	/	/	/	/	/	21.45	1.04	95
February	/	/	/	/	20.7	/	/	0.245	/	/	1.90	/	16.67	1.44	91
Mart	/	/	/	24	22	8.3	/	0.71	/	22.74	2.01	91	19.60	6.47	67
April	/	/	/	/	22.1	/	/	/	/	18.15	0.89	95	14.80	1.90	87
May	/	/	/	/	27	/	/	/	/	23.83	2.65	89	5.51	5.16	6
June	/	/	/	29.9	0.94	96.85	/	/	/	21.88	0.56	97	16.05	0.04	100
July	/	/	/	17.7	1.1	93.78	/	/	/	18.45	1.05	94	21.80	5.40	75
August	44.6	8.9	80	38.5	/	/	/	/	/	17.60	0.58	97	26.03	11.79	55
September	53.8	3.06	94.31	/	/	/	/	/	/	18.60	1.05	94	/	/	/
October	31.9	5.35	83.22	/	/	/	/	/	/	17.17	0.48	97	25.15	2.95	88
November	32.12	23.3	27.45	/	2.71	/	/	/	/	18.52	1.82	90	17.80	3.14	82
December	23.65	16.5	30.23	/	/	/	/	/	/	12.98	0.50	96	/	/	/

Table 9. P limit value for discharges in surface water was 2 mg/l

Year	2018			2019			2021			2022		
Month	Influent average	Effluent average	Average % of removal	Influent average	Effluent average	Average % of removal	Influent average	Effluent average	Average % of removal	Influent average	Effluent average	Average % of removal
January	/	/	/	5.097	1.28	75	/	/	/	4.39	0.61	86
February	/	/	/	5.54	1.95	65	/	/	/	4.82	1.55	68
Mart	/	/	/	5.092	1.48	71	5.29	3.24	39	6.16	3.17	49
April	/	/	/	/	/	/	5.06	4.28	15	4.60	0.83	82
May	/	/	/	/	/	/	5.56	2.32	58	4.49	1.11	75
June	/	/	/	/	/	/	4.17	1.56	63	3.73	1.03	72
July	/	/	/	/	/	/	4.61	2.06	55	3.77	1.70	55
August	/	/	/	/	/	/	4.81	1.89	61	4.24	0.99	77
September	/	0.493	/	/	/	/	7.13	5.34	25	/	/	/
October	6.34	0.351	94	/	/	/	10.12	2.48	75	5.49	2.46	55
November	5.65	1.59	72	/	/	/	11.73	1.01	91	3.02	0.82	73
December	9.07	1.65	82	/	/	/	2.65	0.50	81	/	/	/
Average	**7.02**	**1.021**	**85**	**5.243**	**1.57**	**70**	**6.11**	**2.47**	**60**	**4.47**	**1.43**	**68**

Table 10. Limit value for releases in surface water for **NO_3** was 2 mg/l, **NO_2** was 1mg/l, **Ni** was 0.5 mg/l, **Zn** was 2 mg/l

Year	2021							
Parameter	*NO_3-N mg/L*		*NO_2-N mg/L*		*Ni mg/L*		*Zn mg/L*	
Month	Influent average	Effluent average	Influent average	Effluent average	Influent average	Effluent average	Influent average	Effluent average
January	/	/	/	/	/	/	/	/
February	2.45	0.45	/	0.04	/	/	/	/
Mart	7.61	0.58	0.26	0.13	/	/	/	/
April	3.71	0.66	0.38	0.19	0.10	0.07	0.12	0.05
May	4.50	0.86	0.19	0.48	0.13	0.09	0.04	0.04
June	2.49	1.77	0.57	0/09	0.15	0.14	0.06	0.01
July	0.94	0.76	0.78	0.14	0.50	0.13	0.15	0.02
August	0.57	1.65	0.10	0.01	/	/	/	/
September	0.32	1.38	0.09	0.07	/	/	/	/
October	8.21	3.78	0.43	0.25	0.15	0.13	0.04	0.08
November	6.90	4.46	0.32	0.24	0.18	0.15	0.12	0.10
December	4.20	6.06	0.27	0.24	0.41	0.21	0.13	0.04
Average	3.81	2.04	0.34	0.17	0.23	0.13	0.09	0.05

Table 11. Limit value for releases in surface water: **Cu** was 0.5 mg/l, **Fe** was 2 mg/l, **Pb** was 0.5mg/l, **Cr** was 0.1 mg/l

Year	**2021**							
Parameter	***Cu mg/L***		***Fe mg/L***		***Pb mg/L***		***Cr mg/L***	
Month	**Influent average**	**Effluent average**	**Influent average**	**Effluent average**	**Influent average**	**Effluent average**	**Influent average**	**Effluent average**
January	/	/	/	/	/	/	/	/
February	/	/	/	/	/	/	/	/
Mart	/	/	/	/	/	/	/	/
April	/	/	0.48	0.27	0.26	0.22	0.05	0.02
May	0.26	0.12	0.90	0.30	0.11	0.08	0.05	0.02
June	0.21	0.07	0.56	0.34	0.17	0.18	/	/
July	0.70	0.07	/	/	0.09	0.08	0.03	0.02
August	/	/	/	/	/	/	/	/
September	/	/	/	/	/	/	/	/
October	0.18	0.21	0.55	0.33	0.48	0.24	0.02	0.01
November	0.17	0.13	0.51	0.15	0.31	0.24	0.08	0.03
December	0.58	0.18	0.94	0.31	0.39	0.35	0.03	0.03
Average	0.35	0.13	0.66	0.28	0.26	0.20	0.04	0.02

Table 12 shows the results of thermotolerant coliform bacteria, fecal-derived coliform bacteria and fecal-derived streptococci. According to the Rulebook on the conditions, method and limit values of emission for wastewater discharge after its purification, the method of their calculation, taking into account the special requirements for the protection zones (Official Gazette of Republic of North Macedonia No. 81/2011) the limit value for discharges into surface water of coliform bacteria was 10000 in 100 ml, coliform bacteria originating from feces was 2000 in 100 ml, streptococci originating from feces was 400 in 100 ml.

Table 12. The limit value for releases in surface water for coliform bacteria was 10,000 in 100 ml, coliform bacteria originating from feces was 2000 in 100 ml, streptococci originating from feces was 400 in 100 ml

	Influent	**Effluent**
Thermotolerant coliform bacteria in 100 ml	2400	960
Coliform bacteria originating from feces in 100 ml	2400	960
Escherichia coli in 100 ml	2400	960

Discussion

Improved wastewater management can generate social, environmental and economic benefits essential for sustainable development and is essential to achieving the 2030 Agenda for Sustainable Development.

Wastewater is an undervalued and sustainable source of water, energy, nutrients and other recoverable by-products, rather than something to be disposed of or a nuisance to be ignored.

Wastewater is poised to play a critical role in the context of a circular economy, whereby economic development is balanced with the protection of natural resources and environmental sustainability, and where a cleaner and more sustainable economy has a positive effect on the water quality[8].

The goal for sustainable development (SDG) until 2030 under target 6.3 is "improvement of water quality through reduction of pollution, elimination of waste and minimization of the release of hazardous chemicals and materials, halving of the proportion of untreated wastewater and significant increase to recycling and safe reuse globally"[9].

Insufficient treatment of wastewater and faecal sludge spreads disease and is a driver of antimicrobial resistance. Demand for wastewater as a reliable source water and nutrients for agriculture is growing in response to population growth, urbanization, increasing water scarcity and the effects of climate change. WHO produces global guidelines and tools to

improve treatment and manage health risks at all steps of the chain where wastewater is used. WHO also leads global monitoring of wastewater treatment and safe use as co-custodian of SDG 6.3.1[10-12].

Conclusion

In 2020, 45% of the household wastewater generated globally was discharged without safe treatment.

At least 10% of the world's population is thought to consume food irrigated by wastewater.

Poor sanitation is linked to transmission of diarrheal diseases such as cholera and dysentery, as well as typhoid, intestinal worm infections and polio. It exacerbates stunting and contributes to the spread of antimicrobial resistance.

Treated urban wastewater from Prilep sewerage during the period 2018-2022 was mainly bellow the limit values according to the Rulebook on the conditions, method and limit values of emission for wastewater discharge after its purification, according to the the method of their calculation, taking into account the special requirements for the protection zones. Because of that they have drastically reduced the public health impact by potential release of the abovementioned pollutants that could enter the food-chain and have adverse health effects.

Conflicts of interest declared by authors: None

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