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Evaluation of physico-chemical parameters of the risk of pollution of the Jiu River in Gorj and Dolj Counties

Evaluarea unor parametri fizico-chimici ai riscului de poluare a râului Jiu în Județele Gorj si Dolj

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Keywords: pollution, water, soil, Jiu River, physico-chemical parameters;

Abstract

Water and soil were considered for a long time to be renewable resources, but currently, the opposite is demonstrated and water and soil pollution represent an important factor in causing ecological imbalances that can have serious consequences for the biosphere. The main pollution generating process has become industrialization and technologicalization. The objective of this study was to investigate through a field study the physico-chemical parameters of the Jiu river from 15 specific locations, determining the values of pH, hardness, and dissolved oxygen, for two years (2016/2017). The water samples were collected in special containers and stored in the refrigerator at 4 °C until the determinations were made. To determine the physico-chemical parameters, the portable spectrophotometer model DR 1900 (Hach, Romania) was used and the following physico-chemical determinations were performed: pH; hardness; conductivity; dissolved oxygen. For the water samples collected from the Jiu river on the territory of Gorj county, pH values were obtained between 7.0 - 9.2 in 2016 and between 7.4-8.5 in 2017. The water samples collected from the territory of Dolj county were obtained pH values between 6.0 - 9.2 / 2016 and between 7.0 - 9.0 / 2017. The pH value was higher in January and July in 2016 compared to the values obtained in the same months of 2017. The oxygen concentration in the water samples taken from the Jiu river, both in Gorj and Dolj county was increased in both 2016 and 2017, classifying the Jiu River in ecological class 1 (very good), according to Order 161/2006. The values of the amount of O_2 (mg / L) were higher in 2016, both in January and July, compared to the same period of 2017. The value of O_2 concentration was lower in the samples taken downstream compared to the samples taken upstream.

Rezumat

Apa și solul au fost considerate mult timp resurse regenerabile, dar în prezent se dovedește tot mai mult contrariul, deoarece poluarea apei și a solului reprezintă un factor important în provocarea dezechilibrelor ecologice care poate avea consecinţe grave asupra biosferei. Principalul proces generator de poluare a devenit industrializarea şi tehnologizarea. Obiectivul acestui studiu a fost investigarea printr-un studiu de teren a parametrilor fizico-chimici ale apei Jiului din 15 locații punctuale, cu determinarea valorilor pH-ului, durității și oxigenului dizolvat, pe o perioadă de doi ani (2016 / 2017). Probele de apă s-au recoltat în recipiente speciale și au fost depozitate în frigider la temperatura de 4 °C până la momentul realizării determinărilor. Pentru determinarea parametrilor fizico-chimici a fost folosit spectrofotometrul portabil model DR 1900 (Hach, România) și s-au efectuat următoarele determinări fizico-chimice: pH; duritate; conductivitate; oxigen dizolvat. Pentru probele de apă recoltate din apa Jiului pe teritoriul județului Gorj au fost obținute valori ale pH-ului cuprinse între 7,0 și 9,2 în anul 2016 și între 7,4-8,5 în anul 2017. Pentru probele de apă recoltate pe teritoriul județului Dolj au fost obținute valori ale pH-ului cuprinse între 6,0 și 9,2 / 2016 și între 7,0 - 9,0 / 2017. Valorea pH-ului a fost mai ridicată în lunile ianuarie și iulie in 2016 comparativ valorile obținute în aceleași luni ale anului 2017. Concentrația oxigenului din probele de apă prelevate din apa Jiului, atât de pe raza județului Gorj cât și Dolj a fost crescută atât în anul 2016 cât și 2017, încadrând conform Ordinului 161 / 2006, râul Jiu în starea ecologică 1 (foarte bună). Valorile cantității de O2 (mg/L) au fost mai crescute în anul 2016, atât în luna ianuarie cât și iulie, comparativ cu aceeași perioadă a anului 2017. Valoarea concentrației de O2 a fost mai scăzută la probele prelevate în aval comparativ cu probele prelevate în amonte.

1. Introduction

Water and soil were considered for a long time to be renewable resources, but currently, the opposite is demonstrated and water and soil pollution represent an important factor in causing environmental imbalances that can have serious consequences for the biosphere.

The two essential components that led to the intensification of the use of natural resources were and remain the growth of the population, on the one hand, and the development of human society on the other, the anthropic activities of exploitation and capitalization of these resources. , have also generated appreciable amounts of waste, polluting emissions that have degraded the quality of the environment [1, 6-8, 17].

The fact that man has conquered the entire planet and the rate of population growth is increasing has led to the emergence of large urban agglomerations, with an essential contradiction between balance and harmony in nature compared to man's tendency to achieve maximum production [6, 8, 17].

The main process of pollution became industrialization and technologicalization, this process began in the 18th century in England and has reached an unprecedented magnitude today, the problems of environmental degradation and pollution attracting the need for general legislation and several specific regulations in the field of environmental protection.

Figure 1 shows suggestively the main sources of pollution/contamination of clean groundwater sources, with pollutants from intensive agriculture, extractive industry, urban environment, and marine aquatic environment.

Figure 1. The main sources of pollution / contamination of groundwater sources with pollutants [18].

Continuing our previous studies in this field of ecotoxicology [3, 9-11], the objective of this field study was to investigate through a field study the physico-chemical parameters of Jiu water from 15 specific locations using a high-performance portable spectrophotometer, with the determination of pH, hardness, and dissolved oxygen values, for two years (2016 / 2017), with locations situated upstream and downstream of the largest polluters of Gorj (Turceni Thermal Power Plant) and Dolj (Ișalnița Thermal Power Plant).

2. Materials and Methods

2.1. Water sampling

The water samples were collected in special plastic containers, opaque white, and stored in the refrigerator at 4°C until of determination.

In order to determine a possible threat of contamination or pollution of the sampling locations, it became dependent on the regions of Turceni Thermal Power Plant and Isalnița Thermal Power Plant (Figure 2), upstream and downstream on 15 locations on the Jiu River.

Figure 2. Images of the Turceni (Gorj) and Eșalnița (Dolj) thermal power plants [19, 20].

The water samples were taken from 5 different locations in Gorj County and 10 locations in Dolj County.

For each location, two samples were taken twice a year: the first samples were taken in January, February, July and August 2016, the following in the same months of 2017. Hydrography of Gorj and Dolj County, of course except

The Danube is largely dominated by the Jiu River, to which most of the region's flowing waters converge as tributaries [14, 15].

2.2. Physico-chemical parameters' analysis

The portable DR 1900 spectrophotometer (Hach, Romania) was used to determine the physico-chemical parameters.

It has the advantage of portability, compactness and low weight.

The device is designed to withstand shocks and moisture in the field, as well as to accept the largest dimensional range of ampoules. A large number of pre-programmed methods (over 220 built-in water testing methods as well as the wide reading range of up to 800 nm.) provide results of high technical accuracy and therefore the data processing rate provides accuracy comparable to the one in the laboratory (Figure 3).

Sampling was done by recording GPS coordinates, hardness, pH and dissolved oxygen.

Figure 3. Portable Spectrophotometer Model DR 1900 (Hach, Romania) (Original)

Technical characteristics of the portable DR spectrophotometer:

- detector (silicon photodiode)
- set of 2 × 10 mL tanks
- wavelength: 340-800 nm / ±2 nm
- photometric accuracy: ±0.003% (0.0-0.5)
- photometric linearity: <0.5% (0.5-2.0 Abs)
- scattering light: <0.5% T at 340 nm, with $NaNO_2$
- physico-chemical determinations: pH, hardness, conductivity, dissolved oxygen.

2.3. Statistical analysis

The results were statistically analyzed in the Microsoft Excel program with the generation of comparative graphs.

3. Results and Discussions

The values of pH, hardness, and dissolved oxygen for the first samples (January and February) of 2016 from the Gorj and Dolj counties are presented in Tables 1-2 and Fig. 4 -5.

Table 1.

Values of pH, hardness and dissolved oxygen for water samples taken upstream and downstream of the Turceni plant in January and February 2016

Water sample Gorj county	GPS coordinates	Parameter analyzed	Sampling 1 January	Sampling 2 February
P1 (upstream) Drăgușești	N 44º58'02.8 " E 23º12'54.1"	O2 concentration	9,51 mg O_2/l	9,02 mg O_2/l
		pH	9,0	7,6
		dHº	9,0	7,0
P2 (upstream) Vîrț	N 44º56'55.0" E 23º07'57.3"	O2 concentration	9,35 mg O_2/l	9,30 mg O_2/l
		pH	8,20	7,90
		dHº	8,0	8,20
P3 (downstream) Rovinari	N 44º54'11.6" E 26º09'29.1"	O2 concentration	9,23 mg O_2/l	9,12 mg O_2/l
		pH	8,0	8,10
		dHº	8,20	8,50
P4 (downstream) Brebenei	N 44º38'37.6" E 23º26'21.8"	O2 concentration	9,21 mg O_2/l	9,05 mg O_2/l
		pH	8,50	9,0
		dHº	8,0	7,0
P5 (downstream) Ionești	N 44º37'11.00" E 23º27'1.12"	O2 concentration	9,12	9,0
		pH	8.50	9,0
		dHº	8,0	8,2

Table 2.

Values of pH, hardness and dissolved oxygen for the water samples taken in Șalnita area

Water sample Dolj county	GPS coordinates	Parameter analyzed	Sampling 1 January 2016	Sampling 2 February 2016
P1 (upstream) Schitu	N 44º30'44.50" E 23º30'38.93"	O2 concentration	11,23 mg O_2/l	10,03 mg O_2/l
		pH	8,0	7,0
		dHº	8,0	7,0
P2 (upstream) Brădești	N 44º29'27.86" E 23º35'52.27"	O2 concentration	10,75 mg O_2/l	9,85 mg O_2/l
		pH	7,0	7,0
		dHº	7,0	7,0
P3 (upstream) Coțofenii din Dos	N 44º24'40.11" E 23º40'57.86"	O2 concentration	9,78 mg O_2/l	9,71 mg O_2/l
		pH	7,0	7,0
		dHº	7,0	7,0
P4 (upstream) Mihăița	N 44º21'58.85" E 23º42'34.97"	O2 concentration	9,12 mg O_2/l	9,53 mg O_2/l
		pH	6,0	7,0
		dHº	4,0	5,0
P5 (downstream) Șalnița	N 44º15'38.40" E 23º47'6.23"	O2 concentration	9,24 mg O_2/l	9,30 mg O_2/l
		pH	7,0	7,0
		dHº	7,0	8,0
P6 (downstream) Podari	N 44º11'8.62" E 23º50'55.37"	O2 concentration	8,18 mg O_2/l	9,10 mg O_2/l
		pH	7,0	7,0
		dHº	5,0	5,0
P7 (downstream) Secui	N 44º 1'21.82" E 23º52'41.83"	O2 concentration	8,02 mg O_2/l	9,20 mg O_2/l
		pH	7,0	8,0
		dHº	8,0	6,0
P8 (downstream) Drănic	N 43º49'3.45" E 23º49'36.68"	O2 concentration	7,93 mg O_2/l	8,09 mg O_2/l
		pH	7,50	8,20
		dHº	7,0	7,0
P9 (downstream) Valea Stanciului	N 43º58'42.3" E 23º52'43.2"	O2 concentration	7,65 mg O_2/l	8,00 mg O_2/l
		pH	8,0	8,90
		dHº	7,0	7,0
P10 (downstream) Zăval	N 43º85'12.19" E 23º84'83.37"	O2 concentration	7,43 mg O_2/l	8,00 mg O_2/l
		pH	8,50	9,0
		dHº	7,0	7,0

Determining the pH value is very important because it can have major influences on the life cycle of fish fauna.

At present, with the conservation of the unit in Ișalnița, Dolj County, it seems that the main source of pollution of the East and West Jiu waters is the discharge of domestic wastewater from areas not connected to the sewerage system [2, 5, 8]

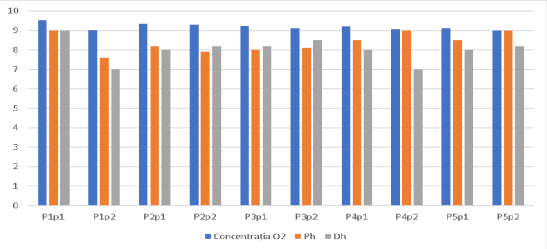

Figure 4. Graphical representation of the values of pH, hardness and dissolved oxygen at the two samples upstream and downstream of the Turceni plant (January, February 2016)

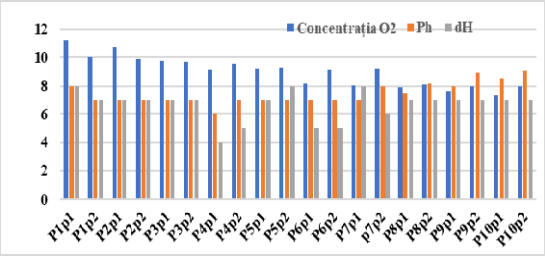

Figure 5. Graphical representation of the values of pH, hardness and dissolved oxygen at the two samples upstream and downstream of the Isalnița area (January, February 2016).

Also, we must not omit the very long period in which the mining industry, by discharging untreated industrial waters affected the two emissaries of the Jiu causing significant imbalances in the ecosystem of the area, an ecosystem that already faces the remaining effects of activity in the Jiu Valley [5]

Tables 3-4. and Fig. 6-7 show the values of pH, hardness, and dissolved oxygen for the samples from July and August 2016.

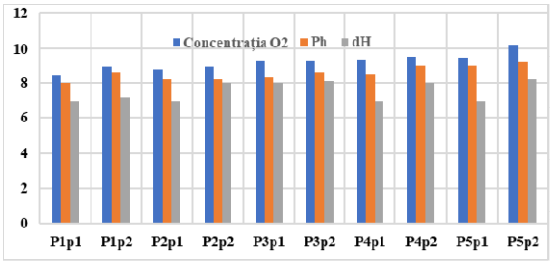

Figure 6. Graphical representation of the values of pH, hardness and dissolved oxygen at the two samples upstream and downstream of the Turceni power plant area (July, Aug 2016).

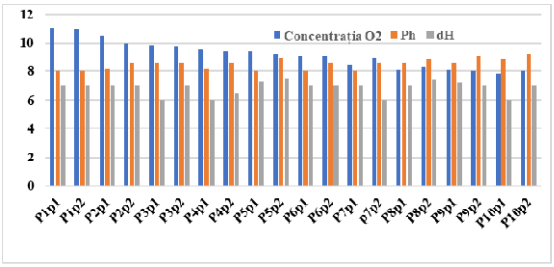

Figure 7. Graphical representation of the values of pH, hardness and dissolved oxygen at the two samples upstream and downstream of the Isalnița area (July, August 2016)

Table 3.
Values of pH, hardness and dissolved oxygen for water samples taken upstream and downstream of the Turceni plant

Water sample Gorj county	GPS coordinates	Parameter analyzed	Sampling 1 July 2016	Sampling 2 August 2016
P1 (upstream) Drăgușești	N 44°58'02.8 " E 23°12'54.1"	O2 concentration	8,42 mg O_2/l	8,92 mg O_2/l
		pH	8,0	8,60
		dH°	7,0	7,20
P2 (upstream) Vîrț	N 44°56'55.0" E 23°07'57.3"	O2 concentration	8,76 mg O_2/l	8,93 mg O_2/l
		pH	8,20	8,50
		dH°	7,0	8,0
P3 (downstream) Rovinari	N 44°54'11.6" E 26°09'29.1"	O2 concentration	9,3 mg O_2/l	9,3 mg O_2/l
		pH	8,30	8,60
		dH°	8,0	8,10
P4 (downstream) Brebenei	N 44°38'37.6" E 23°26'21.8"	O2 concentration	9,35 mg O_2/l	9,5 mg O_2/l
		pH	8,50	9,0
		dH°	7,0	8,0
P5 (downstream) Ionești	N 44°37'11.00" E 23°27'1.12"	O2 concentration	9,45	10,20
		pH	9,0	9,20
		dH°	7,0	8,20

Table 4.
Values of pH, hardness and dissolved oxygen for the water samples taken in the Ișalnita area

Water sample Dolj county	GPS coordinates	Parameter analyzed	Sampling 1 July 2016	Sampling 2 August 2016
P1 (upstream) Schitu	N 44°30'44.50" E 23°30'38.93"	O2 concentration	11,03 mg O_2/l	11,0 mg O_2/l
		pH	8,0	8,0
		dH°	7,0	7,0
P2 (upstream) Brădești	N 44°29'27.86" E 23°35'52.27"	O2 concentration	10,5 mg O_2/l	10 mg O_2/l
		pH	8,20	8,50
		dH°	7,0	7,0
P3 (upstream) Coțofenii din Dos	N 44°24'40.11" E 23°40'57.86"	O2 concentration	9,8 mg O_2/l	9,75 mg O_2/l
		pH	8,50	8,50
		dH°	6,0	7,0
P4 (upstream) Mihăița	N 44°21'58.85" E 23°42'34.97"	O2 concentration	9,6 mg O_2/l	9,42 mg O_2/l
		pH	8,10	8,50
		dH°	6,0	6,50
P5 (downstream) Ișalnița	N 44°15'38.40" E 23°47'6.23"	O2 concentration	9,4 mg O_2/l	9,25 mg O_2/l
		pH	8,0	8,90
		dH°	7,30	7,50
P6 (downstream) Podari	N 44°11'8.62" E 23°50'55.37"	O2 concentration	9,0 mg O_2/l	9,0 mg O_2/l
		pH	8,0	8,50
		dH°	7,0	7,0
P7 (downstream) Secui	N 44° 1'21.82" E 23°52'41.83"	O2 concentration	8,43 mg o_2/l	8,87 mg O_2/l
		pH	8,0	8,50
		dH°	7,0	6,0
P8 (downstream) Drănic	N 43°49'3.45" E 23°49'36.68"	O2 concentration	8,03 mg O_2/l	8,29 mg O_2/l
		pH	8,50	8,80
		dH°	7,0	7,40
P9 (downstream) Valea Stanciului	N 43°58'42.3" E 23°52'43.2"	O2 concentration	8,06 mg O_2/l	8,0 mg O_2/l
		pH	8,50	9,0
		dH°	7,20	7,0
P10 (downstream) Zăval	N 43°85'12.19" E 23°84'83.37"	O2 concentration	7,83 mg O_2/l	8,0 mg O_2/l
		pH	8,80	9,20
		dH°	6,0	7,0

The pH value varied according to each sampling point, so for the water of the Jiu River on the territory of Gorj County and for the areas from which the water samples were collected, it varied between 7.0-9.0 in the months January and February and between 8.0-9.2 in July and August 2016.

Obtaining these values we can say that the water of the Jiu River in these areas is slightly alkaline. For the water samples taken from the Jiu River on the territory of Dolj County, the pH value varied between 6.0-9.0 for the winter months (being from slightly acidic to slightly alkaline) and between 8.0 and 9.2 (slightly alkaline) for July and August 2016.

These small differences that appear between the two areas (Gorj and Dolj) indicate the appearance of factors that change water quality.

For 2017, the values of pH, hardness, and dissolved oxygen are presented in Tables 5-6 and Figs. 8-9.

Table 5.
Values of pH, hardness and dissolved oxygen for water samples taken upstream and downstream of the Turceni plant in January and February 2017

Water sample Gorj county	GPS coordinates	Parameter analyzed	Sampling 1 January 2017	Sampling 2 February 2017
P1 (upstream) Drăgușești	N 44°58'02.8 " E 23°12'54.1"	O2 concentration	8,57 mg O_2/l	8,02 mg O_2/l
		pH	7,50	7,60
		dH°	7,0	6,0
P2 (upstream) Vîrț	N 44°56'55.0" E 23°07'57.3"	O2 concentration	8,88 mg O_2/l	9,02 mg O_2/l
		pH	7,0	7,50
		dH°	7,0	7,20

P3 (downstream) Rovinari	N 44°54'11.6" E 26°09'29.1"	O2 concentration	9,03 mg O_2/l	9,23 mg O_2/l
		pH	7,50	7,0
		dH°	7,0	7,0
P4 (downstream) Brebenei	N 44°38'37.6" E 23°26'21.8"	O2 concentration	9,0 mg O_2/l	9,30 mg O_2/l
		pH	7,50	7,0
		dH°	7,0	6,0
P5 (downstream) Ionești	N 44°37'11.00" E 23°27'1.12"	O2 concentration	9,23	9,30
		pH	8,0	8,0
		dH°	7,0	6,0

Table 6.
Values of pH, hardness and dissolved oxygen for the water samples taken in Ișalnita area

Water sample Dolj county	GPS coordinates	Parameter analyzed	Sampling 1 January 2017	Sampling 2 February 2017
P1 (upstream) Schitu	N 44°30'44.50" E 23°30'38.93"	O2 concentration	10,35 mg O_2/l	10,08 mg O_2/l
		pH	7,0	7,20
		dH°	5,0	6,0
P2 (upstream) Brădești	N 44°29'27.86" E 23°35'52.27"	O2 concentration	10,41 mg O_2/l	10,12 mg O_2/l
		pH	7,0	7,0
		dH°	5,0	6,0
P3 (upstream) Coțofenii din Dos	N 44°24'40.11" E 23°40'57.86"	O2 concentration	10,02 mg O_2/l	9,87 mg O_2/l
		pH	7,50	7,80
		dH°	6,0	6,0
P4 (upstream) Mihăița	N 44°21'58.85" E 23°42'34.97"	O2 concentration	9,75 mg O_2/l	9,65 mg O_2/l
		pH	7,60	8,0
		dH°	6,0	7,0
P5 (downstream) Ișalnița	N 44°15'38.40" E 23°47'6.23"	O2 concentration	9,52 mg O_2/l	9,32 mg O_2/l
		pH	7,80	8,0
		dH°	6,50	7,0
P6 (downstream) Podari	N 44°11'8.62" E 23°50'55.37"	O2 concentration	9,27 mg O_2/l	9,11 mg O_2/l
		pH	8,0	8,0
		dH°	7,0	7,0
P7 (downstream) Secui	N 44° 1'21.82" E 23°52'41.83"	O2 concentration	9,15 mg O_2/l	9,22 mg O_2/l
		pH	8,20	8,50
		dH°	7,20	7,50
P8 (downstream) Drănic	N 43°49'3.45" E 23°49'36.68"	O2 concentration	9,11 mg O_2/l	9,16 mg O_2/l
		pH	8,20	8,20
		dH°	7,0	7,20
P9 (downstream) Valea Stanciului	N 43°58'42.3" E 23°52'43.2"	O2 concentration	9,03 mg O_2/l	9,08 mg O_2/l
		pH	8,50	8,50
		dH°	7,20	7,50
P10 (downstream) Zăval	N 43°85'12.19" E 23°84'83.37"	O2 concentration	8,92 mg O_2/l	9,02 mg O_2/l
		pH	8,50	8,50
		dH°	6,20	6,90

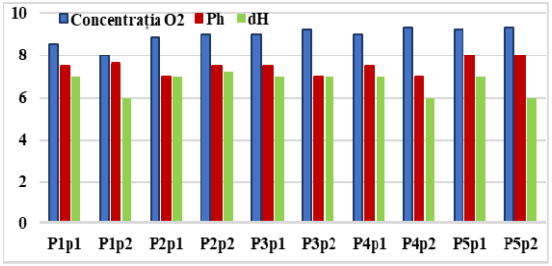

Figure 8. Graphical representation of the values of pH, hardness and dissolved oxygen at the two samples upstream and downstream of the Turceni power plant area (January, February 2017).

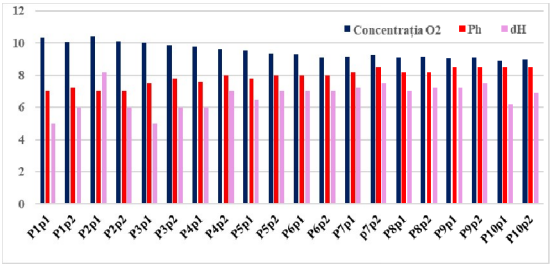

Figura 9. Graphical representation of the values of pH, hardness and dissolved oxygen at the two samples upstream and downstream of the Isalnița area (January, February 2017).

Tables 7-8 and Figs. 10-11 show the values of pH, hardness, and dissolved oxygen for the samples from July and August 2017.

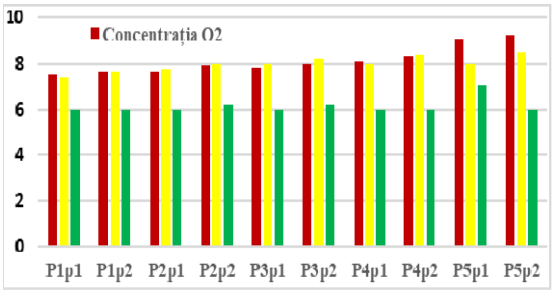

Figure 10. Graphical representation of the values of pH, hardness and dissolved oxygen at the two samples upstream and downstream of the Turceni power plant area (July, Aug 2017)

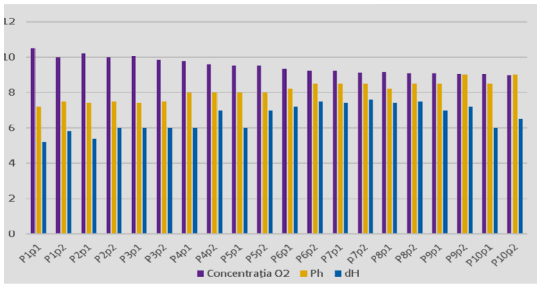

Figure 11. Graphical representation of the values of pH, hardness and dissolved oxygen at the two samples upstream and downstream of the Isalnița area (July, August 2017)

Table 7.

Values of pH, hardness and dissolved oxygen for water samples taken upstream and downstream of the Turceni plant in July and August 2017

Water sample Gorj county	GPS coordinates	Parameter analyzed	Sampling 1 July 2017	Sampling 2 August 2017
P1 (upstream) Drăgușești	N 44°58'02.8 " E 23°12'54.1"	O2 concentration	7,52 mg O_2/l	7,65 mg O_2/l
		pH	7,4	7,7
		dH°	6,0	6,0
P2 (upstream) Vîrț	N 44°56'55.0" E 23°07'57.3"	O2 concentration	7,68 mg O_2/l	7,92 mg O_2/l
		pH	7,80	8,0
		dH°	6,0	6,20
P3 (downstream) Rovinari	N 44°54'11.6" E 26°09'29.1"	O2 concentration	7,85 mg O_2/l	8,02 mg O_2/l
		pH	8,0	8,20
		dH°	6,0	6,20
P4 (downstream) Brebenei	N 44°38'37.6" E 23°26'21.8"	O2 concentration	8,10 mg O_2/l	8,37mg O_2/l
		pH	8,0	8,40
		dH°	6,0	6,0
P5 (downstream) Ionești	N 44°37'11.00" E 23°27'1.12"	O2 concentration	9,10	9,25
		pH	8,0	8,50
		dH°	7,0	6,0

Table 8.

Values of pH, hardness and dissolved oxygen for the water samples taken in the Șalnita area

Water sample Dolj county	GPS coordinates	Parameter analyzed	Sampling 1 July 2017	Sampling 2 August 2017
P1 (upstream) Schitu	N 44°30'44.50" E 23°30'38.93"	O2 concentration	10,5 mg o_2/l	10,0 mg O_2/l
		pH	7,20	7,50
		dH°	5,20	5,80
P2 (upstream) Brădești	N 44°29'27.86" E 23°35'52.27"	O2 concentration	10,22 mg O_2/l	10 mg O_2/l
		pH	7,40	7,50
		dH°	5,40	6,0
P3 (upstream) Coțofenii din Dos	N 44°24'40.11" E 23°40'57.86"	O2 concentration	10,04 mg O_2/l	9,85 mg O_2/l
		pH	7,40	7,50
		dH°	6,0	6,0
P4 (upstream) Mihăița	N 44°21'58.85" E 23°42'34.97"	O2 concentration	9,76 mg O_2/l	9,60 mg O_2/l
		pH	7,60	8,0
		dH°	6,40	7,0
P5 (downstream) Ișalnița	N 44°15'38.40" E 23°47'6.23"	O2 concentration	9,50 mg O_2/l	9,50 mg O_2/l
		pH	8,0	8,0
		dH°	6,0	7,0
P6 (downstream) Podari	N 44°11'8.62" E 23°50'55.37"	O2 concentration	9,35 mg O_2/l	9,22 mg O_2/l
		pH	8,20	8,50
		dH°	7,20	7,50
P7 (downstream) Secui	N 44° 1'21.82" E 23°52'41.83"	O2 concentration	9,21 mg O_2/l	9,11 mg O_2/l
		pH	8,50	8,50
		dH°	7,40	7,60
P8 (downstream) Drănic	N 43°49'3.45" E 23°49'36.68"	O2 concentration	9,15 mg O_2/l	9,09 mg O_2/l
		pH	8,20	8,50
		dH°	7,40	7,50

P9 (downstream) Valea Stanciului	N 43°58'42.3" E 23°52'43.2"	O2 concentration	9,10 mg O_2/l	9,06 mg O_2/l
		pH	8,50	9,0
		dH°	7,0	7,20
P10 (downstream) Zăval	N 43°85'12.19" E 23°84'83.37"	O2 concentration	9,02 mg O_2/l	8,97 mg O_2/l
		pH	8,50	9,0
		dH°	6,0	6,50

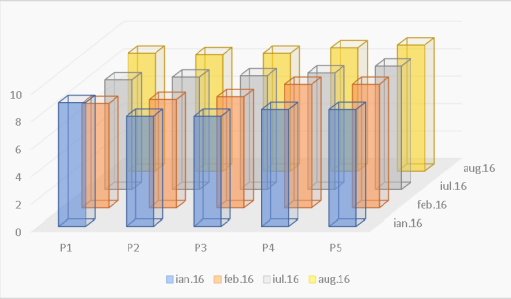

Figure 12. Comparative dynamics of pH values for the two samples from the Jiu river (upstream and downstream of the Turceni power plant area) (2016)

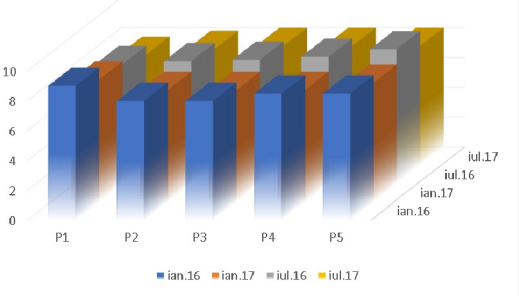

Figure 13. Comparative dynamics of pH values for two samples from the Jiu river (January and July) (upstream and downstream of the Turceni power plant area) (2016-2017)

In 2017, for the water samples taken from different points of the Jiu River on the territory of Gorj County, pH values between 7.5-8.0 were obtained for January and February and between 7.4-8,5 for July and August of 2017.

Thus, the results obtained indicate both the variations that may occur from one sampling point to another and the presence of weakly alkaline water.

In the case of water samples collected from Jiu on the territory of Dolj county, pH values between 7.0 and 8.5 for the winter months and between 7.2-9.0 for July and August 2017.

From the data analyzed and presented in Figures 12 and 13, we can see that the pH value in dynamics, at the two samples collected in January, February, July and August 2016 from the Jiu River shows that the pH value was lower in water samples taken in the winter months compared to the summer months. Also, comparing the values of two water samples in January and July of 2016 and 2017, we found that the pH value was higher in January and July of 2016 compared to the values obtained in the same months of the year 2017.

Figure 14 shows the dynamics of pH values for the 10 samples collected from the Jiu River in Dolj County, values for samples collected in January and July 2016 and 2017.

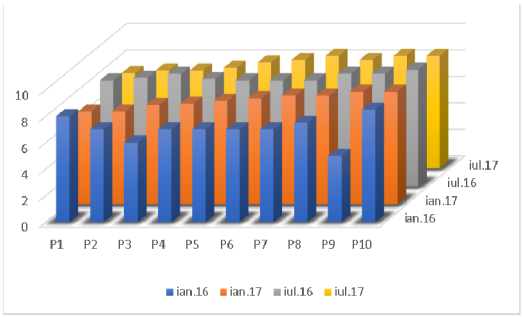

Figure 14. Comparative dynamics of pH values for two samples from the Jiu river (January and July) (upstream and downstream of the Işalnița area) (2016-2017)

Drastic changes in pH can occur in natural waters and due to the discharge of industrial wastewater (mine water causes a drastic decrease in pH), agricultural and domestic [2, 5, 6, 13, 17].

During the summer periods as a consequence of the thermal pollution caused by the hot waters discharged by CET Işalnița, the water temperature can increase by 5-8 °C compared to the average water temperature in the region, so the pH value can reach values of 8.9-9.2 downstream [5].

The comparative dynamics of the O_2 concentration values for the water samples taken from the Jiu River in January and July 2016 and 2017 are shown in Figure 15.

The samples were taken from Gorj County downstream and upstream.

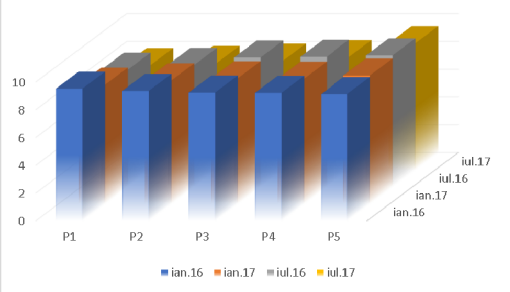

Figure 15. Comparative dynamics of O_2 concentration values for two samples from the Jiu river (January and July) (upstream and downstream of the Turceni power plant area) (2016-2017)

The oxygen concentration in the water samples taken from the Jiu water, both in Gorj County and Dolj County was increased during both 2016 and 2017, classifying the Jiu River in ecological class 1 (very good), according to Order 161/2006 [13, 14].

As can be seen from the recorded data, the values of the amount of O_2 (mg / L) were higher in 2016, both in January and July, compared to the same period of 2017.

In the case of water samples collected from Jiu in Gorj County, we could see that the concentration of O_2 in the water samples taken upstream was lower, gradually increasing downstream.

Comparing the values of O_2 concentration from water samples taken in the winter months (January, February) with those from samples taken in summer (July, August), we can say that the value of O_2 concentration was higher in water samples taken in winter compared to those taken in summer, both for 2016 and 2017.

For the water samples taken from Dolj County, high values of O_2 concentration were determined for both samples collected in winter and summer, but this was lower in water samples collected downstream compared to those collected upstream by Isalnița.

Oxygen regime indicators for surface waters indicate not less than 6 mg O_2/L for summer and not less than 4 mg O_2/L for winter.

Reducing oxygen to less than 2 mg O_2/L leads to the mass extinction of aquatic fauna.

The comparative dynamics of the O_2 concentration values for the water samples taken from the Jiu River in January and July 2016 and 2017 are shown in Figure 16.

The samples were collected from Dolj County downstream and upstream.

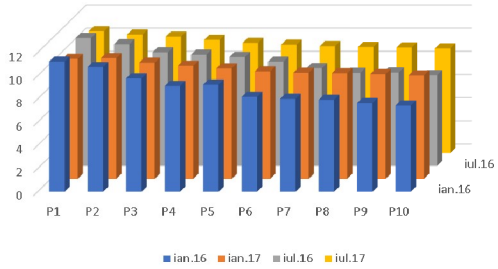

Figure 16. Comparative dynamics of O_2 concentration values for two samples from the Jiu river (January and July) (upstream and downstream of the Ișalnița area) (2016-2017).

As can be seen from the recorded data, the values of the amount of O_2 (mg/L) were higher in 2017, both in January and July, compared to the same period of 2016.

It can also be seen that the value of O_2 concentration was lower in the samples taken downstream compared to the samples taken upstream.

According to the literature, there are correlations between biochemical and chemical oxygen consumption, the amount of dissolved oxygen and the organic concentration, especially phenols of the resulting decomposition products (nitrites, nitrates, ammonium), and the effect of wastewater discharge.

Oxygen consumption due to the activity of aerobic microorganisms and oxygen supply obtained by reaeration and photosynthesis are the two phenomena whose result is the amount of oxygen in the water.

Oxygen deficiency plays an essential role in the reaeration process, which varies directly in proportion to the organic matter concentration of the biotope.

When, as a result of the discharge of wastewater and insufficiently treated, the degree of pollution of natural waters increases, there is a danger that, for the self-

purification phase, natural oxygenation will be insufficient [2, 5, 6, 15-17].

Domestic wastewater that is discharged into a natural emissary without being subjected to the treatment process, causes a significant decrease in dissolved oxygen and at the same time an increase in biochemical oxygen consumption.

In this case, a very large amount of organic matter at the site of discharge will stimulate the multiplication of bacteria, that for development will consume dissolved oxygen from the water [2, 5, 15].

The microorganisms reach a maximum of development after 3-4 days of water flow, at which point the organic matter begins to be disaggregated into NH_3, NO_2, and NO_3, a situation that allows correlations and even predictions of approximate values of CBO_5 and dissolved oxygen.

Given that nitrogen and phosphorus in the composition of organic matter in wastewater stimulate the growth and multiplication of algae, they will proliferate in areas where self-purification has been achieved, respectively the process of water mineralization [4, 8, 11, 13, 15, 17].

Significant fluctuations of populations of plant and animal organisms occur downstream of wastewater discharges. In this context, protozoa, ciliated bacteria that feed on bacteria will multiply, and rotifers and crustaceans, the main ciliate-consuming organisms, will develop to take the place of ciliated organisms [7, 8, 16, 17].

Algae also develop where rotifers and crustaceans develop due to the presence of nitrations, dissolved oxygen, and clear water that stimulates photosynthesis [7, 8, 16, 17].

The evolution of the biocenosis, the quantitative and qualitative succession of the populations of organisms, represents an orderly and predictable process in general, being a trophic chain that begins with the biodegradation of organic matter [7, 8, 17].

When we talk about pollution with organic substances or suspensions, aquatic organisms do not disappear completely in areas of active degradation and decomposition, but only decrease in species and population, as opposed to pollution with toxic substances that can destroy aquatic organisms in parts of the river more or less extensive, they appear only in the recovery area. [3, 4, 9, 11, 16].

For the reasons presented above, there is a fish population characteristic of mountain waters on the two outflows of the Jiu River.

4. Conclusions

Following the present study, we can conclude that from the samples collected from the Jiu river the pH value varied depending on the sampling place, season, and year so, for the water samples collected from the Jiu river on the territory of Gorj county values of pH were between 7.0 and 9.2 in 2016 and between 7.4-8.5 in 2017.

For the water samples collected on the territory of Dolj county, pH values were between 6.0 and 9.2 / 2016 and between 7.0 - 9.0 / 2017.

Comparing the values of two samples in January and July of 2016 and 2017, we found that the pH value was higher in January and July in 2016 compared to the values obtained in the same months of 2017.

The oxygen concentration in the water samples taken from the Jiu river, both in Gorj County and Dolj County was increased in 2016 and 2017, classifying the Jiu River in ecological class 1 (very good), according to Order 161/2006.

The values of the amount of O_2 (mg /L) were higher in 2016, both in January and July, compared to the same period of 2017.

The value of O_2 concentration was lower in the samples taken downstream compared to the samples taken upstream.

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