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PHYSICAL-CHEMICAL PROPERTIES OF WATER IN CRNA RIVER IN THE PELAGONIA REGION

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Abstract
The main purpose of this paper is to examine the physical-chemical properties of water in Crna River in the Pelagonia Region. Therefore, four locations along the Crna River in the Pelagonia Region were taken as target measuring points of the physical-chemical properties of water: measuring point 1 (near village Novaci), measuring point 2 (before the inflow of water to the fifth channel), measuring point 3 (Crna River after the inflow of water from the fifth channel) measuring point 4 (Skochivir). The water samples for analysis were taken in January and July in 2012, 2013 and 2014 and the following physico-chemical parameters were analyzed during our investigation: the water temperature (determined with a digital thermometer), turbidity (by turbidimeter), suspended solids, total organic carbon (TOC), biological oxygen demand (BOD), chemical oxygen demand (COD) and dissolved oxygen (determined with UV PASTEL-instrument). From the obtained results in our investigation it can be concluded that the highest average turbidity is noted in measuring point 1 (24,4 mg/L) in July. The highest average BOD is measured in point 3 (14,1 mg/L) in July, as a result of the water inflow from the fifth channel. The lowest average amount of TOC was noted in January in measuring point 1 (2,0 mg/L), while the content of dissolved oxygen in same measuring point show the highest value (11,53 mg/L).

Keywords: pollution, indicators for oxygen regime, turbidity, suspended solids.

Introduction

The rapid pace of development that is reflected in all segments of Tthe human life, increases the need for water. According to (Tanaskovic and Chukaliev 2013) the global warming leads to a worsening of problems with a lack of quality water for all purposes. The large deficit of clean water imposes a need for constant monitoring of surface and groundwater. This paper examines the water in Crna River in the Pelagonia region. The purpose of this research is to determine the state of the water in Crna River, which is the right tributary of the river Vardar. By determining the critical points to implement effective measures in the treatment of wastewater treatment before flowing into the rivers.

Material and methods

As a material for the work in the research was the water from the Crna River. The selection of the measuring points was at different locations along the Crna River in the Pelagonia Region.As target measuring points for taking sampling were the following: Measuring point 1 (village Novaci). This measuring point is 11 km away from the City of Bitola and according to the number of inhabitants 1 278 is the largest village. Measuring point 2 (before the water flows from the fifth channel in the Crna River). Measuring point 3 (Crna River after the water flows from the fifth channel in which flow the wastewater from the industrial sector, as well as part of the faecal waters from the city of Bitola and the village of Kravari) Measuring point 4 (Crna River in the village of Skocivir). The presence of rocks and stones in this part of the river contributes to the additional aeration of water. Samples for analysis were taken in January and July in duration for three years. In order to obtain a realistic

image of the state of the water in Crna River in the Pelagonia Region, analysis of the physical and chemical parameters were made: the water temperature was determined by a digital thermometer with an accuracy of ± 0,10C.
The measurement of turbidity was determined by a turbidimeter expressed with nephelometric units (NTUs), suspended solids, total organic carbon (TOC), biological oxygen demand (BOD), chemical oxygen demand (COD), and dissolved oxygen were determined With UV PASTEL - a tool for a direct reading of values.

Results and discussion

One of the physical indicators of water quality is temperature. With the rise in temperature, the chemical reactions catalyze which are of crucial importance in the aquatic ecosystems as they affect the biological activity of living organisms (Brutsaerd, 2005).

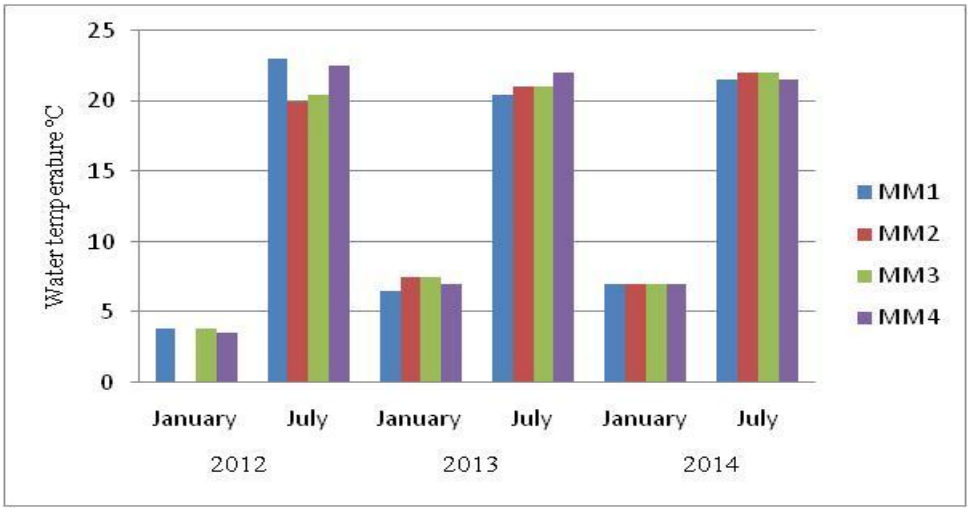

Chart 1. Water temperature in Crna River in January and July

From the results shown in Chart 1, it can be concluded that the higher values of the water temperature are typical for the summer period. The highest value is at the measuring point 1, 23C in July 2012. According to (Chukaliev et al. 2003), in the agricultural production, the temperature of the water for irrigation of crops plays a major role in their development. The turbidity of the water is one of the first visible indicators determining the water quality. Since the river ecosystem is concerned, the erosion processes have influence to the water turbidity, as well as the hydrometeorological conditions and the river bed. (Blazhevska, 2016).

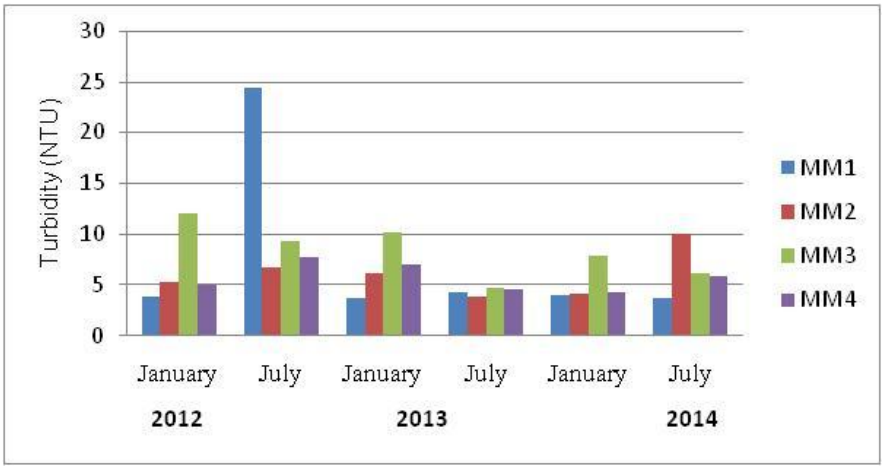

Chart 2. The turbidity of the water in Crna River in January and July 2012, 2013 and 2014

With the measurements of water turbidity in the three-year research period, it was found that Crna River has the highest value in the first year, at the measuring point 1 24,4mg / L in July, near the village of Novaci. This village, according to the number of inhabitants is the largest, therefore the quantity of waste water per resident is greater. In 2013, the highest value is at the measuring point 3, 10,2 mg / L, due to the wastewater from the fifth channel that is discharged into the Crna River. The high average value of turbidity found along the course of the Treska River in November was 34., mg / L according to (Stojanova, 2012) as a result of the heavy rains,inherent in that period of the year. In 2014, there are higher values at the measuring point 3, 7.9mg / L in January and at the measuring point 2, 10mg /L in July. The high value at the measuring point 2 is a result of the characteristics of the riverbed which contribute to the increase in the turbidity. From the obtained values for the turbidity of the water in Crna River according to the Decree on classification of waters in all measuring points the water is in IV and V class. Through the content of suspended solids can be determined the presence of organic and inorganic substances present in the water.

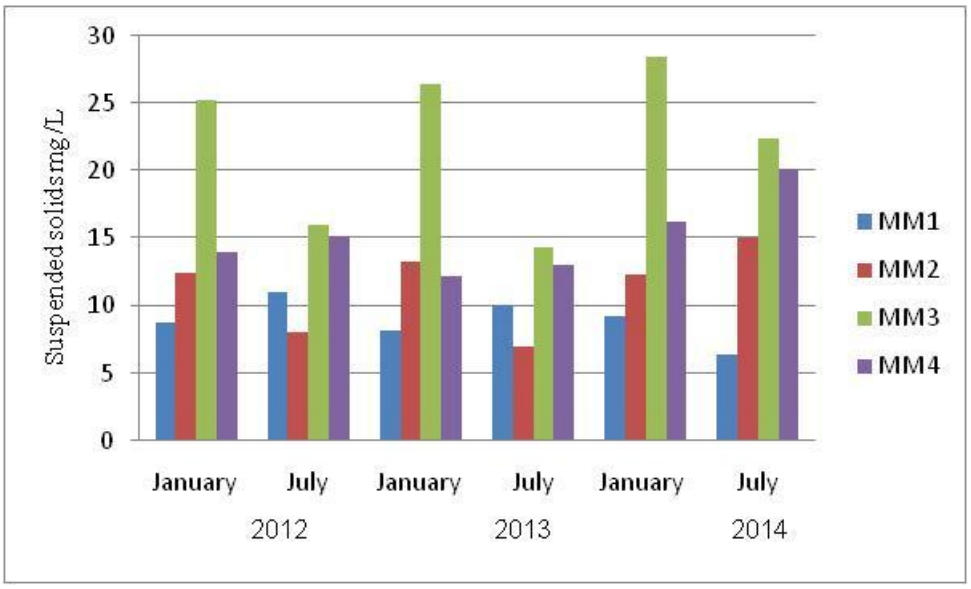

Chart 3. Suspended solids in the water of Crna River in January and July 2012, 2013 and 2014

According to the obtained results from the analysis of the quantity of suspended solids in the water of Crna River in the three years period, the highest values were determined at the measuring point 3, with epmphasised dynamics in January (25.2mg / L; 26.4mg / L; 28, 5mg / L) as a result of additional soil input in the water. As Crna River flows away from the populated areas, the value of the suspended solids in the measuring point 4, has a slight decline, as part of the organic and inorganic substances are sedimented, and part is carried through the stream of Crna River. From the values obtained for the presence of the suspended solids, according to the Water Classification Regulation, the measuring points 1, 2, 3 and 4 are in the II class.The dissolved oxygen in the water is one of the most important parameters for the survival of aerobic organisms.

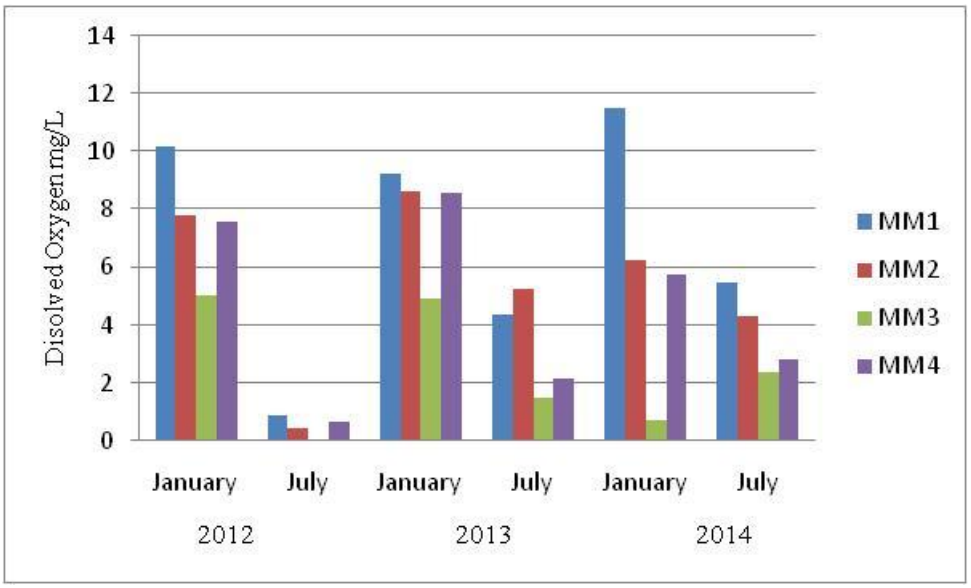

Chart 4. Dissolved oxygen in the water of Crna River in January and July 2012, 2013 and 2014

According to the obtained results of the performed measurements of oxygen in the water of Crna Reka, higher values in all measuring points are recorded at the measuring point 1, which collects the waters from the upper streams of the spring and then follows the measuring point 2. High values are recorded in January, while the lower ones in July, where, according to (Adebao, 2009), the reason is the low water level and the higher concentration of organic matter. This is confirmed in our research, where the lowest value is recorded at the measuring point 3 (0,0mg / L 2012; 1,51mg / L 2013; 2,4mg / L in 2 July 2014) after flowing of municipal and industrial wastewater in the river. According to (Malecka et al., 2006) the biological consumption of oxygen is correlated with the amount of organic matter in the aquatic ecosystem and the biological activity of microorganisms.

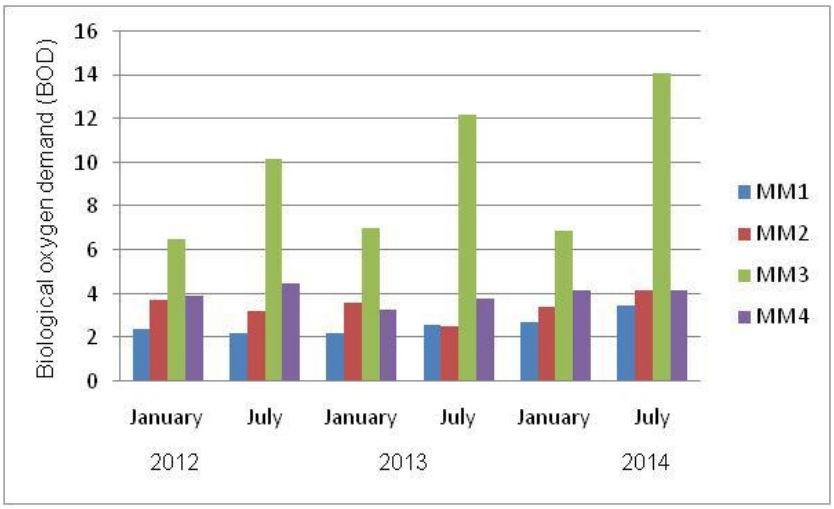

Chart 5. Biological oxygen demand in the water of the Crna River in January and July 2012, 2013 and 2014.

The highest BOD according to the obtained results from the measurements in all three years of examination, it was recorded at the measuring point 3 (10.2 mg / L 2012; 12.2 mg / L 2013; 14.1 mg / L 2014) in July due to the great anthropogenic influence in this part of the Crna River. At the same measuring point, the content of dissolved oxygen is the lowest. The lowest BOD values are recorded at the measuring point 1 (2.4mg / L2012; 2.2mg / L 2013; 2.7mg / L 2014) in January, where the content of dissolved Oxygen is the highest (10.2 mg / L 2012; 9.23 mg / L2013; 11, 53 mg / L2014) in

January. According to the Water Classification Regulation, the measuring points 1, 2, 4 are in the II class, and the measuring 3 of IV class.
The chemical oxygen demand is an indicator of water quality.

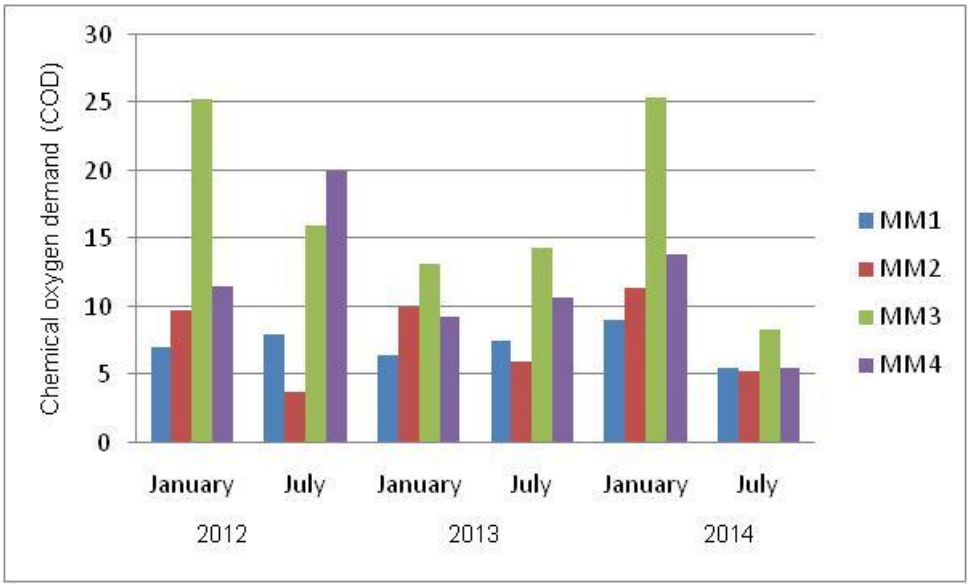

Chart 6. Chemical oxygen demand in the water of Crna River in January and July 2012, 2013 and 2014

The highest chemical oxygen demand in the water of Crna river is registered at the measuring point 3 25.4mg / L in January 2014 as a result of the high content of organic matter present in this measuring point. Higher values have been recorded by (Ziberovski, 2000) on the river Lepenec before entering into the river Vardar, where the value of COD is 32.4mg / L, and such water is not intended for irrigation. There is a low COD content at the measurement point of 2 6,0 mg / L in July 2013 and the measurement point 1 6,5 mg /L in January. These are measuring points where the content of BOD is lower and the content of dissolved oxygen is higher. According to the Decree on the classification of waters the measuring points 1 and 2 are in the III class and the measuring points 3 and 4 are in the IV class. According to (Agbaba et al., 2005), the total organic carbon present in the water is an emitter for the creation of new organic compounds.

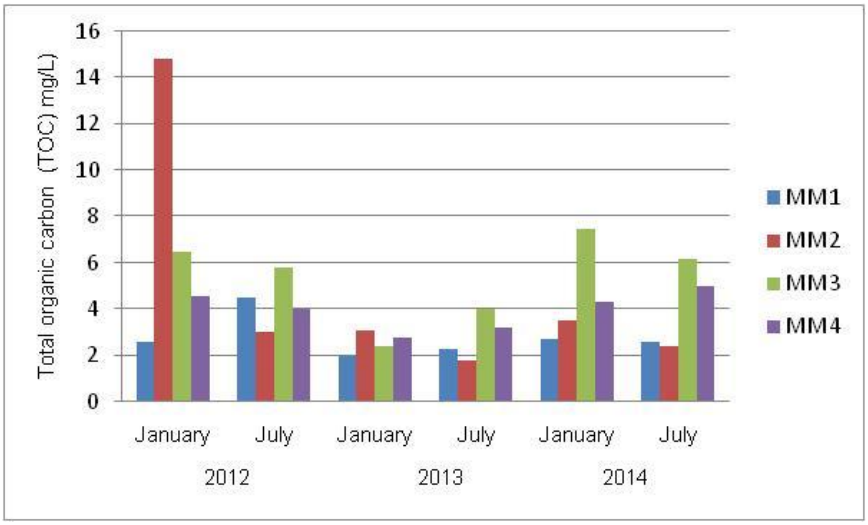

Chart 7. Content of total organic carbon in the river Crna River in January and July 2012, 2013 and 2014

From the obtained values of the TOC in the water of Crna River, the highest value was determined at the measuring point 2 14.8 mg / L in January 2012. In the next two years in January and July at the

measuring point 3, there is a continuous increase in the value of TOC as a result of the constant burden on organic matter from the waste industrial and fecal waters. The lowest value was recorded at the measuring point 2 1.8mg / L in July 2013 and the measuring point 1 2.0mg / L in January 2013. At these measuring points the content of BOD and COD is the lowest. According to the Water Classification Regulation, the measuring points 1 and 4 are in the II class, and the measuring points 2 and 3 in the III class.

Conclusions

In addition to the presence of nutrients in the water, as a limiting factor that determines the development of microorganisms is also the temperature. The established values of the suspended solids coincide with the values for the water turbidity. In the measuring point 3, the anthropogenic influence can be felt the most, because there is a continuous release of waste industrial and fecal waters. All of this suggests that the cleaning of the river beds should become an obligation of the competent institutions, to undertake measures for wastewater treatment before they flow into the canals and rivers.

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