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Natural purification in rivers in consideration with river geomorphological characteristic

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Abstract. In fact, velocity and turbulence of water flow affected by geomorphologic characteristic of river specially slope are the key factors for river water quality improvement and river restoration. Bio-chemical Oxygen Demand (BOD) as a famous parameter can be used as a gauge of the water quality of rivers. The aim of this paper is to investigate the role of geomorphologic characteristic on self-purification capacity of rivers. To this purpose, BOD of six sampling stations were measured along the Bashar river. In each station, three points were taken from across the river and were transferred to the laboratory under standard conditions. Slope percentage of all stations calculated on the basis of the height difference of each station regard to the distance between them. Finally we found meaningful differences of BOD level decrease between stations 4 to 6.

Key words. Slop, BOD, quality, Bashar river.

1. Introduction

Bashar river is one of the major rivers of the Bouyer Ahmad city. Economic and agricultural development of Bouyer Ahmad city with the centering of Yasouj dependent on this river and nowadays many industries located alongside with the river that provide their needed water from it. The water of this river is used mainly in the agricultural sector. Apart from these rivers, Bashar has other uses including recreational use which leads to the survival of aquatic life [1]. Biochemical oxygen demand (BOD) of a water sample determines the amount of oxygen consumed by organisms in the water and it can be measured to determine the water quality. If BOD is low and then water would be clean and has lack of proper organisms or microorganisms in the water would not need oxygen consumption[2, 3]. European standard (EU) has set the value of BOD 6 milligrams per liter and has set the

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Russian standard 3 milligrams per liter (Greenberg et al. 2004). Chemical oxygen demand (COD) is a measure of the total concentration of organic substances in water and it is equal to the amount of oxygen consumed for oxidation of oxidizing organic matter towards the consumed amount in order for the oxidation of the oxidizing organic matters by using a strong oxidizing agent [4].

Understanding of the cause and effect relationships between water quality of river and contaminant loading are the first measures to determine the self-purification capacity of a river. This relationship depended on various physical parameters such as velocity, slope, rising time, temperature and biochemical characteristics such as oxygen demand of the context, algae photosynthesis and respiration and nitrification [5]. This river along its path is influenced by many pollutants, the two important affecting factors on the river and urban runoffs and Wastewater Treatment Plant Effluent of Yasouj [6, 7]. This effect is closely associated with the development of Yasouj. The main sources of river pollution, are the urban runoffs and wastewaters of Yasouj. This river due to the fact that it is crossed the mountainous areas and also due to having the sandy bottom, by crossing the river slope is likely to cause excessive turbulence and increase dissolved oxygen in the river.

2. Materials and methods

Six sampling stations were selected along the river path, these stations were selected based on preliminary studies and by taking into account the climatic conditions, the distribution of pollution sources and water distribution, and it is including of stations of Dehno, Bashar bridge, sugar factory, Mokhtar bridge, hill station of Talgah and Sang Shekan Jokar which their geographical position is shown in Fig. 1. In each station, three points were taken from across the river, poured in the sterile and special container and in less than 2 hours were taken to the laboratory. BOD is measurable by BOD5 incubator device. First, the sample size which was previously defined in the bottle considered by the device and a magnetic number is added to the bottle. The 0.2 grams of sodium hydroxide is added to prevent from the accumulation of gas in the bottle and the lid is closed. The slope of all the stations are measured toward the first station, in a way that based on the difference in altitude from each station to the first station and the distance between the level and slope of stations were calculated [8]. Finally, meaningful differences of BOD concentration between the various stations were determined by SPSS software and two sample t-test.

3. Results and discussion

Figure 1 shows the height difference and distance between sampling stations, as can be seen height is reduced from the first station to the final sampling stations. So Dehno stations is located in upstream and hill station of Talgah is located in the downstream.

To calculate the percentage of slope was used from the height difference and the

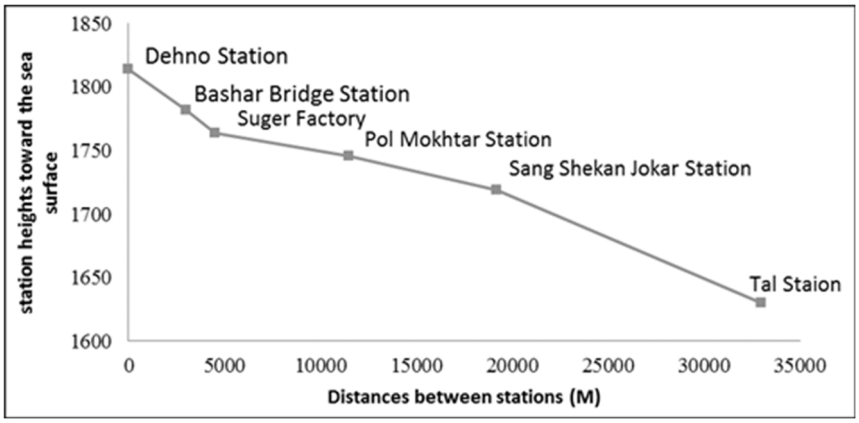

Fig. 1. Height change graph of measurement stations

distance between the stations and the first station, the high height difference and low distance between stations are indicative of steep slope. Table 1 shows the difference in height, distance and slope.

Table 1. Determination of the slope between different stations

Slope Percentage	Slope	Altitude difference	Distance from the station towards the first station	Distance from station	Height	Station
0.00	0	0	0	0	1814	Dehno
1.07	0.010667	32	3000	3	1782	Bashar Bridge
1.20	0.012	18	4500	1.5	1764	Sugar factory
0.26	0.002571	18	11500	7	1746	Mokhtar Bridge
0.35	0.003506	27	19200	7.7	1719	Sang Shekan Jokar
0.64	0.006449	89	33000	13.8	1630	Tal Gah

As can be seen, the slope of the station 4 is the lowest and gradually increased to the final station. The highest percentage of slope is related to the station 3. In Fig. 2, the average parameter of biochemical oxygen demand (BOD) is shown at various stations during the years 2010, 2011, 2012, 2013. As can be seen in Fig. 3, the highest biochemical oxygen demand (BOD) in all years is at Station No. 4 and station No. 6 has the lowest one. But for evaluating the significant differences was used from two sample t-test that the test results can be seen in Table 2.

Table 2. Significant differences in the parameters of BOD in different stations in different years

Years	Stations	Stations					
		1	2	3	4	5	6
2010	1	-	0.059	0.000	0.000	0.000	0.451
	2	0.059	-	0.000	0.000	0.000	0.000
	3	0.000	0.000	-	0.000	0.067	0.000
	4	0.000	0.000	0.000	-	0.000	0.000
	5	0.000	0.000	0.067	0.000	-	0.000
	6	0.451	0.000	0.000	0.000	0.000	-
2013	1	-	0.757	0.000	0.000	0.000	0.996
	2	0.757	-	0.000	0.000	0.000	0.490
	3	0.000	0.000	-	0.000	0.989	0.000
	4	0.000	0.000	0.000	-	0.000	0.000
	5	0.000	0.000	0.989	0.000	-	0.000
	6	0.996	0.490	0.000	0.000	0.000	-

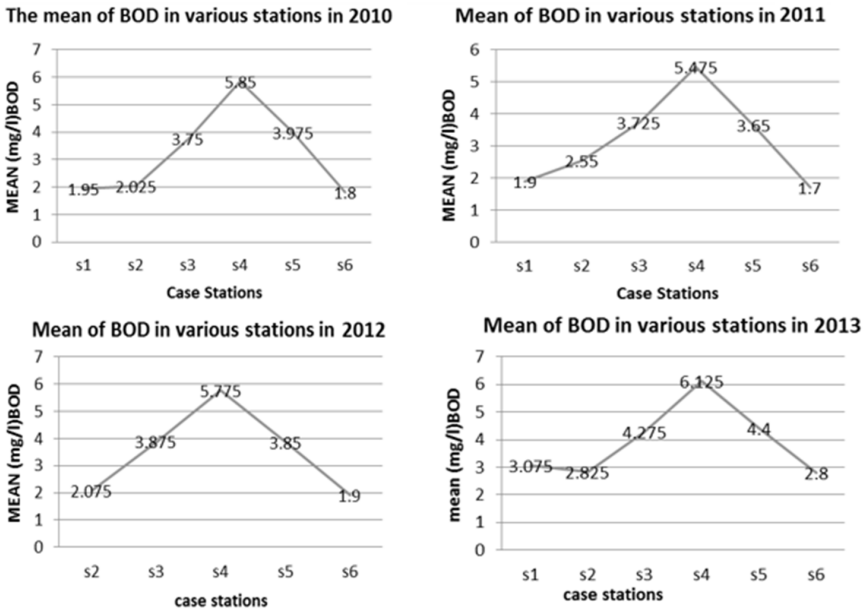

Fig. 2. The average of BOD in various stations during the years of 2010 to 2013

As shown in results, the difference for the parameter of BOD in 2010 between stations 1, 2 and 6, and between stations 5 and 3 is not significant but it is meaningful for the others. In 2011 the difference between Station 1 to 6 and between stations 5 and 3 is not significant but it is meaningful for others. In 2012 the difference between stations 2 and 1 with station 6 and between stations 5 and 3 is not significant but it is meaningful for others. In 2013 the difference between Station 1 and Station 2 and 6 and between stations 5 and 3 is not significant but it is meaningful for others. The least amount of slope between sampling stations is related to the station 4, while

the highest measurement of BOD refers to this same station. On the other hand, the percentage of slope gradually increased from station 4 to station 6 and the BOD level also gradually decreased, so it can be concluded that the slope of the river bed has a positive effect on the BOD and can reduce it.

According to the obtained results, ammonium and nitrite are averagely self-purified from the distance of 92.3 and 18.4 kilometers from the output of Arvad River, but phosphate due to the pollution in the path cannot be self-purified. Checking the self-purification of the river of Siahrud by Karvasi and Saberi in 1996 showed that in the winter due to low temperatures and high flow rate, oxygen uptake rises and accordingly oxygen dissolved in water gets higher and increases the activity of microorganisms of the river water as a result, increases the self-purification.

4. Conclusion

Self-purification capacity of a river is a critical factor in water pollution because when a river has high assimilative and self-purification capacity will have a greater capacity to remove organic pollutants. BOD is the best factor to check the pollution rate of a river towards organic pollutants, so by measuring this parameter along the river path, we can partially realize the self-purification capacity of the river. Among the factors affecting the level of BOD and self-purification capacity of a river can be pointed to the slope. According to the results of this research can be concluded that increasing of the slope percentage of the river bed can reduce the BOD and as a result will increase the self-purification capacity of the river.

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