TJAS
Tikrit Journal for Agricultural Sciences

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Study on the Self-purification of Tanjaro River

ABSTRACT

Self-purification capacity of a river is a significant indicator for the river health and it is in great importance in polluted water. Tanjero River lies southwest of Sulaimani city formed by linking two streams (Qiliasan and Kani-Ban streams) along its path the sewage of wastewater is discharged into the river that causes serious pollution and threatens the quality of water. Samples of water were taken from six stations (S1, S2, S3, S4, S5 and S6) along the Tanjero river. The data obtained from sample locations include velocity, depth, river discharge, water temperature, pH, electrical conductivity (EC), total dissolved solids (TDS), turbidity, dissolved oxygen (DO) and BOD. The De-oxygenation coefficient (k_1) and re-oxygenation coefficient (K_2) are then used to estimate the deficit value of predicted oxygen using the Streeter Phelps equation. The maximum de-oxygenation rate (K_1) and reaeration (K_2) rate (8.259541 day−1) and (15.22917day−1) were recorded in site (4) respectively. The fair ratio (f) or self-purification factor, for the Tanjero river was determined. The maximum fair ratio (f) value of (2.219) was recorded at site (2). The average fair ratio (f) was found to be (1.507) which classifies the river into large streams of low to normal velocities. This study revealed that using Streeter-Phelps method the natural self-purification occurred along the river as a result of continuous increasing of DO value and decreasing BOD value.

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INTRODUCTION

There is a rapid change in earth's climate due to the surges in human demands and rapid economic growth. These changes drive negative influences on the entire biosphere (Mohammed et al., 2021). Water is a natural resource necessary for all living creatures and has important roles for drinking, household, irrigation, fishery, fish fostering, recreation and many other activities. Pollution of the rivers is one of the largest challenges facing the new world, which is producing an unsettling position. Increased human activities and natural resources (spring water and well water) running into rivers make it necessary to assess the current water quality of rivers and predict potential betterments (Gao et al., 2019; Fregoso López et al., 2020). The Tanjero, is a river in Kurdistan region located about 7 km southwest of Sulaimani city. Tanjero River represents a permanent river formed by the confluence of Qiliasan and Kani-Ban streams near Kani-Goma village (Hamasalih, 2008). The River of Tanjero before discharge in Darbandikhan dam merging with some other small tributaries such as Kane Shaswaer and Bestansur. This river moves through Tanjero valley within crop land area. Different types of sewage wastewater discharge into the River

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(such as Industrial areas, Albisaka, Qalawa, Wluba and shekh-Abbas and bakrajo boxes), that caused pollution in the water environment.

Flowing water can purify itself with distances through a process which is called water self-purification. Despite the capability of rivers or streams to clean themselves of sewage or other wastes naturally. It is occurred by various processes which effort as rivers move downstream. Auto-purification includes some different mechanisms such as dilution, sedimentation, reaeration, adsorption, absorption, chemical and biological reactions. This complex mechanism is assessed by a mathematical model (Menezes et al., 2015). Water self-purification of each river system is mainly depending on natural factors some of which are; stram velocity, depth, and water temperature (Longe and Omole, 2008).

Dissolved oxygen (DO) is one of the crucial indicators of the quality and health of aquatic ecosystems and water self-purification processes as well (Gurjar and Tare, 2019; Xu, et al 2019). The fair ratio (f) or Self-purification factor of a river can be determined using Reoxygenation coefficient (K_1) and deoxygenation coefficient (K_2). K_2 is the oxygen uptake rate into the waters from the atmosphere, while the K_1 is the estimation of dissolved oxygen in natural streams. Both K_1 and K_2 depend on biological oxygen demand (BOD) and dissolved oxygen (DO) measurements respectively. The water of Tanjaro river is the source for domestic use, fishing and agriculture. Monitoring self-purification capacity of the will be helpful to put a pollution mitigation plan. The objective of this investigation to determine the de-oxygenation rate (K_1) and re-oxygenation rate (K_2), to know the oxygen sag curve and the ability of natural purification (self-purification) in the waters of Tanjero River.

MATERIALS AND METHODS

Water Sampling and analysis

Water samples were taken from the Tanjero River at different locations during winter 2021. Six stations were taken along the stretch of the river. The locations are labeled S1 to S6. The water samples were collected from sites S1, S2, S3, S4, S5 and S6 along the Tanjero river (Table 1), The total distance between the sampling sites S1 to S6 was about (30.6 km).

The samples of water were collected once a month during the year 2021 in polythene bottles of capacity 1 to 2 liter for several physicochemical parameters. Whereas BOD glass bottles were used for the samples of BOD and DO. All bottles were washed with sterilized deionized water before samples collection. During sampling, the bottles were thoroughly rinsed with the river water at points of collecting samples three times before taking any sample. Afterward, all samples were preserved at a temperature of 4˚C and transferred to laboratory. Due to the shallow water depth, the water sample was collected near the water surface, in the study area. Analyses were carried out in Soil chemistry laboratory of the College of Agricultural Engineering Sciences, at the Department of Natural Resources.

In this research, the water depth was measured using a rope with a metal tied at the tip of the rope at four different points along the river cross section at equal intervals. River discharge was determined by several measurements, including river depth, width and flow velocity. (Table 2). Some of the parameters were measured in-situ while others were determined in the laboratory. The parameter that was determined in-situ is river discharge, water temperature, pH, electrical conductivity (EC), total dissolved solids (TDS), dissolved oxygen (DO) and turbidity. A portable pH meter (Multi 340i/SET multi-parameter instrument WTW Company-Germany) was used to measure the pH of the water sample and a portable EC-meter (Cond 330i, 82362 Weilheim WTW Company-Germany) was used to calculate the water temperature and EC of the water. Turbidity of water was determined using a portable turbidimeter; model (Photo Flex Turb. WTW Company - Germany). Dissolved Oxygen (DO) was measured using a special oxygen-sensitive membrane electrode (HANNA instruments-H12400). Total dissolved solids (TDS) were computed by multiplying the EC (in μScm^{-1}) by a factor of (0.64). Analysis of BOD were done in the laboratory using the (OxiTop Model OC 110 Controller WTW company-Germany) is a handheld digital BOD meter was used to measure the BOD of the water sample.

Calculation of Self-purification capacity

1. Time of Travel (t)

The time of travel, t, was determined from velocity and distance traveled as follows equation:

$$Time\ (day) = \frac{Distance\ (km)}{Velocity\ (\frac{km}{h})} \times \frac{1\ day}{24\ hrs} \qquad (1)$$

2. Determination of De-oxygenation coefficient (K₁) and re-oxygenation coefficient (K₂)

The de-oxygenation coefficient, K_1 (day^{-1}), was computed from the equation below (Weiner and Matthews, 2003).

$$L = L_o 10^{-k1t} \qquad (2)$$

where L = instantaneous BOD, Lo = ultimate BOD and t = time in days. Therefore,

$$K_1 = \frac{1}{t} \log \frac{L0}{L} \qquad (3)$$

Experimental K_2 (day^{-1}) was determined from the equation (Agunwamba et al., 2007):

$$K_2 = \frac{Log\ DO - Log\ D}{t} \qquad (4)$$

which is also the same as:

$$K_2 = \frac{(Log\ DO/D)}{t} \qquad (5)$$

Where: DO is the initial dissolved oxygen; D is the deficit DO and equal to the difference between saturation dissolved oxygen and the observed dissolved oxygen.

3. Self-Purification factor (f)
The self-purification factor (f) can be computed by the following equation:

$$F = K_2 / K_1 \qquad (6)$$

Where:
K_2 = is the re-oxygenation coefficient
K_1 = is the De-oxygenation coefficient

Table (1) The self-purification factor (f) of different water bodies at 20◦C (Garg, 2006)

Tape of water body	Value of f (day^{-1})
Small ponds	0.05 – 1.0
Sluggish streams /Lakes	1.0 – 1.5
Large stream with low velocity	1.5 – 2.0
Large streams with moderate velocity	2.0 – 3.0
Swift streams	3.0 – 5.0
Rapids	>5.0

4. The dissolved oxygen sag curve
The DO sag curve is computed by the Streeter-Phelps equation. This curve is representing how the DO concentration in a volume of water alteration over time or distance after the organic substance is inserted. The DO sag equation which advanced from the pioneering work of Streeter -

Phelps (1925) has been used widely as a model in stream pollution which was developed for use on the Ohio River in 1914. The general form of this equation can be given as follows:

$$Dt = \frac{K1\ LO}{K2-K1}\left[e^{-k1t} - e^{-k2t}\right] + Do\ e^{-k2t} \qquad (7)$$

Where:
D = Oxygen deficit in river after time t, (mg/l)
Lo= Initial ultimate BOD at mix, (mg/l)
Do= Oxygen deficit in river after time Zero, (mg/l)
K_1= De-oxygenation rate constant, to base e (per day)
K_2= Re- oxygenation rate constant, to base e (per day)

Table (2) Data obtained from field work of Tanjero River

Sites	Distance (km)	Longitude	Latitude	River Depth (m)	Velocity (m/s)	Discharge (m^3/s)
S1	0	45° 42 '86" E	35° 47' 30"N	0.33	0.75	4.05
S2	9.81	45° 49 '28" E	35° 43' 69"N	0.35	0.77	3.14
S3	5.06	45° 52 '24" E	35° 40' 11"N	0.38	0.67	3.01
S4	1.53	45° 53 '56" E	35° 39' 32"N	0.35	0.83	4.31
S5	6.25	45° 53 '43" E	35° 39' 76"N	0.37	0.76	4.05
S6	7.96	45° 62 '49" E	35° 35' 53"N	0.40	0.75	4.74

Mapping the parameters

Mapping spatial distribution for all parameters along the Tanjero river was produced by ArcGIS10.8.1 environment. First, ArcGIS10.8.1 was used to create gird base maps based on Aster Digital Elevation Model ADEM (30*30 m) cell size for the river basin. The next hydrological geoprocessing tool is used to create stream attributes from ADEM. The parameters were interpolated by the inverse distance weighted (IDW) method to produce a spatial distribution map for selected sites.

RESULTS AND DISCUSSION

The chemical and physical characteristics of the studied water sample from the six sampling stations in the Tanjaro River were presented in Table (3). In this research, the temperature of the collected water samples varies between (18°C to 19°C). Warmer and colder temperatures are affected oxygen solubility in water. The colder water, the more oxygen content. Water samples show that the pH value ranged between 7.7 in station (2) and 8.1 in station (6) as represented in Figure (1). The pH of the studied area is slightly alkaline. Generally, the pH of water resources in Iraq (Kurdistan region) tends to the slightly alkaline side of neutrality (Nabi, A.O. 2005 and Ali, L., A., 2002).

Table (3) Results of physico-chemical analysis of water samples in the study area

Parameter	Units	Locations					
		S1	S2	S3	S4	S5	S6
Temp.	^{o}C	18	18	19	19	19	18
pH	-	7.82	7.73	7.90	7.94	7.91	8.05
EC ($_{25}^o$C)	µS cm^{-1}	730	722	714	711	685	657
Turbidity	NTU	620	320	169	145	205	233
DO	mg l^{-1}	6.4	6.8	7.01	7.10	7.38	7.46
BOD	mg l^{-1}	12.2	10.3	10.2	9.83	9.14	8.48
TDS	mg l^{-1}	467.2	462.1	456.1	455	438.4	420.5

According to results to of our study, samples of water from studied sites show increase in electrical conductivity (EC) which ranges from (657 - 730 µS cm^{-1}). Specific conductance is significantly influenced by the temperature, so all results modified to a standard temperature of 25°C. The EC is also powerful dependent upon the ionic strength of water (Hmasalih ,2014). The EC value

decreased along the river path, this result is not unexpected because the main water source for the river is wastewater from domestic sewage, which contains high amounts of dissolved salts (Ogunfowokan., *et al* 2005).

As shown in Fig. (2) and table (3) the turbidity of the water sample ranged between (150 - 620 NTU). The samples of water were found to be more turbid in all locations. This may be due to urban household activities, more waste discharge, and algal growth. Other human activities along the river that were noticed include dredging of sand from the river bed for construction objects. The total dissolved solids (TDS) of the studied water sample were ranged between (420 - 470 mg/l) is explained in Fig. (4). This figure shows the maximum concentration of TDS to occur at site (1). May be due to the discharge of several domestic and industrial wastewaters along the stream stretch and others, which contributes to high concentrations of dissolved solids.
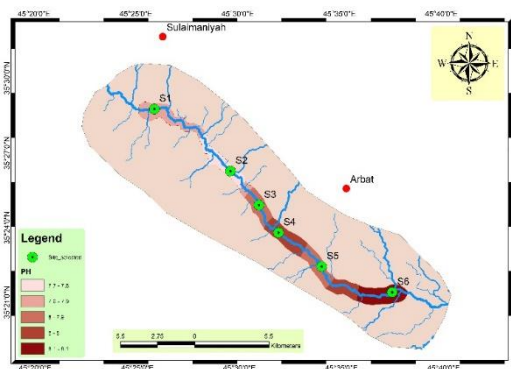

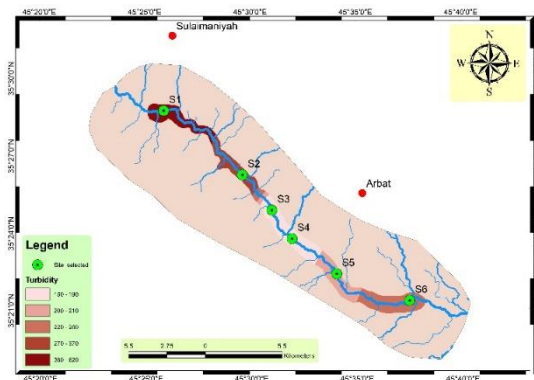Fig. (1) Zoning the PH value in studied area

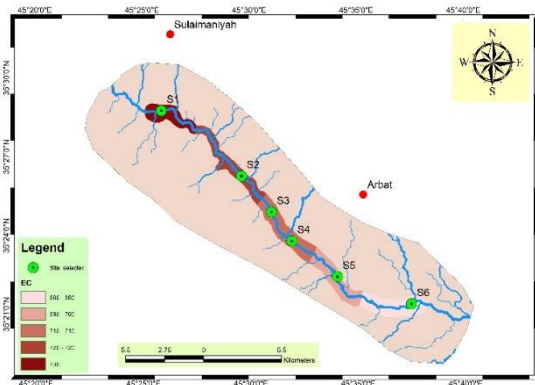Fig. (2) Zoning the Turbidity value in studied area
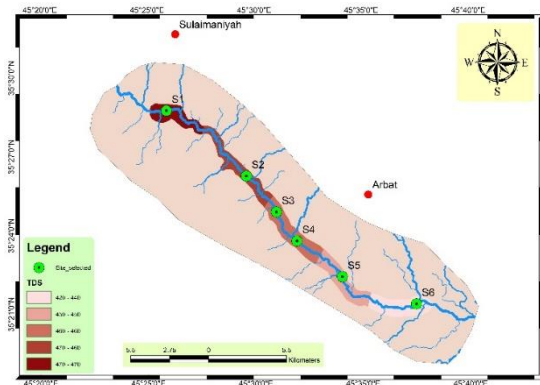

Fig. (3) Zoning the EC value in studied area

Fig. (4) Zoning the TDS value in studied area

Based on the results obtained from the analysis of dissolved oxygen concentration and BOD in the studied area. The DO and BOD values fluctuated in the ranges from (6.4 to 7.46 mg/L) and (8.48 to 12.2 mg/L) respectively. The lowest value of dissolved oxygen was 6.4 mg /L (location 1) and the highest was 7.46 mg /L (location 6) as shown in figure (5). The concentration of DO in the upstream was lower than that of the DO value in the downstream. This could occur because the water quality in the upstream part was deteriorated due to the waste generated from the activity of the residents in the form of domestic household waste, industrial waste, agricultural waste, and animal waste. Meanwhile, on the downstream part, the concentration of organic substance was low. This may be due to the high dilution factor in the downstream by linking with some small tributaries such as Kane Shaswaer that join the river. The temperature impacts the dissolved oxygen

not only by decreasing the solubility but also increasing the accelerate of breakdown (decomposition) of organic substance and therefore affecting the dissolved oxygen concentration in the water (Kaiser *et al.*, 2006).

Figure (6) shows BOD concentrations along the Tanjero River. The lowest BOD value occurred in location (6) was found (8.48 mg/L) and the highest BOD occurred in location (1) was found (12.2mg/L). BOD directly impacts the quantity of dissolved oxygen in rivers. The larger the BOD, the more quickly oxygen is depleted. The concentration of BOD in the upstream was higher than that of the BOD value in the downstream. Generally, the high level of BOD of Tanjero River may be attributed to the discharge of all effluent (untreated wastewater from domestic activities or many sewage outlet disposals, oil refiner, landfilled, restaurants, slaughter houses, industrial area and agricultural activities) of Sulaimani city. At downstream, it can be easily seen that BOD level slightly decreases due to the self-purification of the river.
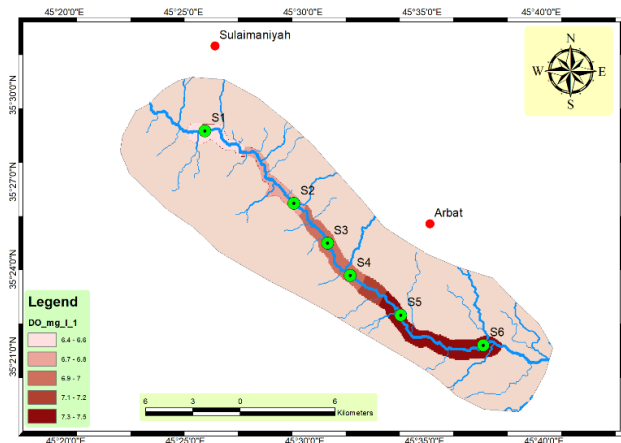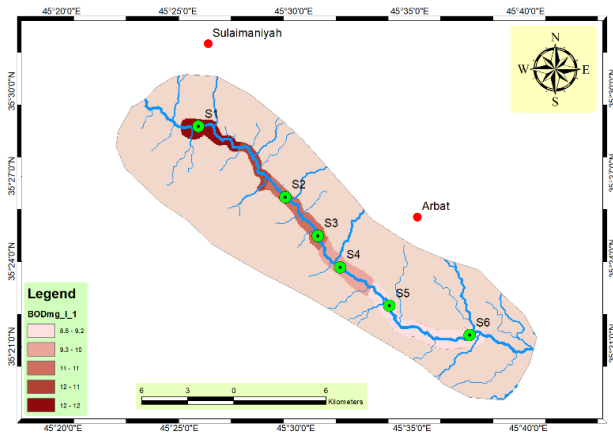

Fig. (5) Zoning the DO value in studied area

Fig. (6) Zoning the BOD value in studied area

DO Sag Curve:

Figure (7) illustrated the stacked line plots of the measured and predicted DO along the river path. From this figure the oxygen sag curves based on DO between (sampling point 1) km 0.0, (sampling point 2) km 9.81, (sampling point 3) km 14.87, (sampling point 4) km 16.39, (sampling point 5) km 22.64 and (sampling point 6) km 30.60 along the Tanjero River.

The De-oxygenation coefficient (K_1) and re-oxygenation coefficient (K_2) are then used to estimate the deficit value of predicted oxygen using the Streeter Phelps equation (equation 7). The oxygen reduction variation towards the distance that occurs in the river illustrated by the Graph of Oxygen Sag (Oxygen Sag Curve).

Figure (7), clarified the graph of oxygen sag (oxygen sag curve) based on dissolved oxygen deficit. The data showed that dissolved oxygen deficit decreased with distance from (km 0.0 to km 22.64) that deficit of dissolved oxygen reduced from (3 to 1.83 mg L^{-1}) and dissolved oxygen reduction increased with distance from (km 22.64 to km 30.60) that deficit of dissolved oxygen increased from (1.83 to 1.94 mg L^{-1}). It is indicated that the re-oxygenation rate (K_2) was higher than de-oxygenation rate (K_1). Obviously natural self-purification happened along the river. The measured dissolved oxygen has decreased at (sampling point 1), while the BOD at this point was increased. The low dissolved oxygen is may be due to of the high organic substance that input the waters, which is the quantity of oxygen consumed by microorganisms in the process of metabolizing organic substance is greater (Fisesa, 2014). The oxygen values content at sampling points 2 ,3, 4 and 5 towards sampling point 6 has begun to increase, The increase possible due to the absence of effluent discharge from both industrial and domestic waste. At these points, the waste enter also begins to decrease until the BOD values also decline. The continuous rise of DO from the lowest value denoted that natural self-purification occurred along the river.
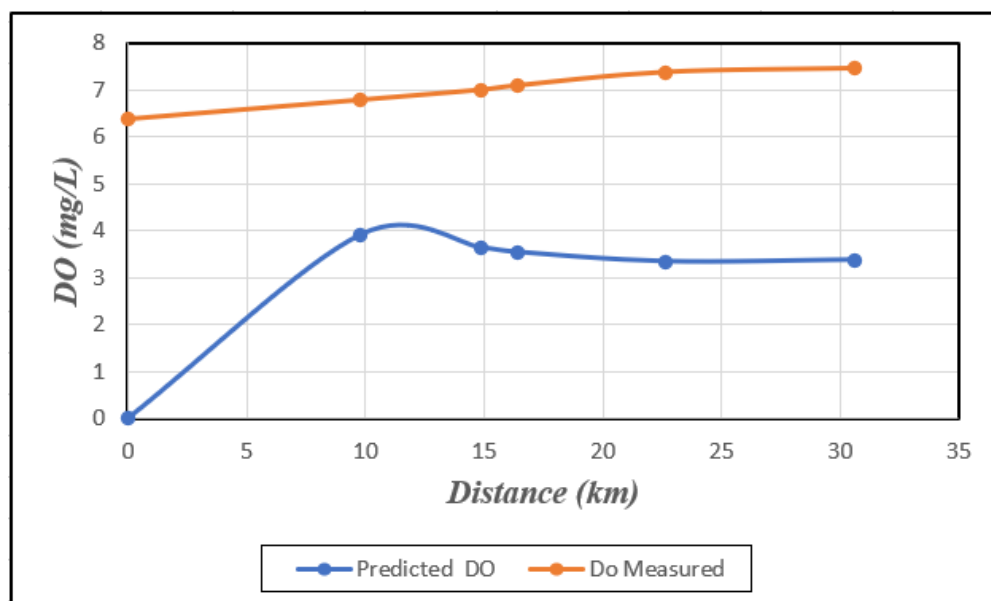
Figure (7) Plot of measured and predicted DO deficit against distance along the river

Self-Purification capacity

The fair ratio (f), and also known as self-purification factor, which is defined as the ratio of the re-aeration coefficient (K_2) to the de-oxygenation coefficient (K_1) is the indices used in estimating the self-purification capacity for this study. The importance of the self-purification factor (f) depends on the reaeration (K_2) and deoxygenation rates(K_1) of each sampling station. The maximum fair ratio (f) value of (2.219) was recorded at site (2). The average fair ratio (f) was found to be (1.507) which classifies the river into large streams of low to normal velocities (Table:1). The highest fair ratio (f) value at site (2) it is because the reaeration rate (K_2) at this location was high, while the deoxygenation rate (K_1) was low.

Re-oxygenation coefficient (K_2) and de-oxygenation coefficient (K_1) are influenced by the speed of the water flow, the distance between each site, and time of travel of water with organic materials in it. The de-oxygenation rate (K_1) was calculated by using Equation *(3)* The maximum de-oxygenation rates (8.259541 day^{-1}) were recorded in site (4) as shown in Table (4). The highest (K_1) values of the studied area may be due to the higher concentration of organic substances. Von Sperling (2014) and Dai et al., (2020) suggested that bodies of shallower water tend to have greater coefficient of re-oxygenation, as a result of ease diffusion of oxygen across the water profile and higher surface turbulence. The higher (K_1) value, might also be due to that the

Table (4) Computation of K_1 and K_2 of Tanjero River

Sites	Time (day)	DO (mg l^{-1})	DO deficit	BOD (mg l^{-1})	K_1 (day^{-1})	K_2 (day^{-1})	F
S1	0	6.4	3	12.2	0	0	0
S2	0.14756	6.8	2.6	10.3	1.267165	2.564311	2.219265
S3	0.08732	7.01	2.2	10.2	2.014051	3.005493	1.946971
S4	0.02129	7.10	2.11	9.83	8.259541	15.22917	1.843828
S5	0.09504	7.38	1.83	9.14	1.850482	3.41197	1.492263
S6	0.12284	7.46	1.94	8.48	1.522204	2.342909	1.539155

depth of the river influences the life of microorganisms in it, where the deeper depth of the river would be reduced oxygen content and less the number of microorganisms present in the water is also the rate of de-oxygenation in a river would be low. The Equation *(4 or 5)* was use to calculation of re-oxygenation coefficient (K_2). From the Table (4) showed that the highest values of K_2 (15.22917day^{-1}) were recorded in site (4). The value of K_2 decreases with increasing depth. The

high rate of reaeration K_2 is affected by flow velocity. The velocity of river water increases, the re-oxygenation coefficient (K_2) also increases, indicating an increased rate of oxygen transfer from the atmosphere to the water body. Also, K_2 increases with an increase in temperature, the greater is this rate, the quicker will self-purification.

CONCLUSIONS

In this research the maximum fair ratio (f) value was recorded at location (2) which shows that re-oxygenation rate (K_2) predominates de-oxygenation rate (K_1) Hence, the river was classified as large streams of low to normal velocities. Increase in velocity of river water results in a greater value of re-oxygenation rate (K_2). The depth of water is inversely proportional to re-oxygenation rate (K_2). The continuous increase of DO value also decreasing BOD value denoted that natural self-purification occurred along the river.

REFERENCES

Agunwamba J.C., C.N. Maduka and A.M. Ofosaren, (2007). Analysis of pollution status of Amadi Creek and its management. J. of Water Supply: Research and Technology-AQUA ,55 (6): 427- 435. https://doi.org/10.2166/aqua.2006.036

Ali, L., A., (2002). Algal studies in Sewage Water within Erbil City. M.Sc. Thesis, College of Science, University of Salahaddin.

Dai, Z., Zhang, J., She, R., Hu, N., Xia, S., Ma, G., ... & Ming, R. (2020). Numerical investigation on Re-oxygenation efficiency of stepped overflow weir in urban stream. Journal of Cleaner Production, 258, 120583. https://doi.org/10.1016/j.jclepro.2020.120583

Fisesa, E. D., I. Setyobudiandi dan M. Krisanti. (2014). Aquatic Conditions and Macrozoobenthos Community Structure in the Belumai River Deli Serdang District, North Sumatra Province, 3 (1):1-9.

Fregoso-López, M.G., Armienta-Hernández, M.A., Alarcón-Silvas, S.G. et al (2020). Assessment of nutrient contamination in the waters of the El Fuerte River, southern Gulf of California, Mexico. Environ Monit Assess 192, 417. https://doi.org/10.1007/s10661-020-08354-7

Gao, Y., Yu, J., Song, Y., Zhu, G., Paerl, H. W., & Qin, B. (2019). Spatial and temporal distribution characteristics of different forms of inorganic nitrogen in three types of rivers around Lake Taihu, China. Environmental Science and Pollution Research, 26:6898–6910. https://doi.org/10.1007/s11356-019-04154-w

Garg, S.K. (2006). Sewage disposal and air pollution engineering. Environmental Engineering, Vol. ll, 18th ed., Khanna Publishers, New Delhi.

Gurjar, S. K., & Tare, V. (2019). Spatial-temporal assessment of water quality and assimilative capacity of river Ramganga, a tributary of Ganga using multivariate analysis and QUEL2K. Journal of Cleaner Production, 222, 550-564. https://doi.org/10.1016/j.jclepro.2019.03.064

Hamasalih, N. Y., (2008). Limnological and Hygienic Studies on Tanjero River within Sulamani city Kurdistan Region – Iraq. M.Sc. Thesis College of Agriculture University of Sulaimani. p.13

Hamasalih, N. Y., (2014). Water Quality Index (WQI) of some well located in the region of Kani Goma and Kanasura in Sulaimani Governorate. Journal of Zankoy Sulaimani- Part A (JZS-A), 2014, 16 (1).

Kaiser M.J., Attrill M. J., Jennings S., Thomas D.N., Barnes D. A., Brierley A. S., Polunin N.V. C., Raffaelli D.G. and Williams P.J. le B. (2006). Marine ecology: Processes, Systems, and Impacts. Oxford, University Press.

Longe, E. and Omole, D. (2008). Analysis of pollution status of River Illo, Ota, Nigeria. The Environmentalist 28 (4): 451– 457 https://doi.org/10.1007/s10669-008-9166-4

Menezes, P. C., Bittencourt P. R., Farias S. M. D., Bello P. I., Oliveira L. F. C. and Fia R. (2015). Deoxygenation rate, reaeration and potential for self-purification of small

tropical urban streams. Revista Ambiente & Água, 10(4): 748-757. https://doi.org/10.4136/ambi-agua.1599.

Mohammed, Fahmy O., Mohammad, A.O., Ibrahim, H.S. and Hasan, R.A. (2021). Future Scenario of Global Climate Map change according to the Köppen -Geiger Climate Classification. Baghdad Science Journal. 18 (2) (Suppl.):1030. https://doi.org/10.21123/bsj.2021.18.2(Suppl.).1030.

Nabi, A.O. (2005). Limnological and bacteriological studies on some wells with in Hawler city, Kurdistan region-Iraq. M.Sc. Thesis College of Science University of Sallahaddin.

Ogunfowokan, A. O., Okoh, E. K., Adenuga, A. A., and Asubiojo, O. I. (2005). An assessment of the impact of point source pollution from a university sewage treatment oxidation pond on a receiving stream–a preliminary study. Journal of applied sciences, 5(1): 36-43.

Streeter, H. and Phelps, E. (1925). A study of the pollution and natural purification of the Ohio River. U. S. Public Health Service. Public Health Bulletin, (146):75.

Von Sperling, M. (2014). Introdução à qualidade das águas e ao tratamento de esgoto. 4. ed. Belo Horizonte: Departamento de Engenharia Sanitária e Ambiental; Universidade Federal de Minas Gerais, (1) :472.

Weiner, R. and Matthews, R. (2003). Environmental Engineering. 4th Edition, Elsevier Sciences.

Xu, J., Jin, G., Tang, H., Mo, Y., Wang, Y. G., & Li, L. (2019). Response of water quality to land use and sewage outfalls in different seasons. Science of The Total Environment, 696, 134014. https://doi.org/10.1016/j.scitotenv.2019.134014 .

دراسة حول التنقية الذاتية لنهر تانجرو

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الخلاصة

الكلمات المفتاحية:
منحنى الهبوط للاوكسجين ,العوزفي الاوكسجين الذائب, معامل ازالة الاوكسجين(k1), معامل الاكسجة (K2) , النسبة العادلة.

تعتبر قابلية التنقية الذاتية للنهر دليل مؤثر لحيوية النهر ولها اهمية كبيرة في تلوث المياه . يقع نهر تانجرو في الجنوب الشرقي لمدينة السليمانية حيث يتكون من التقاء مجرى قلياسان ومجرى كاني بان يتلقى النهر على طول مجراه مياه صرف المجاري مما يسبب بحدوث تلوث خطير ويؤثر على جودة المياه. اخذت عينات المياه من ستة مواقع (S6,S5,S4,S3,S2,S1) على طول مجرى النهر . تم قياس البيانات للمواقع المذكورة لكل من المعايير التالية: السرعة,العمق , تصريف النهر, درجة حرارة المياه , درجة الحموضة , التوصيل الكهربائي , المواد الصلبة الكلية الذائبة , العكارة , الاوكسجين الذائب , الطلب الحيوي للأوكسجين. تم استخدام كل من معامل ازالة الاوكسجين(k1) ومعامل الاكسجة لتقدير قيمة العوز للاوكسجين المخمن بأستخدام معادلة ستيرر فلبس (Streeter Phelps)تم تقياس أعلى قيمة لكل من معامل ازالة الاوكسجين(k1) ومعامل الاكسجة (K2) حيث كانت القيم 15.22917 يوم $^{-1}$ و 8.259541 يوم $^{-1}$ للموقع (S4) على التوالي . تم تقدير النسبة العادلة او عامل التنقية الذاتية لنهر تانجرو حيث كانت اعلى قيمة 2.219   عند الموقع الثاني كان متوسط عامل التنقية الذاتية لنهر تانجرو 1.507   والذي على اساسه يتم تصنيف النهر من ضمن المجاري الكبيرة ذات السرعة البطيئة الى الطبيعية . اظهرت هذة الدراسة بأستخدام طريقة ستيرر فلبس (Streeter Phelps) للحصول منحنى العوز للاوكسجين بأن التنقية الذاتية الطبيعية حدثت على طول مجرى النهر كنيتيجة للزيادة المستمرة في نسبة الاوكسجين الذائب والانخفاض في نسبة الطلب الحيوي للأوكسجين.