MANAGING DECONTAMINATION OF KHORRAM ABAD RIVER

GESTION DE LA DECONTAMINATION DE LA RIVIERE KHORRAM ABAD

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ABSTRACT

Rivers provide water for the industrial, agricultural and urban sectors. Due to water scarcity and continuing industrial development in Iran, maintaining river water quality is of great importance. The pollution load of rivers in Iran is recently increased due to disposing drainage and sewage waters into the rivers. This aspect is to be studied for identifying remediation measures. Sustainable management of water quality requires measurement of contaminants, predict water quality and decide its suitable level of applications. The objectives of this study were to investigate the quantity and quality of contaminations in Khorram Abad River, to identify the contaminant resources and to propose a management scheme to control these pollutants. For these purposes, 31 sampling stations were selected along the river and were assessed for temperature, turbidity, electrical conductivity, Cl^-, SO_4^{2-}, Na^+, K^+, Ca^{2+}, Mg^{2+}, NO^{3-}, PO_4^{2-}, TDS, BOD_5, COD, TSS, pH and heavy metals at different times. It was observed that the pollutant resources of this river were the industrial, urban and agricultural activities. To obtain a relation between river pollution parameters in the studied stations at different time periods, the Pearson correlation was determined between parameters for six time periods, using the SPSS software. The results indicated that EC had high correlation with COD, Mg^{2+}, TSS, BOD, NO_3^-, SO_4^{2+} and turbidity and it had negative correlation with soluble oxygen. Soluble oxygen had negative correlation with most parameters than Na^+, Ca^{2+}, Cl^- and K^+ and among these, had most negative correlation with EC, BOD, Mg, TSS and turbidity. The negative correlation indicates that by increasing pollution, soluble oxygen in water was decreased. The pH had negative correlation with DO and had high correlation with EC, SO_4^{2+}, NO_3^-, po_4^{2-}, temperature, turbidity, BOD, COD, Mg and TSS. This correlation had the same trend variations as for the parameters measured along side of the river. The heavy metals also had high correlations with each other. Heavy metals that have high correlation together had same resources and trend of variations along the river length. The urban sewage is to be treated to reduce pollution of the water in the Khorram Abad River.

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RESUME

Les rivières fournissent l'eau pour les secteurs industriels, agricoles et urbains. En raison de la rareté de l'eau et la poursuite du développement industriel en Iran, l'entretien de la qualité de l'eau du fleuve est de grande importance. La charge de pollution des rivières en Iran a augmentée récemment car les eaux de drainage et les eaux usées sont jetées des dans les rivières. Cet aspect doit être étudié pour identifier les mesures d'assainissement. Pour la gestion durable de la qualité de l'eau il faut mesurer des contaminants et la qualité de l'eau et décider de son niveau approprié d'applications. Les objectifs de cette étude étaient l'étude de la quantité et de la qualité des contaminations dans la rivière Khorram Abad, afin d'identifier les ressources de contaminants et de proposer un schéma de gestion pour contrôler ces polluants. À ces fins, 31 postes d'échantillonnage ont été sélectionnées au long de la rivière et ils ont été évalués pour la température, la turbidité, la conductivité électrique, Cl^-, SO_4^{2-}, Na^+, K^+, Ca^{2+}, Mg^{2+}, NO_3^-, PO_4^{2-}, TDS, DBO_5, DCO, SST, pH et les métaux lourds à des époques différentes. L'on a observé que les sources des polluants de cette rivière éraient les activités industrielles, urbaines et agricoles. Pour obtenir un lien entre les paramètres de la pollution des rivières dans les postes étudiées à différentes périodes, la corrélation Pearson a été déterminée entre les paramètres pour six périodes pendant l'expérience, en utilisant le logiciel SPSS. Les résultats indiquent que la CE avait une forte corrélation avec DCO, Mg^{2+}, SST, DBO, NO_3^-, SO_4^{2+} et la turbidité, et il avait une corrélation négative avec l'oxygène soluble. L'oxygène soluble avait une corrélation négative avec la plupart des paramètres comme Na^+, Ca^{2+}, Cl^- et K^+ etc, et une corrélation négative la plus importante avec la CE, DBO, Mg, SST et la turbidité. The corrélation négative indique que l'oxygène soluble dans l'eau a été diminué en raison de la pollution croissante. Le pH a une corrélation négative avec OD et il avait une corrélation forte avec la CE, SO_4^{2+}, NO_3^-, PO_4^{2-}, la température, la turbidité, DBO, DCO, Mg et SST. Cette corrélation a les même variations que pour les paramètres mesurés au long du côté de la rivière. Les métaux lourds avaient également eu une forte corrélation les uns avec les autres. Les métaux lourds qui ont une forte corrélation ensemble avaient les mêmes ressources et les même variations le long du fleuve.

Les eaux usées urbaines doivent d'être traitées pour réduire la pollution de l'eau dans le fleuve Khorram Abad.

Mots clés: *Décontamination, rivière Khorram Abad, gestion, qualité de l'eau, métaux lourds*

1. INTRODUCTION

A river is part of the hydrological cycle. Water within a river is collected from precipitation, surface runoff, groundwater recharge, springs, and the release of stored water in natural ice and snow packs.

A river is a natural freshwater body, flowing towards an ocean, a lake, a sea, or another river. In a few cases, a river simply flows into the ground or dries up completely before reaching

another body of water. River water is subject to pollution as it flows downstream due to disposal of effluents from agricultural, industrial and domestic systems. Concerning municipal wastewater, the bulk of the collected sewage is discharged untreated and constitutes a major source of pollution to the river and the groundwater and a risk to public health. In a number of cities without sanitary sewerage, households discharge their sewage through open rainwater drains (World Bank, 2005).

Due to water deficiency and industrial developments in Iran, schematization and consideration of water quality of rivers is the most importance that must be taken into consideration. The pollution load of rivers in Iran is recently increased due to drainage out different poor quality waters as well as some sewage. This justifies the need for conducting studies for remediation. Management of surface water resources quality is of great importance for suitable and appropriate use of available resources.

Disposing industrial, agricultural and municipal effluents with different pollutant into rivers have negative effect on river ecosystem. They increase water turbidity and reduce dissolved oxygen. Therefore, possibility of Self-remediation of rivers was reduced. Assessing self-remediation of rivers is one of river pollution control methods in surface water management. Any sustainable management of water quality would lead to reduce contaminant load and to decide upon the water applications in different activities based on its quality.

The objectives of this study were to investigate the quantity and quality status of contaminations in Khorram Abad River, to identify the contaminant resources and to propose a management scheme to control these pollutants. All contaminants remediation is impossible and need much money. Therefore, attempt is to be made to remediate contaminants until river water quality becomes lower than the critical limit.

2. MATERIALS AND METHODS

Lorestan province with 288000 km^2 area is located in the west of Iran. Khorram abad city is situated between 48°, 21' E longitude, and 30°, 43' N latitude. This area has moderate winter and hot summer. Annual rainfall is about 520 mm. It was observed that the pollutant resources of this river are industrial, urban and agricultural activities.

Industrial pollutant. Khorram abad city has 28% of total industries in Lorestan province. Effluents from the industries not only contaminate the water resources used in the city, but also the villages around this city. Critical level of COD, BOD_5, TSS are 60, 30 and 40 mg/lit, respectively. Figure 1 shows wastewater of all industries that discharge their effluent into the river was of higher than critical level.

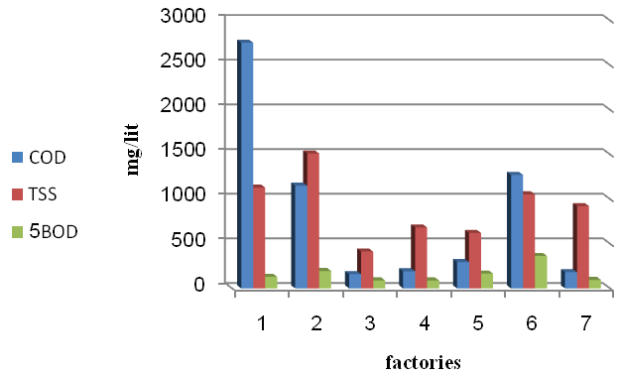

Fig. 1. Trend Variations of COD, TSS and BOD_5 in seven studied industrial factories

Urban pollutant. Due to good slope towards Khorram abad river, all urban sewages, including runoff, drain out into this river. Whereas main part of urban runoff without any control drainage into the river, pollutant concentration of river during rainfall period was increased. Also, the waste water from the villages around the river flow into the river and pollutes the water.

Agricultural pollutant. In the recent years, use of pesticides and fertilizers in farmlands have increased with agricultural development. Agricultural effect on water quality of the river is not only via using water and reducing discharge but also is via drainage of agricultural wastewater into the river.

3. RESULTS

To evaluate water quality and recognize the pollutants, 31 sampling stations were selected along the river and were assessed for temperature, turbidity, electrical conductivity, Cl^-, SO_4^{2-}, Na^+, K^+, Ca^{2+}, Mg^{2+}, NO_3^-, PO_4^{2-}, TDS, BOD_5, COD, TSS, pH and heavy metals at different times. All experiments done based on standard methods of water and sewage experiments (Gupta, 2000).

COD concentration until sixth section was low and it increased thereafter due to drainage of urban sewage. Figure 2 shows trend variations of COD in different months of year.

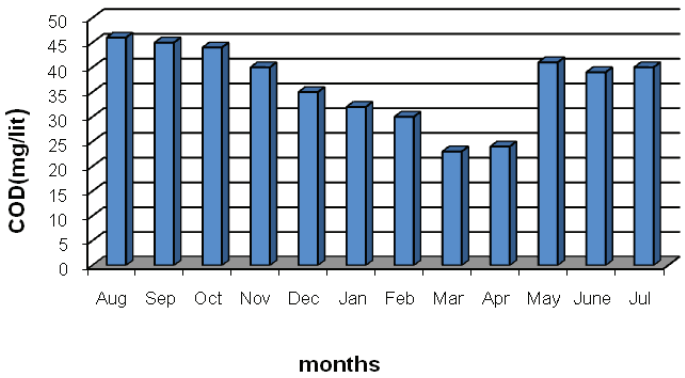

Fig. 2. Variations trend of COD in different months of year in Khorram abad river

BOD concentration slowly increased until 8th section but after that it increased rapidly to higher than critical level due to disposal of urban sewage. Also, contaminant concentration in summer increased due to reduced river flow (Figure 3).

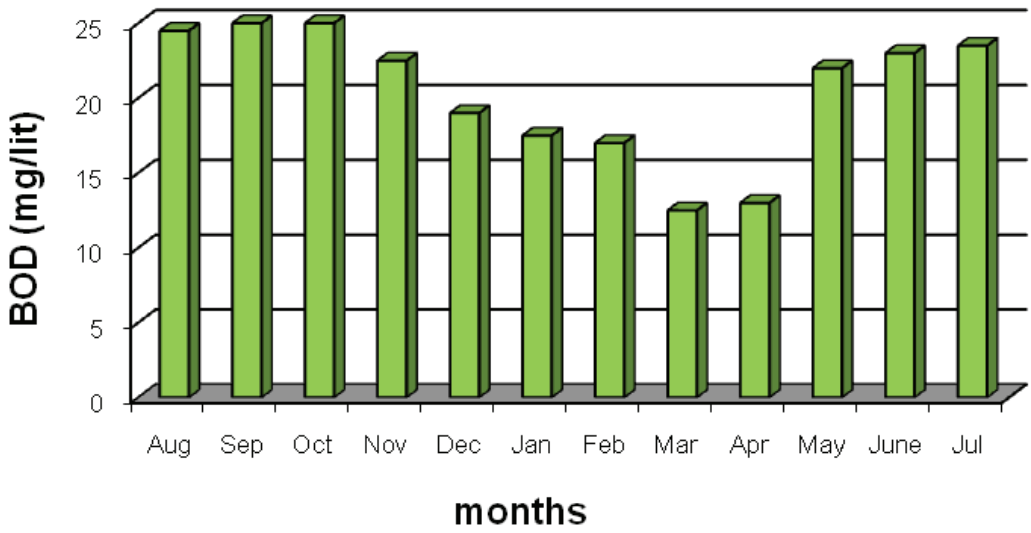

Fig. 3. Variations trend of BOD in different months of year in Khorram abad river

To obtain a relation between river pollution parameters in the stations considered in the study at different time periods, the Pearson correlation was determined between parameters for six time periods, using SPSS software. Table 1 shows correlation between measured parameters in Khorram abad river.

The results indicated that EC had high correlation with COD, Mg^{2+}, TSS, BOD, NO_3^- and turbidity and it had negative correlation with soluble oxygen. Soluble oxygen had negative correlation with most parameters than Na^+, Ca^{2+}, Cl^- and K^+ and among these, had most negative correlation with EC, BOD, Mg, TSS and turbidity.The negative correlation indicates that by increasing pollution, soluble oxygen in water was decreased. The pH had negative correlation with DO and had high correlation with EC, SO_4^{2+}, NO_3^-, po_4^{2-}, temperature, turbidity, BOD, COD, Mg and TSS. This correlation had the same trend variations as for the parameters measured along side of the river.

Table 1. Correlation between measured parameters in the river

	Temp	pH	K	TSS	TDS	Cl	NO_3	PO_4	Mg	COD	DO	BOD	SO4	Ca	Na	EC	
0.53**	0.42*	0.50**	0.19	0.48**	0.41*	0.27	0.50**	0.45*	0.85**	0.59**	-0.60**	0.59**	0.46*	0.35	0.20	1	EC
0.03	0.08	0.23	0.68**	0.22	0.11	0.40*	0.47*	0.49**	0.38*	0.4*	0.11	0.33	0.58**	0.42*	1		Na
0.28	0.57**	0.37*	0.79**	-0.13	0.77**	0.69**	0.90**	0.84**	0.67**	0.69**	0.09	0.67**	0.67**	1			Ca
0.39*	0.52**	0.48**	0.48**	0.33	0.47**	0.56**	0.75**	0.70**	0.71**	0.68**	-0.06	0.67**	1				SO4
0.69**	0.83**	0.78**	0.44*	0.48**	0.51**	0.28	0.89**	0.86**	0.91**	0.99**	-0.34*	1					BOD
-0.66**	-0.54	-0.46*	0.23	-0.63**	-0.11	0.2	-0.19	-0.11	-0.48**	-0.38*	1						DO
0.67**	0.81**	0.75**	0.49**	0.48**	0.55**	0.36*	0.90*	0.87**	0.92**	1							COD
0.65**	0.71**	0.70**	0.47**	0.49**	0.58**	0.41*	0.85**	0.80**	1								Mg
0.40*	0.70**	0.55**	0.67**	0.20	0.58**	0.45*	0.93**	1									PO4
0.55**	0.73**	0.56**	0.73**	0.22	0.74**	0.21	1										NO3
0.01	0.16	-0.06	0.76**	-0.17	0.74**	1											Cl
0.47*	0.41*	0.15	0.62**	-0.001	1												TDS
0.65**	0.38*	0.56**	-0.12	1													TSS
0.11	0.25	0.18	1														k
0.70**	0.73**	1															pH
0.64**	1																Temp
1																	NTU

Also, to estimate relation between heavy metals in stations and different time periods calculated Pierson correlation between parameters. Table 2 shows correlation between measured heavy metals in Khorram abad river.

Table 2. Correlation between heavy metals in the river

Cu	Pb	Cd	Cr	Zn	
0.932**	0.849**	0.890**	0.909**	1	Zn
0.852**	0.954**	0.884**	1	0.909**	Cr
0.730**	0.874**	1			Cd
0.776**	1				Pb
1					Cu

The results also indicated that heavy metals had high correlations with each others. The Zn had the highest correlation with other heavy metals of swages. This indicates that all the effluents contain Zn. The Cd had less correlation with other heavy metals. This shows it doesn't follow the other heavy metals trends. Heavy metals that have high correlation together had same resources and trend of variations in length of river. Finally, for decreasing pollution load of Khorram Abad River, the urban sewage needs to be adequately treated before discharging it into the river. This will highly improve the water quality of the river by reducing organic matter and raising soluble oxygen level in water.

REFERENCES

Gupta, P.K. (2000). Soil, Plant, Water and fertilizer analysis. Agrobios, New Delhi, India. P. 438.

World Bank: Northern Cities Water Supply and Sanitation Project. 2005. Report No: 31984 – IR. P: 29-30