



Changes in Self-Purification Capacity of the Ahvaz Karun River in 2008 and 2014 using QUAL2K_w Model

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ABSTRACT: The Karun River receives large quantities of domestic wastewater, industrial effluents and agricultural drainage water during its course. Since every river has a certain capacity for accepting incoming pollutants and for self-purification, knowledge of the trend of changes in self-purification capacity is of great importance. This research studied changes in the self-purification capacity of the Karun River in the 42-kilometer distance between the Zergan and Kot Amir stations Such as 2008-2009 and 2013-2014. Changes in the parameters of pH, electrical conductivity (EC) and biochemical oxygen demand (BOD) in mentioned two years were first simulated for the two months of August and January using the calibrated Qual2K_w model. The observed data was then compared with the calculated data using the square of the correlation coefficient (R²) and the mean absolute error (MAE). Results showed that the Karun River could not purify itself with respect to the EC parameter in 2008-2009 and BOD parameter in 2013-2014. Moreover, the best simulation of the model was achieved for the pH parameter and the simulations for the BOD and EC parameters were the second and third, respectively.

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1- Introduction

The Karun River is one of the major suppliers of water for various uses including agriculture, drinking water and industries in Khuzestan Province. Therefore, this research studied the self-purification power of the Karun River in 2008 and 2013 to evaluate changes in this power after a period of five years while considering climate change, volumes of water taken from the river and wastewater management during these two years.

2- Methodology

Self-purification of the Karun River in 2008 and 2013 was simulated with the help of the calibrated model Qual2K_w. The simulated diagrams of changes in the biochemical oxygen demand (BOD) (in terms of CBOD), electrical conductivity (EC) and pH in these two years were compared with values measured at the stations in the study region (the Zergan, Ahvaz, and Kot Amir Stations). The related statistical data was obtained from the Laboratory of the Khuzestan Water and Power Organization in Ahvaz.

The main equation of the mentioned model numerically solved was the equation of the one-dimensional distribution of displacements obtained from Eq. (1) [2, 3].

$$\frac{\partial c}{\partial t} = \frac{\partial(AD_L \frac{\partial c}{\partial x})}{A \partial x} - \frac{\partial(Auc)}{A \partial x} + \frac{dc}{dt} + \frac{S}{V} \quad (1)$$

In the above relation:

- *C*: the concentration of the pollutant (mg/l)
- *A*: the cross-sectional area of the element or segment perpendicular to the flow (m²)
- *t*: time (s)
- *D_L*: dispersion coefficient (m²/s)
- *x*: length of the river (m)
- *u*: average flow rate (m/s)
- *S*: external source (mg)
- *V*: volume of the element (m³)

The study region extends from the entrance of the river into Ahvaz in Zargan (longitude of 48° 45' 33", latitude of 31° 22' 33" and average altitude of 18 meters) to its exit from this city at Kot Amir (latitude of 31° 33' 54", longitude of 48° 33' 54" and average altitude of 13 meters). Therefore, the study area covered a 42-kilometer stretch of the river.

River discharge under conditions of water shortage during 20 statistical years at the Ahvaz Station was analyzed and Mordad¹ was selected as the critical month. For this purpose, the river course was divided into 10 segments. The width of the riverbed² was calculated by drawing the profile of each segment using Geographic Information System (GIS) and based on the cross-sectional area of each segment. The slope of each segment of the channel was calculated by dividing the difference between the altitude of the beginning and the end of the segment by the length of the segment. The selected roughness coefficient for the Karun River was 0.028

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¹ The period from 22 July to 21 August

² River bed width

[4]. Meteorological characteristics of the days in the study period used in the model included wind speed, dew point, percent cloudiness, solar energy and 24-hour air temperature taken from the International Meteorological Site [5]. Squared Pearson correlation coefficient (R^2) and mean average error (MAE) were used to compare the accuracy of each simulated parameter with that of the observed value [1].

3- Results

Comparison of the diagrams of changes in the EC parameter in the month of Dey¹ in 2008 and 2013 revealed that the volume of wastewater entering the Karun River was greater in 2008 compared to 2013. That is why the predictions of the model included larger values for 2008. Moreover, in neither of the two years was any self-purification observed in the EC parameter. Comparison of the diagrams for the EC parameter for the month of Mordad in 2008 and 2013 showed its values in 2013 decreased compared to those of 2008. It seems the reduction in the volume of wastewater entering the river was the reason for this decrease. Furthermore, the Karun River was somewhat able to purify itself in 2013, but it could not do this in 2008.

Comparison of the two diagrams and the measured points in 2008 and 2013 for the BOD parameter showed the effects of non-point sources (not considered in the model) were clearly tangible and effective for both years. Comparison of the diagrams for BOD in the month of Mordad in these two years indicated that, in general, its value in 2013 was greater compared to that in 2008.

Comparison of the two diagrams for pH in the month of Dey in 2013 and 2008 showed no considerable differences between them. The water in the Karun River in the month of Dey in both years was alkaline, one of the reasons for which was the discharge of rural and urban wastewater of this region into the river. Comparison of the two diagrams for the pH parameter in the month of Mordad in 2013 and 2008 indicated that the pH values for 2013 were higher as compared to those for 2008, and that the water was alkaline

in this month as it was in Dey.

4- Conclusions

Comparison of changes in the ability of the Karun River for self-purification in the two years showed that during this five-year period the problems with increases in the EC parameter and with increases in water salinity were not solved. Moreover, increases in the BOD parameter and the inability of the river in self-purification (especially in rainy months) will be among the problems the river will face in future. Considering the values of R^2 and MAE, the best simulations were for the pH parameter followed by those for BOD and EC, respectively.

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¹ The period from 22 July to 21 August

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