Impact of Municipal Wastewater and Sulfur Springs on The Physicochemical Properties of The Euphrates River, Western Iraq

Muwafaq Rabeea*[1], Ahmed J. R. Al-Heety[2], Tahseen A Zaidan[1], Mohamed Elhag*[3,4,5], Ahmed Al-Rawi[6]

[1]Department of Applied Chemistry, College of Applied Sciences, University Of Anbar. Hit, Anbar 31007. Iraq.
[2]Seismic Processing Center/ Oil Exploration Company/ Baghdad-Iraq.
[3]Department of Hydrology and Water Resources Management, Faculty of Meteorology, Environment & Arid Land Agriculture, King Abdulaziz University, Jeddah 21589, Saudi Arabia.
[4]Institute of Remote Sensing and Digital Earth (RADI), Chinese Academy of Science (CAS), Beijing 100094, China.
[5]Department of Applied Geosciences, Faculty of Science, German University of Technology in Oman, Muscat 1816, Oman.
[6]Department of Chemistry, College of Pure Sciences, University Of Anbar.
*Corresponding authors E-mail: muw88@uoanbar.edu.iq & melhag@kau.edu.sa

Abstract

In this study, the environmental damage of Euphrates water caused by the three main sources of wastewater (municipal wastewater and tar spring water) in the Hit sector was investigated. Surface water monitoring was performed by selecting four sampling points to describe the upstream, mixing zone and downstream water systems of Euphrates River. The physicochemical properties of water at wastewater confluence sites indicated a hydrochemical uni-intrusion vortex behavior that was detected and confirmed by spatial variation of important indicators related to environmental applications, including (K, Na, Ca , Mg, HCO3, SO4, Cl, NO3, PO4, Temp, DO, BOD5, NH4, Turb., EC, pH, HT, and TDS). The distribution of DO in the Euphrates River was governed by a spatial enrichment gradient of 0.04 to 0.06 mg/l/meter. The distribution behavior of the DO plumes depends on the re-aeration process (K2) at a rate ranging from 0.4 sec-1 to 1.416 sec-1 associated with the re-oxygenation process (K1) ranging from 0.172 sec-1 to 0.82 sec-1. Wastewater is considered to be a source of spot contamination with brackish water and emits chemical pollutants with a total dissolved discharge of 18190 tons/year, which is the source of salinization in river water. The hydrochemical classification revealed the succession of different water facies developed by the intruding water of the Na-SO4-Chloride type in the freshening phases. According to the Canadian Water Quality Index, water in the Euphrates River has categorized as good water for aquatic life.

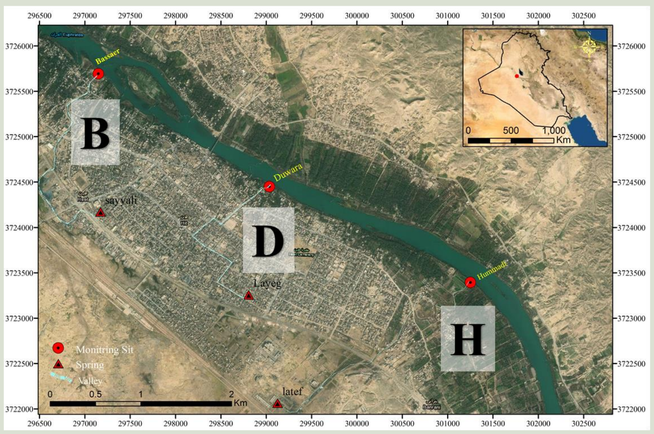
Objectives

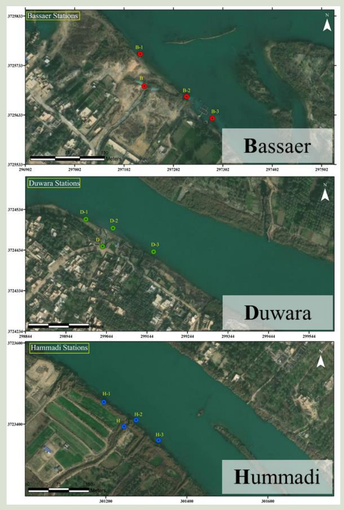
The purpose of this study is to investigate the physicochemical properties of water in the Euphrates River before and after mixing with wastewater. It is also to calculate the amount of disposal load in the river water, estimate the degree of mixing and the coefficient of self-purification, and to explore the behavior of the physicochemical components in the mixing plumes. Finally, assessing the water suitability for aquatic life.

Methodology

The sampling process for Euphrates River Water in the Hit sector was preformed, taking into consideration the locations of municipal wastewater mixed with spring water flowing from different regions of the city (Fig. 1). The coordinates of the water samples points are precisely determined for sampling at each location using the GPS device. These points are called Bassaer (B), Al-Duwara (D), and Hammadi (H). The monitoring program was carried out with 9 labeled points (B1-B3, D1-D3 and H1-H3) (Table 1, Fig. 1). The polyethylene bottles were used to collect water samples (1.5 liters) (Shelton, 1994).

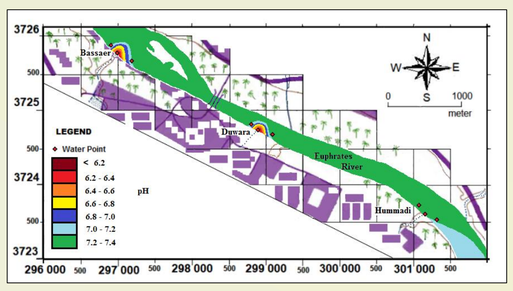
Electrical conductivity (EC), total dissolved solids (TDS), concentration of ion hydrogen (pH), temperature and dissolved oxygen (DO) were measured immediately after sampling using a portable digital device. The major ions (HCO3-, CO3-2, SO4-2, Cl-, NO3-, PO4-3, Ca+2, Mg+2, Na+, K+, NH4+, HT, and Tur) have been analyzed using standard methods proposed by the American Public Health Association (APHA, 2012).



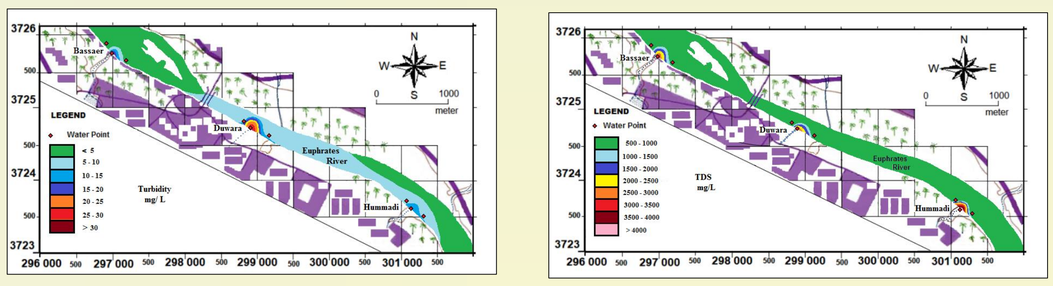


Location map of the study area and monitoring sites, (B, D, H).

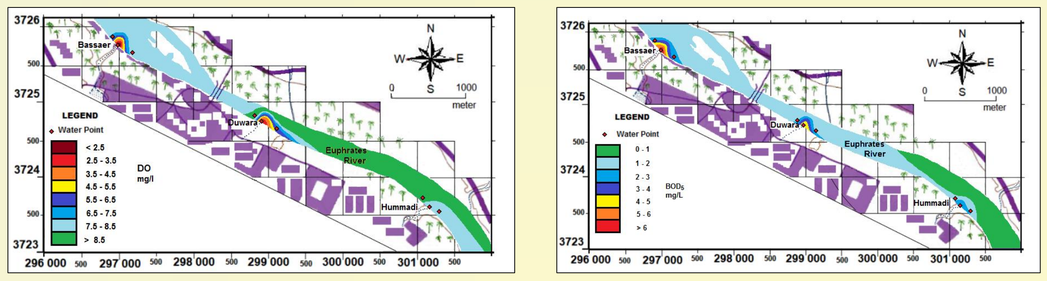
Results



pH Temperature distribution map within the Euphrates water



TSS & TDS distribution map within the Euphrates water



DO & BOD5 distribution map within the Euphrates water

Conclusions

The study dealt with the extent of the confluence of two types of water with an active hydrodynamic behavior during the monitoring period. The residence time of pollutants was ranged between 3.3 and 14 minutes in attenuation distance ranged between 51 and 250 meters away from their confluence sites. Water mingling took place between the sewage and the Euphrates, by an effluent discharge values ranged between 2073 to 6998 m3/day. The water miscibility process calculated from the concentration of chloride in the deterioration zone of the pollution plume showed that 93.4% to 98.8% of the chloride is due to its concentration in wastewater and 1.2% to 6.6% due to its concentration in the Euphrates River. The dissolved load of the sewage was dispersed within the deterioration zone between the source of pollution and the recovery zone, in a mixing rate of water < 2.7% from the sewage, and >97.3% originating from the Euphrates.

The wastewater at the disposal sites is a brackish water source. The discharge load values of sewage pollutants ranged from 12.46 to 23.33 tons/day, with a total annual rate ranging from 4,548 to 8,515 tons/year, which represents the source of salinization in the river water.

The distribution of the DO concentration in the Euphrates River was controlled by a mechanism of spatial enrichment gradient of 0.04 to 0.06 mg/l/ meter. The values of the DO concentration were increased under a process of re-aeration rate (K2), which ranged between 0.4 sec-1 to 1.416 sec-1, taken into consideration the process of reoxygenation (K1), which ranged from 0.172 sec-1 to 0.82 sec-1. Accordingly, the self-purification factor within the pollution plumes at the Bassaer, Duwara, and Hummadi sewage-disposal sites reached 2.99, 1.72 and 2.32, respectively.

Since the sewage mixes with the river, the water of the pollution plume cannot be used for irrigation and drinking purposes. Wastewater should be treated and this will control pollution and prevent the deterioration of the quality of river water