Journal of **WATER & WASTEWATER**

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Editor : N. Moradi
English Editor : E. Roustazadeh
Graphic Designer : M.R. Rahimi
Word Processor : A.R. Shafiee

Printed by : Shakiba

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Journal of Water and Wastewater (Ab va Fazilab ) is a bimonthly journal that publishes peer-reviewed research focusing mainly on integrated municipal water management and water supply with special concern to water resources management at catchment areas. While covering a wide variety of general topics and challenges involving usual municipal water and wastewater management which in itself are reflected from physical, natural and human activities in the urban residential area, the Journal has special emphasizes over issues that are reflected from suburban, river basin and catchment areas.
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- Waste sludge management (treatment, disposal and reuse)
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- Urban water accidents managements, data collection, standards, regulations and strategies related to water and wastewater management
- Water governance and Sustainable water resources management and pollution control.

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Although the journal is sponsored by Water and Wastewater Consulting Engineers (WWCE), its editorial policies are independent of the WWCE.
**ISSN: 1024-5936**
**eISSN:2383-0905**

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# Using the Prey-Predator Equation for the Water Allocation Problem and Its Comparison with Conventional Water Allocation Methods, A Case Study of The Atrak River Basin

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***(Received May 3, 2014 Accepted Nov. 12, 2014)***

## Abstract

Allocating the water resources in a basin to several stakeholders is a common issue at both national and international levels. Despite the many extensive studies carried out on the water allocation problem, a method still needs to be developed for the equitable and sustainable allocation of water to all the stakeholders in a shared basin. Over the last few decades, a number of mathematical methods such as the Nash bargaining, area monotonic, equal loss, and Kalai-Smorodinsky solutions have been applied to the problem of conflict resolution that are collectively known as optimization methods, each one yielding a single solution. In this study, a novel mathematical model based on the prey-predator equation is employed for water allocation to resolve conflicts among stakeholders in the agricultural sector. The advantage of the proposed model lies in its capability to calculate balanced allocation of irrigation water to stakeholders aimed at the sustainable development of the region. The model calculates the stakeholders' profits and payoffs and determines their interactions in a time series. Finally, the model is employed for resolving conflicts in the Atrak River basin in the northeast of Iran which is now facing a serious water tension. Comparison of the results obtained from the proposed model and those from four conventional conflict resolution methods applied to the same basin implies the superiority of the proposed model in yielding dynamic solutions rather single ones.

***Keywords:*** Water Allocation, Conflict Resolution, Optimization Methods, Prey-Predator Model, Atrak Basin.

# Multi-Objective Optimization of the Hedging Model for reservoir Operation Using Evolutionary Algorithms

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*(Received Apr. 30, 2014 Accepted Nov. 21, 2014)*

## Abstract

Multi-objective problems rarely ever provide a single optimal solution, rather they yield an optimal set of outputs (Pareto fronts). Solving these problems was previously accomplished by using some simplifier methods such as the weighting coefficient method used for converting a multi-objective problem to a single objective function. However, such robust tools as multi-objective meta-heuristic algorithms have been recently developed for solving these problems. The hedging model is one of the classic problems for reservoir operation that is generally employed for mitigating drought impacts in water resources management. According to this method, although it is possible to supply the total planned demands, only portions of the demands are met to save water by allowing small deficits in the current conditions in order to avoid or reduce severe deficits in future. The approach heavily depends on economic and social considerations. In the present study, the meta-heuristic algorithms of NSGA-II, MOPSO, SPEA-II, and AMALGAM are used toward the multi-objective optimization of the hedging model. For this purpose, the rationing factors involved in Taleghan dam operation are optimized over a 35-year statistical period of inflow. There are two objective functions: a) minimizing the modified shortage index, and b) maximizing the reliability index (i.e., two opposite objectives). The results show that the above algorithms are applicable to a wide range of optimal solutions. Among the algorithms, AMALGAM is found to produce a better Pareto front for the values of the objective function, indicating its more satisfactory performance.

***Keywords:*** Hedging, Multi Objective Optimization, Reservoir Operation, Meta-heuristic Algorithms.

# Simulation of Integrated Qualitative and Quantitative Allocation of Surafce and Underground Water Resources to Drinking Water Demand in Mashhad

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*(Received Feb. 27, 2014 Accepted July 7, 2014)*

## Abstract

Despite the fact that both surface and groundwater resources inside and outside the city of Mashhad have been already exploited to their maximum capacity and that the large water transfer Doosti Dam Project has been already implemented to transfer a considerable quanity of water to Mashhad, the city will be encountering a daily water shortage of about 1.7 m3/s by 2021. The problem would be even worse if the quality of the water resources are taken into account, in which case, the shortage would start even sooner in 2011 when the water deficit will be about 0.9 m3/s. As a result, it is essential to develop short- and medium-term strategies for secure adequate water supplies for the city's domestic water demand. The present study aims to carry out a qualitative and quantitative modeling of surface and groundwater resources supplying Mashhad domestic water. The qualitative model is based on the quality indices of surface and groundwater resources according to which the resources are classified in the three quality categories of resources with no limitation, those with moderate limitations, and those with high limitations for use as domestic water supplies. The pressure zones are then examined with respect to the potable water demand and supply to be simulated in the MODSIM environment. The model thus developed is verified for the 2012 data based on the measures affecting water resources in the region and various scenarios are finally evaluated for a long-term 30-year period. Results show that the peak hourdaily water shortage in 2042for the zone supplied from no limitation resources will be 38%. However, this value will drop to 28% if limitations due to resource quality are also taken into account. Finally, dilution is suggested as a solution for exploiting the maximum quantitative and qualitative potential of the resources used as domestic water supplies. In this situation, the daily peak hour water shortage will be equal to 31%.

***Keywords:*** Decision Support System, MODSIM, Water Allocation Scenarios, Dilution.

# Modifiying the CE-QUAL-W2 Model to Simulate Volatile Organic Compounds in River-Reservoir Systems

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*(Received May 29, 2014 Accepted Jan. 14, 2015)*

## Abstract

In this research, the 2D hydrodynamic and mass transport model, CE-QUAL-W2, is modified to simulate the fate and transport of volatile organic compounds (VOCs) in standing and flowing water bodies. The modifed model is applied to the Karkheh river-reservoir system. For this purpose, a subroutine model is added to the CE-QUAL-W2 source code to simulate the physical, chemical, and biological fate of VOCs in water bodies. In a second step, the VOC mass continuity model is employed to evaluate the performance of the modified CE-QUAL-W2 model. The results confirm the accuracy of the modified CE-QUAL-W2 model. The modified CE-QUAL-W2 model is employed to simulate the Karkheh river-reservoir responses in sudden MTBE spill in Karkheh water body. The effects of reservoir operation (withdraw values and locations) on MTBE fate and transport are investigated. The results show, compared to the old version of the CE-QUAL-W2, the modified version in which VOC evaporation is considered shows a reduction in MTBE concentration in the water body under investigation. Furthermore, the effects of such environmental parameters as wind speed, water temperature, and air temperature on MTBE fate and transport are evaluated. The results show that increasing wind speed and water temperature accelerate the evaporation rate of VOCs and decrease the reservoir cleanup time while reducing air temperature leads to reduced VOC evaporation rates and increased VOC concentration in the water body.

***Keywords:*** Sudden Pollution Spill in Water Body, Volatile Organic Compound, 2D Hydrodynamic and Water Quality Model, CE-QUAL-W2, MTBE.

# Predicting Groundwater Chlorine Concentration in Dezful Aquifer Using the Panel Data Model

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*(Received Aug. 27, 2013 Accepted May 18, 2014)*

## Abstract

Groundwater resources are of great importance in arid and semi-arid regions due to their ease of access and low extraction costs. Compared to studies conducted on the quantity of groundwater resources, less research has been devoted to groundwater qulity. The present study was thus designed and implemented to forecast groundwater chlorine variations in Dazful Plain in Khuzistan Province, Iran. " Panel data" is a regression model that considers variables of different units over time. In this study, it was exploitedfor the simultaneous prediction of groundwater quality in different wells. For this purpose, meteorological parameters such as rain and ET0 as well as the quality parameters including EC, sodium, calcium, and magnesium were collected in ten wells in the study area on a seasonal basis over a period of 8 years. In the next step, the data thus collected were subjected to different "panel data" regression models including Common Effects, Fixed Effects, and Random Effects. The results showed that the Random Effects Regression Model was best suited for predicting groundwater quality. Moreover, performance indicators (R2= 0.96, RMSE= 2.445) revealed the effectiveness of this method.

***Keywords:*** Panel Data, Groundwater Quality, Modeling, Dezful Plain.

# Comparison of the Efficiencies of Zero-Valent Iron Nanoparticles and Stabilized Iron Nanoparticles for Nitrate Reduction from Polluted Waters

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***(Received March 10, 2013 Accepted Dec. 22, 2013)***

## Abstract

The present study was conducted to evaluate the feasibility of zero-valent iron nanoparticles (ZVIN) for the removal of nitrate from aqueous solutions. For this purpose, bare zero-valent iron nanoparticles (bare-ZVIN) and CMC-ZVIN were synthesized using the borohydride reduction method and their morphological characteristics were examined via scanning electron microscopy (SEM), X-ray diffraction (XRD), and Fourier Transmission Infrared Spectroscopy (FTIR). The effects of pH of the aqueous solution, initial nitrate concentration, ZVIN concentration, and contact time on nitrate reduction were investigated as operational parameters and the kinetics of nitrate reduction was studied in batch experiments. The results showed that 93.65% of nitrate was removed by stabilized nanoparticles at pH=6 while non-stabilized nanoparticles at pH=2 were able to remove 85.55% of the nitrate.Furthermore, nitrate reduction was enhanced by increasing ZVIN concentration and contact time while it was decreased as a result of increasing initial nitrate concentration. The major product of nitrate reduction at an acidic pH was found to be ammonium; at an alkaline pH, however, nitrate was converted to nitrogen and nitrite production dropped to less than 2%. Kinetic analysis demonstrated that denitrification of nitrate by the nanoparticles fitted well with first-order and second-order reaction models. The results also demonstrated that the stabilized ZVI nanoparticles were more effective than bare-ZVIN for nitrate reduction in aqueous solutions.

***Keywords:*** Nitrate Reduction, Carboxymethyl Cellulose, Aqueous Solution, Zero-valent Iron Naoparticles.

# Oxytetracycline Removal with Nano Zero Valent Iron Using the Photo-Oxidation Process and Optimization of Comparative Ions

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***(Received Aug. 18, 2013 Accepted Oct. 21, 2013)***

## Abstract

Due to their rather non-degradability and the emerging genetic resistance against them, antibiotics discharged into domestic effluents pose a serious environmental hazard while the conventional biological treatment methods are not adequately efficienct in removing them. In the present study, the chemical reaction between oxytetracycline (OTC) and nano zerovalent iron (NZVI) modified by UV-A radiation was investigated. In the batch experiments, concentration of reactants, pH, UV power, and time were optimized. In this process, the UV power was 200 W and 155 mg/L OTC in an aqueous solution was degraded after 6.5 hours using 1000 mg/L of the nano-iron powder at pH 3. TOC and COD removal efficiencies of 87, 95, 85, and 89% were achieved at 290 and 348 nm, respectively. In a similar process, no organic compounds remained after 14 hours. Based on XRD analysis, FeO and FeOOH comprised the oxide layer on the surface of the nanoparticles, which had positive effects on the photocatalytic process. Changing the parameters of ORP, pH, and DO during the process caused the photocatalytic reaction to start after 3 hours. It was also found that, due to the presence of ions such as calcium, magnesium, chloride, nitrate, sulfate, and bicarbonate in sewage and surface water compositions, it is necessary to consider their mixture in the oxytetracycline elimination process while their statistical modeling using the response surface methodology also helps in the prediction ofe the effects of these ions. Data optimization results matched thos eof the model at 95% confidence level. It was found that while bicarbonate and sulfate ions had no effect on the process, chloride and nitrate ions had more negative effects than calcium and magnesium on OTC removal since they prohibit the destruction of aromatic rings.

***Keywords:*** COD, TOC, Calcium, Magnesium, Chloride, Nitrate.

# Investigation of the Performance of Electro-Fenton Process in the Degradation of Acid Black 1 and Acid Blue 113 in Aquatic Environment

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*(Received Aug. 31, 2013 Accepted Jan, 5, 2014)*

## Abstract

Azo dyes are a major environmental concern due to the presence of benzene rings in their structure. The present experimental study investigates the capability of the Electro-Fenton process as an Electrochemical advanced Oxidation Process for degrading Acid Black 1 and Acid Blue 113 in an aquatic environment. In this study, a lab-scale EF batch reactor equipped with four electrodes and a DC power supply was used for removing the dye. The effects of such operating parameters as pH, voltage, $H_2O_2$, initial dye concentration, cathode materials, and operation time were evaluated. The results showed that initial pH of the solution, initial $H_2O_2$ concentration, as well as different applied voltages and reaction times were highly effective in the dye removal efficiency of the process so that the 98% of both dyes were removed after 10 min of reaction at pH=3.0, a voltage of 20 V, and a $H_2O_2$ concentration of 100 mg/L. Removal efficiency decreased dramatically when pH was increased from 3 to 11, and voltage from 20 to 40 V. The presence of $H_2O_2$ was found to be the prerequisite to this process since the maximum dye removal obtained at an $H_2O_2$ concentration of zero was 7% for both dyes. The results of this study indicate that the Electro-Fenton method can be considered as an alternative process for the traditional treatment processes used.

***Keywords:*** Electro-Fenton, Electrode, Acid Black 1, Acid Blue 113.

# Survey of Basic Red 18 Dye Removal Using Biofilm Formed on Granular Bagass in Continuous Aerobic Reactor

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***(Received Aug. 29, 2013 Accepted Aug. 11, 2014)***

## Abstract

Dyes comprising a major pollutant in the effluent from textile plants are mostly toxic, carcinogenic, mutagenic, and non-biodegradable. This experimental-laboratory study was carried out using a biofilm formed on a granular bagass bed in a continuous aerobic reactor to investigate the kinetic coefficients of the aerobic reactor as well as the effects of color concentration (30-200 mg/L), hydraulic retention time (2-8 h), and BOD concentration (200-100 mg/L) on the removal of Basic Red (18) from textile effluents. The results revealed a maximum removal efficiency of 90% for an initial color concentration of 30 mg/l and a hydraulic retention time of 8 hours. A color removal efficiency of 86% was recorded for an influent BOD concentration of 200 mg/l. Also, maximum substrate utilization rate (K) for organic loadings of 100 and 200 mg/L were 0.23 and 1.41 while the half velocity constant values were 44.85 and 19.39, respectively. Moreover, for the same organic loadings, the values of 0.35 and 0.5 were recorded for decay coefficient (Kd) and 37.36, 4.83 for maximum specific growth rate coefficient (μm), respectively. Based on the findings of this study, it may be claimed that the biofilm formed on a granular bagass bed in a continuous aerobic reactor has a good Basic Red (18) removal efficiency.

***Keywords:*** Basic Red 18 Dey, Biofilm, Bagsse, Aerobic Reactor.

# Hexavalent Chromium Removal from Wastewater Using Scrap Iron

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***(Received Apr. 13, 2014 Accepted Dec. 14, 2014)***

## Abstract

Hexavalent Chromium is one of the heavy metals found in industrial effluents, which is both very toxic to humans and dangerous for the environment. Conversion of Cr(VI) to Cr(III) is useful because the species with a higher mobility and greater toxicity is in this way transformed into one with less mobility and lower toxicity. For this purpose, zero-valent metals, such as scrap iron, can be used as electron donors for the conversion of Cr(VI) to Cr(III). In this study, the effect of pH was studied on reduction of Cr(VI) by scrap iron. It was found that scrap iron would reach its maximum reduction capacity at the beginning of the experiment when lower pH level was low. Results showed that the highest reduction capacity was 12.5 mg Cr(VI) for 1g of scrap iron at pH=2.0. Increasing pH to 7.3, however, reduced the reduction capacity of scrap iron to 1.9 mg Cr(VI)/g of scrap iron. Based on the findings of this study, it may be concluded scrap iron has the potential to be used as an effective method for Cr(VI) removal in wastewater treatment provided wastewater pH is not extremely acidic since the H+ ions at this pH level may lead to the rapid corrosion of scrap iron.

***Keywords:*** Hexavalent Chromium, Heavy Metals, Scrap Iron, Wastewater Treatment.

inlet and outlet flows. The average removal efficiencies of Total Suspended Solids (TSS) and Total Coliform (TC) in the effluent from the three Lysimeters with local soil with vetiver, local soil without vetiver, and artificial soil assortment for the filtration rate of 0.2 ml/min were: 67.75% and 99.7%, 58.33% and 99.6%, and 56.25% and 99.5%, respectively. For a filtration rate of 0.6 ml/min, these values were: 53.33% and 98.93%, 48.8 and 98.77%, and 47.68% and 98.64%. Finally, the values obtained for a filtration rate of 0.6 ml/min were: 50% and 93.96%, 46.42 and 91.34%, and 44/04% and 88/81%, respectively. The results from the study showed that the Lysimeter with local soil and the vetiver plant recorded the best removal efficiency for a filtration of 0.2 ml/min. Thus, it may be concluded that the land-plant system as an advanced treatment process is capable of producing effluents that meet discharge quality permit limits and therefore, it is an economical process using the advantages of advanced treatment if enough and available lands possible.

***Keywords:*** Land Treatment, Vetiver Plant, Total Coliform, Total Suspended Solids (TSS).

# Investigation of TC and TSS Removal Efficiencies at Ahvaz West WTP Effluent Using the Land-plant Treatment Process

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*(Received Nov. 6, 2013 Accepted Sep. 20, 2014)*

**Abstract**

Although the conventional (primary and secondary) treatment processes are known to remove up to 95–99% of some micro-organisms, they do not provide adequate treatment to make the effluent suitable for direct reuse, mainly due to the presence of high concentrations of pathogenic microorganisms. Obtaining reusable effluents, therefore, requires the use of processes that can be justified both technical and economic grounds. One such indigenous, low cost option is the land-plant process that can be used for advanced wastewater treatment. It is the objective of the present study to determine the efficiency of the local soil in Ahvaz and that of the vetiver plant in reducing the microbial load in the effluent from municipal wastewater treatment plants. A pilot studywas thus carried out including three Lysimeters installed in West Ahvaz Wastewater Treatment Plant. Local soilwas used in one Lysimeter, local soil with vetiver plant in the second one, and an artificial assortment of soilcomprising local soil, silica sand (0.5-1mm), and sand (15-30mm) in the third. In addition, the effluent from the secondary settling outlet at the WTP was transferred by pumping at the three filtration rates of 0.2, 0.6, and 1 ml/min into the system with three replications for each rate and samples were collected from both

# Removal of $Cu^{2+}$ from Wastewater Using Synthesized Magnetite Bentonite Nano-absorbent

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*(Received Oct. 12, 2013 Accepted May 25, 2014)*

**Abstract**

The objective of the present study was to investigate absorption of copper from wastewater using the synthesized magnetite ($Fe_3O_4$) bentonite nanoadsorbent. Synthesized magnetite-bentonite nanoparticles (20–40 nm) were produced using the coprecipitation method and subsequently subjected to Scanning Electron Microscopy (SEM), X-Ray Diffraction (XRD), and Fourier Transform Infrared Spectroscopy (FT-IR) for analysis and evaluation. The nanoparticles were finally used as an adsorbent in wastewater treatment. Experiments were also designed using the Design of Experiment (DOE) software. Absorbent quantity, contact time, $Cu^{+2}$ concentration, and pH were the most important factors selected for investigation. In a second step, the CCD design model was used to identify the optimum conditions for achieving the best metal ion absorption (removal) efficiency. It was found that 89% of Copper metal ions were absorbed under optimum conditions. Finally, experiments were performed on the inorganic effluent (from the Sarcheshme Copper Mines) under the optimum conditions. Results revealed a sorption content of 30% for $Cu^{2+}$.

***Keywords:*** Magnetite Nanoparticels, Synthesized Benthonit Magnetite, Wastewater Treatment, Metal Pollutants, Removal of Cu.

# Determination of Liquid and Solid PAC Purities for Use in Developing a National Standard

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***(Received June 12, 2013 Accepted Oct. 16, 2013)***

**Abstract**

In recent years, poly aluminum chloride has been replaced as an efficient coagulant for other coagulating material. Despite the diversity in the formulations of this family of coagulants, it is necessary to develop a comprehensive national standrad for the qualitative analysis and determination method for these materials. The presents study aims to investigate the standard approach adopted in China as a major supplier of these coagulants. For this purpose, literature review, scientific findings, and test-based comparisons are exploited for the assessment of these materials and for developing relevant recommendations.In the course of these investigations, the effect of pH, heating procedure, elimination of impurities, and identification of proper reagents will be described.

***Keywords:*** PAC, Tempreture, Purity, Indicator.