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Modeling the zeolite channels effect on the effluent of treatment plant in Shiraz industrial town

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Expanded Abstract

Introduction

In this study, the mathematical model of relationship between the exceeded and loaded values of wastewater was determined. The correlation coefficients of COD with TDS, and COD with TSS were 83% and 90%, respectively. ARIMA results showed that lag time extent about one day has the best relationship in COD estimating. Therefore, daily COD amount estimated according to the wastewater TSS and TDS amount of previous day by linear and nonlinear models and clustering analysis with and without normalized data. The simulation model based fuzzy inference system (FIS) had good corresponding with distribution of estimated and observed data of COD (R^2 = 0.76). The results showed that the curve of COD (t) than TDS (t-1) has a turning point that occurs in TDS (t-1)= 1746 ppm. In this TDS amount, zeolite refining capacity of COD will be 52. This point is the threshold of COD that could be refined by zeolite. To manage wastewater treatment loaded amount of pollutants and mass transfer of wastewater trough Zeolite channel should be controlled together.

Materials and Methods

Wastewater station and monitoring

Water Reclamation Plant is located in Shiraz industrial town, Fars, Iran. Wastewater of 1100 small and medium industrial units are collected through the sewage system and treated in this station. Its capacity is 2500 m^3 per day but now, loaded wastewater is only about 1200 to 1500 m^3 per day. Treatment Methods is completely biological and chemical purification method does not use in reactors. Logon and stilling pond with anaerobic system, UABR system, UASB, Selector, SBR and wetland are the parts of this plant. Biological treatment starts from anaerobic lagoons, that wastewater fixation done there, afterward gas and methane produced as a result of bacteria's activity. At this point, pollution concentration decreased and the amount of COD were reduced. In order to wastewater could achieve suitable retention time to provide sufficient time for the biological response, two lagoons and a stilling pond designed between the lagoons that is Plug Flow reactor type. This system will reduce energy consumption and operating costs. Depth of lagoons is about 5 to 6 m and stilling pool depth is 120 cm in stilling pond sewage find enough time to complete the biological process. Wastewater inters to lagoon1initially and after crossing the stilling pool sheds to the lagon 2. In stilling pool sewage finds enough time to complete the biological process. Sludge deposited along the way and not transferred to the next unit, is drains from lagoons once a week.

Data

Changes in effluent before and after crossing the zeolite channel were measured according intended indices in the laboratory by regular sampling (90 samples during 3 month). pH, temperature, TSS, TDS, EC, and COD of wastewater loaded and exceeded to zeolite channels were measured. Same analysis methods were applied to determine the effluent characteristics.

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Modeling process

In order to model the effect of zeolite channels on the wastewater characteristics at first the relationship between daily values of (EC) and COD of exceeding effluent from Shiraz industrial town treatment plant after crossing the zeolite channel according other examined factors of loaded wastewater was studied. For this purpose, values of indicators such as pH, temperature, TSS, TDS, of loading wastewater were used as known values and factors such as EC, and COD were considered as unknown values. Correlation coefficient was used to predict wastewater quality parameters. Then curve fitting approach was used to consider several linear and non- linear models to simulate this correlation. This method was used to find the correlation coefficients between exceeding COD and EC and other loaded factors from industrial wastewater. The results of forecasting models in the calibration phase and the results of their validation process were used to select the appropriate model.
Performance of models were studied according to Root Mean Square Error (RMSE). Then, curve fitting approach used to achieve a simulation model on relationship between the normalized data of exceeded daily COD and loaded TDS on previous day. Several linear and non-linear models based on curve fitting approach used to find a simulation model for defining the relationship between the normalized data of exceeded daily COD and loaded TDS at previous day. Then cluster analysis and the fuzzy inference system applied to improve the simulation of this relationship. The best correlation coefficient and p-vale were obtained between the exceeded values of EC and the loaded values of TSS for each day. Equations could be shown as follow:

$$CODE(t) = F(TDSL(t)) \quad (1)$$

$$ECE(t) = F(TSSL(t)) \quad (2)$$

The correlation coefficients of COD with TDS, and COD with TSS were 83% and 90%, respectively. Because measuring TDS is easier than the TSS, then Equation (1) was selected to estimate COD.
ARIMA models results offered the log time of one day have the best relationship than other models. Daily changes in TSS and TDS according to their value of the one day before predicted. This model predicted EC(E) and COD(t) through TSS(L) and TDS(t-1). As a result, the decision maker could be having the optimization analysis by means of practical strategies to change the collection network or Zeolite filtration capacity.
$CODE(t) = F(TDS\ L(t-1))$ (3) $ECE(t) = F\ (TSS\ L(t-1))$ (4)
After that curve fitting approach with and without normalized data were used to achieve a function of CODE(t) based on TDSL(t-1) and ECE(t) with TSSL(t-1). These approaches couldn't improve the regression coefficient of each linear and nonlinear function, too. Weak relationships between CODE(t) and TDSL(t-1) is the cause of how data distribution (Fig. 3). As shown in Table 4, it was assumed that this trend has the fuzzy behavior and using the fuzzy inference systems (FIS) model was appropriate to simulate this distribution. Therefore, at first the membership functions of input (TDS (t-1)) and output (COD (t)) variables in Mamdini approach was defined based on the average of each class.

Discussion and Result

With the study purposes of achieving the appropriate model of variability of TDS(L), TSS(L), and exceeded COD(E), EC(E), no significant correlation coefficient was obtained by analyzing approaches such as multivariate, curve fitting with linear and nonlinear models, time series, and clustering with and without normalized data. Therefore, the results of classification were utilized to define the mean and range of each membership function for input variables TDS(t-1) and the output COD(t).
As noticed, fuzzy roles describe data distributions of input and output variables which other deterministic models couldn't consider subject matter. Feature of fuzzy roles in this point caused a good conformity with estimated and measured values of exceeded COD(t) with $R^2 = 0.76$. As a result, fuzzy behavior assumption of data distribution was admitted. The result of simulation model showed that data distribution of input variables TDS(t-1) and the output COD(t) function was similar to S shape curve. It could be refered to Zeolite channels filtering capacity.
FIS simulation model had good corresponding with distribution of measured and observed data of COD (t) R2 = 0.76. As seen in Figurers 3 and 4, Zeolite filtering capacity may be affected by other factors. Low input of TDS observed when rainfall occurred, so entering wastewater content and loaded TDS affected by runoff.
The result of simulation model showed that a certain range of TDS exists in which Zeolite could be effective. In this study, TDS threshold occurred in 1746 ppm in which COD is equal to 52. Result obtained in this study indicated that fixed value of soluble solids concentration on mass transfer of wastewater entering the treatment plant had important role in the effectiveness of Zeolite filtration.
As seen in Figurers 4c and 5, while loaded TDS was low and high, then exceeded COD was high and low or closed to standard level, respectively. This result indicated that Zeolite filtering capacity maybe affected by other factors. Low input of TDS observed when rainfall occurred, so entering wastewater content and loaded TDS

affected by runoff. In the other word, while the volume of wastewater increased during this period, TDS values decreased.
In this condition, loaded wastewater was more than daily filtering capacity of Zeolite Channel. Although TDS values were low, the volume of wastewater entering to the treatment plant was high then Zeolite channel could not operate its ion exchange capacity appropriately. Its filtering operation was better when a few wastewaters with more TDS value entered to the Zeolite channel. Finally, this result could be achieved that to manage wastewater treatment loaded amount of pollutants and mass transfer of wastewater trough Zeolite channel should be controlled together.
The best regression coefficient of EC(E) with the TSS(L) was less than 0.5. Curve fitting approaches could not improve the regression coefficient of each linear and nonlinear function, too. Based on the results of clustering analysis the ranges of ECE(t) and TSSL(t-1) variables classified into three major classes. FIS simulation model did not have good corresponding with distribution of measured and observed data of ECE (t).

Keywords: fuzzy simulation, industrial wastewater, optimization, Zeolite.

Colored Wastewater Treatment Using Electro-coagulation-flotation Method with Mesh Stainless Steel Electrodes

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Expanded Abstract

Introduction

The aim of this study was to evaluate the efficiency of electrochemical systems for removing of Acid red 14 contaminants, in which electrical coagulation and flotation methods by steel electrodes are used simultaneously. It is expected that simultaneously using of electrical flotation and electrical coagulation process eliminate gravity sedimentation unit for the separation of the clot, and result both in the separation of emissions and reducing the cost of the treatment. Researches in the field of electrochemically dye removing methods are based on electrical coagulation, and flotation properties of bubbles are rarely used. In this research, innovations such as gridded horizontal were used to improve the performance of flotation. The impact of key parameters on electrochemical system performance including current density and initial dye concentration were examined and optimized based on the amount of energy consumption and anodes consumption and ensuring the proper functioning in terms of coagulants and bubbles. In optimum conditions, in order to evaluate the performance of coagulation and flotation process in treating of real wastewater plants, electrochemically treatment of the actual colored wastewater was evaluated.

Materials and Methods

Cubic Plexiglas electrochemical cells with small dimensions of 15×7×7, with a pureed volume of 735 ml was used for electrical coagulation and electrical floatation process (Fig. 1). Two mesh stainless steel 316 electrodes with a purity of 99%, with horizontal monopole arrangement was used as the anode and cathode in the reactor. Because hydrogen gas at the cathode play a key role in floating suspended particulates, current flow was introduced in a way that the cathode and anode were placed on top and down, respectively.

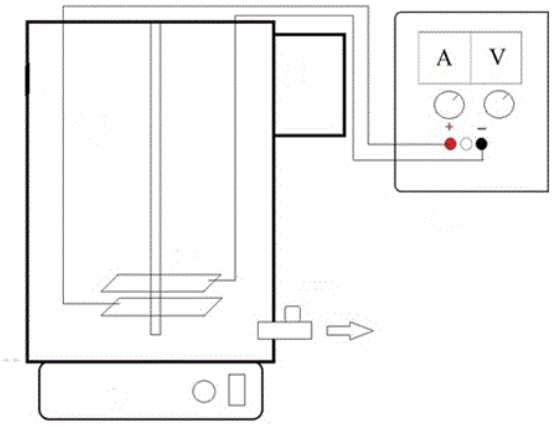

Fig. 1. Studied reactor

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Acid red 14 dyestuffs, which was used as the main contaminants to create artificial wastewater, is anionic and has an Azo group with chemical formula of $C_{20}H_{12}N_2Na_2O_7S_2$ and molecular weight of 502.4 gr/mol. In addition, in order to evaluate the effectiveness of the system in optimal conditions, discoloration of real wastewater was studied. In order to determine the optimal electrical current density and optimal initial concentration of dye by using of single-element method, synthetic wastewater was prepared with desired specifications.

Discussion and Results

In order to determine the optimal amount of electrical current density, experiments are performed in different electric current densities when other affecting parameters considered to be constant. According to the observations, by increasing the amount of electric current, the speed of dye removal is increased. This is because, production speed of coagulants and hydrogen and oxygen gases has been increased by increasing current density, which leads to coagulation, flocculation and faster separation of contaminants. The specific energy consumption and reduction of the anode metal mass is evaluated as a criteria for better comparison of the economic and environmental terms according to which, by removal efficiency of 99% in 10, 20, 30 ,40 and 50 mA/cm^2 electrical current densities and for kg dye removal, energy consumption is respectively 3.57, 3.22, 3.19, 2.52 and 2.26 kWh and anode consumption rate is 0.4, 0.34, 0.63,0.54 and 0.67 kg Fe/kg $_{\text{Dye Removed}}$, respectively. Finally, the optimal electrical current density was selected equal to 20 mA / cm^2 (0.4A) according to the results, in which 99% of dye was removed in less than 20 minutes, and the amount of specific energy consumption was 3.22kWh / kg $_{\text{Dye Removed}}$, anode's consumption was 0.34kg Fe/kg $_{\text{Dye Removed}}$ and the TSS of sludge was 3820mg/L.

Various experiments with different concentrations of dye take place in order to determine the optimal value of this parameter with optimized electrical current density where other parameters were kept constant. According to these tests, dye removal rate decreased with increasing initial concentration and more time is required in order to get fixed removal efficiency. This is because at a constant electric current density, the produced coagulant metal hydroxide is constant with time and this amount of metal hydroxide is not sufficient to coagulation and flocculation greater amount of pollutants. It should be noted that at very high concentrations (500mg/L) dye removal process go slower but the performance is much better in compare with other studies. By comparing of energy and anode's consumption with efficiency of dye removing in terms of time, the optimum concentration was selected equal to 250 mg/L, in which 99% of dye was removed in less than 30 minutes, and the amount of specific energy consumption, anode's consumption and TSS of sludge was 1.9kWh/kg $_{\text{Dye Removed}}$, 0.95kg Fe/kg $_{\text{Dye Removed}}$ and 3700mg/L, respectively.

Using the optimal conditions obtained from previous experiments, to evaluate the performance of coagulation and electrical flotation process in real waste water treatment, real sewage electrochemical treatment for actual dyeing is considered, in which, after 30 minutes treatment by removal efficiency of 63%, the primary COD equal to 803 mg/L reached to 296 mg/L. In synthesized sample, after 30 minutes treatment with removal efficiency of 79%, the primary COD magnitude decreased from 278 to 58mg/L. This amount is lower than the standard limit of discharge to surface water and catchy wells. After 30 minutes treatment with removal efficiency of 77%, the color of actual wastewater decreased from 1.5 Gardner in the beginning to 2.1 Gardner. The energy and anode's consumption in actual wastewater treatment for removing of 63% of COD in 30 minutes were 3.11 kWh/kg $_{\text{COD Removed}}$ and 0.565 kg Fe/kg $_{\text{COD Removed}}$ respectively. These values for synthetic wastewater with removal efficiency of 79% in the same time were 2.10kWh/kg $_{\text{COD Removed}}$ and 1.38kg Fe/kg $_{\text{COD Removed}}$, respectively.

Conclusion

Electrical coagulation and flotation has the advantages of low sludge production, in comparison with similar methods and fully automatic and continuous operation is possible. The parameters involved in the process can be easily controlled and the safety of equipment is high. Tiny bubbles with the same size are produced and there is a little or no need to add chemicals. Also, very high tolerance against organic, hydraulic and toxins shocks and reduced number of processing plants and thus reducing the required surface for treatment plant and reducing in operating costs are another advantages of this method.

By increasing of electrical current density, production speed of coagulants and gases was increased, which leads in faster coagulation, flocculation and flotation. However, when electrical current density is increased in very high rate, the amount of iron in the separated sludge is increased with high speed. Increasing of iron clots in the water containing sludge, in spite of their high volume, and because of lightness, reduce the TSS of separated sludge and therefore the ability of system in flotation and separation of clots is reduces.

Due to the limited amount of coagulants produced at a time of electrolysis and consistency of electrical current density, with increasing of initial concentration of dye (from 50 to 500mg/L), the removal efficiency decreased. However, according to the amount of energy used and the high dissolution of anode at lower concentrations, concentration of 250 mg / L was chosen as the optimal concentration.

Anode consumption and the need for its renewing and cathode corrosion are the disadvantages of this method. However, according to results, 99% of dye was removed in less than 30 minutes, where specific energy consumption was 1.9 kWh/kg $_{\text{Dye Removed}}$, the anode's consumption and the TSS of sludge was 0.95 kg Fe/kg $_{\text{Dye Removed}}$ and 3700 mg/L, respectively. These results proved the ability of electrical flotation and coagulation methods in treatment of wastewater containing dye, with low consumption of materials and energy. The proper functioning of this procedure in real waste water treatment, which are containing different combinations of colored dyes, suggest that this method can be used for wastewater treatment in dyeing industry, textile and other industries. In addition, low sludge produced in this treatment reduces sludge's treatment, disposal, and its relative problems costs. As a result, using of this method as an alternative option to conventional methods is considerable.

Keywords: anode dissolution, concentration, current density, dye removal, real wastewater

Evaluation of vanadium distribution in agricultural and industrial land uses; areas in Isfahan Region

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Extended Abstract

Introduction

Heavy metals in the soil are an important indicator of global environmental contamination and constitute an important part of the pollutants, which due to toxic and aggregate properties, even at low concentrations, have high environmental significance. Therefore, the distribution of their contamination is highly noticeable. Population growth, urban expansion, industrial development and distribution without management in agricultural inputs are among the most important factors in increasing the concentration of heavy metals. To improve the management recommendations for controlling and eliminating these pollutants, it is necessary to determine the spatial pattern of pollutants. In practice, the precise separation of ground contaminated with heavy elements is difficult due to the complexity of the pattern of spatial variations, the severe changes, and the presence of local contaminants. But there are several studies for the interpolation and determination of spatial distribution of heavy metals concentration in the soil. The analysis of the spatial distribution of heavy metals in soils is of fundamental importance in a vast number of applications, including general soil surveying and characterization, delineation of potentially polluted spots at unsampled sites, or planning remediation strategies. The relevance of heavy metal soil pollution has favoured the application of advanced geostatistical techniques such as kriging in their different varieties. Kriging techniques have also been widely applied in other earth sciences applications such as mapping of precipitation, air temperature or solar radiation at different temporal and spatial scales. Vanadium is a trace element, which is widely distributed in nature. The average abundance of vanadium in the crust is approximately 0.01%. Vanadium in the environment comes from (1) weathering of parental rocks, (2) combustion of fossil fuels, (3) mining and high-temperature industrial activities including steel-iron refining, electronics and dyeing, etc. While in the soil, vanadium is derived from parental rocks and deposits human activities, such as the disposal of vanadium-contained waste and oil leakage, may also provide a certain amount of vanadium to the soil. Consequently, there are few countries, where standards and regulations for environmental pollution in soil with vanadium are accepted, for example, Russia, where the maximum of 150 g g^{-1} allowed in agricultural soil. Because of industrial activities and anthropogenic emissions, the concentrations of vanadium in soil have significantly increased in recent years, and the number of people affected by vanadium pollution is also increased. The purpose of this paper was to: (i) estimate the upper baseline concentration of As in topsoils of Isfahan Province (central Iran); (ii) evaluate factors controlling the spatial distribution of soil V concentrations, and (iii) delineate polluted from unpolluted areas using geostatistic methods.

Materials and Methods

This research was conducted in Isfahan province, central Iran. Isfahan has an arid climate and is about 6800 km^2 around Zayandehroud River. Mean annual precipitation and temperature are 120 mm and 14.5 ^oC, respectively. Direction of dominant wind in study area is NW-SE (Fig. 2b). The area extends from easting of $51^o15'$ to $52^o41'$ longitude and northing of $32^o7'$ to $32^o59'$ latitude. The area covers different land uses including agricultural, industrial, urban and uncultivated lands. There are several big steel factories in the study area. The underlying geology consists mainly of recent terraces, resent alluvial deposit and undifferentiated terraces, all of quaternary age. In addition, lower Cretaceous grey limestone containing Orbitalin and Jurassic shale are found in the south west and south of region.

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In this study, soil sampling strategy was random stratify. A total of 207 soil samples (0-20 cm) were collected. At each sampling point, the coordinates were obtained using a portable GPS and its land use was recorded the distances.
Soil samples were air dried and ground to pass through a 2 mm sieve. Total V concentration in the soil was determined by XRF.
Statistics including mean, variance, maximum, minimum, coefficient of variation (CV) were calculated using SPSS 11.0 for Windows. Based on the land use information, data sets were grouped into three subsets: industrial and urban, agricultural, and uncultivated lands. After calculation, 46.5% of the sampling locations occurred in agricultural lands, 43.5% in uncultivated lands and 10% in industrial and urban areas. The ANOVA was then used to compare the effect of land use
The spatial variability analysis is a necessary step prior to applying kriging techniques. In this work several theoretical variogram functions including linear, exponential and spherical forms considering nugget effects were evaluated using the VARIOWIN and WINGSLIB software. With the sets of fitted variogram functions, the next step is cross validation of the prediction models with MSE. Distribution maps of V was produced using the ordinary kriging procedure and mapped. Correlation coefficient (Pearson) computed between real and estimated data with ordinary kriging that this parameter is identifier of relatively high accuracy estimation in maps. Maps were produce with Surfer (version 10) and ILWIS (version 3.3).

Discussion & Results

The average V concentration was 82.9 mg/kg with range of 19.2-140.1 mg/kg in Isfahan surface soils. Total V concentration was scanned for trend determination and no trend was apparent. Therefore, V concentration roughly followed a normal distribution indicating that the data is from a single statistical population. Total V concentrations in different land uses were compared using one-way ANOVA. Total V concentrations were significantly affected by land use and total V concentrations in agricultural lands also industrial and urban areas are higher significantly. Directional variograms for V concentration computed along twelve directions of azimuth 30 degree with tolerance ± 15 degree. The best variograms fitted in directions of 90 degree and a spherical theoretical covariance model suitable for spatial fields was fitted. Present of spatial dependence (sill/ C^0) indicates that distribution of V has intermediate spatial dependence class. Distribution maps of V indicates high concentration of V in parts of east Isfahan province and industrial and mining activity are important factor to concentration of vanadium in these regions and direction of dominant wind which has affected spread of V in east of the study area. Pearson coefficient in V concentration was rather high and this parameter is identifier of relatively high accuracy estimation in maps.

4. Conclusion

The overall distribution of heavy metals in surface soil can be due to local changes in rock, land use, and climatic processes. The average V concentration is 82.9 mg/kg in Isfahan surface soils and this is not higher than global average concentration. Land use did have significant effect on V concentration. Agricultural and industrial activities are probably effective factors causing increase in the V concentration of the region. Vanadium is one of the impurities of earth crust deposits. Considering the wide expansion of industries such as Isfahan Iron Ore in the Lenjan and Mobarakeh Steel Area in Mobarakeh, and also the significant difference in the average concentration of vanadium in urban land-industrial areas with incult land, the role of industrial activities in these areas can be increased in extend of vanadium. Direction of dominant wind has affected in spread of Vanadium in the high concentration spot in study area.

Keywords: *geostatistic, Isfehan, kriging, Vanadium.*

Geochemical processes affecting groundwater chemistry in Khosh_yailagh carbonate formation, north of Iran

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Expanded Abstract

Introduction

Carbonate formations (including karst springs and wells) have important role in supplying domestic and irrigation water in our country. Along with the exploitation of these resources, it is required to be considered geochemical characteristics and factors affecting water quality changes. Khosh-Yailagh carbonate formation is a formation of Devonian age in the north of Iran. The outcrops are located in mountainous areas and in the margins of Gorganroud plain. The local base level of erosion is high due to particular tectonic behavior. Because of low thickness and coarse texture of alluvium, well yields do not respond to different uses.

Groundwater hydrochemical assessment is usually based on a set of comprehensive information about the chemistry of groundwater. Chemistry of groundwater is affected by different factors such as geology, climate, type of rock weathering reactions, and recharge water quality (Guler et al., 2004; Subramani et al., 2005; Coetsiers, 2006).

The purpose of this study is to evaluate the evolution of geochemical processes and water quality of Khosh-Yailagh carbonate formation. Water quality graphic methods, multivariate statistical methods, hierarchical cluster analysis (HCA), principal components factor analysis (PCA) and chemical mass balance were used in determination of hydrochemical parameters and assessing geochemical process of water of carbonate formation.

Materials and Methods

The study area located in the east Alborz structural-sedimentary zone in Golestan province, north of Iran between the N36º48' 00" to S37º00'00" and W54º47'00" to W55º08'00". Minimum height in the region of 118 m and a maximum altitude is 1834 m. Various formations outcrop in the study area. Khosh-Yailagh is the most important of these formations, which is carbonate with karst development potential.

Twenty water samples were collected from springs. Field analysis of temperature, pH and conductivity was done when the sample is collected. The major elements (Na^+, Ca^{2+},Mg^{2+}, K^+, Cl^-, SO_4^{2-}, HCO_3^-, NO_3^-) were analyzed in the lab using standard methods. Composite diagrams were used to indicate relation between different ions. The statistical technique of multivariate analysis was used to characterize hydrochemical processes through data reduction and classification. The factor analysis derived principal components from a correlation matrix and rotated axes with a quartimin rotation.

Results and **Discussion**

All of the groundwater samples are low salinity with electrical conductance ranges from 220 to 706 µs carbonate-calcium water type. Clustering analysis was used for combining cases (water samples) into clusters (Fig. 1). This clustering routine resulted in three groups of water samples on the basis of variables (pH, EC and major elements).

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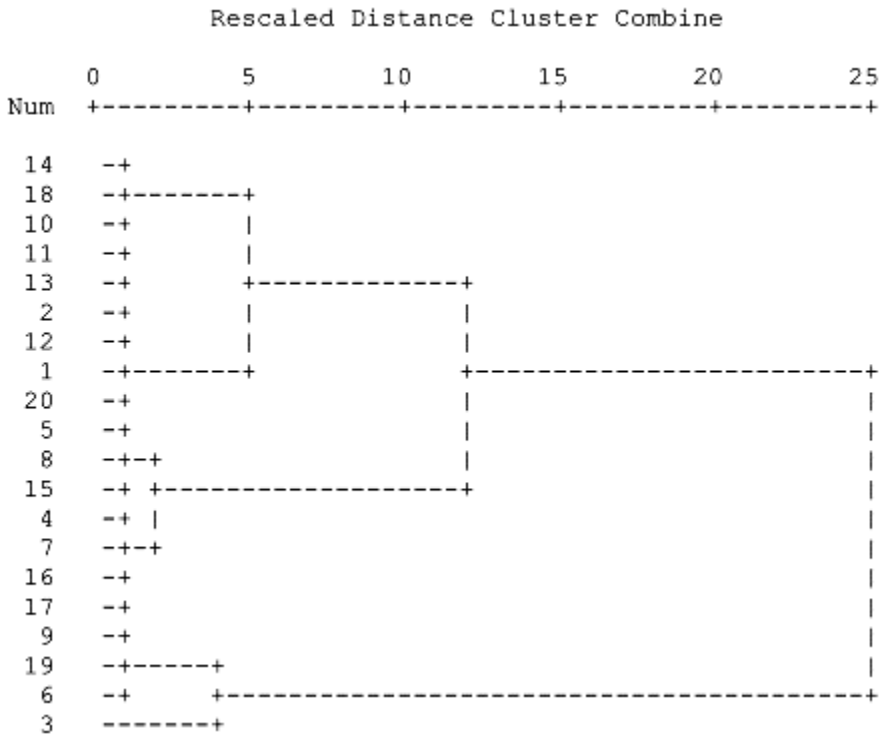

Fig. 1. Results groundwater samples cluster analysis

Group 1. Low salinity waters (309 ≤ EC ≤ 589µs, samples 1, 2, 5, 10, 11, 12, 13, 14, 18, and 20). Average TDS of this group is 41.27 mg/l.
Group 2. Low salinity waters (451 ≤ EC ≤ 538µs, samples 4, 7, 8, 15 and 16). Average TDS of this group is 37.22 mg/l.
Group 3. Electrical conductance of this group ranges between 495 to 706µs. This group contains samples 3, 6, and 19. These samples indicate more water-rock interaction. Groups 1 and 2 are more similar and could be consider as one group.
Most measured parameters showed weak correlation, which is the evidence on the effects of different processes in the water chemistry. Factor analysis was applied to identify the dominant processes controlling major chemical components of groundwater. The variables of factor analysis were Na^+, K^+, Mg^{2+}, Ca^{2+}, HCO_3^-, Cl^-, SO_4^{2-}, EC and pH. The virmax orthogonal rotation method was applied. Four factors are extracted to represent the contributions influencing chemical composition of groundwater (Table 1). The variables of TDS and Ca have high positive loading of factor 1. The variables K and HCO_3 have high positive loading of factor 2. The factor loading of pH show high positive value on factor 3. The variables Na and Cl have positive loadings on factors 4.

Table 1. Results of principle component analysis

Variables	Component			
	P1	P2	P3	P4
TDS	**.916**	**.507**	-.770	-.040
pH	-.082	.007	**.969**	.017
Ca	**.895**	.263	-.004	.009
Mg	-.907	.316	.211	.056
Na	-.306	.195	-.325	**.785**
K	.190	**.844**	-.199	.131
HCO_3	-.211	**.774**	-.015	.287
Cl	.193	.201	.335	**.796**
% of variance	24.072	23.207	20.463	17.252

Ion-exchange reactions occur both positive and negative direction depending on the flow distribution and mixing of groundwater. In order to understand the dominant lithology of environment in which water is flowing, the

molar ratio of calcium and magnesium was used. Molar ratio of 1.44 represents interaction of water with dolomitic limestone and dolomite formations. Saturation indices of calcite, dolomite and gypsum indicate that the groundwater is not at the chemical evolution.
The processes that govern changes in the groundwater composition, as interpreted from the factor analysis, are mainly determined. In plotted Gibbs diagram, the water samples lie in field of water rock interaction. Dissolution and precipitation of carbonate minerals is the main factor controlling chemistry of groundwater in the study area. Cation exchange processes influence the concentration of cation such as Ca, Mg and Na. Rainwater that is charged with biogenic and atmospheric CO_2 is another component determines chemistry of groundwater in the recharge area.

Keywords: carbonate spring, hydrochemistry, Khosh-Yailagh formation, multivariate analysis, saturation index.

Treatment of soil contaminated with petroleum compounds using stabilization/ solidification method (Case study: Salafchegan Industrial Estate)

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Expanded Abstract

Introduction

In recent times, petroleum compounds contamination has become a major concern for the environment. Soils contaminated with petroleum hydrocarbons and heavy metals are among the major environmental problems and thus remediation of these soils is important in terms of environmental and health standards, and should be included in the agenda of practitioners. On the contrary, stabilization and solidification of petroleum hydrocarbon contaminants and heavy metals have been known as a technology in inhibiting transference of contaminants to deeper layers of soil and groundwater. By encapsulation of heavy metal contaminants and using some measures, the solidification and stabilization process develops more stable compounds out of wastes by adsorbing hydrocarbons at macro- and microstructure and separating certain compounds of the contaminants, where leakage of contaminants from them is minimized. In addition, modified clay soils (organophilic) provide a suitable ground for cation exchange through high specific surface area and large cation exchange capacity. In this regard, these soils have a remarkable capacity in Chemical fixation of hydrocarbon or heavy metal contaminants. Note that in the past two decades, special attention has been paid to stabilization and solidification processes in addition to the environmental reasons owing to availability of solidifying materials including cement and cement materials (lime, fly ash, furnace slag, etc.) and economical effectiveness. In spite of the extensive research on stabilization of keeping contaminants with the help of materials such as cement or lime, limited attention has been paid to the investigation of the microstructure of cement-oil hydrocarbon contaminant interaction process as well as removal of factors disrupting the hydration process of cement or lime by implementing stabilization methods for special contaminants (e.g. stabilization of petroleum hydrocarbons) before solidifying the contaminant. Therefore, the aim of this research is to examine the process method of cement-quicklime-modified clay soil and petroleum hydrocarbon contaminant interaction in terms of microstructure as well as investigation of contaminant leakage from solidified matrix and obtaining the optimal mixing percentage of solidifier and stabilizer materials in terms of the best efficiency from different aspects (unconfined compressive strength, microstructure and extent of leakage) in the solidification and stabilization method.

The main focus of this research is on the performance of stabilization and solidification process in removing the contamination of second-hand bleaching soil in second treatment units of engine oil (which are contaminated with petroleum hydrocarbons) through cement and quicklime in the presence of modified clay soil (organophilic).

In the first stage of this research, the properties of wastes of second treatment of oil industries in Salafchegan Industrial Estate are determined along with the materials used in solidification and stabilization process. For this purpose, sampling has been performed on the landfill sites of Salafchegan Industrial Estate by the method proposed by American Environmental Protection Agency. The wastes of this site (with an area of 4 hectares which is related to only the depo and discharge of secondhand bleaching soil wastes of second treatment of oil units established in this Industrial Estate), will be investigated in terms of the total level and compounds of the extent of oil hydrocarbons, level of aromatic hydrocarbons, heavy metals, pH, and humidity. In this stage, some tests such as density, humidity, Atterberg limits (Plastic limit and Liquid limit), and concentration of petroleum contaminants would also be performed on the contaminated soil of this site.

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The second stage of this research involves investigation of the leakage properties of the solidified samples of second-hand oil industries waste with added compounds, and across different states and conditions. For this purpose, the use of TCLP test and unconfined compressive strength in investigating the microstructure of solidified samples in terms of morphology using SEM (Scanning Electron Microscopy) on solidified samples has been performed.

Materials and Methods

The materials used in this study are: typical Portland cement (OPC Type I 42,5), contaminated secondhand bleaching soil, modified clay soil (organophilic), experimental quicklime, solvents, and other materials required for performing the experiments. Note ordinary portland cement applied in this study was obtained from the Tehran Cement Factory. The modified clay soil required for this plan has been purchased from Southern Clay Products, Inc. (USA), with a trade name of Claytone 40. Organoclays can be created by exchanging the hydrated exchangeable cations of clay (usually bentonite) with various types of quaternary ammonium cation or other techniques. In this research, modified bentonite has been produced via a wet method by using quaternary ammonium salt (QAS) of hexadecyle-trimethyle ammonium (HDTMA). Some physical and chemical characteristics of Portland cement and modified bentonite are presented in Tables 1 and 2. Deionized water was used for preparation of the samples and synthesis of the solutions has also been provided by the water which resulted from ion exchange column located in Arian Fan Azma trustee laboratory. Other solvents and chemicals acquired for the experiments were purchased from Merck Co.

The analysis of the total oil hydrocarbons in this design is performed by using a method similar to 8015 C method presented by American Environmental Protection Agency. Methylene chloride was used as an extractor for hydrocarbons using the ultrasonic sequential extraction method as described in EPA method 3550 C. For PAH analysis, however, silica clean-up was carried out using EPA method 3630C, followed by GC analysis of the sample. Furthermore, to analyze the heavy metals present in the mixed sample of the contaminated soil of the site, 3050 B method (EPA) has been employed. Note that these experiments have been performed in the instrumental analysis laboratory of Arian Fan Azma Trustee (the trustee laboratory of the Environmental Protection Agency) in Tehran. TCLP test has also been performed according to guideline 1311 of American Environmental Protection Agency. Compressive strength device in the laboratory at the University of Qom has been utilized to test the strength of the solidified samples of the contaminated soil. The samples on which this experiment has been performed included the solidified samples of the soil contaminated with oil hydrocarbons with a curing time of 28 d.

Other experiments that involve the physical properties of the contaminated soil have been performed according to the following methods in the laboratory at Qom industrial University:

- Soil's natural humidity by ASTM D 2216 method
- The density of raw particles by ASTM D854 method
- Atterberg limits of soil (liquid limit and plastic limit) by ASTM D4318 method
- pH of the soil by ASTM D4972.

Furthermore, for the information relating to the chemical properties of the modified clay (a type of modified montmorillonite), a modified soil commercially referred to as Clayton R40 has been used, in which the quaternary salt of ammonium called dimethyl di(hydrogenated) Tallow has been the agent for modification of this clay, based on the technical information sheet provided by its producer company (South Clay Products Company, Table 1).

In order to determine the value of hydrocarbons in the contaminated soil in the waste depot site in Salafchegan Estate, the value of total petroleum hydrocarbon (TPH) index has been interested as the main and target index, and for the sampling, the guideline presented by American Environmental Protection Agency was utilized. Note that the aim of sampling is to achieve the minimum number of necessary samples such that it is the representative of the entire contaminated soil in the site. For other analyses (including polycyclic aromatic hydrocarbons and heavy metals), however, a homogenized composite sample was prepared by mixing equal amounts of samples from each grid.

For solidification and stabilization of the soil contaminated with petroleum hydrocarbons, 16 samples (from the prepared compound sample) were mixed with different compositions of cement, quicklime, and modified clay soil. Table 3 shows the decomposition of these materials in the mentioned samples. In addition, in order to complete the hydration process of cement as well as lime, the prepared samples were kept without contact with free air for 28 d. Initially, modified clay was blended with the soil to allow it to adsorb the petroleum hydrocarbon effectively and, after 20 min, Portland cement and Quicklime was added to the mixture. Water was then added based on the workability of the mix (i.e., slump test). After thorough mixing, samples were transferred into the molds which have been made as per ASTM D 1633 method A with the height to diameter ratio of 1.15.

Results and Discussion

The results of the experiments conducted on the contaminated soil of interest suggest that the soil humidity has been 12.26% and the specific density of the soil has been 1.22. Furthermore, the plasticity index of the soil was obtained as 5.07. Based on the numbers of limit of fluidity and plasticity index obtained here, it was found that the contaminated soil of interest in this research belongs to sticky soil of organic soil (soil with high concentration of organic compounds) in terms of granulation, with a low permeability. The tests of heavy metal have shown the traces of iron, barium, lead, chrome, cobalt, cadmium, manganese, copper, nickel and zinc in the soil samples but their amounts are under the standard limits. Therefore, the soil being studied in this research does not have the heavy metal contamination potential.

The tests of aromatic hydrocarbons show the existence of acenaphthylene, acenaphthene, fluorine, fluoranthene and pyrene in the soil in amounts more than other aromatic compounds but still their amounts are under the standard limits. Therefore, the soil being studied in this research does not have the polycyclic aromatic contamination potential.

To analyze the effectiveness of the solidification and stabilization of the soil, the leakage in a control sample (without organophilic clay and quicklime as solidifiers) is measured and compared to the samples containing solidifiers. The comparison between the leaked contaminants concentrations from stabilized samples and control sample shows that in all of the solidified and stabilized samples, an appropriate percentage of oil hydrocarbon removal has happened. In other words, most of the organic compounds and heavy metals diagnosed in the soil are encapsulated in the matrix and are not present during TCLP test. It shows that using organophilic clay has a good effectiveness for solidification and stabilization of the used bleaching soil in waste disposal site of Salafchegan Industrial Estate. The tests of free pushing resistance show that the addition of clay will increase the resistance of the samples.

Conclusions

Overall, based on the conducted experimental investigations and studies, the leakage test indicated that across all the samples, addition of modified clay soil has resulted in reduced leakage. In the overall removal of oil hydrocarbons, the samples containing 20% cement or lime and 30% modified clay soil (within the curing time of 28 d) have had the best efficiency in comparison with other samples with a removal efficiency of 98% for TPH, 98% for barium heavy-metal, and achieving the minimum compressive strength required for waste disposal (between 368 and 398 KPa). In these samples, the sample's efficiency has been better with greater levels of modified clay, such that the sample with 30% of modified clay (with 20% quicklime or cement) has had the best efficiency. The results obtained from free compressive strength indicated that the increase in the amount of modified clay (up to 30%) will not result in reduced free compressive strength to an unacceptable level. The results of SEM and leakage test (TCLP test) imply that two factors have been effective in enhancing the efficiency of the solidified samples. One has been elevation of the level of modified clay, resulting in increased absorptivity of oil hydrocarbons in the stabilization and solidification of the contaminated soil in the site; the second has been reduction of the pores in the matrix, leading to reduced leakage (the volume of the leaked material). Overall, the samples containing modified clay with 20% cement have had less empty pores in comparison with the samples containing modified clay with 30% cement. Therefore, the former has had a better efficiency. Furthermore, the presence of hydration products in the SEM of some samples (e.g. C20M30 sample) confirms the fact that cement hydration has occurred almost completely and the amount of water consumed for preparation of the samples has been suitable. Moreover, the results of the investigation suggest that if only the solidification mechanism is effective in reduction of contaminants leakage, it is expected that leakage from samples containing 30% cement or lime and 30% modified clay occurs less than for other compounds. However, in addition to solidification, stabilization of contaminants by the modified clay in the matrix has also been effective in reducing their leakage, an interaction occurs between the two mentioned mechanisms and this interaction goes as far as the point when the effect of one mechanism overcomes the other.

Generally, it can be concluded that the use of modified clay in improving the efficiency of stabilization and solidification process is positive in stabilization of oil hydrocarbons and heavy metals in the contaminated soil of the site. Furthermore, its application with the optimal percentage obtained as 20% cement and 30% modified clay (organophilic) is recommended for stabilization and solidification of the contaminated soil at the landfill site of Salafchegan Industrial Town. Note that at this percentage (optimal percentage), across the experimented samples, the strength properties of the solidified matrix as well as the SEM results have also been evaluated as positive and completely provide acceptable executive conditions to implement this process.

Keywords: leakage test, oil-contaminated soils, organophilic clay, polycyclic aromatic hydrocarbons, solidification and stabilization.

Investigation and simulation of upper-Gotvand dam challenge and management solutions

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Expended Abstract

Introduction

Upper Gotvand dam is one of the Iran's largest dams being constructed on Karun River, southwest of the country. This dam has been located in the distance of 380 km from the outfall of Karun River and 12 km from northeast of Gotvand city, in Khuzestan Province. The important and well-known challenge about Gotvand is the existence of massive salt formations (known as Gachsaran formation) in the dam reservoir that has been raised from the beginning of its impoundment. Predicted of the submergence of these formations, the reservoir water is salted and caused extremely undesirable environmental consequences at the downstream.

In order to attainment of proper operational options, the reservoir salinity stratification studies should be done. By implementation of reservoir water quality management, water can be extracted from different layers and also the saline layers directed outside the reservoir as a water flow with lower concentrations and the risks of using saline water at downstream can be prevented. On the other hand, reservoir water quality management and assessment of its feasibility need a comprehensive knowledge of the flow hydrodynamic coupled with salinity stratification and salt accumulation process in the reservoir. Hence, the main objectives of this study is three-dimensional simulation of hydrodynamics and salinity/ temperature stratification of Gotvand dam reservoir and presentation of the management solutions to attain this goal.

This study investigates the feasibility of reservoir quality management, regarding to the present challenge, by three-dimensional simulation of hydrodynamics and salinity of Gotvand dam reservoir and predicts the future situation, also provides management strategies. The main innovations of the presented study includes the three-dimensional simulation of hydrodynamics and salinity of Gotvand dam reservoir, calibration of dissolution rate of salt formations by using of the remarkable measured data at dam reservoir and presentation of management strategies.

Materials and Methods

Hydrodynamic and salinity/ thermal stratification in dam reservoir is a three-dimensional phenomenon, hence for exact calculation of variables at the surface and depth, a three-dimensional model is required. Also, the position of salt formations in the dam reservoir (which have spread on one side of the reservoir) and the need for stratification calculations in depth, necessitate application of a three-dimensional model. In this study, for simulation the mentioned phenomenon, a commercial model has been developed by the Danish Hydraulic Institute (DHI). MIKE 3 introduced since 1998 and due to its great capabilities in simulation of flow hydrodynamics and water quality have been used in several studies. Three-dimensional simulation of hydrodynamics and salinity/ thermal stratification of the Gotvand dam reservoir need various data and parameters. It worth to mention that for provision, verification and preparation of required data, too much time and cost were spent which is one of the strengths of this study.

In order to generate the horizontal mesh of the solution domain, two types of grids have been used: flexible rectangular and triangular grids. The main path of the river covered by high-density rectangular grids and the reservoir surface by triangular ones. In order to create the vertical mesh of solution domain 46 depth layers were selected; a combination of 40 Z-Level layers and six Sigma layers with equal thickness.

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Salinity sources were placed at the exact location of salt formations in the reality, in order to consider dissolution of these formations in the model. The point sources covered the entire surface of salt formations with consideration of the wall slope with a distance of 50 m and 5 m height difference.
The most important part of this study is calibration of the dissolution rate of salt formations. The dissolution of salt formations in the dam reservoir is a complicated and nonlinear phenomenon, due to the effect of numerous factors, such as different water levels in the reservoir, reservoir hydrodynamics, salinity gradient and temperature, etc.

Conclusion

Several strategies have been presented to solve the present challenge, including removal of salt formations, preventing the contact of reservoir water with salt formations to reduce the dissolution rate, via some coatings such as geomembran or clay blanket, construction of conveyance pipelines at the reservoir bed, in order to transfer salt to the Persian Gulf and finally the reservoir water quality management.
In this study, the reservoir water quality management, through water extraction from various layers, has been investigated. Due to complex circumstance of the problem, it is difficult to predict the future condition of the dam. Here, a 3D numerical simulation was implemented to accurate prediction of the reservoir water quality conditions with respect to time, in the interaction with salt formations, and salinity/ thermal stratification into the dam reservoir obtained. Using the model results, the reservoir can be monitored in terms of salt accumulation, so the quality management strategies can be offered.
Based on the results of dissolution rate calibration, it was found out that the amount of dissolution was not constant during the impoundment and varies according to water extraction method (decreasing and increasing at the rate of inflow and outflow and the outcrop surface of the salt formations). In this study, the minimum and maximum value of dissolution rate obtained as 0.5 and 7 cm per hour, respectively.
The most effective factor in the variations of dissolution rate is variations in flow hydrodynamics in the dam reservoir, due to its three directional variations in different stages of impoundment resulting in various dissolution rates. Also, the results of thermal stratification of the Upper Gotvand dam reservoir indicates that due to extreme variation in temperature in the dam reservoir site and because of highly variable salinity at different depths of the reservoir, there are different patterns of stratification cycle and overturning.
Another important point is that at the time of simulation, with the assumption of equilibrium dissolution rate as 0.5 cm per hour and consideration of imported salinity of upstream boundary and salty rivers leading to the reservoir, the salt accumulation amount in the reservoir will be 875 kg/s, which failure in discharge of that, resulting in a severe salinity gradient and serious challenges for the Upper-Gotvand dam. Discharge of accumulated salt by downstream outflow can prevent from salt accumulation in the reservoir, so the amount of flow discharges and corresponding salinity concentrations have been proposed. However, this act will follow the degradation of downstream water quality and relevant consequences including the loss of agricultural land efficiency, degradation of water quality at downstream and environmental impacts. As a solution, the discharge of salinity could be conducted in the non-cultivation seasons and according to the associated standards that need further investigations at downstream.

Keywords: : dissolution rate, Gachsaran formation, salinity stratification, three-dimensional model, Upper-Gotvand dam.

Making the soundscape map of the city using the grounded theory and Nvivo application (Case study: the District 12 of Tehran)

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Expanded Abstract

Introduction

According to the definition of Trucks, the soundscape concept is a subjective component. It means the way that the environment is understood by the individuals and communities and it examines concepts such as people's expectations. The last attempt to define the soundscape has been carried out as an interdisciplinary subject related to an ISO group called ISO/ TC 43/ SC 1/ WG 54. It is obliged to provide a comprehensive and standardized definition of the landscape term after examining the 24 participating countries: An acoustic environment which is perceived experienced or understood by a person or group of people. Definitely, all of these definitions focus on the two main issues: environment or listener person. There is a lot of studies defining the soundscape based on the acoustic environment and the place of the individual. But, in newer definition the main emphasis is on the listener person.

Materials and Methods

Since the assessment of the soundscape is an interdisciplinary subject and is examined from different aspects (social sciences, environmental, psychology, design, planning and urban management, landscape architecture, acoustics, etc.), it seems that using a combinatorial approach is more logical that can cover the existing approach as much as possible. Therefore, in this study, the various methods and models have been used to progress each target of the study. First, the use of the grounded method was selected for the fieldwork and data analysis. Since, the main emphasis of this method is on the results arising from the memory writing of the participants, in other words, it is based on the listener's individual in the research process, because in the recent years, most of studies have emphasized to the individual than the place or acoustic environment. This indicates a shift direction in the definition and evaluation of the soundscape. For this purpose, it is required to express all the subjects related to how a listener's individual can be the center of this study and using a linguistic approach to apply its concepts for the recognition of soundscape issues. Finally, the model of soundscape planning of the Pier Headforce has been used. It is known as the Sonotop map to provide better solutions. This model has been also used somewhat in the Global Sustainable Soundscape Network project (CNH-RCN).

Discussion of the Results

The final evaluation and analysis of data shows there are mainly four types of judgment about soundscape:

1. High soundscape, but acceptable

There is a deep thought about the sound in this category of soundscapes, a decision of having the role and sinking in the voice of the activity. This case often related to other aspects of the acoustic preferences of the listeners. Although participants sometimes like silence, but they really like being around other people and enjoy from the dialogue with them. The live music is one of their main methods and preferences for the leisure time. Although, the live music events are noisy and controversial, but these events are also very heartfelt to them and they are not afraid to share his private space.

2. High soundscape and unacceptable

The largest category of reactions to the negative effects is unwanted interferences. These sounds are usually loud noises and stimulating such as sirens, cars and motorcycles horn. Reactions and the main reasons for this

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interference are more complex and extensive than they seem. Initially, those sounds were considered likely that someone could generally expect the irritation from them, but they are considered as an inseparable part of the soundscape. The police and ambulance sirens are some examples of non-irritated irritation, although the sirens are certainly louder and more irritating, and especially they are designed for people attraction, but the sounds of the horns are much more persecutor.

3. Calm soundscape and acceptable
Desirable and calm environments have been generally described by joy or peace feeling. Many phonetics researches have been focused to generate quiet environments and have achieved a relative success as well. These researches are generally focused on the urban parks and their potential and bracing nature. It also seems that there is very little attention to the peaceful places that are not the urban green spaces. In contrast, very few people have been used in the study of the urban parks for this purpose.

4. Quite soundscape, but dreadful
There was only a concept for this category: places that are silent, but have a negative manner and accordingly, the loneliness and fear issues have been formed, some issues like the public subjects that are the key tools in the confronting mechanisms that the listeners use them to conflict with the spaces that have been judged as the undesirable, but silent soundscapes. The actively understanding process of these soundscapes relatively is clear. The listener wants generally a level of human passive companionship. If they fail to hear or understand someone who is around them, show their loneliness and generally use a confronting mechanism in these cases. This case is often linked to the space.

Conclusion
In this study grounded theory is used: how the perception of sound judgment and a variety of audio available from soundscape was found in the study area. The results show that the sounscape are manifold and complex concept and people's Perception of different factors affecting the environment is soundscape on their overall satisfaction. Consequently, in evaluating soundscape according to the emotions of each person and the background of their social and cultural is very important, so that in case of providing satisfaction, a sense of comfort created in person, and if not satisfied, if a person's ability to control the environment not by ignoring the noise, vandalism and leaving phenomenon will be occured.
Harvest information by memory correspondence and interviews within the study, it was concluded that when threshold attention of person to enter into a soundscape to be enough, this soundscape considered and responded listener in the way of his judgment about soundscape impressive. The changes range of the soundscape is "high, but acceptable", "high, but unacceptable", "calm and acceptable" and "the quiet soundscape but dreadful." The most important voices that can be heard from the city are unpleasant sounds such as traffic voice, construction, street factories and repair shops, neighbors loud music sound, uproar sounds and so on. Gray voices have created some brown fields that have been surrounded into the spaces between the buildings.
Here, the main question would be "how to apply the results of the evaluation soundscape design and urban planning in the area to be used?" Since urban planning based on the location information, using GIS are different models for the future, proper planning in order to improve the environment. Thus, sounscape evaluation purposes in the study area from theory into practice are more closely coordinated.
Per Hedfors used Ian McHarg method of landscape analysis to evaluate soundscape maps. In this regard, the researcher stated that the method can be combined with a clear map to show different aspects of the same soundscape. Sundscape layer (sonotope) proposed as one of the information layers in planning urban soundscape. To define the existing sonotops, the expected aural modes of the users should be considered about the relevant locations. Expected activities in their place are very important due to the land use in the planning or designing the acoustic and appropriate conditions. A list of available acoustic resources can be drawn based on the land use plan. The planning resource can be allocated to the new places in the soundscapes. Therefore, the acoustic fields map can be identified through all acoustic, effective resources in the area. Nowadays, the common method of the description of the acoustic fields for one or more acoustic resources to design or understanding is often limited to the sound intensity feature.

Keywords: district 12 Tehran, ground yheory, NVivo, sound, soundscape.

Analyzing land use change trends and socio-economic driving forces of land degradation in Arasbaran Biosphere Reserve

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Extended abstract

Introduction

Land use and land cover change (LULCC) is a complex phenomenon rising from several drivers such as biophysical, socio-economic, cultural, intuitional and technological factors. Environmental and socio-economic factors consider as the main LULCC drivers which consist natural environmental processes and socio-economic drivers (i.e. demographic changes), respectively. Demographic variables mainly and population growth especially expected to play key roles in LUCC process. It should be considered that population size doesn't cause LUCC but also other aspects such as urbanization, occupational, literacy and household size are vital. LUCC drivers needs to be considered in LUCC management in protected area and other areas under the surveillance of the Departments of Environment (DOE) or Environmental Protection Agencies (EPAs) that have been gone under notable changes. As long as LULCC occurs within or surrounding the protected areas, their usefulness regarding conservation of biodiversity for the future generations will be severely threatened.
Biosphere reserves (BR) is the area including coastal and terrestrial ecological systems and is established to promote solutions to reconcile conservation of biodiversity beside its sustainable use. Unfortunately, despite its potential for sustainable land use management practices, the BR model in Iran has only been used for a primary zoning of landscapes with exceptional natural resources followed by a static (more often) unsuccessful management. Local communities affect the BR management systems and should be known as one of the main factors in order to take advantage of collaborative management. So, regards to land use and land cover roles on environmental quality and health and ecology of protected area especially in BR, studying LULCC drivers is so important to adopt poroper management decision. This study aims to analyze spatiotemporal land use change trends and socio-economic driving forces of land degradation in Arasbaran Biosphere Reserve, Iran.

Materials and Methods

Case study

The Arasbaran BR is located in the north of the Eastern Azerbaijan province, Iran and lies within 38^{o} 43' 41" N to 39^{o} 8' 11" N and 46o 39' 50" E to 47o 1' 48" E. Regards to Iranian Population and Housing Census in 2011, the total population in this area was about 7911 persons distributed in 79 villages (4 of them abandoned today) and were almost farmers.

Methods

The RS images of Landsat satellites used to consider potentially possible for monitoring and evaluating LULCC dynamic during the last 24-years. Data preprocessing including geo-referencing, haze reduction was done for each image. The unsupervised and supervised classification carried out (using maximum likelihood method) and after modification and correction on the maps, the final land use and land cover maps were extracted for 1989, 2000 and 2013 from TM, ETM+ and OLI images, respectively.
Four socio-economic variables including population, occupational, literacy and household size growth rate were selected to analyze correlation between the LUC and four socio-economic drivers. It should be noted that LUCC

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(i.e. forest to range land and residential areas, range land to agriculture and residential areas and agriculture to bare land) consider as land degradation in this study. Temporal relation between above mentioned socio-economic drivers for 73 villages within the study area with the land degradation analyzed using multivariate regression model.

Results

According to the limitations in selection of Landsat images, land use and land cover maps were extracted for 1989, 2000 and 2013 and classified to three categories: agricultural land, bare land and built-up area (also expresses as human built environment or urban area in this paper). The obtained overall statistical Kappa values of each classified map for 1987, 2000 and 2013 were 0.82, 0.84 and 0.86, respectively. The Kappa values indicate high classification accuracy for each map.

The main types of land use and land cover were bare (range) land with 56.91%, 61.39% and 60.81% of Arasbaran Biosphere reserve total surface area in 1989, 2000 and 2013 respectively. Results indicate that a continuous intense trend of reducing the forest area from 1989 to 2013 occurred. The agricultural land coverage increased from 2313.462 to 4641.12 ha during the studied time span regards to the fact that the traditional livelihood is yet farming.

The amount of deforestation during 1989-2013 was 1351.07, 3954.28 and 159.331 ha within the core zone, buffer zone and transition area, respectively. Land degradation amount was about 7868.43 ha during first period and experienced 12952.35 ha of land degradation in second period. The total land degradation was 2408.58 ha in the studied time span.

In order to analyze socioeconomic variable affected LULCC during 1989 to 2013, raw data for population, occupational, literacy and household size were taken from Statistical Centre of Iran for the all villages and the change rates were calculated. Also, the land degradation within the buffer of 5 km from the center of each village for whole time span was calculated. Correlation between dependent variable (Land degradation) and independent variables (population, occupational, literacy and household size growth rate) were calculated by using multivariate regression method in IBM SPSS Statistics 21. Results show that literacy change rate was insignificant and so omitted from the model. The remnant variables analyzed through multivariate regression method and projecting land degradation model regards to socioeconomic variables were obtained (Equation 1):

$$P = \frac{75\exp(1.3 + 0.01A_1 - 0.008A_2 - 0.017A_3)}{1 + \exp(1.3 + 0.01A_1 - 0.008A_2 - 0.017A_3)} \quad (1)$$

where P: land degradation (ha), A_1: population change rate (%), A_2: occupational change rate (%) and A_3: household size growth rate (%).

Conclusion

To analyze LULCC drivers in the study area using approach derived from landscape ecology, spatiotemporal of LULCC carried out. Spatial and quantitive land use changes determined using cross tabulation method that is important in sustainable management of protected area especially biosphere reserves. Results indicate that overlaying LULCC maps and BR' zones cause to identify potential threats for each zones especially core zone. The obtained result shows considerable change within the core zone indicating the necessity of rapid management action. Modeling socioeconomic variable of LULCC in the local scale shows that three of the studied factors (population, occupational, household size growth rate) were significant. The obtained model that predicts land degradation based on socioeconomic variables can be used to get amount of LULCC in area indirectly regards to independent variables. The applied methods cause to apply bottom-up approach in the planning process of the study area.

Keywords: driving forces, land degradation, protected areas, socio-economic variables.

Environmental effect assessment using ecological footprint method (Case study: Energy Engineering Department of Sharif University of Technology)

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Extended abstract

Introduction

Ecological footprint is an index that shows the amount of human occupation in nature. This method assesses the impact of human on the environment. In other words, using this approach, the amount of demolition on nature by a specified activity is determined. The ecological footprint is based on this thought that for consuming energy or materials and waste absorption, a land in one or several groups of ecology is required. This concept shows that whether our consumption level is more than biocapacity or lower than the biocapacity of Earth. The objective of ecological footprint is the establishment of the balance between "consumption of resources as well as production of waste products by human" and "production of resources and absorbing waste products by nature". By the analysis of ecological footprint, an area of land to meet individuals and residents' needs in a determined area of land can be estimated. Ecological footprint is defined as a simple index to contribute to the preservation against unsustainability. Ecological footprint method has been used at national, regional and urban levels. Jomepour and Shahnavaz (2013) analyzed the sustainability of Rasht using the ecological footprint method. The results of this study indicated that the ecological footprint of Rasht is higher than its biocapacity and as a result, this city is unsustainable in terms of ecology. Gharakhloo et al. (2012) investigated ecological footprint in Kermanshah. According to their results, the ecological footprint of this city is 1.82 hectares. The biological capacity of Iran is 0.8 hectare. This indicates that Kermanshah depends on a region beyond Kermanshah Province to meet its biological needs. Levan et al. (2001) determined the ecological footprint of Santiago based on the Chili national estimation. Based on the calculations, the biological capacity of chili is 50% more than the global average. The ecological footprint of Chili is 2.44 hectares, while the biological capacity of the country is 3.2 hectares.

The household sector accounts for a major part of the final energy consumption so that 31.7% of total electricity sales and 33.5% of gas consumption in 2013 were related to this sector. On the other hand, this sector needs considerable material and water and its amount of waste production is significant. For example, water consumption per capita in Tehran in 2015 was more than 220 liters per day and per capita household waste generation in Tehran was 320 kg per year, which amounts higher than the global average. The high consumption of energy, water and food as well as high production of solid waste from this sector causes significant environmental effects. Therefore, the analysis of sustainable development in this sector is required in a way that its different aspects on the ecosystem are analyzed. According to this issue, "sustainable building" was developed that means " the practice of (1) increasing the efficiency with which buildings and their sites use energy, water, and materials, and (2) reducing building impacts on human health and the environment, through better siting, design, construction, operation, maintenance, and removal-the complete building life cycle". Since the past, various researches have studied on sustainable buildings. Hakkinen and Belloni (2011) explored the motivations and barriers facing the development of these buildings and offered strategies to promote these buildings. Increasing customer awareness of the benefits of sustainable buildings and the need for teamwork in the design are among their proposed solutions.

In this study, to evaluate the environmental impacts of household, commercial and public sectors in Iran, the activities of the Energy Engineering Department of Sharif University of Technology is studied as a case study. Prior to this study, in a study by Soleimani and Avami (2016), the activity of this department was assessed using life cycle method and to reduce emissions of carbon dioxide, low-cost methods such as shading were investigated. In this study, the activity of the faculty is studied using ecological footprint method. In addition to direct effects, the indirect effects of the faculty activities are considered as much as possible.

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Materials and Methods

Given the complexity of the ecological footprint method, this study only refers to the operation of the building and the stages of construction and destruction are not included. The faculty environmental effects include direct and indirect effects. The direct effects are the results of energy and material consumption or waste production at the faculty site. The indirect effects are the results of the consumption of materials or energy in a place rather than the faculty site. In this study, transportation of students to the faculty conducted by various modes of transportation is among the indirect effects. In this study, the consumption of electricity and gas is calculated using electricity and gas bills for one year. Using emission coefficients, carbon dioxide emitted by fossil fuel consumption is calculated. The land area required to absorb this amount of carbon dioxide is calculated and finally using the equilibrium factor, the land is converted to global hectares. Water consumption is also calculated using water bills for one year. Forest land is considered as the source of water production and annual consumption of water is converted to forest land that by applying equilibrium coefficient is converted to global hectares. Concerning the transportation sector fuel consumption, to calculate the number of students from any mode of transportation and kilometers traveled by each mode of transportation, a questionnaire survey was prepared and distributed among students. Using the results of this survey, as well as per capita fuel consumption calculated for each mode of transportation, the annual fuel consumption of each mode is calculated and converted to global hectares similar to energy consumption of department. At the end, the total ecological footprint of the faculty is obtained by the sum of the above cases.

Discussion of results

Table 1 shows the summary of results.

Table 1. Summary of the results of ecological footprint of the activities of the department

	Energy consumption of faculty		Waste production			Infrastructure land	Energy consumption of transportation		
	Natural gas	Electricity	Water	Plastic	Paper		Riding	BRT	Subway
Ecological footprint (gha /year)	87.24310	3.15593	97.5	5737.0	574.0	377.1	147.1512	7.7	86.23

According to the results, most of the ecological footprint is caused by the consumption of energy at the department. In order to assess the potential of reducing the ecological footprint, the ecological footprint of electricity and gas consumption of the faculty is calculated assuming global average values for electricity and gas consumption per capita in two scenarios. In scenario 1, for calculating the total energy consumption of the faculty, gas consumption is calculated by assuming the global gas consumption per capita and is added to the current electricity consumption of the faculty. In scenario 2 electricity consumption is calculated by assuming the global electricity consumption per capita and is added to the current gas consumption of the faculty. According to the results, ecological footprint caused by the energy consumption of the faculty in scenarios 1 and 2 will reduce 14.3% and 20.7% respectively.

The major part of the waste products is paper and plastic. The recycling rate of plastic and paper for Iran are 9% and 2%, respectively, while in 2014, these values in Europe were 69.2% and 71.7%, respectively. The increase of recycling rate for plastic and paper will reduce the ecological footprint of waste. The major of the ecological footprint of transportation is related to private cars that have higher per capita fuel consumption. The increasing use of public transportation by students significantly reduces the ecological footprint of transportation, if all students who use private car for transportation to department, use subway, the ecological footprint caused by transportation will be reduced 93.4% and if they use BRT, it will be reduced 77.8%.

Conclusion

In this study, the environmental impact caused by the activities of Energy Engineering Department of Sharif University of Technology was studied using the ecological footprint method. Results indicate that the total ecological footprint of the faculty is 41456.37 hectares per year that its major part is related to gas and electricity consumption of the faculty. Thus, the reduction of energy consumption of the building will reduce this index significantly. Moreover, increasing the recycling rate of wastes and using public transportation are other solutions of reducing this index.

Keywords: department, ecological footprint, environmental effects assessment, energy consumption.

Environmental Kuznets Curve Test in Iran and OPEC Countries: A generalized method of moments approach

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Extended abstract

Introduction

Proponents of economic growth theory believe that growth is the only way to create the necessary capital for environmental protection. Energy is used to achieve higher economic growth. Human needs energy and the consumption of the most types of fossil fuels such as coal, oil and gas. In recent decades, by increased in population of the planet and industrial development and economic growth, there have been changes in the climate and the atmosphere that increase greenhouse gases for an example. The most important greenhouse gas is carbon dioxide and the main source of this is combustion of fossil fuels. These fuels are currently the main means of producing energy in industrialized countries. Energy is the part of the general equilibrium model in economy. In this model, all markets and services are in balance. Supplying and demanding in a particular market is influenced by other markets as static or dynamic. Economic growth in the most countries has been accompanied with environmental pollution.

Air pollution inflicts costs on people's lives; for example reduced in health, loss of life, reduce in productivity, increasing health costs, waste of facilities and economic resources, and increased in government control costs. According to this, increased in pollution is obstacle in economic development.

It is important to study the factors affecting the spread of pollution and its relation with economic growth in countries.

Kuznets curve shows relationship between pollution and per capita income in developing country. After a certain per capita income, pollution levels begin to decline, because the country is able to invest in more efficient technologies and new production methods. This curve associated with the development of the country. In the agriculture, the country has a per capita income and low pollution. By approaching the stage of industrialization, pollution increases. At low levels of development, quality and environmental degradation is continued to work activities on natural resources and the limited quantities of biodegradable waste is limited. Whit the extraction of natural resources and agricultural activities and industrial mutation occur worse. At higher levels of development, structural changes in the industries related to information and services. High technology and demand for environmental quality have led to a steady decrease in the destruction of the environment.

In the first stages of growth, knowledge of people about the environment is low. This causes an increase in air pollution. In the next stages of growth, knowledge about the environment increases. So that environmental protection is important. In these circumstances government uses policies such as strong laws against environmental polluters. These policies make it along with economic growth. After the Industrial Revolution, by using more energy, average productivity increased. But energy consumption has been associated with environmental degradation. Study of economic dimensions of greenhouse gas emissions and their environmental impacts, especially in the current situation where greenhouse gas emissions are increasing, is very important. Pollution has become one of the main challenges facing countries, in such a way that countries, in addition to policies and actions within their borders, organize pollution in the international area. Countries are struggling with efficient policies and use of important methods along with economic goals. Reducing environmental damage of economic growth without knowing about the relation between economic activity and environmental pollution is not possible.

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In 1987 report called Our Common Future, the concept of sustainable development was raised in the debate on environment versus development. This topic was expressed by the International Union for conservation of nature and in 1980 was accepted. Growth is the only way to provide the capital necessary in protection of environment.
In this research, Kuznets hypothesis test for the first time in two models generalized the method of moments for OPEC's countries. The Environmental Kuznets Curve was studied in Iran and OPEC countries by Generalized Method of Moments for 1992-2013 periods. Because of existence largest share of carbon dioxide emissions in combining greenhouse gases, we used this variable to test the Kuznets hypothesis. Environmental Kuznets Curve hypothesis for individual countries was not accepted in both models. In fact, the amount of carbon dioxide emissions in the process of economic growth in these countries has continually increased. Growing urbanization, population growth, energy consumption and real GDP had positive and significant impact on emissions in these countries. Saudi Arabia has highest carbon emissions and economic growth among OPEC members. Iran has fourth rank in economic growth in these countries. Based on this model, among these countries, the path of pollution in the OPEC countries is still rapidly rising and has not reached the curve return point.

Matherials & Methods

In this research, two models are used. The first model derived from the Manaji et al. (2009), Sharif Hossain (2011), Iwata et al. (2011) and Shahbaz et al. (2011).

$$LCO_{it} = \beta_{0i} + \beta_{1i} LCO_{it-1} + \beta_{2i}LGDP_{it} + \beta_{3i} (LGDP)^2_{it} + \beta_{4i}LURBAN_{it} + \beta_{5i}LENERGY_{it} + U_{it}$$

Second model derived from the Oh and Lee (2006), Hang and Sheng-Yuan (2011) and Ren et al. (2014).

$$LCO_{it}=\beta_{0i} + \beta_1 LCO_{t-1} + \beta_{2i}LGDP_{it} + \beta_{3i} (LGDP)_{it}^2 + \beta_{4i}LPOP_{it} + \beta_{5i}LENERGY_{it} + U_{it}$$

In the above models, LGDP is logarithm of real per capita GDP at constant prices 2005, $(LGDP)^2$ is squared logarithm of real per capita GDP at constant prices 2005, LENERGY is log of per capita energy consumption, LCO is logarithm of carbon dioxide emissions, LURBAN is growth of urbanization, and LPOP is population growth. The research period is 1992-2013 and the OPEC countries investigated. These countries include Angola, Ecuador, Nigeria, Libya, Iraq, Iran, United Arabic Emirates, Saudi Arabia, Venezuela, Algeria, Qatar and Kuwait. All the necessary data for this study were collected from the World Bank. In this research, generalized method of moments is used. In this method, it is necessary first to estimate the model instrumental variables used in the model. GMM estimator depends on the validity of the adjustment tools. This credit can test stipulated by Arellano and Bond (1991) tested. Sargent tests the validity of the test instruments. Failure to reject the null hypothesis in this test shows evidence of the validity of instruments.

Conclusions & Discussion of results

According to the results, LGDP square was not confirmed, indicating that the Kuznets hypothesis could not be verified. Kuznets curve is not inverted U-shaped in these countries. These countries are part of the Kuznets curve upward. Dirt track of these countries is still rapidly ascending curve being not come to terms. For OPEC countries, Kuznets hypothesis cannot be confirmed in this study. In both models the energy consumption and carbon dioxide emissions before and after the logarithm of GDP had the greatest influence on carbon emissions. Developed countries need to support the production support environment. The environmental Kuznets curve views are known in experimental models. The Kuznets curve in these countries is not inverse U shape. These countries are on the upward side of the Kuznets curve. These countries, including Iran, have not yet achieved to degree of economic growth that the Kuznets curve confirmed for them in reverse U shape. The pollution route of these countries is still rising rapidly and no return to Curve Return Point.
In this study, the Kuznets hypothesis is not confirmed in OPEC countries. Energy consumption coefficient in both models is estimated 0.58. It indicates an increase in the consumption of energy carriers with more pollution and expresses the undesirable use of energy and low technology in these countries. Urbanization according to Shahbaz et al. (2014) and Sherma (2011) had positive and meaningful effect on carbon dioxide emissions. Gross domestic product, according to Iwata et al. (2011), and Narayan and Narayan (2010), had positive and meaningful effect on carbon dioxide emissions.
According to this the following suggestions are provided. 1. Installation of equipment cleaner emissions pollution, 2. Taxes on pollution, 3. Use of new technologies, 4. Improving research and development in clean technologies and environmentally friendly alternative, 5. Management of energy consumption according to the highest efficiency, 6. Use of clean energy and renewable energy use in production. Urbanization due to the positive impact on the carbon dioxide emissions can be reduced by controlling the urban population and try to prevent it from emissions of carbon dioxide gas.

Keywords: environmental pollution, GMM, Iran, Kuznets Curve, OPEC.

Assessment and ranking of urban districts to refer ecological quality of urban green spaces using TOPSIS method (Case study: Urban districts of Mashhad)

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Extended abstract

Introduction

The ecological benefits of green space are not limited only to absorption CO_2 and producing O_2, purifying air pollution, decreasing noise, improving soil condition and groundwater recharge and moderating microclimates and reducing the heat island effect in cities. But also creation a living and dynamic system have improved urban ecological structure and function and promoted the quality of the urban environment. Basically, green space is a part of urban landscape structure which has an important influence on a wide range of ecological patterns and processes. As well as multiple social and economic benefits, ecological value of urban green space can improve through synergies with the urban spatial structure and function. Spatial structure of landscapes is a central object of investigation in landscape ecology. This structure finds its expression in landscape pattern, which integrates both complex conditions of the natural environment. In order to landscape literature review, spatial structure is a major subset of the concept of spatial heterogeneity, usually referring to the spatial configuration of the system property. Ecological processes and the relationship between them can be identified by determining spatial configuration and urban green spaces composition. However, findings from the literature show that the quality concept was carried out by ecological and environmental variables. In particular, the quality of urban green space is defined by quantitative and qualitative factors, that if it was understood and analyzed properly, it can be concluded the concept of quality. Based on quality of life and attractiveness measures, it applied to urban green space when created delightful and beautiful environment for outdoor activities and provide key ecosystem functions and services as “green sources”. Strengthening ecological quality and ability provides species, nutrients and energy for “green sinks”. From ecological perspective, the explicit consideration of the quality is related to spatial structure and spatiotemporal interaction of processes in ecological research that involved the main contribution of landscape ecology to this paradigm shift. With an emphasis on structural aspects of landscape and urban green spaces, landscape ecology approach has been provided a powerful tool to assess changing green patches and landscape. In this study, conceptualized framework of quality, based on landscape ecology approach and method which can facilitate the representation and analysis of changes and environmental processes, addresses the environmental quality and specifies the requirements. By landscape ecology approach, we can interpret the effects of above-mentioned processes for environment ecological features and achieve a primarily classification of green space quality and function. According to this, the quality concept dependent on the nature of the ecological process that occurred in different level of scale, measured at the plot context analyzed in several time and displayed and represented in spatial patterns. Conceptually, landscape structure referred to spatial composition and configuration of environmental and ecological units and relationships among them. Due to the effects on ecological processes independently and interactively, the quality of landscape can be characterized by composition and configuration properties.

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Material and Method

Mashhad, the capital of Khorasan Razavi, is located in the northeast of Iran at latitude: *36°18'N and 59°36'E*. With an area of 382 km^2 and current population 2.9 million, Mashhad is the second most populous city in Iran. In recent decades, it has witnessed rapid growth, mostly because of its economic, social and religious attractions. Due to the physical development of Mashhad in most areas, urban green spaces have been replaced with different buildings, so it is necessary to study urban green spaces in term of quality. Based on the divisions of Mashhad Municipality, it has 13 regions, each of them has different area, population and green spaces types and conditions. As quantity, Table 1 shows distribution of green space and urban parks.

Data processing and green space distribution map

Satellite images were utilized to derive urban green space maps. The detail of satellite image data (Landsat 8 ETM+) used in this study obtained from the U.S. Geological Survey (USGS), dated on June 21, 2014. All image processing, classification and GIS analyses were performed using ENVI 4.7 software and Arc GIS 10. To provide a green space map, the unsupervised classification method was used to generate patch layer map (i.e., a polygon layer) in ENVI 4.7 software environment. Types and features were created based on integrated land use map and calculating and extracting the normalized difference of vegetation cover index (NDVI). To obtain a green spaces distribution map, the NDVI map was rectified and geo referenced by the Arc GIS 10.

Landscape metrics

To select and application the landscape metrics, previous studies have introduced landscape metrics according to objectives and methodology of research. Although, a series of landscape metrics have been developed to characterize the spatial patterns of landscapes and to compare ecological quality across the landscapes, the number of metrics can be used in evaluating the ecological quality, but not all landscape metrics can easily be classified as representing landscape composition or landscape configuration. For example, mean patch size and patch density of a particular patch type reflect both the amount of a patch type present (composition) and its spatial distribution (configuration).

Rank and TOPSIS method

For ranking and assessment of ecological quality, one of the MCDM methods named TOPSIS has been applied in this research. In this section, TOPSIS method is explained. TOPSIS (Technique for Order Preference by Similarity to Ideal Solution), developed by Hwang and Yoon, is one of the MCDA/MCDM methods to resolve real-world decision problems satisfactorily. TOPSIS attempts to indicate the best alternative that simultaneously has the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution. The positive ideal solution is a solution that tries to maximize the profit criteria and minimize the cost criteria, whereas the negative ideal solution is just opposite to previous one. The positive ideal solution is composed of all the good values attainable of criteria, whereas the negative ideal solution consists of all worst values attainable of criteria. In the TOPSIS method, precise scores that each alternative receives from all the criteria are used in the formation of a decision matrix and normalized decision matrix. By taking into consideration the rates of all attributes, positive and negative ideal solutions are found. By comparing the distance coefficient of each alternative, the preference order of the alternatives is determined.

The stepwise procedure of Hwang and Yoon for implementing TOPSIS is presented as follows:

Step 1. Construct normalized decision matrix of beneficial and non-beneficial criteria.

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{j=1}^{J} x_{ij}^2}}, j = 1,2,3,\ldots\ldots\ldots,J; i = 1,2,3,\ldots\ldots\ldots,n$$

where x_{ij} and r_{ij} are original and the normalized score of decision matrix respectively.

Step 2. Construct the weighted normalized decision matrix by multiplying the weights W_i of evaluation criteria with the normalized decision matrix r_{ij}.

$$v_{ij} = w_i * r_{ij}, j = 1,2,3,\ldots\ldots,J, i = 1,2,3,\ldots\ldots,n$$

Step 3. Determined the positive ideal solution (PIS) and negative ideal solution (NIS).

$$A^* = \left\{ v_1^*, v_2^*, \ldots\ldots\ldots, v_n^* \right\} \max imum\ values$$

where $v_i^* = \{\max(v_{ij}) \text{ if } j \in J; \min(v_{ij}) \text{ if } j \in J^-\}$

$$A^- = \left\{ v_1^-, v_2^-, \ldots\ldots\ldots, v_n^- \right\} minimum\ values$$

where $v^- = \{\min(v_{ij}) \text{ if } j \in J; \max(v_{ij}) \text{ if } j \in J^-\}$.

Step 4. Calculate the separation measures of each alternative from PIS and NIS.

$$d_i^* = \sqrt{\sum_{j=1}^{n} \left(v_{ij} - v_j^*\right)^2}, \quad j = 1, 2, \ldots\ldots, J$$

$$d_i^- = \sqrt{\sum_{j=1}^{n} \left(v_{ij} - v_j^-\right)^2}, \quad i = 1, 2, \ldots\ldots, J$$

Step 5. Calculate the relative closeness coefficient to the ideal solution of each alternative.

$$CC_i = \frac{d_i^-}{d_i^* + d_i^-}, \quad i = 1, 2, \ldots\ldots, J.$$

Step 6. Based on the decreasing values of closeness coefficient, alternatives are ranked from most valuable to worst. The alternative having highest closeness coefficient (CC_i) is selected.

Results and Conclusion

Urban green space has many usages and benefits on quality of human life. The results indicate that green spaces of Mashhad have no adequate relative frequency and patches of green spaces have undesirable conditions in terms of spatial composition and configuration. Now it has no enough extent and continuity to provide ecological services and improving ecological quality. Appropriate distributions of patches are recognized in these areas, proximity of patches is extremely uniform and there is heterogeneous distribution of patches. There is no appropriate distribution of green space patches in other regions of the city; green spaces patches have been distributed non-uniformly and heterogeneous. Most patches are small and fragmentation is recognized. There are no appropriate ecological conditions; therefore there would be no appropriate ecological quality. Ranking ecological urban areas is done with TOPSIS. The results of this study showed that the best quality ecological area is 5 and area 12 has the most undesirable ecological quality.

Keywords: ecological quality, landscape, ranking, TOPSIS, urban districts of Mashhad.

The measurement of the spatial coefficient acoustic comfort in the metropolitan of Ahvaz

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Extended abstract

Introduction

Noise, it is said, is any sound that is unpleasant to the ear. Medically, when it persists, it can damage the ear. Considering the ear organ, it has been said that human ears were designed to process naturally occurring sounds and they are beautifully adapted to handle that task. Noise is most often defined as 'unwanted' sound. From this seemingly simple definition, two salient points can be isolated: one, that all noise is sound; and two, that all noise is subjective. The first point implies that some sort of noise is inevitable since it cannot be a noise- free environment.

Under these set of factors are the increasing rate of urbanization, accelerated socio-economic progress and the deepening religious culture. One of the characteristics of sound which cannot be overlooked in any discussion of noise problem is its wide range in intensity. However, sound measurement is usually done in Decibels (dB) rather than the watts since the latter can be clumsy to work with. In the decibel system, logarithms of the ratios of loudness are used to compare sound intensities. Acoustic comfort generally have two sources of industrial and non-industrial city. Royal believes that the most important factors in making urban acoustic comfort by streets and highways within the city include traffic volume, traffic composition, speed of movement, flooring and slope of the street, intensity and wind direction, away from buildings and streets is.

Methods and Materials

The dominant approach to this research is location analyze. According to the research literature and standards presented in Environmental Protection Organisation, the land use in Ahwaz city and related data are provided. In local analysis, after identifying all of contaminants uses, noise pollution zoning was carried out in two steps including the pollutant uses (step I) and local arteries (step II), and finally map acoustic comfort (step III) of the composition of the maps using Fuzzy Overlay analysis and operator SUM, for urban areas was obtained. The analysis in this part is the predictable sound (dB) per usage, based on existing standards.

Discussion

Commotion and noise is an integral part of modern life. Our ancestors lived in a more quiet environments and exposed to the sounds were softer. Special analysis in this study are considered in three dimensions.

- The first dimension, analyzing the results in urban areas. The following map was prepared to measure acoustic comfort segregated areas, where the results of the analysis indicate that the urban areas, in the district 5, zone 2 and zone 4 and zone 2 military police the area ratio (0.827), the district 1 area three, four regional areas 1 and 4, district 4 area, 5, 6 regional district 1, district 4 area 7, area 1 and industrial area by a factor of 0.720 region eight-noise ratio is very high compared to other areas and low acoustic comfort in these areas respectively.
- The second dimension is spatial analysis in the metropolitan area of Ahvaz. In zone 2 (0.782) and 6 (0.767) rather than other urban areas, the average coefficient of noise pollution is more and these areas are less acoustic comfort. The main reasons for the high level of noise pollution in these areas can be pointed to the presence of contaminants user and businesses.
- After the third, topical analysis. Among the selected indicators involved in noise pollution, heavy industry, passenger terminals, workshops annoying, multiple workshops, the military-disciplinary and

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cross the road network (motorways and main roads), are the most important pollutants that foreclose it is comfort, such as railways in the region of 6, Ahvaz airport in the region 3, the center of the military police in the area, highway crossing zones 2 and six and 7 and 8 regions and passenger terminals located at the end of the street revolution the six-pointed Khorramshahr in the region .

Conclusions and Solutions

Research findings indicate that, 4-2 district (area 4 in region 2) by a factor of place 0.879 and 1-6 areas by a factor of 0.807 have the lowest comfort. Also regions 1-5 had audio as well as areas (area 1 in 5) and 5-4 (zone 5 in region 4) had the highest coefficient of acoustic comfort.
Following methods are suggested to enhance the acoustic comfort factor in Ahvaz Metropolis: 1. Accounting and transfering units and workshops disturb the six metropolitan region of Ahwaz (welding, turning, rough and repair shops) out of town, 2. The implementation to plan annoying jobs, 3. The development of green spaces in metropolitan areas of Ahvaz using two and six plant species suitable environmental conditions areas, 4. Reforming network traffic engineering in order to avoid the heavy traffic and increase user and create facilities such as public parking in the area, 5. Decentralization of downtown and core services in the areas of second and third degree.

Keywords: acoustic comfort, Ahwaz, noise pollution.