Where, K_P is the predicted re-aeration coefficient and K_M is the measured. K_P and K_M are the mean of predicted and measured coefficient for the n no. of observations.

3. Results and discussion

Models developed using MLR with different input parameters and compared with their performance using training, testing and validation data sets. Equations were formed and solved by forming a design matrix, X = [ones (size(x1)) x1 x2 x4 x5 x6 x7 x8]; solved by a parameter using backlash operator, a = X/y. To validate the model maximum of absolute value of deviation of data is calculated. Performance of the developed models were evaluated are summarized in Table 1. Model is considered to be best fit with correlation coefficient coming closer to 1. MLR models developed with maximum value of R and R^2 and minimum value of RMSE is indicated in bold, can be concluded as the production of best relation between the observed and predicted variable. The best regression equation developed is described as:

$$K_P = 4.353\ 0.735Q + 20.121V\ 0.015D$$

$$0.033W\ 0.128\,TOC\ 0.006\,C + 0.011\,SS\,4$$

Comparative plots were designed to indicate the performance of best fit model of MLR as shown in fig 1. It is clear from the graphs that estimated results produces greater correlation with the measured values of re-aeration coefficient. In order to predict the applicability of model for the prediction of re-aeration coefficient, model can be coupled with the water quality model and also used for the prediction of water quality and to propose the pollution control strategies for urban water management [11, 12].

QUAL2Kw is widely used water quality model available with updated kinetics to measure the most conventional pollutants [13]. Simulation of rate of generation and depletion of oxygen with the decomposition of organic compounds available in river can also performed with the coupling of re-aeration model with QUAL2Kw.

Table1: Models developed using MLR

Input	R	R^2	RMSE
Q, V	0.656	0.431	2.427
Q, V, D	0.701	0.491	2.295
Q, V, D, S, W	0.711	0.506	2.258
Q, V, D, S, TOC, SS	0.846	0.732	1.834
Q,V, D, S, W TOC, C, SS	0.896	0.794	1.685

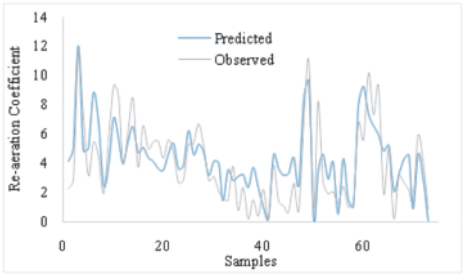


Figure1: Comparative plot of observed and predicted variable of best fit MLR model

4. Conclusions

Models were developed to predict the re-aeration coefficient for the estimation of assimilative capacity of river using MLR and performance of model were also evaluated to obtain the best fit model. The model equation generated, can also be coupled with the water quality models to manage the urban water quality for the riverine system development. However, accuracy of the model can also be improved by using neural network techniques, fuzzy logic, and other mathematical computing techniques and applied on other applications of hydrological modelling. It is expected that accuracy of model can be improved with the large data set.

5. References

[1] Jago-on, K.A., Kaneko, S., Fujikura, R., Fujiwara, A., Imai, T., Matsumoto, T. 2009.**Urbanization and subsurface environmental issues: an attempt at DPSIR model application in Asian cities,** Science of the Total Environment, 407 (9), 3089-3104

[2] CPCB, 2006. Water Quality Status of Yamuna River, Central Pollution Control Board, Ministry of Environment and Forest, Delhi.

[3] Oihana Izagirre, Urko Aguirre, Miren Bermejo and Arturo Elosegi. 2008. Environmental controls of whole-stream metabolism identified from continuous of Basque streams, Journal of the North American Benthological Society, 27(2), 252-268

[4] Grace, M.R. and Imberger, S.J. 2006. Stream Metabolism: Performing & Interpreting Measurements. Water Studies Centre Monash University, Murray Darling Basin Commission and New South Wales Department of Environment and Climate Change, 204.

[5] Rathbun, R. E., Stephens, D. W., Shultz, D. J. and Tai D. Y. 1978. Laboratory studies of gas tracers for re-aeration, JEED, ASCE, 104(EE2), 215-229

[6] Genereux, D.P. and Hemond, H.F. 1992. Determination of gas exchange rate constants for a small stream on Walker Branch watershed, Tennessee. *Water Resources Research 28*

[7] Hornberger, G. M. and M. G. Kelly. 1975. Estimation of atmospheric re-aeration in a river using productivity analysis. J. Environ. Eng. Div., ASCE 101: 729 739

[8] Chapra, S.C., and Di Toro, D.M. 1991. Delta Method for Estimating Primary Production, Respiration, and Re-aeration in Streams. J. Environ. Eng., 117(5), 640-655.

[9] Mcbride, G. B. 2002. Calculating Stream Re-aeration Coefficients from Oxygen Profiles, Journal of Environmental Engineering, 128(4), 384-386

[10] Jha, R., Ojha, C. S. P., & Bhatia, K. K. K. 2001. Refinement of predictive re-aeration equations for a typical Indian river. *Hydrological Processes, 15*(1), 10471060

[11] Parmar, D. L. and **Keshari, A. K. 2012.** Sensitivity Analysis of water quality for Delhi stretch of river Yamuna. *J. Environmental Monitoring and Assessment*, 184, 14871508

[12] Cox, B. A. 2003. A review of currently available in-stream water-quality models and their applicability for simulating dissolved oxygen in lowland rivers, Science of The Total Environment, 335(77), 314-316.

[13] Chapra, S. & Pellettier, G., 2003. QUAL2K: A Modelling Framework for Simulating River and Stream Water Quality. Documentation and

A sustainable resilience framework for regional coastal wetlands through aquaculture and geospatial monitoring

Rojith.G[1], Zacharia.P.U1, Grinson George[1] and Dhanya Joseph[2]
[1]Central Marine Fisheries Research Institute, Cochin, Kerala, India-682018
[2]Foundation for Environmental Research and Innovation, Kannur, Kerala, India-670691
*E-mail: grojith@yahoo.com

ABSTRACT:

Several wetlands, mainly coastal wetlands are vulnerable to climate change impacts such as sea level rise, saline intrusion, floods, etc that necessities effective interventions in the urban as well as rural coastal wetlands. India have 5,55,557 small wetlands (<2.2ha) including coastal, estuarine and fresh water ecosystems which highlights the need to align the resilience strategies with focus on region specific small wetland management so as to enhance sustainability. The framework proposed through this paper involves integration of regional small coastal wetlands status into GIS platform, implementation of aquaculture with community participation and a comprehensive continuous qualitative and quantitative monitoring system. Panchayat level small coastal wetland maps of coastal states could be created using remote sensing data along with construction of spatial database for better resource management and utilization. Local self-government bodies or other concerned institutions could finance for the geospatial analysis of coastal wetlands within their geographical area. The hydro-biological, physico-chemical and ecological data could be integrated to the spatial database. Wetland assessment facilitates degraded wetlands restoration as well as management of vulnerable wetland ecosystem for improved ecosystem functions. Integration of aquaculture practice with stress tolerant fish species is the proposed means to ensure community participation, regional level nutrition security and regular biophysical water quality monitoring. The qualitative monitoring of the wetlands could be done through remote sensing images whereas quantitative periodical water quality data through aquaculture practices could be integrated to GIS platform resulting in a comprehensive monitoring system. The competent scientific bodies could provide aquaculture guidelines and technical assistance, whereas NGOs could engage in geospatial analysis as well as management of wetlands. The multi component framework ensures networked information about regional small wetland status that could be used by policy managers and stakeholders for enhancing regional level vulnerability assessment, wetland governance and climate resilience. The framework could be extended to other wetland categories as well for sustainable resilience of rural and urban environment.

Keywords: Climate change, Coastal wetland, Resilience

Artificial Neural Network Model for Prediction of Nitrate concentration in groundwater of Kadava River basin

Wagh V. M.,[1]*Panaskar D. B.,[1] Muley A. A.,[2] Mukate S. V.,[1] and Pawar R. S.[3]
[1]School of Earth Sciences, SRTM University, Nanded (M.S.) 431606
[2]School of Mathematical Sciences, SRTM University, Nanded (M.S.) 431606
[3]School of Earth Sciences, Solapur University, Solapur (M.S.) 413255
*E-mail: wagh.vasant@gmail.com

ABSTRACT:

An attempt has been made to develop Artificial Neural Network (ANN) model for prediction of nitrate concentration in groundwater of Kadava River basin, Nashik District, Maharashtra. The study area lies between latitude 19055': 20025'N and longitude 73055:74015'E. River Kadava is one of the tributary of Godavari originates in Sahyadri hills and flows in NW to SE direction. The aim of the study is to develop ANN model to predict the nitrate concentration in groundwater of Kadava River basin. Forty (40) representative groundwater samples were collected from dug/bore wells and analysed for major cations and anions during pre and post monsoon season of 2012. Exploratory statistical techniques were used to identify the nature of the data. Further, ANN model has been proposed and derived for optimization of nitrate concentration. The Levenberg - Marquardt Back Propagation algorithm and three layer back-propagation ANN is employed for the architecture.

Analytical results were compared with the Bureau of Indian Standards (BIS) confirms that, 67.50% and 75% of groundwater samples having NO3 concentration beyond the permissible limit (>45 mg/L) in both the seasons. The consumption of water having high nitrate contents is harmful to human health; consequently, it reduces the oxygen carrying capacity of the blood and in infant causes methemoglobinemia. The optimal ANN model consisting 10 input neurons, 6 hidden neurons and 1 output variable were used for estimation of nitrate concentration. The coefficient of determination (R2), Residual Mean Square Error (RMSE) and Mean Absolute Relative Error (MARE) values shows the efficiency of the ANN model (10-6-1). The spatiotemporal analysis inferred that, nitrate prone areas located in North and Central part of the study area, may be due to intense agriculture/overuse of nitrogen rich fertilizers and natural process viz., dissolution, percolation and leaching. The present model gives satisfactory results for dataset and confirms consistent acceptable performance. The proposed ANN model may be helpful for similar studies. The outcomes of the study will be helpful to local public health bodies and policy makers to develop the strategies.

Keywords: Groundwater; Nitrate; ANN; Kadava River; Nashik

An assessment to evaluate the effects of changing climate on glaciers using stable isotopes and remote sensing

Suhail A Lone[1], Ghulam Jeelani[1]*, R D Deshpande[2], Rouf A. Shah[1]
[1]Department of Earth Sciences, University of Kashmir Srinagar-190006 India
[2]Geosciences Division, Physical Research Laboratory (PRL) Ahmedabad 380009 India
Email: geojeelani@gmail.com; Cell No. +91 9419013565

ABSTRACT:

Stable water isotope ratios in glacier samples were measured to associate hydro isotopic variation with relative changes in glacierized area. Glacier melt samples (n=50) were collected monthly from six major glaciers of Liddar and Suru basin during melting season from May 2012 –November 2013 for δ18O and δ2H. It was observed that the glacier samples from Suru basin were more depleted in 18O and 2H as well as d-excess. This vital difference in isotopic characteristics of glaciers of these two basins suggests two different glacio-hydrological regimes. Highly depleted isotopic value in glacier melt indicates the melting of the glacier even above equilibrium altitude (4000 m). The geospatial observation also revealed that 20% glacier extent (glacierized area) in Liddar basin has been lost in <35 years.

Keywords: Suru, Liddar, stable water isotopes,

1. Introduction

Snow and glaciers, an integral part of the cryosphere, serve as most reliable, sensitive and natural indicators of climate-change due to their proximity of melting condition (Scherler et al., 2011). Temporal changes in the surface/subsurface water flow due to potential effects of climate variability, variation in accumulation and distribution of snow cover is highly uncertain. Accurate monitoring and proper characterization of snow and glaciers are useful for understanding snow/glacier melt processes (Gat, 2010). In the present study the characterization of stable isotopes of water and assessment of climatic effect on water resources was carried out. The study area comprises two glacier dominated basins of the Kashmir and Ladakh region: Liddar basin in Kashmir and Suru basin in Ladakh.

2. Material and methods

Glacier melt samples (n=50) were collected from six major glaciers in Liddar and Suru basin during melting season from May 2012 –November 2013 for δ18O and δ2H. Samples were collected near the snout as melt and solid ice at different altitudes. The samples were sent to Isotope Hydrology Section, Physical Research Lab (PRL), Ahmedabad for the isotopic analysis. Glaciers in Liddar and Suru basin were mapped using multi-temporal optical remote sensing data from the Landsat series.

3. Results and discussion

The $\delta^{18}O$ and $\delta^{2}H$ of glaciers ranged from -8.2 to -16.2‰ for $\delta^{18}O$ and -52.6 to -115‰ for $\delta^{2}H$ with an average of -11.3‰ and -73.4‰, respectively. The isotopic values of glaciers of the Liddar basin were comparatively depleted than glaciers of the Suru basin. This difference in isotopic values of glaciers in these two regions is attributed to their different elevation (Suru basin glaciers: 3500-6000 and Liddar basin glaciers: 3200- 4500m, asl) and climate (Suru: cold-arid and Liddar: temperate) (Fig.3).

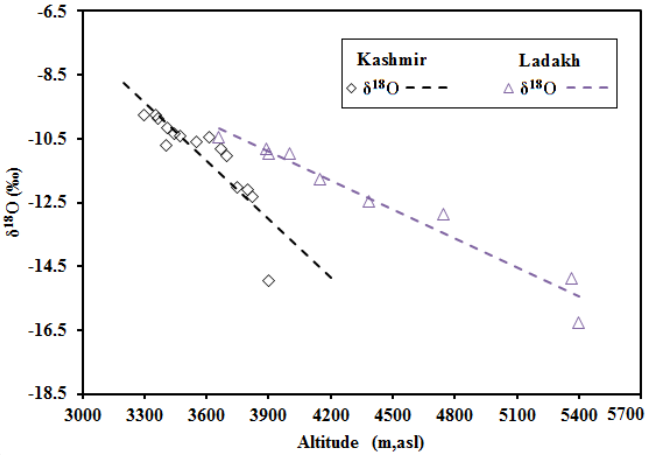


Figure 3 Decrease of δ18O and δ2H in glacier melt with increase in altitude in Liddar and Suru basin glaciers

aThe glaciers in Suru basin exhibited higher correlation (R^2 = 0.96, p = 0.008) than the glaciers of Liddar basin (R^2 = 0.79, p = 0.01). The estimated isotope altitude gradient for the glaciers of Liddar basin varied from -0.55 to -0.68‰ for $\delta^{18}O$ and -3.3 to -5.1‰ for $\delta^{2}H$ per 100 m. The isotope altitude gradient of the glaciers of Suru basin ranges from -0.3 to -0.6 ‰ and -1.4 to -3‰ for $\delta^{18}O$ and $\delta^{2}H$, respectively.

The glaciers showed heavier isotopic values with wide range at the start of the melting season. However, as the summer advanced, depleted isotopic values with narrow range were recorded (Figure 4).

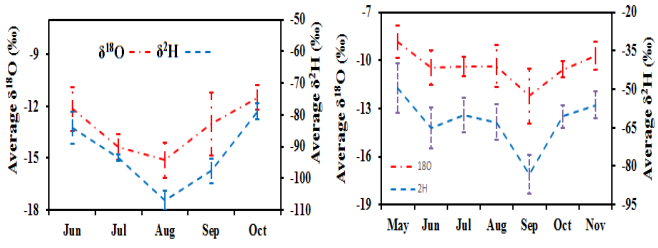


Figure 4 Temporal variation of $\delta^{18}O$ and $\delta^{2}H$ in glacier melt of: (a) Suru and (b) Liddar basin)

The large variability with heavier isotopic values at the start of the melting season (May) reflect the mixed contribution from winter accumulated snow and glacier melt. As the melting season advances the seasonal snow cover is reduced and almost disappears in August/September, which produces the lighter isotopic values.

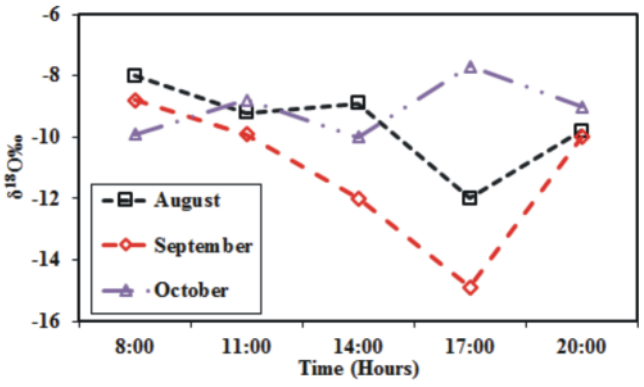


Figure 5 Diurnal variation of isotopic values in glacier meltwater from 8.00 am to 20.00 pm

Overall the isotopic values of glacier melt at snout was heavier in the morning and lighter in the afternoon or evening depending upon the ambient temperature of the day (Fig.5). Highly depleted isotopic values (-14.9 ‰) were observed at the snout of the glacier during sunny days of September is ascribed to be releases probably in the zone of accumulation. This sensitivity of the glaciers to climate variability reveals that the glaciers of the Liddar basin are not the ideal sites for ice coring for paleo-climatological studies.

Deuterium excess of the glaciers

The d-excess values of Suru basin glaciers were lower (13.5 ‰ to 21.6‰) than that of Liddar basin glaciers (17 to 28 ‰) (Figure 6).

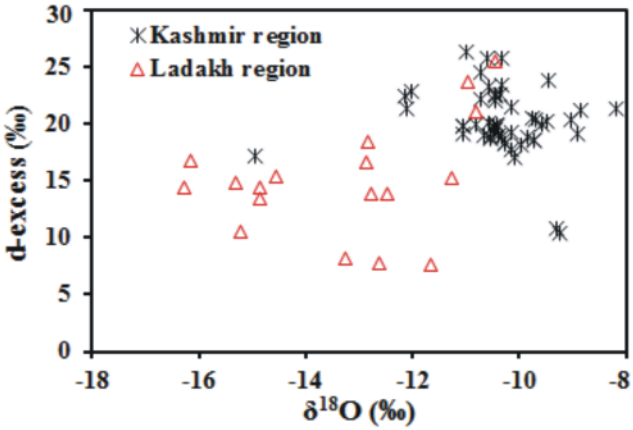


Figure 6 Relationship of δ18O with d-excess

The lower d values in glaciers of Suru basin could be attributed to the sublimation of snow and glaciers under cold arid climatic condition.

Change in glacier extent and snout position

The results indicate that 11-29 % glacier extent (glacierized area) in Kashmir region has been lost in <35 years. The Kolahoi glacier in Liddar basin exhibits higher retreat than other monitored glaciers. In 1980, the total extent of the Kolahoi glacier was reported as 13.55 km2, which reduced to 11.18 km^2 in 2015, indicating that 2.37 km^2 of the its extent has been lost from 1980-2015.Similarly, other glaciers in the region have also witnessed significant retreat and decrease in their surficial extent (Sheshram: 0.70 km^2, Hoksar: 0.37 km^2, and Sonsar: 0.31km^2.

4. Conclusion

The depleted isotopic values with lower d-excess of glacier samples in the Suru basin than the glacier samples of the Liddar basin reveals their distinct physiographical and climatological environments. Highly depleted isotopic values observed in the glacier melt during warm and sunny days of September implies that more depleted glacier meltwater is released, probably in the zone of accumulation. It was observed that (20%) Liddar basin glaciers have retreated over the last 35 years. The significant retreat of glaciers, if continue, would have disturbing consequences on the economy of the region.

5. References

1. Gat, J.R (2010). Isotopes Hydrology: A case study of the water cycle, Imperial College press, 6,189p.
2. Scherler. Dirk, Bodo Bookhagen and Manfred R. Strecker., (2011). Spatially variable response of Himalayan glaciers to climate change affected by debris cover. DOI: 10.1038/ngeo1068.

Estimation of Re-aeration Coefficient Using MLR for Modelling Water Quality of Rivers in Urban Environment

Sameer Arora[1]* and Ashok K. Keshari[2]
[1]Department of Civil Engineering, G D Goenka University, Haryana 122103.
[2] Department of Civil Engineering, Indian Institute of Technology, Delhi (IITD), New Delhi 110016.
*E-mail: sameer_arora01@yahoo.co.in

ABSTRACT:

Re-aeration is the natural phenomenon responsible for the generation of oxygen through the air water interface, advection, dispersion and transient storage reactions. The process of re-aeration, produces the coupling of these equation with the pollutants to generate the harmless products and aids to assimilate pollution load from domestic and industrial waste-water discharges in to river. For the modelling of water quality, re-aeration coefficient is required to be estimated. Study was carried out to estimate the re-aeration coefficient for the Yamuna River. In this study, MLR was used to develop the various models using MATLAB. Developed models were trained, tested and validated using 5 yearlong experimental data. Performance of models were evaluated using Coefficient of determination (R^2), correlation coefficient (R) and root mean square error (RMSE). The study would support the water quality management for urban area by linking the best fit developed model with the water quality models.

Keywords: Re-aeration; MLR; Advection; Water quality

1. Introduction

Urban water usage as well as urban water quantity and quality problems is closely linked to the city's development [1]. Maintaining the quality and quantity of urban water resources is recognised as a very complex task including different spatial and temporal scales due to the variation in physical, chemical and biological parameters such as temperature, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Total coliform and fecal coliform [2]. River systems are greatly affected by the abstraction of water for the municipal supplies and the discharge of urban wastewater through drains/tributaries during low flow period. Largely biological waste from urban distributed sources joins the river undergo biological and chemical changes using dissolved oxygen. Continuous changes in metabolism of stream [3] is critically depends upon the estimation of re-aeration coefficient, which indicate the exchange of oxygen between air-water interface [4]. Many methods have been developed to measure the re-aeration coefficient: tracer gases [5], empirical formulae based on channel hydraulics [6], the night-time drop of oxygen concentration [7], the time lag between noon and the peak of oxygen concentration [8, 9], among others. The choice of the most appropriate method depends on the type and size of river to be studied, as well as on time and budget constraints. Various researchers dominantly have used predictive equations to measure the re-aeration coefficient [10], whereas large errors were found when applied to the other study areas. MLR is the most widely accepted machine learning method and commonly used in water-related research areas to identify the direct relation between the predictor and response variable.

However, study was carried out with the objective to develop the several models using MLR to estimate the re-aeration coefficient that could be applicable to wide range of study areas and identification of best fit model on the basis of their applicability and performance analysis. The model obtained could be coupled with the water quality model to design the pollution control strategies for the urban water management.

2. Material and methods

The study was carried out in the Delhi-Agra stretch of Yamuna River, which is a major river of Ganga Basin. Physio-chemical test were performed on the 78 samples collected from the different sections of river using standard methods for the examination of water (APHA, 2005). MATLAB have been used to develop the models of MLR to predict the relation between predictor variables and response variables. Re-aeration coefficient is selected as response variables whereas, flow (m3/s), velocity (m/s), depth (m), slope (1/S), width (m), TOC (mg/l), conductivity (μS/cm) and suspended solids (mg/l) were selected as predictor variables. Five different models were designed using different combinations of predictor variable to observe the variation in response variable.

Statistical evaluation were performed using coefficient correlation (R), coefficient of efficiency (R^2) and root mean square error (RMSE).

$$R = \frac{\sum_{i=1}^{n}\{(K_{Pi}-\bar{K}_P)(K_{Mi}-\bar{K}_M)\}}{(\sum_{i=1}^{n}(K_{Pi}-\bar{K}_P)^2 \sum_{i=1}^{n}(K_{Mi}-\bar{K}_M)^2)^{1/2}} \quad \ldots\ldots (1)$$

$$R^2 = 1 - \frac{\sum_{i=1}^{n}(K_{Pi}-K_{Mi})^2}{\sum_{i=1}^{n}(K_{Pi}-\bar{K}_P)^2} \quad \ldots\ldots (2)$$

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n}(K_{Pi}-K_{Mi})^2}{n}} \quad \ldots\ldots (3)$$

Where, KP is the predicted re-aeration coefficient and KM is the measured. $K\square_P$ and $K\square_M$ are the mean of predicted and measured coefficient for the n no. of observations.

3. Results and discussion

Models developed using MLR with different input parameters and compared with their performance using training, testing and validation data sets. Equations were formed and solved by forming a design matrix, X = [ones (size(x1)) x1 x2 x4 x5 x6 x7 x8]; solved by a parameter using backlash operator, a = X/y. To validate the model maximum of absolute value of deviation of data is calculated. Performance of the developed models were evaluated are summarized in Table 1. Model is considered to be best fit with correlation coefficient coming closer to 1. MLR models developed with maximum value of R and R^2 and minimum value of RMSE is indicated in bold, can be concluded as the production of best relation between the observed and predicted variable. The best regression equation developed is described as:

$$K_P = 4.353 - 0.735Q + 20.121V - 0.015D - 0.033W - 0.128\,TOC - 0.006\,C + 0.011\,SS \quad \ldots 4$$

Comparative plots were designed to indicate the performance of best fit model of MLR as shown in fig 1. It is clear from the graphs that estimated results produces greater correlation with the measured values of re-aeration coefficient. In order to predict the applicability of model for the prediction of re-aeration coefficient, model can be coupled with the water quality model and also used for the prediction of water quality and to propose the pollution control strategies for urban water management [11, 12].

QUAL2Kw is widely used water quality model available with updated kinetics to measure the most conventional pollutants [13]. Simulation of rate of generation and depletion of oxygen with the decomposition of organic compounds available in river can also performed with the coupling of re-aeration model with QUAL2Kw.

Table1: Models developed using MLR

Input	R	R^2	RMSE
Q, V	0.656	0.431	2.427
Q, V, D	0.701	0.491	2.295
Q, V, D, S, W	0.711	0.506	2.258
Q, V, D, S, TOC, SS	0.846	0.732	1.834
Q,V, D, S, W TOC, C, SS	0.896	0.794	1.685

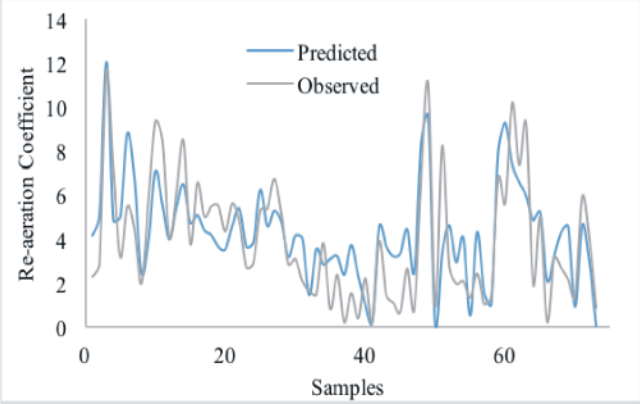


Figure1: Comparative plot of observed and predicted variable of best fit MLR model

4. Conclusions

Models were developed to predict the re-aeration coefficient for the estimation of assimilative capacity of river using MLR and performance of model were also evaluated to obtain the best fit model. The model equation generated, can also be coupled with the water quality models to manage the urban water quality for the riverine system development. However, accuracy of the model can also be improved by using neural network techniques, fuzzy logic, and other mathematical computing techniques and applied on other applications of hydrological modelling. It is expected that accuracy of model can be improved with the large data set.

5. References

[1] Jago-on, K.A., Kaneko, S., Fujikura, R., Fujiwara, A., Imai, T., Matsumoto, T. 2009. Urbanization and subsurface environmental issues: an attempt at DPSIR model application in Asian cities, Science of the Total Environment, 407 (9), 3089-3104

[2] CPCB, 2006. Water Quality Status of Yamuna River, Central Pollution Control Board, Ministry of Environment and Forest, Delhi.

[3] Oihana Izagirre, Urko Aguirre, Miren Bermejo and Arturo Elosegi. 2008. Environmental controls of whole-stream metabolism identified from continuous of Basque streams, Journal of the North American Benthological Society, 27(2), 252-268

[4] Grace, M.R. and Imberger, S.J. 2006. Stream Metabolism: Performing & Interpreting Measurements. Water Studies Centre Monash University, Murray Darling Basin Commission and New South Wales Department of Environment and Climate Change, 204.

[5] Rathbun, R. E., Stephens, D. W., Shultz, D. J. and Tai D. Y. 1978. Laboratory studies of gas tracers for re-aeration, JEED, ASCE, 104(EE2), 215-229

[6] Genereux, D.P. and Hemond, H.F. 1992. Determination of gas exchange rate constants for a small stream on Walker Branch watershed, Tennessee. Water Resources Research 28

[7] Hornberger, G. M. and M. G. Kelly. 1975. Estimation of atmospheric re-aeration in a river using productivity analysis. J. Environ. Eng. Div., ASCE 101: 729 739

[8] Chapra, S.C., and Di Toro, D.M. 1991. Delta Method for Estimating Primary Production, Respiration, and Re-aeration in Streams. J. Environ. Eng., 117(5), 640-655.

[9] Mcbride, G. B. 2002. Calculating Stream Re-aeration Coefficients from Oxygen Profiles, Journal of Environmental Engineering, 128(4), 384-386

[10] Jha, R., Ojha, C. S. P., & Bhatia, K. K. K. 2001. Refinement of predictive re-aeration equations for a typical Indian river. Hydrological Processes, 15(1), 1047–1060

[11] Parmar, D. L. and Keshari, A. K. 2012. Sensitivity Analysis of water quality for Delhi stretch of river Yamuna. J. Environmental Monitoring and Assessment, 184, 1487–1508

[12] Cox, B. A. 2003. A review of currently available in-stream water-quality models and their applicability for simulating dissolved oxygen in lowland rivers, Science of The Total Environment, 335(77), 314-316.

[13] Chapra, S. & Pellettier, G., 2003. QUAL2K: A Modelling Framework for Simulating River and Stream Water Quality. Documentation and

Application of ferrihydrite treatment to improve RT-qPCR virus detectionin Tokyo coastal water after rainfall event

Vu Duc Canh[1]*, TakashiHijikata[1], HiroakiFurumai[1]and HiroyukiKatayama[1,2]
[1]Department of Urban Engineering, School of Engineering, The University of Tokyo, Tokyo113-8656
[2]Department of Environmental Engineering, Vietnam-Japan University, Hanoi 129-140
*E-mail: canh@env.t.u-tokyo.ac.jp

ABSTRACT:

In Tokyo coastal area, combined sewer overflow takes place during rainfall events and releases untreated wastewater, causing microbial water pollution and posing higher risk of infection.RT-qPCR method has been widely used to determine viruses in coastal water; however, this method can be interfered by organic compoundsinsamples collected after rainfall events due to their increased concentration.This study aimed to evaluate the effectiveness of ferrihydrite (Fh) treatment for improving RT-qPCR virus detection in coastal water collected from Tokyo coastal area after rainfall events. The Fhtreatment was able to effectively mitigate PCR inhibitions and the optimal Fh dose was observed at 1,000mgFe/Lfor coastal water samples at 1.5cm-1ofUV254.

Keywords: Ferrihydrite;combined sewer overflow; coastal water; virus detection

1. Introduction

There are several favorablewaterfronts for recreational activities in Tokyo coastal area. However, the coastal area is surrounded by the highly populated urban areaswith the combined sewer system. During rainfall events, combined sewer overflow (CSO) takes place and releases untreated wastewater to the coastal area, causingmicrobial water pollution and posing higher risk of infection. In addition, marine sport games have been occasionally organized in OdaibaSeaside Park, where a triathlonwill be heldin the Tokyo Olympics 2020.Therefore, it is important to quantitatively assess microbial quality of coastal waterand to manage the infection risk in Tokyo coastal area after the rainfall events. Although bacteria concentration has been found to be increased after rainfall events, the behavior of pathogenic viruses in coastal waterimpacted byCSO has not been well understood.

Quantitative polymerase chain reaction (qPCR/RT-qPCR) method has been widely used to quantify viruses in coastal water with the high sensitivity and specificity; however, this method can be interfered due to increasing concentration of organic compounds incoastal water samples after rainfall events.There is a need to remove organic inhibitors in coastal water samples before applying RT-qPCR method. In this study, we aimed to evaluate the effectiveness ferrihydrite (Fh) particles as absorbent for removal of inhibitory organic matters and to apply the Fh treatment for mitigation of RT-qPCR inhibition. Then we evaluated the improvement of RT-qPCR virus detection in coastal water samples collected after rainfall events.

2. Material and methods

Sample collection:In the first campaign,coastal water samples (around 1.0L) were collected at 4 sites (Odaiba, Shibaura, Meguro, Sumida) in Tokyo bay on 1st, 3rd, 5th and 8thdays after the rainfall event in October2016. In the second campaign, coastal water samples with large volume of 20L were collected at Odaiba on 1st, 2nd and 3rd days after the rainfall event in November 2016. These collected sampleswere concentrated to around 700µL by using negatively charged membrane as described elsewhere .

Ferrihydrite treatment: Concentrated samples were mixed with the ferrihydrite (ranging from 0 to 200mg/L) for 5mins and passed through 0.45µm PVDF centrifugal filter. The treated samples were used for further analysis.

RNA extraction and reverse transcription: Viral RNA was extracted from 140µL of the treated samples using QIAamp viral RNA minikit (Qiagen), the manufacturer's protocol.

Virus quantification by quantitative PCR: Concentration of viruses were determined by the quantitative PCR using StepOnePlus real-time PCR system (Applied Biosystems, Tokyo, Japan)

3. Results and discussion

Occurrence of viruses incoastalarea after a rainfall event in October 2016is shown in Table 1. High Pepper mild mottle virus (PMMoV) concentration (averagely 6.6 log10 copies/L)wasobserved for 8 days after the rainfall, while the Aichivirus (AiV)concentrations was observed at lower levels (averagely 3.7 log10 copies/L)on 1st day and gradually decreased by time. However, Norovirus genogroups GI and GII (NoV-GI and GII) andenterovirus (EV) were not detected, possibly becausetheir concentrations were under the limit of detection (approx. 2.0 log10 copies/L).

Table 1. Virus detection at each sampling point after a rainfall event on October 17-18, 2016.

Viruses (Log copie/L)	Day after rainfall	Locations			
		Od	Sh	Me	Su
PMMoV	1st	6.39	6.69	6.65	6.87
	3rd	6.88	6.85	7.03	6.72
	5th	5.99	6.29	n.d	6.09
	8th	6.73	6.30	6.55	6.46
AiV	1st	3.28	3.98	3.37	4.26
	3rd	3.17	3.27	3.43	3.14
	5th	n.d	2.65	n.d	3.03
	8th	n.d	n.d	2.93	2.37
NoV (GI and GII) and EV	1st	n.d	n.d	n.d	n.d
	3rd	n.d	n.d	n.d	n.d
	5th	n.d	n.d	n.d	n.d
	8th	n.d	n.d	n.d	n.d

Note: n.d – not detected
Od: Odaiba; Sh: Shibaura; Me: Meguro; Su: Sumida

In the 2nd sampling campaign in November 2016, Odaiba samples with large volume of 20L were concentrated to increase the sensitivity of virus detection method. However, virus detection was completelyinhibited for thesesamples (data not shown). To mitigate inhibition, these samples were treated with Fh prior to RT-qPCR. Before the Fh treatment, these samples were diluted to obtain UV254 of 1.5 cm-1 and then spiked with AiV for determining the optimal Fh dose.

Figure 1 shows the detection of spiked AiV in Odaiba samples (UV254=1.5cm-1). The AiV detectionswere gradually improved as the Fh dose was increased. The highest detection was observed atFh dose of 1,000mgFe/L for all samples.

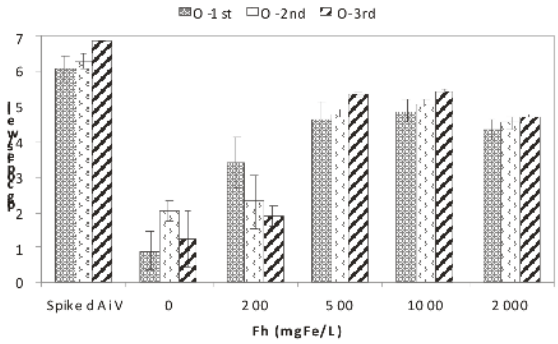


Fig 1. Detection of spiked AiV in Odaiba samples after 1st (O-1st), 2nd (O-2nd) and 3rd (O-3rd) days rainfall event withthe Fh dose ranging from 0 to 2,000 mgFe/L.

Accordingly, Odaiba samples in the 2nd campaign were treated at the optimal Fh dose (1,000mgFe/L) for detecting indigenous viruses. As shown in Table 2, the high concentrations of PMMoV and AiV were detected, indicating that the Fh treatment was able to effectively mitigate the inhibition caused by organic matters in coastal water after the rainfall event.

Although the inhibition was mitigated, the concentration of PMMoV in these samples was observed less than those of the samples collected in the 1st sampling campaign (Table 1), appearing thatthevirus concentration can be fluctuated depending on particular rainfall event.

Table 2. Detection of indigenousviruses (PMMoV and AiV) in Odaiba samples after Fh treatment at optimal dose (1,000mgFe/L)

Viruses (Log copie/L)	Day after rainfall	Odaiba	
		diluted	original
PMMoV	1st	2.73	3.73
	2nd	3.13	3.53
	3rd	2.90	3.41
AiV	1st	2.20	3.20
	2nd	2.89	3.29
	3rd	2.13	2.64

Note:
diluted: samples were diluted to obtain UV_{254} of 1.5 cm^{-1}
original: samples were calculated with the dilution ratio

4. Conclusions

The Fh treatment was able to effectively mitigate PCR inhibitions and the optimal Fh dose was observed at 1,000mgFe/Lfor coastal water samples at 1.5cm-1 of UV254.

5. References

[1] Katayama et al., 2002. 68(3), 1033-1039.

Influence of DOM and POM on Photolysis of Diclofenac

Sanjeeb Mohapatra[1],Daniel Snow2, Manish Kumar[3], Patrick Shea[4], Lokesh P. Padhye[5], andSuparna Mukherji[1]*

[1]Centre for Environmental Science and Engineering, IIT Bombay, Mumbai, India; [2]Water Sciences Laboratory, UNL, NE, USA; [3]Department of Environmental Science, TezpurUniversity, India; [4]School of Natural Resources, University of Nebraska Lincoln, NE, USA; [5]Department of Civil and Environmental Engineering, The University of Auckland, New Zealand

ABSTRACT:

Diclofenac is one of the most commonly detected non-steroidal anti-inflammatory pharmaceutical in both water and wastewater. In the present study, the aqueous photochemistry of diclofenac was investigated in the presence of dissolved organic matter (DOM) and particulate organic matter (POM) derived from wastewater (primary and secondary effluent), and lake and creek sediment samples. The role of triplet excited state of DOM (*DOM), hydroxy radical (OH?), and singlet oxygen ($^1O_2$) on photodegradation of diclofenac were also evaluated. Diclofenac was found to undergo rapid photodegradation following pseudo first order reaction kinetics(kD=1.6 hr^{-1}). Some lowering in the pseudo first order rate constant was observed in the presence of DOM. In presence of POM, the decay rate of diclofenac was significantly reduced. Although these results suggest that direct photolysis may be an important reaction mechanism, poor UV penetration in natural systems may hinder photolysis leading to persistence of diclofenac in the environment.

Keywords: Diclofenac, DOM, POM, *DOM, $^1O^2$, OH?, photodegradation

1. Introduction

Increasing production, frequent consumption, inappropriate disposal, and incomplete removal at the wastewater treatment plants (WWTPs) have contributed to increase in the concentration of pharmaceuticals and their toxic metabolites in water bodies. This has attracted researchers around the world to study occurrence, fate and removal of pharmaceuticalsfrom various environmental matrices. Thenon-steroidal anti-inflammatory drug, diclofenac is widely used with an estimated 940 tons per year global consumption. Exposure to diclofenac has beenreported to cause renal failure in the Indian vultureand gill alterations in rainbow trout. Incomplete removal in WWTPs (< 40%) has resulted in their frequent occurrence in surface waters. Both sunlight mediated direct photolysis and natural photosensitizer mediated indirect photolysis are reported to influence its photodegradation kinetics. In particular, the presence of organic matter can promote the transformation of pharmaceuticals through reactive oxygen species (OH?,1O2,) and *DOM(Carlos et al., 2012).However, both DOM and POM may also impede the decay of diclofenac by screening UV and visible light penetration into the aqueous system.The objective of this study was to investigate photodegradation and fate of diclofenac in the presence of various photosensitizers.Althoughsome information on photochemical decay of diclofenac is available, no systematic study has beencarried out till dateto evaluate the impact of POM. In addition, the role of various reactive oxygen species on photodegradation of diclofenac has not been elucidated.

2. Material and methods

Thephotodegradation experiments were carried out in a photochemical reactor (RPR-100,RAYONET, Connecticut,USA) by irradiating diclofenac (10 mg/L) in the absence and presence of DOM and POM. POM wascollected from a WWTP (primary and secondary effluent), lake and creek sediment.Humic acid (HA) (Sigma, USA) was used as a model DOM for this study(10 mg/L). The test solution (250 ml, pH=7) was continuously agitated with a magnetic stirrer (150 rpm)situated at the baseof the reactor throughout the experiments. Three 24 W lamps with intensity maxima at 350 nm were used to illuminate the reactor. The lamps were arranged radially around the periphery of the reaction chamber.In the quenching experiments, isopropanol (ISP) (Fisher, USA), furfuryl alcohol (FFA) (Fisher, USA),andtrimethyl phenol (TMP) (Fisher, USA) were usedto quench OH?, $^1O^2$ and *DOM, respectively. Samples (1 ml) were collected intermittently at different time interval from the reactor over 24 hr. The samples were filtered through 0.45 μm syringe filter prior to HPLC analysis. The concentration of diclofenac was determined usingHPLC (Waters 2695, USA) equipped with photodiode array (PDA) detector and followed pseudo first order kinetics. Particle size distribution of the isolated POMs was determined using a particle size analyser (Brookhaven Instruments Corp., USA).

3. Results and discussion

Photodegradation of diclofenac (10 mg/L) in the presence and absence of humic acid (10mg/L) is depicted in Figure 1.The pseudo first order degradation rate constant was calculated considering the initial phase of the photodegradation. In absence of humic acid complete removal of the diclofenac was achievedwithin7 hr of continuous UV exposure(kD=1.6hr^{-1}).Whereas, in the presence of humic acid, more than 8 hr of exposure was required to achieve complete removal (kD,HA=0.9hr^{-1}).

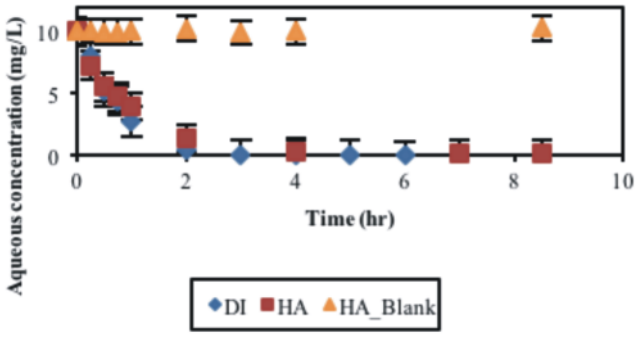


Figure 1.Photodegrdaation of diclofenacin the presence and absence humic acid at pH 7

The pseudo first order degradation rate constants for diclofenac in the presence of FFA, TMP and ISP were found to be 0.986 (kD,FFA), 0.936 (kD,TMP) and 0.967hr-1(kD,ISP),respectively (Figure 2). Since no significant differencein kDvalues($p>0.05$) was apparent, it may be concluded that diclofenac follows direct photolysis mediated degradation as also reported by Carlos et al. (2012).

During environmental sample preparation, POM is commonly removed by filtration. Thus, in most studies the role of POM on photo degradation is not reported. In presence of POM isolated from primary and secondary effluent, creek and river sediment samples, the pseudo first order decay rate constant for diclofenac was found to be 0.03, 0.07, 0.12, 0.05hr-1, respectively. Even after 24 hr of irradiation, removal of diclofenac was only 49, 39, 38, and 14 %in primary effluent, secondary effluent, creek and river sediment samples, respectively (Figure 3). Such low degradation rate may be caused by the reduction in irradiation intensity due to the screening effect of POM.

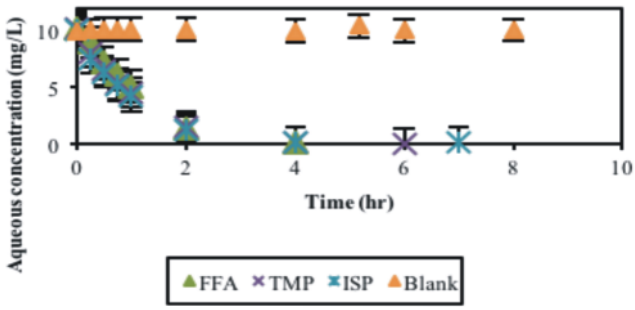


Figure 2.Role of different reactive species towards photodegradation of diclofenac

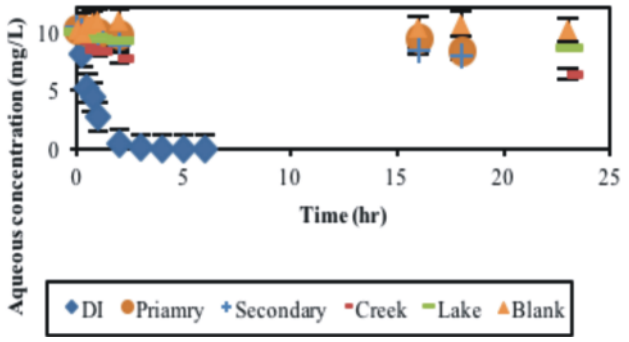


Figure 3.Photodegradation of diclofenac in the presence of POMderived from primary effluent, secondary effluent, lake and creek

4. Conclusions

Diclofenac was found toundergodirect photolysis. Reactive oxygen species and *DOM didnot play a significant role in photodegradation. Decay of diclofenac was significantly reduced in the presence of POM, while DOM had negligible effect. Since concentration of POMis significantly higher in wastewater and comparable to that used in this study for surface water, it may be responsible for hampering the degradation of diclofenac significantly.Moreover, the photolysis rates achieved in-situ may be much lower even in absence of POM due to poor UV penetration in natural systems.

5. References

[1] Carlos, L., Mártire, D.O., Gonzalez, M.C., Gomis, J., Bernabeu, A., Arques, A., Amat, A.M., Arques, A., 2012. Photochemical fate of a mixture of emerging pollutants in the presence of humic substances. Water Res. 46, 4732-4740.
[2] Mohapatra, S., Huang, C.-H., Mukherji, S., Padhye, L.P., 2016. Occurrence and fate of pharmaceuticals in WWTPs in India and comparison with a similar study in the United States. Chemosphere 159, 526–535.
Snow, D.D., Cassada, D.A., Hunt, S.L.B., Li, X., Alessio, M.D., Levine, R., Zhang, Y., Sallach, J.B., 2015. Detection , Occurrence and Fate of Emerging Contaminants in Agricultural Environments. Water Environ. Res. 87, 868–882.

Human exposure and health risk assessment in the upper Brahmaputra floodplain (Lakhimpur, Assam, India) with special reference to arsenic and fluoride geochemistry

Ritusmita Goswami[1]), Arbind Kumar Patel[1]), Dipika Buragohain[1]) and Manish Kumar[1]*
[1]) Department of Environmental Science, Tezpur University, Assam-784028, India
* Corresponding author: manish.env@gmail.com

ABSTRACT:

Occurrences of arsenic (As) and related toxicology is of serious concern worldwide. In the present study, an integrated study was carried out to understand the scenario of arsenic (As) in Lakhimpur district, Assam, India through analysis of groundwater samples and human health risk assessment.A total of 60 groundwater samples were collected to represent pre-monsoon season.The groundwater samples were analysed for As, Fe, Mn, F- and other major ions to find out their correlation with As. Overall, the prevalence of both anoxic and oxic conditions indicated the existence of a mixed aquifer system in the region which also appears to affect As speciation in the groundwater. Poor positive correlations were observed between As vs Fe, As vs Mn and As vs F-. The poor relationship between As and Fe indicates that, there are other processes responsible for release of As in the groundwater and that some of these may not involve Fe. However, further intensive sampling including sediments and data analysis is needed for better understanding of the As release mechanism. The health risk assessment indicated that groundwater As is a matter of serious concern in this region as the younger generation are at higher cancer risk.

Keywords: Arsenic, groundwater, fluoride, iron, health risk, cancer

1. Introduction

In recent times, As concentrations beyond the WHO limit of 10µgL-1 have been reported in many places of Assam, India (Goswami et al. 2014). However, the impact assessment and health risk due to As exposure has not been specifically quantified in this region except the recent studies by our group in the Brahmaputra floodplain (Goswami et al. 2014; Kumar et al. 2016a). Presumably, there are other As hotspots where still it remains to be recognized in the Brahmaputra floodplain covering the state of Assam, India. Regardless of the advances made inrecent years inunderstanding thegroundwater As contamination status in entire state of Assam, predictability in certain areas is still poor.Therefore, a study was conducted in Lakhimpur district to understand the As contamination. Moreover, understanding of drinking water risk exposure among private well users of the study area has not been explored yet and there is no study on the perspective of environmental risk due to As exposure till date.Therefore, we made an approach to study the present scenario of Lakhimpur district, Assam in terms of its groundwater status and risk assessment.

2. Material and methods

In this study sixty groundwater samples were collected in May 2016 (pre-monsoon) in the Lakhimpur district of Assam, India.For As, Fe and Mn samples were filtered using 0.45m millipore membrane filters and preserved using HNO3 (1:1) and later storedat 4°CAs was analysed using atomic absorption spectrometer (Thermo Scientific ICE 3000) and analysis of Fe was carried out using inductively coupled plasma optical emission spectroscopy (Perkin Elmer Optima DV2100).F was measured using ISE meter (Thermo Fisher Scientific, STARA2140).

3. Results and discussion

The mechanisms of As release in groundwater are controlled by various biogeochemical processes under certain conditions and, it may vary with location depending on hydrogeological conditions; hence, it is imperative to study the relationship of various water quality parameters for assessing the likely mechanism of As mobilization. In the present study, the summary of statistical parameters likerange, average and standard deviation values of hydrochemical parameters analysed has been shown in Table 1 and the results of inter correlations of various parameters of Lakhimpur groundwater are presented in(Fig. 1).

It was found that the As groundwater of Lakhimpur was distributed in patches showing a broad range. Therecordedmean pH value indicated a circum-neutral

Table 1. Descriptive statistics of the parameters analyzed for groundwater (n=60). All units are in mgL-1 except EC, ORP and As which are in µS/cm, mV and µgL-1 respectively.

Parameters	Range	Mean ± SD
pH	4.8-7.2	6.07±0.35
EC	50-671	217±96.6
TDS	33.5-449	145±65.1
ORP	-88.0-365	20.5±44.8
DO	1.4-2.82	2.65±1.79
Na^+	10.1-75.6	31.6±19.6
K^+	1.51-35.1	3.94±2.55
Ca^{2+}	3.52-110	55.7±32.0
Mg^{2+}	0.99-37.1	11.6±7.93
HCO_3^-	6.61-506	275±118
Cl^-	28.4-106	31.5±28.7
Fe	0.11-103	24.4±20.3
Mn	1.15-25.8	3.31±4.07
F^-	0.02-0.66	0.21±0.11
As	0.31-300	54.5±59.8

condition of the groundwater with slightly acidic conditions at certain places (as observed from the minimum value, Table 1). High concentration of arsenic (>50 µgL-1) found in the pH range between 5.3 to 6.7 (Fig. 1a).

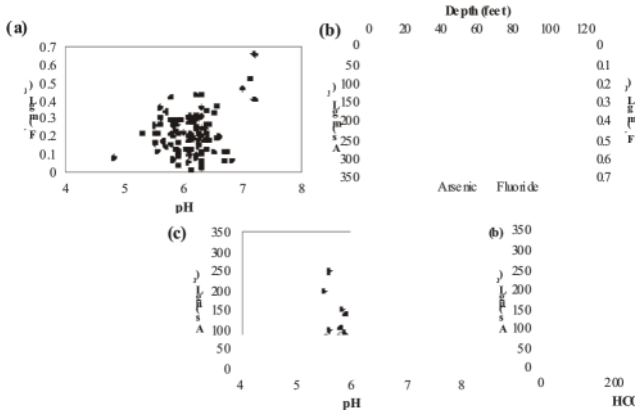


Figure 1.Scatter plots showing correlation of a) F-vs pH, b) Depth with As and F-, d) As vs pH

The F- values in the present study were found to be in the low range; all the values were below the WHO permissible limit of 1.5 mgL-1 (Table 1). The possible reason might be the non suitability of the groundwater environment for promoting the F-enrichment in the study area. The interaction between As and F- in the groundwater was investigated by scatter plotting of As and F- against each other and followed by other variables.. The F- in Lakhimpur groundwater was found to be dominant in the pH range of 5.5-6.8 (Fig. 1a) and there observed no definite trend between F- and pH. The plot of As and F- with depth (Fig. 1b) was prepared to find the depth distribution of these two,both the elements were found to be predominant in shallow aquifers (between 20-60 feet), however a unique trend was not found between the two with reference to depth.

Higher HI values were found ranging from 8 to 233 (n =20) in case of children and 2 to 66 (n=20) among the adult group.The HI values were much higher than the unit value (HI>1) considered for determining the cancer risk for both the children and adults,indicates that the As exposed population of Lakhimpur districtprone to severe non-carcinogenic health impacts together with significantly high cancer risk in near future.

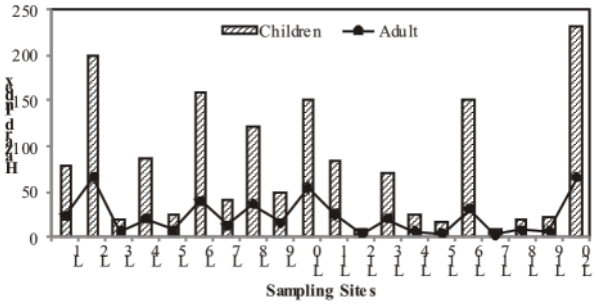


Figure 2.Health risk assessment in terms of hazard index (HI) among children and adult

4. Conclusions

From the present study it was found that the arsenic situation in Lakhimpur district is alarming and the source of As in the region appears to be geogenic in nature, however the pathways of As mobilization were not clear.The prevalence of both anoxic and oxic conditions indicates the existence of a mixed aquifer system in the region. The levels of F-were below the WHO limit and there observed no correlation between As and F- in the groundwater. Health risk assessment results indicated that in comparison to adults, children are more susceptible to cancer, and the chances of developing non-cancerous symptoms are also higher among the studied children group. Consequently, a new generation is at higher risk of As menace.

5. Acknowledgement

This work is funded by Science and Engineering Research Board (SERB), the Department of Science and Technology (DST), under the Govt. India under the Fast Track Young Scientist Scheme awarded to Dr.RitusmitaGoswami (SR/FTP/ES-27/2013).

6. References

Chakraborti D., Rahman M.M., Das B., Murrill M., Dey S. and Chandra Mukherjee S. (2010).Status of groundwater arsenic contamination in Bangladesh: a 14-year study report. Water Res. 44 (19), 5789–5802.

Chiou H.Y., Hsueh Y.M., Liaw K.F., Horng S.F., Chiang M.H., Pu Y.S., Lin J.S.N. Huang C.H. and Chen, C.J. (1995). Incidence of internal cancers and ingested inorganic arsenic: A seven-year follow-up study in Taiwan. Cancer Res. 55, 1296–1300.

Mechanism and identification of reaction byproducts for the degradation of Chloramphenicol drug in heterogeneous photocatalytic process

Ardhendu Sekhar Giri[1]* and Animes Kumar Golder[2]

[1],*Department of Chemical Engineering, National Institute of Technology Jalandhar, Punjab-144011

[2]Department of Chemical Engineering, Indian Institute of Technology Guwahati, Assam- 781039

***E-mail:** drasg82@gmail.com*

ABSTRACT:

The aim of the present study was to investigate the degradation behavior of chloramphenicol (CHPL) drug in the presence of TiO2 under UV light to compare the performance of photocatalytic reduction of both CHPL molecule and total organic carbon (TOC) at a high concentration. The reduction in organic carbon was resulted from the cleavage of C-C hemolytic bond which was in the accordance of LC-MS spectra. The TOC removal was trailed by 23.19 % than CHPL with TiO21.25 g/L, CHPL 100 mg/L, pH 3, and irradiation time 45 min. The antimicrobial activity of CHPL towards the inactivation of E. coli XL 10GOLD was decreased by 67.4% after 45 min of decomposition.

Keywords: Photocatalysis; Drug decomposition; Total organic carbon; Antimicrobial activity

1. Introduction

The antibiotic drugs are over-administered in the developing countries like India and, the presence of these antibiotics in the environment is a serious concern of the scientific community. They exhibit low biodegradability and toxic effects and, could contribute to the development of resistant bacteria in the aqueous systems (Liu et al., 2009). The municipal wastewater treatment plants have been identified as the main source of entry of antibiotics in aquatic environments due to low removal efficiency to this class of compounds. Thus, antibiotics and their metabolites are released constantly in the environments (Parsley et al., 2010). Photocatalysis is considered as one of the main processes for the elimination of these compounds present in surface waters.

So, the main aims of this study are to (i) evaluate the performance of UV-photocatalysis (UVPC) for the decomposition of CHPL molecule and its effectiveness for TOC reduction and (ii) identify the degradation products when CHPL decomposition was almost invariant. The proposed mechanism showed the routes of CHPL decomposition and release of CO2 leading to TOC reduction. Furthermore, the antimicrobial activity of CHPL and its degradation products were evaluated using E. coli.

2. Material and methods

2.1 Chemical

CHPL (purity >99% w/w) was obtained from Sigma-Aldrich (China). TiO2 (particle size: 30 nm and crystal type: 30% rutile and 70% anatase type) was procured from Merck. Sulfuric acid (98% v/v purity), NaOH (purity >98% w/w), E. coli XL 10GOLD (purity >98% w/ w) was collected from the Department of Biosciences and Bio-engineering, Indian Institute of Technology Guwahati. Yeast (99% w/v purity) and tryptone (98% v/v purity) were from Himedia (India).

2.2 Experimental

Batch experiment was conducted for the degradation study with continuous stirring. A 1000 mL capacity cylindrical borosilicate vessel (Ø 10.5 cm) was used as the reactor. An amount of 400 mL CHPL solution with 100 mg/L concentration was used and pH was adjusted to 0.05(N) H2SO4 prior to addition of catalyst. Then 1.25 g/L TiO2 was added and mixed for 10 min (400 rpm) to equilibrate CHPL sorption. A point UV-source (λ= 282 nm and intensity 12 W/m2) located at 15 cm apart from the top solution surface was illuminated. Finally about 5 mL of clear liquid were taken out and centrifuged at 400 rpm for 30 min for catalyst separation for the determination of CHPL and TOC.

2.3 Analytical procedure

High performance liquid chromatography (HPLC) (Simadzu, Japan, LC-20AD) and LC-MS(Waters, USA, Q-Tof Premier & Aquity UPLC) were used for the determination of CHPL concentration and identification of degradation fragments based on mass to charge ratio. The antimicrobial activity test was carried out following the procedure reported by Liang et al. (2013).

3. Results and discussion

3.1 Dynamics for CHPL and TOC removal

The transition for both CHPL and TOC reduction was from 2.5 to 10 min. Maximum CHPL and TOC removal were found to be 93.8 and 68.9%, respectively (Fig. 1). The faster initial rate of TOC removal was due to mineralization of amide chain (Kavitha et al., 2004). The second stage was related to the opening and mineralization of substituted benzene ring.

3.2 Proposed mechanistic pathways for CHPL degradation

Total nine intermediates were detected in the mass spectra within the mass to charge ratio of 100 to 400 (Fig. 2). The proposed mechanism implies that most of the

intermediates were formed by the degradation of side chain of CHPL molecule. Aliphatic amide chain was cleaved by HO attack at C2 centre.

3.3 CHPL degradation and antimicrobial activity

The toxicity of CHPL and its degradation products during UVPC to E. coli in LB media was determined after 24 h of exposure. Due to generation of toxic fragments like benzyl alcohol and p-nitrobenzene shown in CHPL degradation mechanism, the percent death of bacteria cell was as high as 67.4 % (Demir et al., 2010).

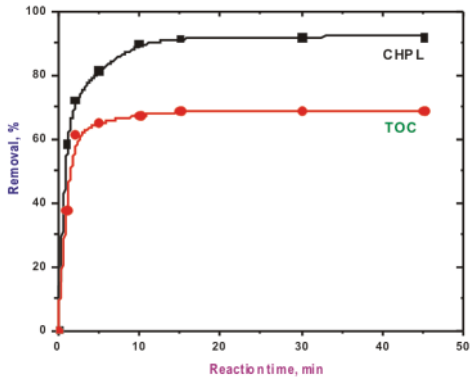


Figure 1.CHPL and TOC removal with reaction time. Experimental condition: [CHPL]0 = 100 mg/L, pH = 3.0, TiO2 = 1.25 g/Land temperature =25°C. Photo-reaction with a UV lamp of 12 W/m2).

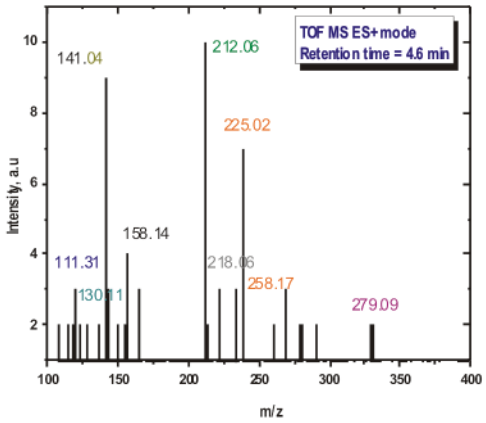


Figure 2.Mass spectra recorded at 10 min of UVPC.

4. Conclusions

- Maximum CHPL removal of 92.09% was noted against mineralization efficiency of 68.9% in UVPC.
- Total nine daughter molecules were appeared in mass spectra.
- Proposed degradation mechanism evidences significant TOC reduction.
- The growth of E. coli was completely inhibited in the presence of 100 mg/L CHPL owing to –NO2 compounds.

5. References

Demir, E., Kocaoglu, S. and Kaya, B. 2010. Kavitha, V. and Palanivelu, K. 2004.The role of ferrous ion in Fenton and photo-Fenton processes for the degradation of phenol, Chemosphere, 55, 1235-1243.

Parsley, L. C., Consuegra, E. A. M., Harper, W. F. and Liles, M. R. 2010 "Identification of diverse antimicrobial resistance determinants from an activated sludge microbial assemblage, Appl. Environ. Microbiol., 76 (11), 3753-3757.

Liu, H., Zhang, G., Liu, C. Q., Li, L. and Xiang, M. 2009. The occurrence of chloramphenicol and tetracyclines in municipal sewage and the Nanming River, Guiyang City, China, J. Environ.Monit., 11 (6), 1199-1205.

Assessment of genotoxic effects of benzyl derivatives by the comet assay, Food Chem. Toxicol., 48, 1239-1242.

Liang, B., Cheng, H. Y., Kong, D. Y., Gao, S. H.; Sun, F., Cui, D.,Kong, F. Y., Zhou, A. J., Liu, W. Z., Ren, N. Q., Wu, W. M., Wang, A.J. and Lee, D. J. 2013. Accelerated reduction of chlorinated nitroaromaticantibiotic chloramphenicol by biocathode. Environ. Sci. Technol., 47, 5353-5361.

Water environmental issues and sustainability [SESSION A5] [PROCEEDING]

Performance and cost analysis of decentralized wastewater treatment plants: A case study from Northern India

Nitin Kumar Singh[1]*, Absar Ahmad Kazmi[1]
[1]Department of Civil Engineering, Indian Institute of Technology, Roorkee 247667.
*E-mail: nitin261187@gmail.com; Email: absarakazmi@yahoo.com

ABSTRACT:

In this study, a techno-economic analysis of 16 decentralized WWTPs based on various technologies was performed in Northern India. The technologies assessed are extended aeration, moving bed bioreactor, sequential bioreactor, rotating biological contactor, onsite package (aerobic and/or anaerobic), and membrane bioreactor. The land use for onsite package treatment systems was estimated between 0.125 and 0.8 m^2/pe (population equivalent) and higher than for cluster type WWTPs, which require between 0.039 and 0.159 m^2/pe. The data collected from this study show that package plant treatment costs are high compared to those of cluster types, ranging from 0.0676 to 0.1045 (±10%) and 0.0353 to 0.1891 (±15-20%) US$/m3, respectively. Moreover, the operation of WWTPs was found to be economically viable even without the sale of treated water, except for one anaerobic package plant. For all plants evaluated, specific power consumption (SPC) was found to vary between 0 and 1 KW/m3.

Keywords: Cost-benefit analysis; Wastewater treatment; Cost utilization; Energy consumption; India

1. Introduction

One of the biggest challenge in establishing wastewater treatment systems is financial constraints. Furthermore, the limitations of treatment objectives such as effluent quality and usable by-products, and available resources including land availability, investment costs, operational costs, and energy requirement also increases the complexity of the problem [1]. India, being a developing country, has closely followed the most of the advances in wastewater technologies of developed countries. However, the implementation of these technologies at full-scale is largely influenced by the availability of resources and local conditions of developing countries. Therefore, to drive forward the future of wastewater management strategies in India, an independent evaluation of existing WWTPs is required to develop sound conclusions and recommendations as well as to opt appropriate one according to their resources and requirements instead of relying exclusively on western experiences to solve their wastewater management problems promptly and cost-effectively. Besides, latest technological development must be evaluated with respect to the "tried-and-tested" technologies of the region that has been the standard for wastewater treatment in past.

2. Material and methods

Some 16 WWTPs representing different climates and topographies, and installed by municipal, institutional and residential organizations, were selected for this study. They were divided into two broad categories, i.e. onsite package and cluster types. In particular, 4 onsite package [2 anaerobic (AnP) and 2 aerobic (AP)], 4 extended aeration (EA), 4 moving bed bioreactor (MBBR), 2 sequential bioreactor (SBR), 1 rotating biological contactor (RBC) and 1 membrane bioreactor (MBR) plants were reviewed for this study. Analyses of influent and effluent grab samples was done following Standard Methods [2]. The benefits related to the environment were calculated by using shadow prices of removed pollutants (COD, 0.139072 US$/kg; SS, 0.005406 US$/kg; N, 8.544024 US$/kg; P, 32.800852 US$/kg) arising from productive activities that have no market value [3].

3. Results and discussion

Among the 4 onsite package plants, anaerobic systems had low removal efficiencies of between 60 and 66% for COD, BOD and TSS, with relatively lower efficiencies for TN and TP removal. On the other hand, both aerobic package systems showed significant COD, BOD and TSS removal efficiencies (80 to 91%), while TN and TP removals were observed to be between about 60 and 68%. Among the cluster type systems, all EA-based WWTPs showed appreciable removal efficiencies (90 ± 5%) for COD, BOD and TSS, but not for TN and TP. The lowest efficiencies were those for phosphorus removal (30 to 40%), TN removal was in the range 70 to 80%.

Among all, onsite anaerobic plants had the highest value recorded at 0.8 m^2/pe whereas SBR plants showed minimum usage at ~0.04 m2/pe. The land usage for RBC and MBR plant was comparable (~0.10 m^2/pe) with that of MBBR- (~0.08 m2/pe) and EA- (0.11 m2/pe) based WWTPs.

All on-site plant had high capital investment (92.3 to 153.8 US$/pe) compared to other technologies (Fig. 1). Among the evaluated WWTPs, the highest capital investment (~153.8 US$/pe) was required for onsite anaerobic systems, followed by MBR (~123 US$/pe). EA-based WWTPs have the lowest capital investment needs (7.6 to 30.7 US$/pe). The onsite package plants had annual O & M costs ~3 US$/pe except for the one aerobic plant (~18 US$/pe). The annual O & M costs for EA- and SBR-based WWTPs were less than ~4 US$/pe, whereas MBBR-based WWTPs were costlier (~11 US$/pe). RBC and MBR plant O &M costs were ~12 and 5 US$/pe, respectively.

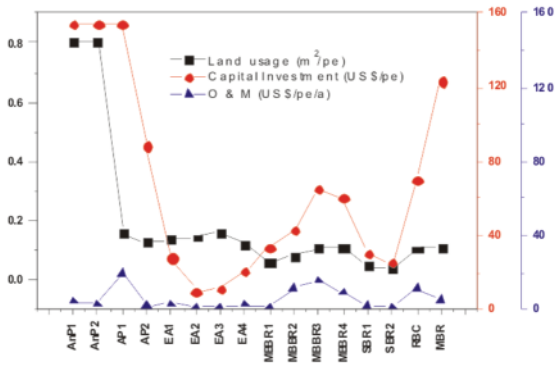


Fig. 1 Land usage, capital investment, and operation and maintenance (O & M) data for the WWTPs

The WWTPs produce highly variable environmental benefits since the minimum value is 0.298272 US$/m3, while the maximum value is 1.034016 US$/m3. The greatest environmental benefit is associated with the nitrogen removal because it represents 56.08% of the total benefits. Phosphorus is observed to be the next most important pollutant, with a 29.83% of total benefits. The environmental benefit accounted for COD and SS are 13.72 and 0.38%, respectively. The average net profit was found to be 0.33642, 0.38027, and 0.42412 US$/m3 in scenario 1, 2 and 3, i.e. (i) no sale of treated water, (ii) 50% sale of the treated water and (iii) 100% sale of the treated water, respectively. For all the other studied WWTPs, NPV values were observed to be positive i.e. they are viable from an economic point of view.

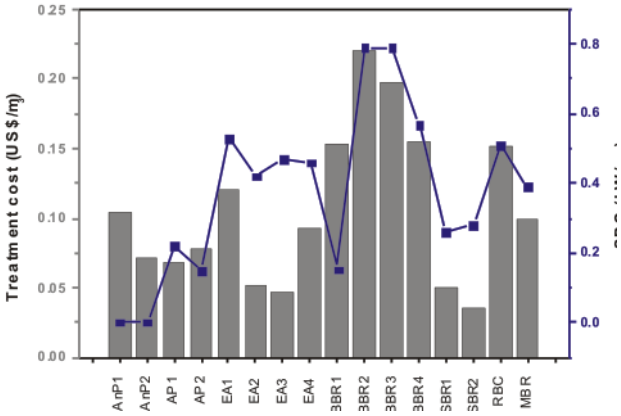


Fig. 2 SPC and treatment costs for WWTPs

The cost of treatment was in the range 0 to 0.23 US$/m3 (Fig. 2). On average, 0.076 US$/m3 was calculated for EA- and SBR- based WWTPs. MBBR-based plants were the costliest in operation at 0.13 to 0.23 US$/m3, followed by RBC- and MBR- based plant at about 0.13 and 0.09 US$/m3, respectively. The SPC values were found to be varying in the range of 0 and 1 KW/m3.

4. Conclusions

The maximum environmental benefits are associated with nitrogen removal from wastewater, while the removal of suspended solids contributes the lowest percentage to the overall environmental benefit.

Approximate treatment costs were between 0.067 and 0.104 (±10%) and 0.035 and 0.189 (±15 to 20%) US$/m3 for on-site package and cluster-type plants, respectively. For all plant types evaluated, SPC was in the range 0 to 1 KW/m3.

5. References

[1] Poch, M., Comas, J., Rodríguez-Roda, I., Sànchez-Marrè, M., Cortés, U., 2004. Designing and building real environmental decision support systems. Environmental Modelling & Software. 19, 857–873.

[2] APHA, 2005. Standard methods for the examination of water and wastewater. 21st ed. Washington.

[3] Molinos-Senante, M., Hernández-Sancho, F., Sala-Garrido, R. 2010. Economic feasibility study for wastewater treatment: A cost–benefit analysis. Science of Total Environment. 408, 4396-4402.

Characterizing River Morphology and Watershed Characteristics Using Satellite Data for Improved Hydrological Forecasting

Swati Tak and Ashok K. Keshari*
Department of Civil Engineering, Indian Institute of Technology Delhi,
Hauz Khas, New Delhi 110016, India.
*E-mail: akeshari@hotmail.com, akeshari@civil.iitd.ac.in

ABSTRACT:

Accurate assessment of water resources is an important task in planning and engineering of water systems in urban environment, as most water systems fail to provide safe and sufficient drinking water supply to urban dwellers. In India, many urbanized cities are located on rivers that are perennial as they originate from Himalayan region which has warehouses of snow and glaciers, and have considerable base flow from groundwater. To assess the water availability precisely, it becomes essential to improve the understanding of river morphology, watershed characteristics and spatial heterogeneities that influence hydrological predictions to a greater extent. In this paper, a methodology is presented to characterize the river morphological features, derive watershed characteristics and quantify spatial heterogeneities in a river basin for improving the hydrological predictions. The methodology presented in this paper integrates Geographic Information System (GIS), remote sensing technique and data analytics. The application has been shown for part of the Ganga river basin as this houses a number of urbanized cities and is a life line for the economic and social development of these cities. The fluvial and glacial systems have been delineated and morphological parameters are derived from the satellite images. The spatial distributions of snow cover and glaciers are obtained from high resolution satellite data, which lead to the evolution of melt water contributing to stream flow and would improve the hydrological forecasts. The advance and retreat of glaciers also indicate the scale of climate change. Such study would be very useful in the planning and engineering design of water systems.

Keywords: Remote Sensing, GIS, Satellite Data; Geomorphology; Glaciers; Snow; Hydrological Forecast; Urban Water System

1. Introduction

The remote sensing is becoming a powerful tool for numerous applications in hydrology, water resources and environment [1, 2, 3, 4]. The use of remote sensing is also increasing in monitoring snow and glaciers [3, 5, 6, 7]. The present study is aimed to characterize river morphology and watershed characteristics that will help in the development of new models for improving hydrological forecasts. It is essential to carry out such study in order to delineate the glaciated and fluvial systems and quantify spatial heterogeneities as these water systems will involve different hydrological processes in runoff simulation. The application is carried out for the Ganga basin as it houses a large number of urbanized cities and the Ganga river basin is a lifeline for millions of people and economic and social development of these cities. The source of the Ganga river is considered to be the Bhagirathi river. It originates from the Gangotri glacier near Gomukh at an elevation of about 7,010 m above mean sea level in the Uttarkashi district of Uttarakhand state, and descends down the valley up to Devprayag where another hill stream Alaknanda joins it.

2. Material and methods

The remote sensing technique along with the Geographic Information System (GIS) tools and data analytics have been used for deriving various morphological parameters and watershed characteristics for characterizing the river morphology, delineating fluvial and glaciated regions and obtaining glacier geomorphology. Remote sensing technique has been used for the inventory of the glaciers in harsh climatic conditions to bring out the information about the large number of glaciers. The study has been carried out using satellite imageries, hydro-meteorological and snow data and satellite derived DEM data. With the help of satellite data and conventional hydrological and topographic data, a number of thematic layers were prepared. Analysis of satellite data, namely, IRS P6 AWiFS and SRTM DEM data is carried out using image processing and GIS tools for deriving various parameters and characteristics of river system, glaciated region and urban environment. IRS P6 AWiFS, SRTM DEM and other ancillary based glacier morphology map and data sheet form the main basis of data for the study.

The methodology for identifying the fragile glaciers has been implemented in the ARC/INFO GIS environment. The data has been systematically organized in ARC/INFO GIS for assessing the glacier health of the Alaknanda sub-basin which is the headstream of the Ganga river basin. The primary physical parameters are taken from the inventory datasheet and with these parameters, secondary parameters are derived. Morphological parameters such as total area of glacier, length, elevation, orientation and ice exposed area are the primary parameters, while the secondary parameters such as accumulation area ratio, percent debris cover, percent slope are the derived parameters.

3. Results and discussion

Fig. 1 shows the FCC of Ganga basin obtained from the IRS P6 AWiFS satellite data, where in the glaciated and fluvial systems of Ganga river basin have been delineated. It is evident from this figure that the glaciated region is being seen as white indicating high reflectance from snow and glaciers. It also shows that the snow or glaciers in the Himalayan region of Ganga basin covers 0.94 million Km2 area.

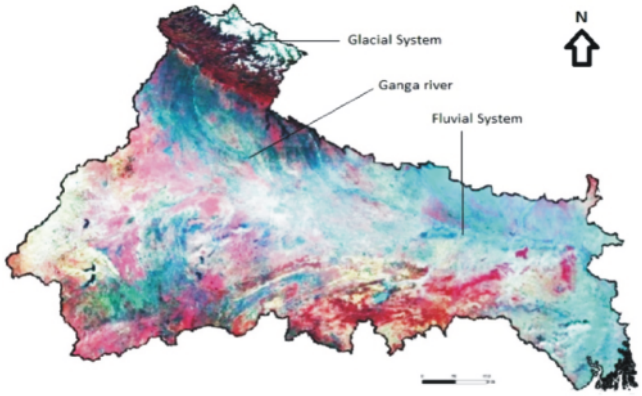


Fig. 1 FCC of Ganga river basin showing glaciated and fluvial regions

The land use of the Ganga river basin is shown in Figs. 2-3. It is evident from these figures that the Ganga basin is dominated by the agriculture and forest or green cover. Fig. 3 shows the built up area, water bodies and snow or glacier area.

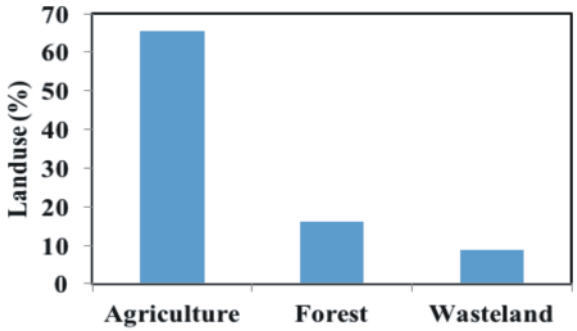


Fig. 2 Dominant land use in Ganga basin

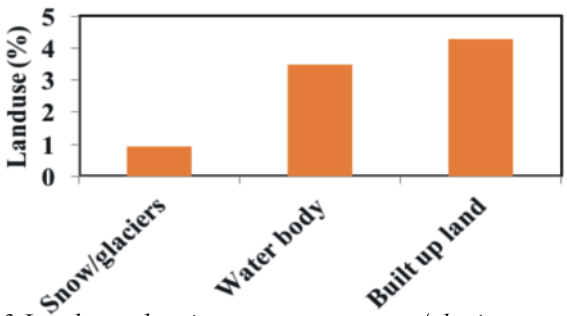


Fig. 3 Land use showing percentage snow/glaciers, water bodies and built up area in Ganga basin

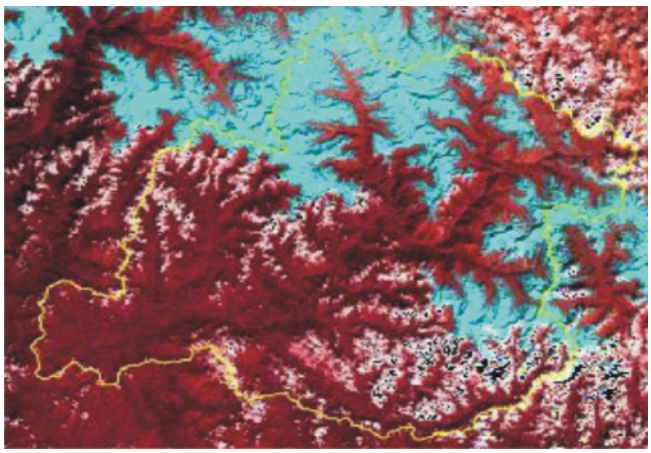


Fig. 4 Satellite image showing Alaknanda basin and its glaciated region as obtained from bands 2, 3 and 5 of AWiFS image of 26 September 2006

It is evident from this figure that the Alaknanda sub-basin has 253 glaciers, covering total sub-basin area 3252.142 km2. Morphologically, the glaciated area is distributed into accumulation area, ablation area debris and ablation area ice covering. It has an accumulation area of 783.07 km2 and ablation area debris of 349.79 km2. The total glacierized area that includes glaciers and permanent snow is 1351.09 km2. Fig. 5 shows the areal coverage of glaciated and fluvial systems in the Alaknanda sub-basin. It is evident from this figure that the glaciated region is equally comparable to the fluvial region, and thus the hydrological models must incorporate the prevailing hydrological processes appropriately to improve the understanding of hydrological cycle in such catchment and to have better hydrological forecasts. Some studies have utilized varying models for hydrological predictions from snow bound catchments [7, 8] based on basic data on snow and glaciers [9, 10].

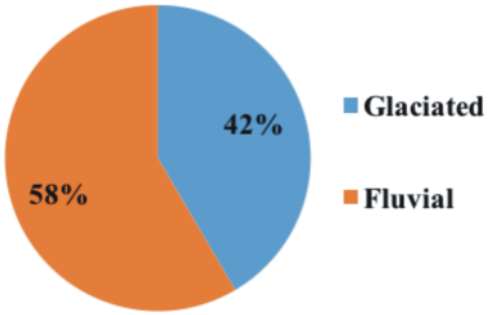


Fig. 5 Glaciated and fluvial regions of Alaknanda sub-basin.

4. Conclusions

The study reveals that the snow or glaciers in the Himalayan region of Ganga basin covers 0.94 million Km2 area. The Alaknanda sub-basin of Ganga basin spreads over 3552.142 km2 area and has 253 number of glaciers. These glaciers cover 1385.57 km2 of glaciated area, and thus comprises of 42% glaciated and 58% fluvial systems. The accumulation area is 787.07 km2, ablation area debris is 349.79 km2, and ablation area ice is 193.07 km2. The glaciers in the Alaknanda sub-basin are dirty due to higher percentage of ablation area under debris cover. The total volume of glacier ice as estimated in the Alaknanda sub-basin is 183.85 km3. Alaknanda glaciers account 16.77% glaciated region of the Ganga basin. There is need to develop new hydrological models for runoff simulation/prediction from the glaciated-fluvial systems. The study investigates Himalayan glacier region for the interest of several reasons including hydrology, climate research and water resources and the findings obtained would be useful in precise hydrological predictions.

5. References

[1] Keshari, A.K. and Singh, R.P. 1994. Assessment of global environment using microwave radiometry, Journal of Advances in Space Research, V. 4, No. 1, pp. (1)233-(1)236.

[2] Ambast, S.K., Keshari, A.K. and Gosain, A. K. 2002. An operational model for estimating regional evapotranspiration through surface energy partitioning (RESEP), International Journal of Remote Sensing, V. 23, No. 22, 4917-4930.

[3] Keshari, A.K. and Singh, R.P. 1991. Use of microwave radiometry for monitoring the alpine Environment, In : Snow, Hydrology and Forests in High Alpine Areas, International Association of Hydrological Sciences, IAHS Publ. No. 205, 81-89.

[4] Laha, Ch. and Bandyapadhyay, S. 2013. Analysis of the changing morphometry of river Ganga, shift monitoring and vulnerability analysis using space-borne techniques: a statistical approach, International Journal of Scientific and Research Publications, Volume 3, No. 7, 1-10.

[5] Keshari, A.K., Singh, R.P. and Rastogi, A. 1992. Microwave radiometry of ice covers in polar regions, In: PORSEC, Okinawa, Japan, V. 2, 663-668.

[6] Sharma, A.K., Singh, S.K., Kulkarni, A.V. and Ajai. 2011. Snow and Glaciers of the Himalayas, Space Application Centre.

[7] Siddiqui, Z.A., Farooq, M., Khan, P.A. and Shah, S.S. 2003. Use of Landsat data for snow cover estimation and related river runoff in Jhelum river basin in Pakistan, In: Proc. of 21st International Cartographic Conference, Durban, South Africa, August 10-16, 2498-2502.

[8] Morid, S., Gosain, A. K. And Keshari, A.K. 2001. Challenges in snowmelt-runoff simulation, Journal of the Earth and Space Physics, V. 27, No. 2, 11-20.

[9] Kulkarni, A.K. and Buch, A.M. 1991. Glacier Atlas of Indian Himalaya, SAC/ RSAGMWRD/ SN/05/91, 62 p.

[10] Ageta, Y., Naito, N., Nakawo, M., Fujita, K., Shankar, K., Pokhrel, A.P. and Wangda, D. 2001. Study project on the recent rapid shrinkage of summer accumulation type glaciers in the Himalayas,1997-1999, Bulletin of Glaciological Research 18: pp 4549.

A Paradigm shift towards integrated approach in wastewater management for future cities

Santanu Das[1]*, P.L.N Raju[2]
[1] Scientist/Engineer (SC), North Eastern Space Application Centre, Umiam, Meghalaya 793103.
[2] Director, North Eastern Space Application Centre, Umiam, Meghalaya 793103
*E-mail: 1 santanudas.0906@gmail.com, 2 director@nesac.gov.in

ABSTRACT:

Wastewater is regarded as an unwanted element in urban environment which needs to be disposed of as efficiently and safely as possible. The present research aims to bring in a fundamental change in urban wastewater management by examining alternatives in which decentralised technologies and natural systems are involved.

The study aims to demonstrate how an integrated approach can be more sustainable than conventional wastewater management and emphasises on a number of options to implement substantial change in this direction.

Keywords: Urban wastewater management; Decentralized technologies; Alternative treatment; future cities

1. Introduction

Quality of life in urban areas can be determined based on the state of water and affects adversely the wellbeing of city dwellers if managed poorly, and thus compromising the economy and natural environment. For instances

a. Health and Diseases: Irresponsible disposal of wastewater causing water borne diseases.
b. Natural hazards: Poor storm water management leading to urban floods putting lives and property to risk.
c. Economy: Inadequate water supply limits economic activities impacting on development of a city. Excess of water too causes damage on the same aspects.
d. Environment: Disposal and discharge of wastewater into urban water bodies leading to degradation of ecosystems which limit their value as natural resources.

Urban water systems are also exasperated with conditions posing notable changes. Cities are facing intricate demand that aggravate current issues and also possibly emerge with new ones. The impacts of climate change, fast pace urbanisation and existing infrastructure being deteriorated causes flooding events, water scarcity, epidemics and rehabilitation costs on a scale that will inundate the coping capacities of cities.

2. The need

Apparently looking deep into the issue, however, there are sizeable actions to be taken concerning management of waste water flows, ensuring:

a. The danger of contamination and human disease is eliminated; and
b. Natural environment suffers minimal damage.

Urban wastewater management comprises of collection, conveyance, treatment and reuse or disposal of various sources differing in composition and treatment and disposal requirements. These include Flush water, Black water, Grey water and Storm water. Each of these elements is made up of different quantities of water, pathogen loads and nutrient content. The challenge cities are facing is to manage the different elements in an affordable way with minimal impact on human health and the natural environment.

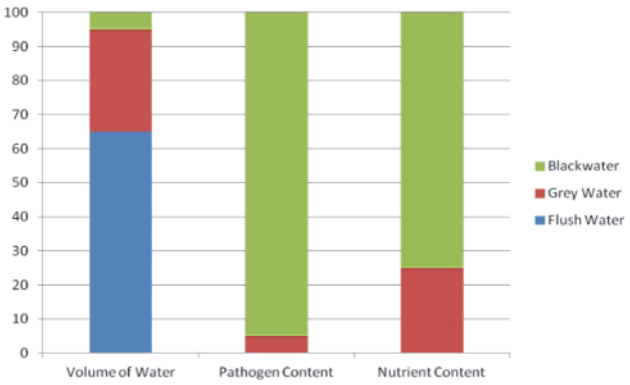


Figure 1. Composition of different elements of wastewater

3. Conventional approach vs. Integrated approach

The conventional approach differs from integrated approach in three (3) aspects namely

a. Collection
b. Treatment
c. Disposal and reuse

Conventional wastewater management is designed to combine the different streams during collection before applying centralised treatment and discharging the effluent to receiving water bodies whereas an integrated approach is based on the separate collection and separate wastewater elements are treated using innovative, decentralised technologies and natural systems. Treated effluent is reused locally for non-potable water supply purposes. Nutrients are recycled and reused locally through the recycling of urine and creation of bio-solids from faecal sludge. Separate systems are expected to reduce the

amount of sewage to be treated, to avoid overflows, and to deal more effectively with periodic and potentially large volumes of urban runoff occurring under storm conditions.

Figure 2. Collection, treatment and disposal/reuse sectors for Waste water management

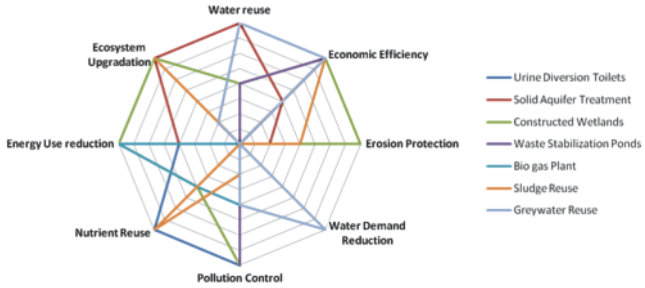


Figure 3. Positive Influence of Decentralized wastewater treatment technology on water cycle

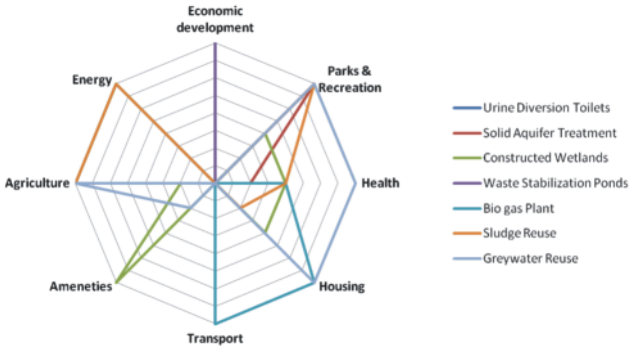


Figure 4. Positive Influence of Decentralized wastewater treatment technology on urban development

4. Achievable objectives & Conclusion

An Integrated approach towards wastewater system and reuse, tend to solve a number of emerging environmental and social issues but not limited to Savings on water, Energy recovery, total sanitation coverage, opportunity for flexible population growth, nutrient recycling, energy recovery, employment generation, effective waste treatment and urban biodiversity and restoration.

5. References

[1] Brown, R., Keath, N.,Wong, T.,(2008). Transitioning to Water Sensitive Cities: Historical, Current and Future Transition States. Proc 11ICUD, EICC, Edinburgh, Scotland. 31 August - 5th Sept. ISBN 978 1899796 212.

[2] Geels, F., Kemp, R., (2000). Transitions from a societal perspective. UNUMERIT Maastricht, The Netherlands.

[3] Moriarty P. (2007) SWITCH Learning Alliance Briefing Note No.4: A brief introduction to action research concepts and practice.Athttp://www.switchurbanwater.eu/outputs/pdfs/WP6-2_BRN_4_Action_research.pdf

[4] Ison, R., Collins, K., Bos, A., Iaqinto, B., (2009). Transitioning to Water Sensitive Cities A summary of the key findings, issues and actions arising from five national capacity building and leadership workshops. International WaterCentre.www.watercentre.org

[5] Van der Steen P. and Howe C. (2009) Managing Water in the City of the Future; Strategic Planning and Science. Reviews in Environmental Science and Bio-Technology, Vol. 8, No. 2, p 115-120

[6] Smith. A and Stirling. A., (2008a). Shaping technology systems: critical issues for sustainability governance. Long-term policies: governing socio-ecological change, Panel on Shaping System Dynamics. UKIHDP Conference, Berlin.

Nepal's agriculture and climate change challenges

Sudarshan Ananta Nepal[1]*, Sarojini Kafle[2]
[1]Central Department of Economics, Tribhuvan Univesity (Post-graduate Student)
[2] School of Management, Kathmandu Univesity (MPhil Scholar)
*E-mail: sudarshannepal100@yahoo.com samarita_sarojini@yahoomail.com

ABSTRACT:

Nepal is primarily an agrarian economy and agriculture is the main stay of life. At present, the development consensus is that a strong performing agricultural sector is fundamental for overall economic growth. But the fluctuating growth rate over the years has been posing a serious threat and challenge to Nepalese economy for sustaining a steady growth. So a sustained growth of agriculture sector is crucial for sustaining poverty alleviation in Nepal. In recent year the poverty has declined largely attributing to the circular migration and influx of remittance; the sustainability of poverty reduction is uncertain in the long run as contributing factor for poverty reduction are particularly exogenous and are subject to external vulnerability. The use of modern tools is also relatively low which shows that household sector still lack assets that require relatively larger investments. Evidence has soon that ignoring the climate change has damage economic growth. So the authority has to find out adaptive measures to mitigate the effects to untold natural disaster and miseries due to recent erratic weather pattern.

Keywords: agrarian, posing, influx, exogenous, vulnerability

1. Introduction

When we delve into the history of agriculture, it can be observed that until mid-20th century there had been low productivity and subsistence production system in family-based farming activities. Similarly, the famous Green Revolution with semi-commercial technology led agriculture from 1960s till 1980s. From this date to present, commercial agriculture was enveloped with the introduction of the technological breakthrough in fields like production modulation and technology, bio technology, information and communication technology to enhance agricultural development (Hazell , 2009). South Asia's agriculture has witnessed gradual shift from the traditional and labour- intensive farming to capital intensive commercial farming from the middle of the last century. Out of the world's 1.09 billion extremely poor people, about 74 % or 810 million live in marginal areas and rely on small-scale agriculture for their livelihood (Setboonsarng, 2008). The 18th SAARC summit deserve accolades as it took laudable decisions by promoting sustainable agriculture and urging seed bank board be constituted at its earliest.

Nepal is primarily an agrarian economy and agriculture is the main stay of life (Dahal, 2014). Since decades, agriculture has been considered as active sector and a co-partner of the industrial sector in the development process (Thorbecke, 2006). Agricultural development is an integral part of overall economic development. It besides contributing as a food to the nation, absorbs labour, provides saving, earns foreign currencies and supports the market of industrial goods.

At present, the development consensus is that a strong performing agricultural sector is fundamental for overall economic growth (Stringer & Pingali , 2004). In low income countries, it plays important role where there are large sector in terms of aggregate demand and total labour force (Dethier & Effenberger , 2011). In last few decades Nepal has made a remarkable progress on the different socio economic indicators but economic growth at the snail pace growth. Poor Gross Domestic Product (GDP) growth has been a major challenge with other issues like high youth unemployment rate, inequalities, gender gaps for most socio-economic indicators and so on.

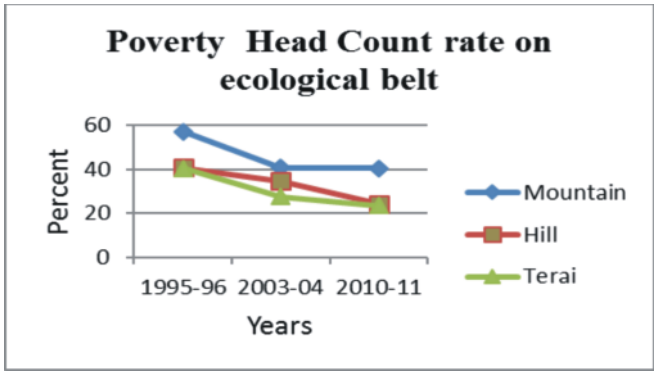
2. Material and methods

Our data on agricultural output was collected from various district level government agencies such as the Department of Irrigation, Agricultural Input Co-operation, Department of Agriculture, Ministry of Agriculture, Central Bureau of Statistics and the District Agriculture Development Offices. The data were collected by copying office records, i.e., they were mostly available as hard copies of historical reports.

3. Results and discussion

Agro ecological zone as the proportion of the total land is 23 percent, 35 percent and 42 percent in terai region, Hilly region and Mountain region respectively. In context of Poverty Head Count Rate on ecological belt, we can find that the Terai region have the lowest rate in 2010-11 rate of 23.44 percent from 40.3 percent (1995-96). Hills region have gradual decrease in with 24.32 percent (2010-11) from 40.7 (1995-96). In mountain region, we can find the gradual decrease in 2003-04 with 32.6 percent from 57.0 percent 1995-96 but in 2010-11 we can find a sharp increase with 42.27 percent.

Figure 1: Poverty Head Count Rate on ecological belt



At micro aspect the section analyses the decision to small scale investment in agriculture related inputs, technology or assets made by the household for inch up productivity and ultimately poverty reduction. Nepal Living Standard Survey (NLSS III) third round data has been required. NLSS section 13 provide information which are required for the analysis like spending on seeds and young plant, fertilizer and insecticides, irrigation changes and maintenance of warehouses, transportation of crop to the market, repair and maintenance of the equipment among others. (Central Bureau of Stastistics, 2012)

Region	Use of Improved Seeds	Use of Chemical Fertilizer	Plough	Tractor/ power tiller	thresher	Water pumps	Grain storage
Development Region							
Eastern	9.70	9.71	58.1	1.0	0.7	10.2	21.6
Central	9.36	9.71	36.6	1.5	1.7	8.2	18.5
Western	9.40	8.89	46.2	1.1	2.1	5.3	31.2
Mid West	8.23	7.13	74.2	0.2	0.2	3.4	64.1
Far West	8.50	6.94	66.9	0.6	0.5	6.1	62.5
Ecological Belts							
Mountains	8.21	6.41	65.3	0.0	0.0	0.0	37.5
Hills	8.61	8.28	54.7	0.3	0.4	0.5	29.2
Tarai	9.20	10.07	47.1	2.0	2.3	16.0	36.4
Consumption Quintile							
Poorest	8.50	7.60	61.4	0.2	0.7	3.7	34.0
Second	7.68	7.61	60.2	0.3	1.1	4.6	29.0
Third	8.42	7.81	56.7	0.3	0.6	6.6	34.1
Fourth	9.88	10.47	48.0	0.7	0.9	8.0	32.2
Richest	11.18	10.39	33.7	3.8	3.0	13.5	36.2

4. Conclusions

Firstly, agriculture provides employment and eradicate especially rural poverty and extremely susceptible to risk and uncertainty. The poverty is increasingly intense among small farmers and agricultural laborers, an upsurge in agricultural productivity could potentially be one of the most effective tactics to alleviate rural poverty (Adhikari , 2014).The fluctuating growth over the years has been posing a serious threat and challenge to Nepalese economy for sustaining a steady growth. The poverty has declined the poverty has declined from 31 percent to 25 percent in last decade and indicators in social and human indicators are comparable within region.

Secondly, we can find evidences of climate change in Nepal (1975 to 2007) resulting to late or pre monsoon, unusual precipitation, decreased rainy days, extreme fog condition in terai regions. The impact of climate change in agriculture sector is negative in the long run.

5. References

Hazell , P. B. (2009, November). The Asian Green Revolution.

Adhikari , C. B. (2014). Economic Relationship between Access to Land and Rural Poverty in Nepal . Applied Economics Journal.

Central Bureau of Stastistics. (2012). Nepal Living Standard Survey 2010/11.

Dahal, M. K. (2014). Nepal: AFifteen- Year Agriculture Tax Policy Perspectives (2015-2030). Nepalese Journal of Agriculture Economics .

Dethier , J.-J., & Effenberger , A. (2011). Agriculture and Development. The World Bank Development Economics Research Support Unit .

Paudyal, D. R. (2015). Pro-Poor Land Management System: A Study Considering Dynamic Aspect of Land Tenure in Nepal. ResearchGate.

Setboonsarng, S. (2008, February). Global Partnership in Poverty Reduction: Contract Farming and Regional Cooperation. ADB Institute Discussion Paper No. 89.

Stringer , R., & Pingali , P. (2004). Agriculture's Contributions to Economic and Social Development . Journal of Agricultural and Development Economics .

Thorbecke, E. (2006). The Evolution of the Development Doctrine, 1950-2005. UNU World Institute for Development Economics Research (UNU-WIDER)

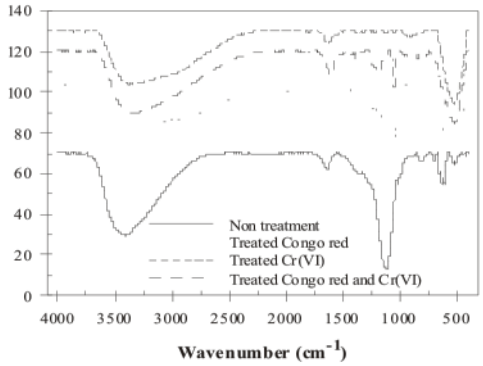


Figure.1. FTIR spectra for synthesized manganese oxide before and after equilibrating with aqueous solution containing congo red, Cr (VI) and congo red with Cr(VI).

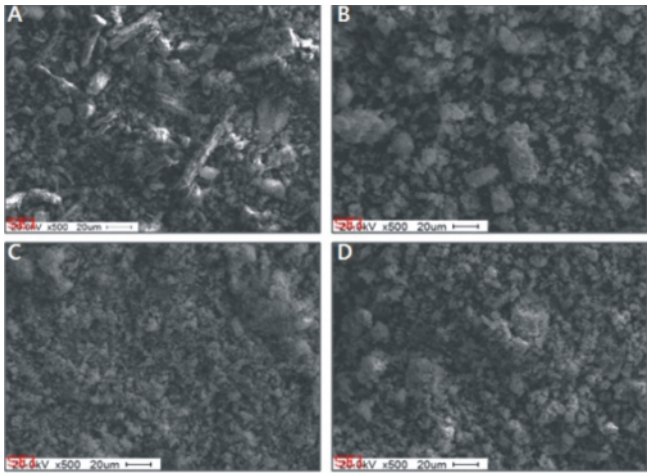


Figure.2. FESEM micrographs of synthesized manganese oxide: before (A) and after equilibrating with aqueous solution containing congo red (B), Cr (VI) (C) and congo red with Cr (VI) (D)..

4. Conclusions

Manganese powder was synthesized from spent battery waste and was characterized and tested for congo red and hexavalent chromium removal. XRF, FTIR and XRD results confirmed the presence of Mn oxides in the synthesized powder. Also, FESEM results showed the change in surface morphology before and after the treatments. The synthesized manganese powder was successfully able to simultaneously remove congo red and Cr (VI) with a greater efficiency of removal of congo red. Different reagents were tested for desorption study of the treated zero manganese powder and 0.1 M HCl and 0.1 M NaOH which are easily available commercial reagents, showed the greatest desorption capacity for CR and Cr (VI) respectively.

5. References

Journal

[1] Blackburn, R.S., 2004. Natural polysaccharides and their interactions with dye molecules: applications in effluent treatment. Environ. Sci. Technol. 38, 4905–4909.

[2] Chatterjee, S., Lee, D.S., Lee, M.W., Woo, S.H., 2009a. Enhanced adsorption of congo red from aqueous solutions by chitosan hydrogel beads impregnated with cetyl trimethyl ammonium bromide. Bioresour. Technol. 100, 2803–2809.

[3] Talreja, N., Kumar, D., Verma, N., 2014. Removal of hexavalent chromium from water using Fe-grown carbon nanofibers containing porous carbon microbeads. J. Water Proc.Eng. 3, 34-45.

Water Resources management of Port Blair city: an appraisal

Amlanjyoti Kar*

* Regional Director(i/c), Central Ground Water Board, Eastern Region, CP-6,Sector-v,Salt Lake city,Kolkata-700091 , E mail-karamlanjyoti@gmail.com,rder-cgwb@nic.in, cell- 09540686777

Extended abstract

The establishment of Port Blair dates back to 1774 while British East India Company decided to develop the small islands of Andaman and Nicobar through Penal Settlement. Ultimately the nucleus of the urban Centre was formed in 1859, immediately after the Sepoy Mutiny. Considering the hydrogeology, Britishers constructed few wells, number of ponds to harvest copious rainfall to fulfill the water requirement. Many such ponds still exist in and around the city of Port Blair. The water supply to ships even used to be maintained from pond under gravity through concrete aqueduct. However, in the Post independence the water scarcity in Port Blair has gradually become acute due to unscientific rise in population till 2000. Tourism is the chief industry in the island territory and it's pivoting on Port Blair because of its connectivity with mainland by sea and air routes. The hydro geological framework of the city does not support good ground water potential. Even surface water development has been hindered due to various prevailing climatologic, geologic and hydrologic factors. Water related miseries aggravated till 2007-08 because of wrong town planning without considering proper water management policies. However, by 2007-08 few major options of water supply were approved by A&N Administration to mitigate the water crisis in Port Blair keeping in view of boom in tourism industry. This has also filled up the huge gap of demand and supply of water existing. Consequently the role of ground water from the available resources and Inter island transfer of spring water has been pivotal in sustainable water supply. The total area of urban centre of Port Blair is 16.64 Sq.km. It has recently been declared as a smart city and the population as per 2011 census is 1,08,058. The city is bounded within the geographical coordinates of $11^0$37/00// to $11^0$40/00// North latitude and $92^0$43/34// to $92^0$43/56//East longitude.

The demand of water for the city is 354 lakh litres and it is mostly catered through the supply of water from Dhanikhari dam, Spring water through inter island transfer from Rutland island by ships and burges, few ponds,dugwells and bore wells located in and around the city. Due to paucity of groundwater potential in the city it has not been regulated with introduction of artificial recharge by laws. However, rainwater harvesting by laws in households has been introduced in the city. The paper reviews the causes of underdevelopment of water resources potential and mitigation of water supply crisis with various water supply options and the role of groundwater thereof.

Key words: Port Blair, hydrogeology, ground water, surface water, springs, wells, ponds , rain water harvesting, artificial recharge, inter island transfer , water supply options

Poster Session

[PROCEEDING]

Simultaneous removal of Cong red and Cr (VI) in aqueous solution using Manganese powder from battery waste solution

Deepa Kumari[1], Payal Mazumder[2], Jeong-Muk Lim[3] and Jaehong Shim[4]

[1]Department of chemistry, Visva Bharti University, Bolpur, West Bengal-731236, India

[2] Center for Environment, Indian Institute of Technology, Guwahati, North Guwahati, Assam-781039, India

[3]Division of Biotechnology, Advanced Institute of Environment and Bioscience, College of Environmental and Bioresource Sciences, Chonbuk National University, Iksan, Jeonbuk 570-752, South Korea

[4]Center for Convergence Bioceramic Materials, Korea Institute of Ceramic Engineering and Technology (KICET), 101, Soho-ro, Jinju-si, Gyeongsangnam-do 52851, Kore

E-mail: jaehongshim@gamil.com

ABSTRACT:

Adsorption capacity of manganese powder synthesized from spent battery waste solution was analyzed for simultaneous removal of congo red and hexavalent chromium. Manganese powder was synthesized by heat treatment followed by reaction with sodium borohydride to spent lithium-ion batteries. The removal conditions viz., pH, dosage of manganese and various concentrations of congo red and hexavalent chromium were optimized. The synthesized manganese powder was characterized by X-ray fluorescence spectrometer (XRF), X-ray diffraction (XRD) and Fourier transform infrared spectroscopy (FTIR). Further, FESEM was done to observe difference in surface morphology of the particles with and without treatment. The adsorption performance was studied and the highest adsorption by the zero manganese was 475 mg/g and 125 mg/g for CR and Cr (VI), respectively when different concentrations of the contaminants (400 mg/L CR and 100 mg/L Cr (VI)) was used. Under the optimum conditions simultaneous removal from 450 mg/L of CR to 250 mg/L and 125 mg/L of Cr (VI) to around 74 mg/L was achieved. Desorption study of the treated zero manganese exhibited that acid treatment (0.1 M HCl) for CR and alkali treatment (0.1M NaOH) for Cr (VI) as the suitable reagent for desorption.

Keywords: Lithium-ion battery waste; congo red (CR); hexavalent chromium (Cr (VI)); manganese powder

1. Introduction

The dyeing effluent discharged from various industries such as paper and printing, leathers, cosmetics, textiles etc. pollute the water bodies (Blackburn, 2004). Among the dyes, congo red (CR) is a benzidine-based azo dye that is expected to metabolize to benzidine. Prolonged use of this dye may cause tumor formation in humans leading to cancer (Chatterjee et al. 2009a). Along with dyes, elevated levels of certain metals such as Cr (VI) are also found in the textile effluents as Cr metals are widely used as mordents (i.e., color ?xing agents). The toxicity of Cr (VI) is mainly attributed to its strong oxidizing property that enables it to become a mutagen, carcinogen, and teratogen (Talreja et al. 2014; Natale et al. 2015). Therefore it is very important to remove the dyes from wastewater before disposal in to natural waters. The remediation to water pollution due to toxic heavy metals prompt an imperative demand for the development of low cost adsorbents with high efficiency (Goswami et al., 2016). Among these adsorbents, Manganese oxides (MnOx) provide sites for adsorption of and reaction with contaminants (Kumpiene et al., 2008).

2. Material and methods

The capacity of the synthesized manganese powder to remove congo red and Cr (VI) was determined by adding (1% w/v) of it to flasks containing different concentrations of congo red (100, 200, and 300 mg/L), Cr (VI) (30, 50, and 100 mg/L) in water at an initial pH of 6.65 ± 0.12. Removal of congo red and Cr (VI) from a mixed contaminant solution was also determined.

3. Results and discussion

The synthesized manganese powder was able to remove CR and Cr (VI) simultaneously. The synthesized manganese powder composition was analyzed by XRF. The result showed MnO (62.721%) as the major component in the mixture, followed by SO3 (31.691) and Na2O (2.544%), etc. The FTIR spectrum of zero manganese powder extracted from battery waste is shown in fig.1. The spectrum was recorded in the range of 500-4000 cm-1. The FESEM images shows the change in surface morphology of the synthesized zero manganese and the treated samples (shown in fig.2.).

Phytoremediation of zinc by Lemna minor from aqueous solution

Monashree Sarma Bora[1]*, Priyanka Gogoi[1], Kali Prasad Sarma[1]
Department of Environmental Science, TezpurUniversity, Assam 784028
*Email: msenv15@tezu.ernet.in

ABSTRACT:

This study examined the ability of Lemna minor as a phytoremediation agent of zinc in hydroponic solution. The plants were exposed to different Zn concentration (5.86 mg L-1, 13.59 mg L-1and 20.08 mg L-1) for a period of 8 days to assess the tolerance and effect of Zn on L. minor. No visible sign of Zn toxicity was observed on the plants grown in 5.86 mg L-1 and 13.59 mg L-1 Zn treatment solution. Relative growth of the plants decreased with increasing metal concentration as well as duration of exposure. Highest Zn removal percentage was 79.32 at 20.08 mg L-1 Zn treatment. Zn removal kinetics was found to follow both first order and second order kinetic equation with high coefficient of determination (R2>0.9). Bioconcentration factor (BCF) and Tolerance index (Ti) values indicate that L. minor maintains a good efficiency of Zn bioaccumulation and tolerance. SEM-EDX analysis of the leaf and root was carried out for cellular localization and anatomical changes due to high Zn concentration. FTIR analysis determined different functional groups responsible for binding of Zn ions. Based on these results we conclude that L. minor is a good zinc accumulator and effective in removing Zn at low to moderate concentrations.

Keywords: Lemna minor, zinc, phytoremediation, removal kinetics

1. Introduction

The world's ever increasing population and progressive adoption of an industrial based lifestyle has inevitably led to an increased anthropogenic impact on the biosphere [1]. Industries such as smelters, metal refineries and mining operations have been indicated as major sources of metal release into the environment. Most of the heavy metals are toxic or carcinogenic and pose threat to human health and the environment. As an innovative treatment technology, aquatic plants have been shown great potential for removal of organic and inorganic pollutants from wastewater [2]. Lemna minor is chosen for the study as it is easy to culture and harvest, and have a high growth rate [3].

2. Materials and Method

L. minor plants were collected from local ponds near Tezpur University, Assam and acclimatized in Hoagland nutrient solution for 7 days. Selected L. minor fronds were weighted to 15 g and were exposed to different concentration of Zn treated Hoagland solution for 8 days along with a set of control plants. The solutions were analysed at 2 days of interval to determine the changes in concentration of Zn during the experiment. All plants were analysed only at the termination of the experiments to see the accumulation of Zn in different parts viz. leaf and root. Chlorophyll content and proline content in the plant were measured. SEM and FTIR techniques were used for cellular localization and determination of functional group in plant biomass respectively.

3. Result and discussion

3.1 Chlorophyll and proline content in L. minor

The total chlorophyll content in L. minor was found to be reduced as the concentration of Zn increases and effect of Zn on the chlorophyll b content was more as compared to chlorophyll a, whereas the proline concentrations were significantly increased with the increase in Zn concentration.

3.2 Percentage removal of Zn by L. minor

Zn was significantly reduced from the aqueous solution by L. minor with increase in time.

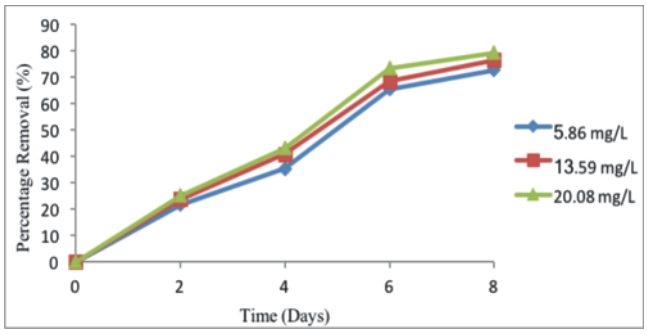


Figure 1. Percentage removal of Zn by Lemna minor at different initial concentrations

During the early days of experiment Zn removal occurred rapidly, irrespective of the initial Zn concentration. Bioconcentration factor (BCF) values indicate L. minor as moderate accumulator of Zn.

3.3 Zn Removal kinetics

The Zn removal kinetics in the L. minor were found to follow both first-order and second-order kinetic equations with high coefficients of determination (R2 > 0.9). However, L. minor was found to follow first order removal kinetics more suitably than second order kinetics at all concentrations for removal of Zn based on R2 values.

3.4 SEM analysis

Stomatal closure is found as one of the most evident symptoms of Zn toxicity which was confirmed by measuring the diameter of the stomata of the abaxial side of the leaves of L. minor. Loss in the cell shape and distortion of the vascular bundles was observed in the Zn treated root of L. minor.

3.4 FTIR analysis

Shifting of FTIR peak position in treated biomass revealed the presence of amides, alkanes, carboxylic acids, aromatic and aliphatic amines, alcohol, and alkyl halides which are found as possible functional groups responsible for binding of Zn ions.

4. Conclusion

As indicated in the results L. minor has a good potential to tolerate and accumulate zinc in lower to moderate concentration. Therefore, L. minor could be a good candidate for cleaning of wastewater polluted with Zn.

References

[1] Ugya, A.Y. 2015. The efficiency of Lemna minor L. in the phytoremediation of Romi stream: A case study of Kaduna refinery and petrochemical company polluted stream, Jornal of Applied Biology and Biotechnology, 3, 011-014.

[2] Alkorta, I., Garbisu, C. 2001. Phytoremediation of organic contaminants. Bioresource Technology, 79(3), 273–276.

[3] Rahmani, G. N. H., Sternberg, S.P.K. 1999. Bioremoval of lead from water using Lemna minor, Bioresource Technology, 70, 225-230.

An Attempt To Enhance Potassium Content In Vermicompost By Adding Mica Waste -A High Potassium Containing Mineral

Chayanika Kalita, Prabhat Pramanik*
Soils Department, Tocklai Tea Research Institute, TRA, Jorhat-, Assam
*Corresponding Author: Dr. P. Pramanik ; E-mail: prabhat2003@gmail.com

Production of huge amount of solid waste has become an increasing environmental thread now a days. This Management or recycling of solid waste is becoming a topic of interest for sustainable environment management. Vermicomposting is an eco-friendly rapid recycling technique to manage organic wastes in agro-ecological system. The tea cultivation involves huge amount of potassium (K) consumption because of its biological importance in protein synthesis and activation of enzymes. A huge amount of MoP (100 Kg/ha) is normally applied in soil to supply K in tea plants. The increasing price of fertilizer and its ecologically threatening use has made the workers to think about alternate source of soil fertilization.
K-minerals like mica waste contain about 12% K by its weight. In-spite of being a potential K reservoir, the K of mica waste is not directly accessible to plants.
Previously, several experiments were conducted to enhance nitrogen and phosphorus content in vermicompost by incorporating chemical and/ or organic substrates. The objective of this work was to evaluate the potential of mica waste addition with organic substrates prior to vermicomposting for enhancing K content in the final product. In this study, different proportions of mica waste were mixed with cattle manure and changes of different chemical properties were periodically evaluated.
In this experiment, the values of different parameters namely total carbon, total nitrogen, total potassium, water extractable K, exchangeable K in decomposing organic substrates were increased depending on the proportions of cattle manure and mica waste. The experiment also involved comparison in efficacy of two different earthworm species, Eisenia fetida and Eudrilus eugeniae. The highest decrease in organic carbon was found in Eisenia fetida. Feeding of cattle manure by earthworms leads to 45-62% increase in total K content. The relative effect of Eisenia fetida was more on mica waste as it released highest K in treatments than that of its analogous under action of Eudrilus eugeniae. This study suggested that mica waste may be mixed with waste materials for increasing K content in the final product and Eisenia fetida is found to be more effective earthworm than Eudrilus eugeniae.

Keywords: Mica Waste, Vermicompost, K minerals, Earthworms

Distribution of Heavy metals in road deposited sediments of NH37 in the stretches of Kaziranga National Park of Eastern Himalayan Region

Upasona Devi[1], RazaRafiqul Hoque[1] Kali Prasad Sarma[1],*
[1]Department of Environmental Science
Tezpur University , Tezpur 784028 (India)
*Corresponding author email: sarmakp@tezu.ernet.in

ABSTRACT:

Road Deposited Sediments (RDS) were collected from NH37 in the stretches of Kaziranga National Park (KNP). This portion of the highway is also intersected by the Asian Highway-1 that runs from Tokyo, Japan via Korea and ends with European rote E80. The samples were collected in a time series for two years covering the pre- and post- monsoon period and were characterized for heavy metals viz. Co, Cr, Cu, Ni, Fe Mn, Pb and Zn. Explicit temporal and spatial treads of heavy metals were observed, which could be attributed to varying vehicular strength and road conditions respectively. The enrichment factor calculated for the metals analysed were found to be in the order Cd > Zn>Pb>Cu>Cr>Ni>Co>Mn. Pollution index and ecological risk factors were calculated and it was found that Cd is posing maximum ecological risk to KNP. Principal component analysis (PCA) identified four possible sources.

Key words: Road Deposited Sediments, enrichment factor, Pollution index, ecological risk factors, PCA.

Introduction:

Environmental pollution is a ubiquitous phenomenon today. Heavy metals constitute one such group of contaminants that pose great risk to human health and biota. These metals originate from both natural and anthropogenic sources. Metals do not degrade and, therefore, remain in the environment persistently. The heavy metal as a pollutants have been extensively studied in different environmental matrices such as air, water, soil, road dust, plant matrices, etc.[1,2].The present study is the first assessment of degree of pollution caused by heavy metals introduced by a busy highway that passes through a rich biodiversity zone –Kaziranga National Park (KNP) through assessment of metals contents in the road deposited sediments (RDS). Density of motor vehicles on NH37 has increased several folds in the last two decades posing an obvious factor of perturbation to the park. Heavy metals released from vehicular movements pose a risk of mobility and bioavailability. These heavy metals could be transported by air and water to wider areas of the park and accumulate in soils, sediments and food chains resulting potential environmental impacts and undergo considerable physical and chemical transformations [1]. Heavy metal input from NH37 in the stretch of KNP could be a useful indicator of their level and distribution of contamination in the surface environment [2-5].

The objective of the study is to assess the heavy metal levels in the RDS and to find the probable source of these metals.

Materials and method:

Geographically KNP is positioned within 26°30 N-26°45 N. and 93°08 E - 93°36 E. The region experiences sub - tropical monsoon type of climate with average annual rainfall of 1320 mm. Fourteen representative locations were chosen within the entire length of 49 km for the collection of RDS. Four rounds of sampling of RDS were carried out in a time series, alternately for pre- monsoon and post-monsoon seasons. Fifty-six samples of RDS were collected during the entire period. Samples were acid digested for metal analysis by method earlier used by Chen and Ma[3]. Heavy metals concentrations were determined by ICP-OES (PerkinElmer / Optima 2100DV). The recovery percentage for the eight observed metals ranged between 80% and 110%. In order to determine the precession of the analytical procedure triplicate analysis were performed with some of the samples. Along with the metals pH and organic carbon was measured in samples[4,5].

Result and discussion:

An explicit seasonal trend was observed. For most instances, mean metal concentrations were higher in the post monsoon samples excepting for Pb. For a situation where vehicles are the primary and main contributor of metal pollution, seasonal variations in the metal concentrations would mean a variation in the strength and composition of vehicles between the seasons. A vivid spatial variation of metal concentrations among sampling points was found which could be attributed to road geometry, speed of traffic and surface condition of read.

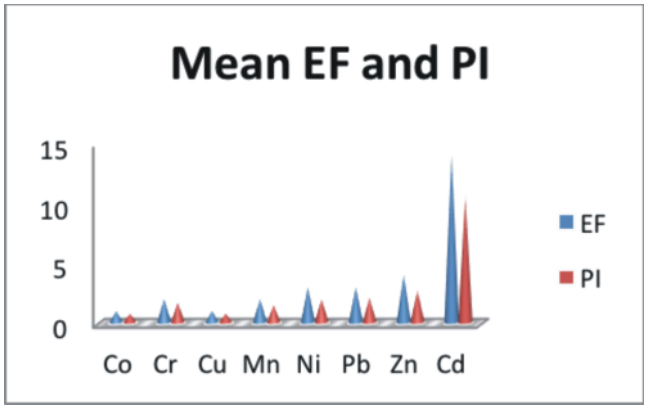


Figure : Mean EF and PI of the fourteen sampling sites

EFs of Co and Mn were slightly less than 2. Cr, Cu, Ni, Pb and Zn were moderately enrichment indicating that these in RDS could originate from both anthropogenic and natural sources. Also, metals being non-biodegradable, pre-existing lead in the environment could also be there. Enrichment of Zn could be attributed to wear and tear rate of tyre. For Cd apart from the vehicular traffic spraying of pesticide in the nearby tea garden and agricultural areas. Mean PIs indicate that Cu, Co and Mn represent low pollution group; Pb, Ni, Cr represent moderate pollution group and Cd high pollution group.

Percentage contributions of maximum Eir posed by various RDS metals of NH37 are illustrated in figure 2. Cd

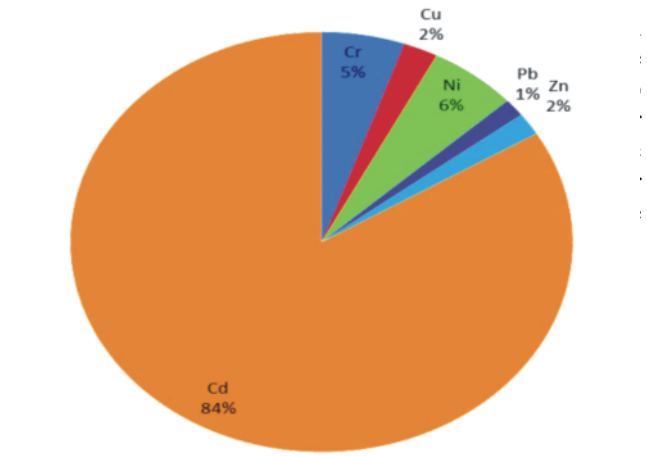


Figure : Mean ecological risk

Conclusion:

An explicit seasonal and spatial treads of heavy metals were observed, which could be attributed to varying vehicular strength and road conditions respectively. High levels of Pb and Cd has implications on the ecology, which is clear from the calculated levels of PIs and ecological risks. From the study it is clear that there were large input of toxic material into the pristine biodiversity rich KNP from NH37 which will ultimately washed and contaminated the water bodies nearby areas.

References:

1. L. Xiang, Y. Li, Z. Yang and J. Shi, Seasonal difference and availability of trace metals in street dust in Beijing,2010Journal of Environmental Science and Health Part A45, 1092–1100
2. S. Charlesworth, M. Everett, R. McCarthy, A. Ordonez, E. Miguel, A comparative study of heavy metal concentration and distribution in deposited street dust in a large and a small urban area: Birmingham and Coventry, West Midlands, UK 2003. Environment International29563–573.
3. M. Chen and L. Q. Ma, Comparison of three aqua regia digestion methods for twenty florida soils, 2001.Soil Science Society of American Journal,65,491-4999.
4. L.S.Clesceri, A.E.Greenberg, A.D. Eaton ,Standard Method for Examination of Water and Waste water.20th edition. APHA,AWWA,WEF, Washington DC,1998.
5. M.L.Jackson, Soil Chemical Analysis. New Delhi: Prentice Hall (1973).

Consequences of climate changes on watershed and its effect on Urban Environment, a case study of Guwahati watershed

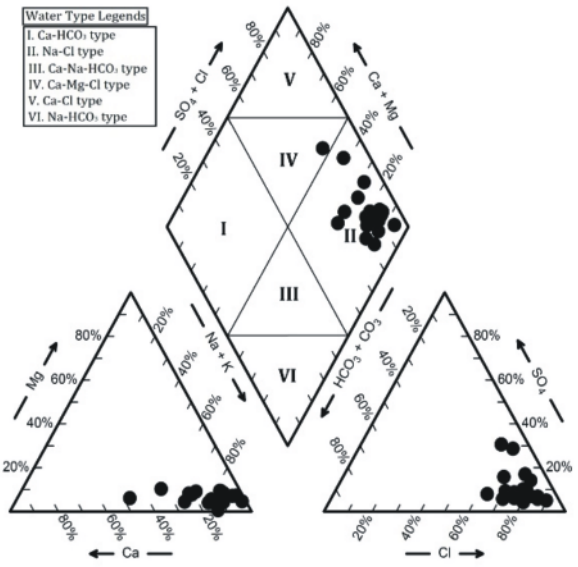
Jyoti Prakash Deka[1], Sudipta Biswas1, Arbind Kumar Patel[1], Manish Kumar[1]*
[1]Department of Environmental Science, Tezpur University, Assam 784028
*Email(Corresponding Author): *manish.env@gmail.com

ABSTRACT:

Watershed management is an adaptive measure of managing natural resources on the basis of a physiographic nature of watershed boundary within its region. World has seen an expanding number of climate phenomenon, all exacerbated by climate change. Ice caps and glaciers are vanishing all the more rapidly, diminishing this essential freshwater hold and changing down-incline streams. All urban communities and urban ranges overall utilize 75% of the world's vitality and are in charge of 75% of worldwide ozone harming substance discharges, 60% of private water utilize, and 76% of wood utilized for a mechanical reason. At the point when the deforestation prompts watershed destruction around human settlements and urban communities, life-saving fresh water supply also dries up. In the current scenario, more than one billion city-dwelling people lack access to clean and healthy water, because of the lack of integrated land use in urban and urban watershed management. We are just now starting to understand some of the future consequences of these actions. Present day need is for a holistic management of watershed and improves public awareness on sustainable management of watersheds. Groundwater is the major source for various purposes in the most parts of the world. Guwahati is one of the fastest developing cities in India and major city in North-Eastern India. Although the mighty river Brahmaputra flows through the northern periphery of the Guwahati city, water necessity depends heavily on the groundwater source. Presence of low or high concentration of certain ions is a major issue as they make the groundwater unsuitable for various purposes. With an objective to identify the governing hydro-geochemical processes and to evaluate their impact on the arsenic contamination in the groundwater of Guwahati, sampling was done in November 2012 (n=20). In general groundwater of Guwahati is slightly alkaline in nature. The groundwater quality of the study area is mainly having problem of high dissolve solids which makes it unfit for drinking. Piper Plot alarmingly showed Na+-Cl- water type in all samples which needs further investigation. Gibbs plot showed that rock water interaction is the major source of groundwater in Guwahati. Factor analyses substantiate the findings that geochemical processes like weathering. ion-exchange & the dissolution process is governing factor for the water quality in the area.Groundwater quality of Guwahati is badly affected due to rapid urbanization and lack of alternate water sources. Due to which water level went down and water related problems start to appear nowadays.Introduction:
Among the Earth's total water 3% is fresh water in which groundwater constitutes 30.1%, more than the rivers of the World. Groundwater chemistry is largely a function of the mineral composition of the aquifer.Geochemical processes are primarily responsible for overall quality of the groundwater which got special attention in the recent past due to geogenic contaminants like Arsenic (As), Fluoride (F-), Iron (Fe) etc.Guwahati is one of the fastest developing cities in the North-Eastern India, which is heavily dependent on the groundwater for their water necessities.Therefore, the objective of this study was to identify the governing hydro-geochemical processes and their impact on groundwater quality of Guwahati.

Methodology:

Guwahati is one of the fastest developing cities in India. The city is between the banks of the Brahmaputra river and the foothills of the Shillong plateau. It is gradually being expanded as North Guwahati to the northern bank of the Brahmaputra. The Guwahati Metropolitan covers an area of 254 km².



Results & Discussion

A descriptive summery of groundwater quality in Guwahati area can be understood by the below summery table(Table 1).

Table.1.The statistical summary of hydrogeochemical Parameters of Groundwater of Guwahati

All parameters are in mgL^{-1} except for pH, EC(µS/cm)

Parameter	*Range*	*Average±SD*
pH	7.5-8.2	7.9±0.2
EC	148.7-942	416.92±230.4
TDS	104.5-745	236.8±162.1
Ca2+	2.2-59.8	16.6±14.1
Mg2+	0.4-4.6	4.14±0.9
Na+	45.9-206.8	104.9±40.5
K+	0.4-3.2	1.6±0.8
HCO3-	15-75	31.2±16.1
SO42-	8.63-53.4	19.5±14.2
Cl-	51.1-181.8	102.5±38.4
PO43-	0.03-0.3	0.08±0.06
SiO2	16.4-54.8	33±9.8
Cu	0.03-0.68	0.08±0.14
Fe	0.4-7.5	1.9±2.1
As	0.7-6	1.8±1.2

Graphical representation of the hydro-geochemical data:
Piper Plot(Fig. 1) (1944) is one of the classical way to illustrate overall water type. Diamond field above alarmingly plots all the samples in the zone of Na+-Cl- water type. This needs further investigation whether such water type has geogenic origin or anthropogenic signatures.
A plot of (Na++K+)/ (Na++K++Ca2+)and Cl-/(Cl-+Alk) versus TDS (Fig.2)helps to identify dominant geochemical processes operative in the area (Gibbs 1970). Fig. 2 shows that rock water interaction is the major source of groundwater in Guwahati. Evaporation is also likely to have some impact one of the groundwater chemistry.

Fig. 1 Piper plot of groundwater

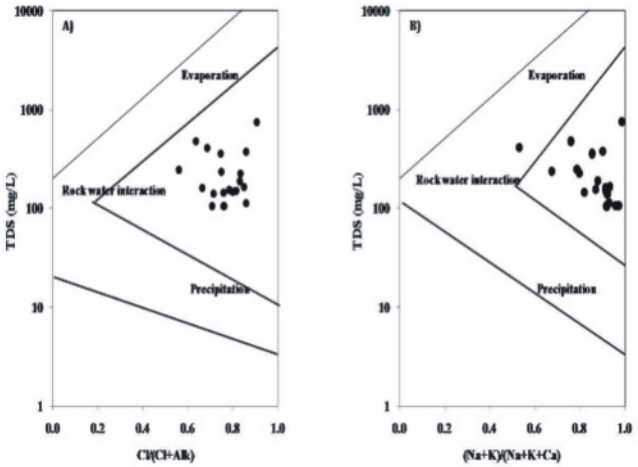


Fig. 2 Mechanism controlling GW chemistry (A) & (B)

With depth As value decreases and higher As conc. were mostly found at shallow depth. With depth reduction potential increase(Fig.3). With higher reduction potential SO42- will reduce to S2- which will adsorb As Kim et al,2012). No relationship is observed between As & Fe. This indicated that one of them is conserved in the system while the other is regularly being removed from the system.

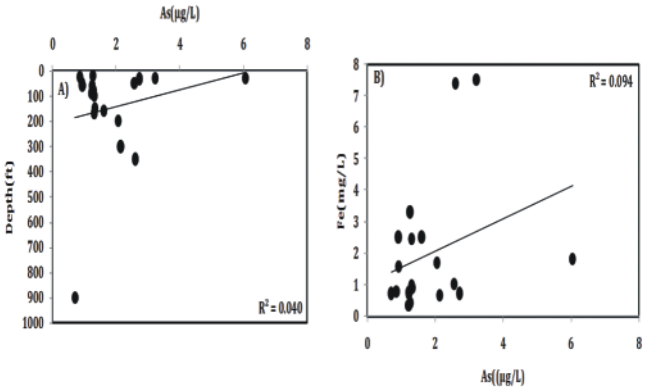


Fig. 3.Scatter Diagram showing relationship

As with A) depth & B) Fe concentration.

Multivariate analysis for GW sample of Guwahati

Factor1 vs Factor2 (SPSS16) showed that high positive loading for EC, TDS, Ca2+ ,HCO3- , Na+, Cl-.EC, TDS, Ca2+ & HCO3- identified in factor 1indicated ion-exchange and carbonate weathering, while high EC & TDS indicated dissolution process. The 2nd factor was identified to be the set of Na+& Cl- hinting at halite dissolution which needs further confirmation through mineralogical study.

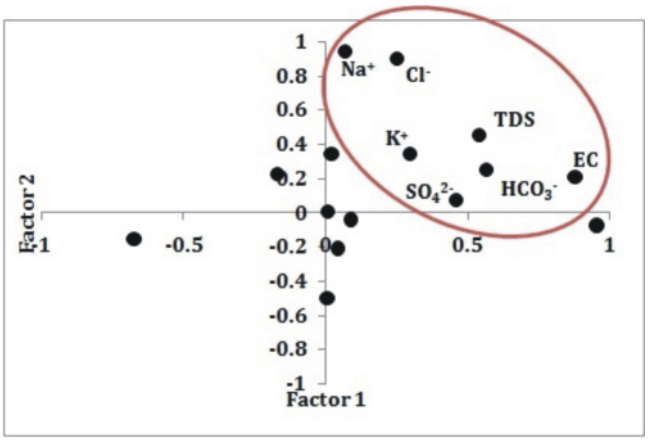


Fig.4:Multivariate analysis for GW sample of Guwahati

Conclusion

- The groundwater quality of the study area is mainly having problem of high dissolve solids which makes it unfit for drinking.
- Rock-water interaction is the major hydro geochemicalprocesses governing groundwater chemistry which is gradually becoming brackish.
- Factor analyses substantiate the findings that geochemical processes like weathering. ion-exchange & the dissolution process isgoverning factor for the water quality in the area.
- Overexploitation, irrigation return flow, untreated wastewater discharge and industrial water use is likely to aggravate quality related problem.

Reference

1. American Public Health Association (2005). Standard methods for the examination of water and wastewater(21st ed.). New York
2. Gibbs RJ (1970). Mechanisms controlling worlds water chemistry. Science 170:1088–1090.
3. Piper AM (1944). A graphical procedure in the geochemical interpretation of water analysis. Am Geophysics Union Trans 25:914–928 .
4. Kim et al.(2012) Co-contamination of arsenic and fluoride in the groundwater of unconsolidated aquifers under reducing environments. Chemosphere 87 (2012) 851–856.

Effects of unhygienic practices on water quality and health risk to population of Chincholi industrial area of Solapur, Maharashtra, India

Shrikant Mukate[1]*, Dipak Panaskar[1], Vasant Wagh[1]Aniket Muley[2] and Chandrakant Jangam[1]
[1]School of Earth Sciences, SRTM University, Nanded, Maharashtra 431606
[2]School of Mathematical Sciences, SRTM University, Nanded, Maharashtra 431606
*E-mail: mukateshrikant@gmail.com

ABSTRACT:

A comprehensive hydrochemical study has been carried out to evaluate the impact of anthropogenic sources like industrial effluents, open defecation and untreated sewerage disposal on surface water and groundwater in Chincholi industrial area, Solapur, Maharashtra. The study area comprises of 3 villages with approximate 7000 population and out of that 81 % openly defecates in the periphery of villages due to inadequate sanitation system. Hence, there is need of capital investment in sewerage network system and treatment for open waste disposal in land of sewage. It is observed that, few groundwater sources are contaminated in the vicinity of disposal sites. The field survey revealed that industrial effluent is discarded in simple pit without any prior treatment and people harnessed the water from these aquifers. A total 55 water samples out of that 6 surface water and 49 groundwater samples from industrial/residential/ agricultural area have been collected during pre and post monsoon season of 2015. The surface water is mainly polluted with chloride, sodium and sulphate and its values found beyond the permissible limit of the Bureau of Indian Standards (BIS). Analytical result reveals that groundwater is slightly alkaline and hard to very hard type. According to the BIS, the contents of Cl, TDS, Na, and Ca exceeded the permissible limit in Chincholi and Pakni villages in both the seasons. The hydrochemical analysis confirms that, alkaline earth (Ca+Mg) exceeds the alkalis (Na+K) and strong acid (SO4+Cl) dominate over weak acid (CO3+HCO3) in pre and post monsoon. The Spatio-temporal analysis illustrates that, the groundwater samples located along the effluent discharged stream are mainly dominated by Chloride, Nitrate and TDS; moreover, samples nearby the human settlements are also dominated by chloride and Nitrate. In post monsoon season Nitrate and Chloride concentration is elevated due to percolation and leaching of organic contaminants. The study concludes that the unhygienic practices like sewerage disposal, open defecation and effluent disposal are affecting the surface and groundwater quality. From an industrial perspective, the groundwater corroborates the corrosive and incrusting property, hence not suitable for industrial applications. To overcome the problem water need some treatments prior to domestic use and industrial waste before its disposal.

Keywords: Groundwater; Surface water; Sewage; public health; Chincholi Industrial area

Groundwater quality assessment on Arsenic and Fluriode contamination in the Guwahati city, Assam Northeast India

Arbind Kumar Patel[1] & Manish Kumar[1]*
[1]Department of Environmental Science, Tezpur University, Assam 784-028, INDIA
***Corresponding author: manish.env@gmail.com**

ABSTRACT:

Contamination of groundwater by both chemical and biological agents has proved to be a problematic aspect. In order to examine the quality of groundwater and the underlying hydrogeochemical processes associated, sampling was conducted in Guwahati, Assam, India. A total of 17 groundwater samples were collected during pre-monsoon season of June 2014 and post-monsoon season of January 2015. The standard methods prescribed by the American public health association (APHA) were used for all the hydrochemical analyses.Silicate weathering was shown to be quite dominant in the region as a shift was observed from Mg2+-Cl- in the pre-monsoon to Na++K+-HCO3--Cl- water type in post-monsoon by the Piper diagrams. The same can be observed from the scatter plots of Tz+ (total cations) vs (Na++K+) and (Ca2++Mg2+).The HCA (Hierarchical Cluster Analysis) also shows that Fe and Ni are clustered together in the pre and post-monsoon season, which could be due to the involvement of (hydro)xides like limonite. Principal components analysis (PCA) was found to show that hydrolysis of Fe and Ni (hydro)xides was a major process in both the pre and the post-monsoon seasons.

Keywords: Groundwater, Hydrogeochemistry, Cluster analysis, Guwahati

1. Introduction

Groundwater in urban areas can suffer from many kinds of contamination from both natural and anthropogenic sources.Among contaminants from natural sources, arsenic and fluoride are the most serious. Originally, these elements are contained in rocks, and then released into groundwater by the weathering of these rocks.High concentrations of As and F (>10 µgL-1) F- (> 1.5 mgL-1) in th groundwater have been found to be a major problem around the world. (WHO 2008; Kumar et al., 2015)

As for anthropogenic, these contaminants are either discharged to the ground by factories, households, and then migrate to the subsurface together with rainwater infiltration, or they can be directly discharged into subsurface soil layers through leaking sewer pipes.

An effort has been made to determine the suitability of groundwater of Guwahati city for drinking purpose. The study has been undertaken with the following objectives- 1) Assessment of water quality for drinking purpose. 2) Identification of hydrogeochemical process governing groundwater quality.

2. Material and methods

A total of 17 groundwater samples were collected during pre-monsoon season, June 2014 and post-monsoon season, January 2015. The standard methods prescribed by the American public health association (APHA, 1998) were used for all the hydrochemical analyses. Fluoride were measured using ThermoscientificOrion STARA 214. Arsenic was analyzed using Atomic Absorption Spectroscopy (AAS, Thermoscientific ICE 3000). Electrical conductivity (EC), pH, and total dissolved solids (TDS) were measured onsite using a multi-parameter probe (HANNA HI9828)

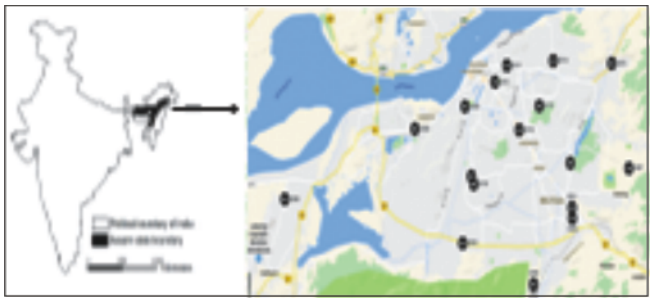


Fig: 1.Map showing sampling locations of Guwahati

3. Results and discussion

It is likely that, F- and Fe(Fig. 2. a)shows some correlation with Fe in post-monsoon season. Probable reason could be secondary release of F- from Fe(hydr)oxides during post-monsoon.

Fluoride andPO43- (Fig. 2. b)did not show any correlation with PO43- and depth(Fig. 2. d), while with HCO3-(Fig. 2. c)there appears to be a weak correlation.

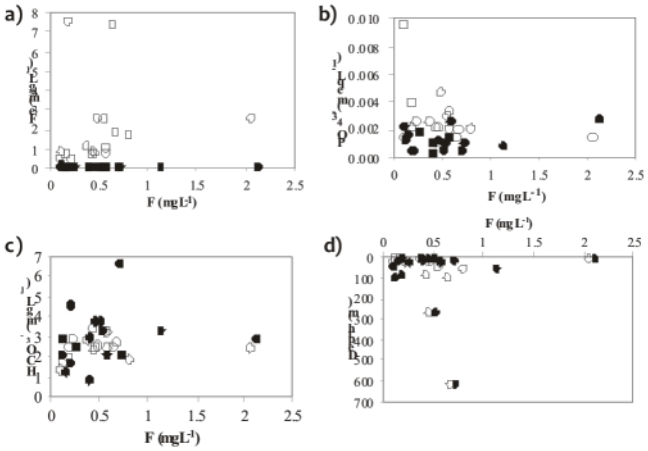


Fig: 2. Scatter diagram of (a) Fe Vs F (b) PO43- Vs F (c) HCO3- Vs F(d) Depth (m) Vs F

Note: Black dot represent pre-monsoon while blank dots represent post-monsoon respectively

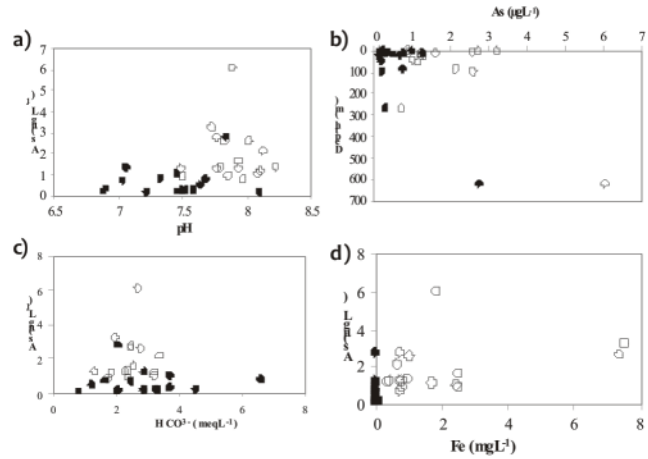


Fig: 3.Scatter diagram of (a) As Vs pH (b) As Vs Depth (m)(c) As Vs HCO3-(d) As Vs Fe

Note: Black dot represent pre-monsoon while blank dots represent post-monsoon

A clear relation is not observed between As and pH(Fig. 3. a).Reductive hydrolysis appears to be dominant processes in the post-monsoon as observed from(Fig. 3. d) the correlation between As and Fe. Influx of rain water could lead to a more saturated state by driving out the air from the aquifers, thus enhancing the reducing condition conducive for reductive hydrolysis of Fe (hydr)oxides.

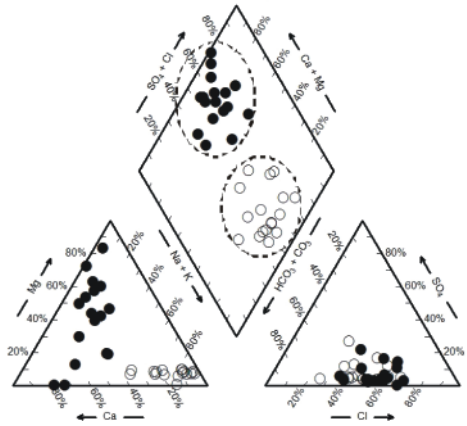


Fig: 4. Piper diagram for pre (black dots) and post monsoon (blank dots)

Piper diagram (Piper, 1954) can be utilized to determine the water types. It can be observed from (Fig: 4) that there is a clear indication of recharge during the post-monsoon season. In the pre-monsoon season the water type is mainly Mg2+-Cl-. In the post-monsoon season, silicate weathering becomes dominant as the water type becomes primarily Na++K+-HCO3--Cl- type.

4. Conclusions

Overall, the drinking water quality in the groundwater samples was found to be suitable in relation to the various parameters analysed. Except one place (Narengi, Guwahati) which shows F level more (2.06 mgL-1) then the permissible limit (> 1.5 mgL-1) of WHO. However, as the number of samples analysed was quite small therefore, a detailed study is necessary to precisely predict the present scenario and monitor the groundwater quality for the future.

5. References

Brindha, K., Rajesh, R., Murugan, R., Elango, L., 2011. Fluoride contamination in groundwater in parts of Nalgonda district, Andhra Pradesh, India. Environ. Monit. Assess. 172, 481-92.

World Health Organization (WHO) 2008. "Guidelines for drinking-water quality: incorporating first and second addenda to third edition, Vol. 1, Recommendations."

Piper, A.M., 1953. A graphic procedure for the geo-chemical interpretation of water analysis. USGS groundwater. Note 12.

Groundwater Resilience & Response in South west Neyveli basin, Cuddalore District, Tamil Nadu, India

S.Aravindan and Vijayaparbhu
Dept. of Earth Sciences, Annamalai University, Annamalai Nagar – 608 001, Tamil Nadu, India

ABSTRACT:

To understand the aquifer characteristic fluctuation of groundwater table, flow and recharge mechanisms is required for Hydro geological Study of an area. Importance of hydrogeology was documented by Ven Te Chow (1964). The pre monsoon water table contour fluctuates between 2.83 m to 49.41m (AMSL) due to variation in relief of the terrain. Shallow groundwater table's values are found in south western part where as deeper levels are found in the north and southern part. The Post Monsoon water table varies from 1.23 m to 64.57 m AMSL. Water level data of majority of wells has increasing trend in pre monsoon when compared to Post monsoon water level data. Highest elevation in water level is found in Pudukuraipettai, Iruppu and sathamangalam which has exact coincidence with recharge area boundary of Neyveli basin from the earlier literatures of 30 to 60 m AMSL contours from Northeast to southwestern part.

Keywords: aquifer characteristic, Hydro geology, Water levels, Water table and South west neyveli basin

1. Introduction

It is a fact that the occurrence and movement of groundwater depends upon lithology, landforms and structure. A good aquifer is one which can be recharged during the period of monsoon when rain water gets infiltrated and recharged. This means that during the pre-monsoon period aquifers used to have a low water table condition compared to post monsoon period. The area has a tropical climate with the highest and lowest temperatures recorded in year of 2012 and 2006 respectively. The hot weather period starts from March and ends in July with a mean temperature of > 30ºC. Precipitation of the study area mainly depends upon North east monsoon, which is attributed to the development of low pressure in the Bay of Bengal.

2. Material and methods

Representation of water table by conventional contour maps showing elevation of water level above mean sea level is generalized in nature, not being capable of bringing out the pertinent features of the dynamics of groundwater flow and is liable to subjective errors (Biswas and Chatterjee, 1967), yet it gives visualizable behaviour of it by using GIS tool. The difference in water table can be calculated once the water table of both seasons is recorded. Water level data for both monsoons was collected from 2002 to 2013. Water table data is converted to mean sea level referenced data by using altitude value. After getting the MSL referenced water level data, water table contour map is prepared with the help of Arc GIS 9.3 software.

3. Results and discussion

The Annual rainfall for the year from 1997 to 2014 with the highest rainfall of 46 % (2186.52 mm) at Kuppanatham, moderate Rainfall of 29 % (1361.88 mm) at Sethiyathope and 25 % of rainfall (1207.91 mm) is received at Virudhachalam in south west Neyveli basin. Water level data of 7 wells were interpolated for both pre monsoon (PRM) and post monsoon (POM) period. Wells are fairly distributed throughout the study area. Water table conditions of pre and post monsoon season are shown in Table.1.

Table.1 Water table data (in m) of South West Neyveli basin

S.No	Well Locations	PRM	POM	Water level fluctuation
1	Sethiathope	26.72	26.77	-0.06
2	Virudachalam	20.01	17.19	2.82
3	Sattamangalam	2.83	1.23	1.60
4	Pudukuravapetai	49.41	64.57	-15.16
5	Vadalur	10.90	2.53	8.36
6	Neyveli1	4.55	3.49	1.05
7	Irruppu	46.01	58.15	-12.14

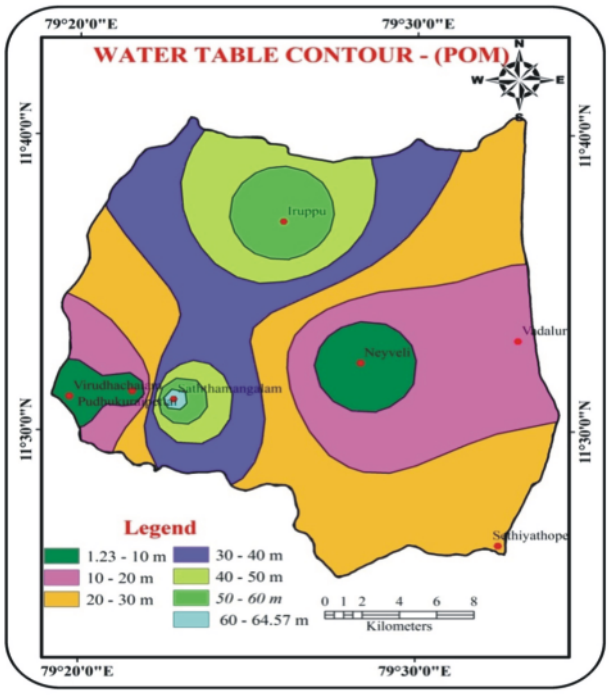


Figure.1 Water Table Contour Map of Post Monsoon

The pre monsoon water table fluctuates between 2.83 m to 49.41m (AMSL) due to variation in relief of the terrain. Lower values are found in south western part where as deeper levels are found in the north and southern part (Table.1).The Post Monsoon water table varies from 1.23 m to 64.57 m AMSL, (Figure.1). Ground water level data of pre monsoon has general increasing trend when compared to Post monsoon water level. Highest elevation in water level is found in Pudukuraipettai, Iruppu and sathamangalam which has exact coincidence of recharge area boundary of Neyveli basin from earlier literature of 30 to 60 m AMSL contours from Northeast to southwestern part of the study area (Table.1 & Figure.1).

1. Conclusions

The result indicates that a minimum water level fluctuation of 1.05 meters is found in Neyveli and a Maximum of 15.16 meters at Pudukuraipettai. However the groundwater fluctuation varies from 1.05 meters and 2 meters in the west, southeast and northeast of the study area. From the fluctuation map, it is found that maximum recharge of water level is found in southwest and central part of the study area by (–15.6 m BMSL). South western part of the study area Virudhachalem shows moderate fluctuation in water level with less than 8.36 m. This may be due to the contribution of leaky aquifer from the lower confined aquifer to upper unconfined aquifer due to adequate pumping also from lower aquifer as the dip is from North West to southeast and groundwater also follows the same trend.

2. References

Journal

[1] Biswas, A.B., and Chatterjee, RK., 1967 On representation of water-table by grid-deviation method. Bull. Geol. Soc.. Ind. 4, pp. 12-14

[2] ESRI 2011. Arc/GIS Desktop: Release 10.1 Redlands, CA: Environmental Systems Research Institute.

[3] Theis, C.V., 1935. The relation between the lowering of the piezometric surface and the rate and duration of discharge of well using groundwater storage, Am. Geophys. Union Trans., vol. 16, pp. 519-524

Assessment of pH dependent leaching behaviours of As, Mo, and Se from lead smelting slag

Rashmi Rekha Bora, Monikonkana Saikia, MumeeGogoi, Kaberijyoti Konwar, NabajyotiSaikia*
Department of Chemistry, The Assam Kaziranga University, Jorhat-785006, Assam, India
* Corresponding author, E-mail: saikianj@gmail.com; mobile no.: 00919508102298

ABSTRACT:

In order to gain better understanding of the toxicities of heavy metals and ground water pollution potential of lead smelting slag, in this investigation, some leaching tests are performed. Special attention has been paid to know the release behaviour of As, Mo and Se under varying pH conditions. The leaching results of these elements were assessed by using the concentrations of major elements.

Key-words: Lead slag, Heavy metals, pH dependent leaching, Oxyanions, Water pollution.

1. Introduction

Because of the lack of proper waste management and treatment options, disposal of several types of wastes materials such as metallurgical slags and municipality solid waste incineration ash is a problem. Some of these wastes contain high concentrations of heavy metals and therefore considered as hazardous. The releasing of toxic constituents from them can pollute the ground water of nearby area. The understanding of chemical and environmental behaviours is important for effective managements and treatments of these wastes. Several types of leaching tests are normally performed to assess their toxicities. This investigation was performed to understand the heavy metal leaching behaviours from lead smelting slag. Leaching behaviours of As, Mo and Se were evaluated by using pH dependent leaching tests as well as normal DIN test. Interpretation of pH dependent leaching results were done with the support of existing geo-chemical modeling results for similar types of wastes.

2. Materials and methods

The metallurgical slag (SLG), a residue from a lead blast furnace is a very hard black colour granular material. The leaching behaviour of SLG was evaluated by using European standard test, EN 12457-2 (DIN test), where powdered SLG was agitated with distilled deionised water for 48 h maintaining a 10:1 liquid-to-solid ratio. The prEN 14429 test was used to identify the leaching behaviour of SLG under certain pH conditions. The test consists of a set of parallel batch extractions of the material at L/S = 10 (L kg-1) in closed flasks, where granular samples (25 g) were in contact with aqueous solutions with increasing quantities of HNO3 and NaOH/KOH for 48 h under agitation, prior to the measurement of pH for the titration plots. The elemental compositions of leachates were analyzed by ICP-MS.

3. Results

The acid neutralization curve (ANC) graph of the SLG (Fig.1 (A)) indicates initial slow decrease of pH from around 13 to12 with increasing addition of acids followed by a rapid change in pH within a very small range of acid or base addition range and then again slow pH decrease with increasing acid additions. The initial slow change in pH indicates the existence of a buffering zone. Considering the Ca and Si concentrations in the slag and the leachates, the carbonation and associated interaction of CO2 with mineral phases like Portlandite, calcium silicate hydrates may be the major cause of such behaviour [1]. Another factor is the solubilizations of alkali metals embedded in glassy phases. The conductivity vs. pH curve (Fig. 1(B)) shows a conductivity minimum at the pH range of 9-11.5. This range also corresponds to the maximum precipitation region for most of the major and minor elements.

Fig. 2 shows the leaching behaviours of As, Mo and Se along with a few related other species. The solid and broken lines respectively indicate the total amounts in SLG and permissible levels.The DIN test data is presented by open red triangle. The concentrations of most of the trace elements in the leachants are above the maximum permissible limits of trace elements for drinking water as defined in Indian standard.

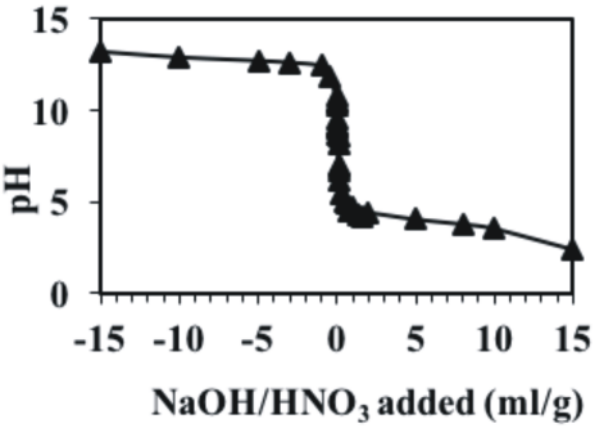


Fig.1. (A) Acid neutralization capacity graph

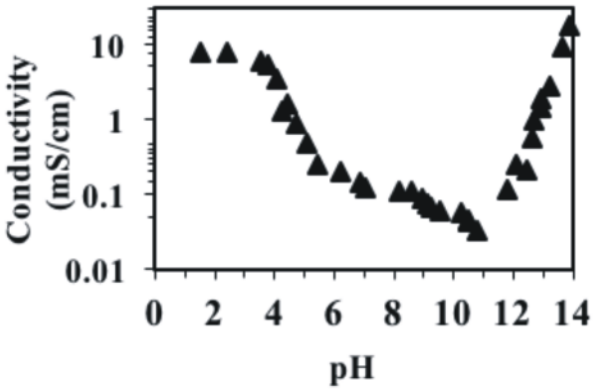
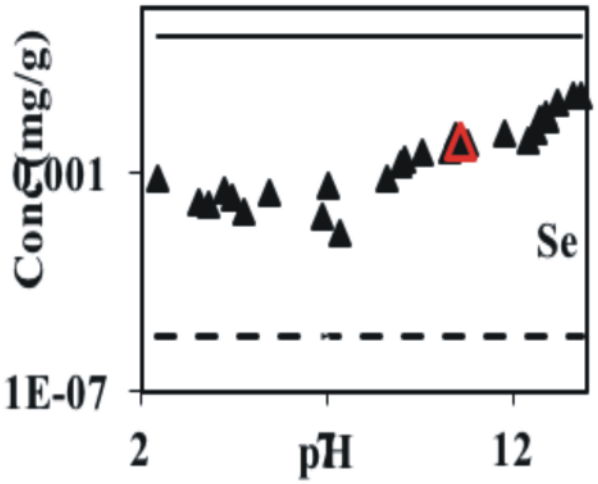
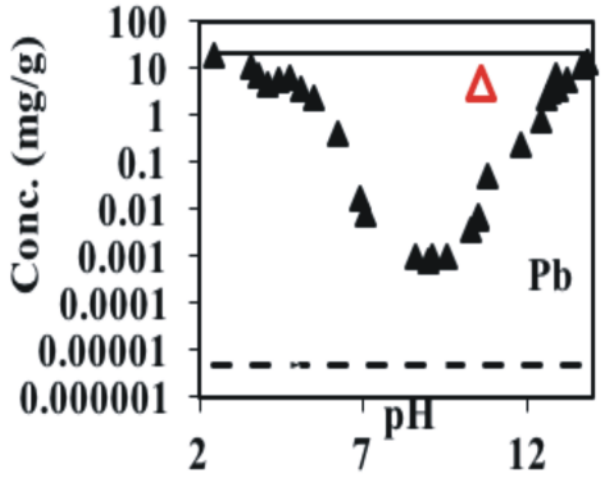
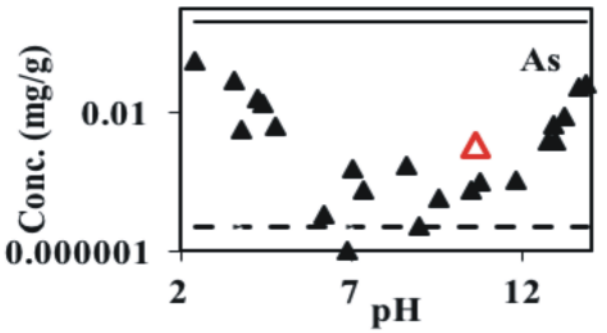


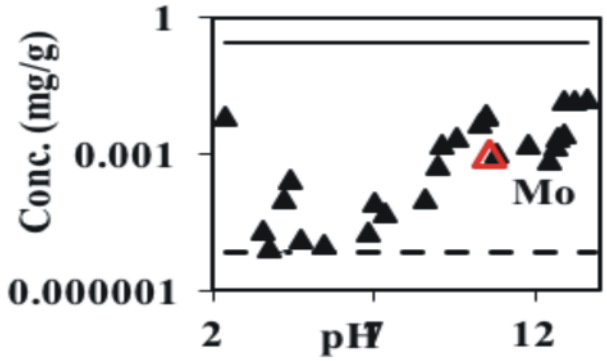
Fig.1. (B) pH dependent conductivity graph.

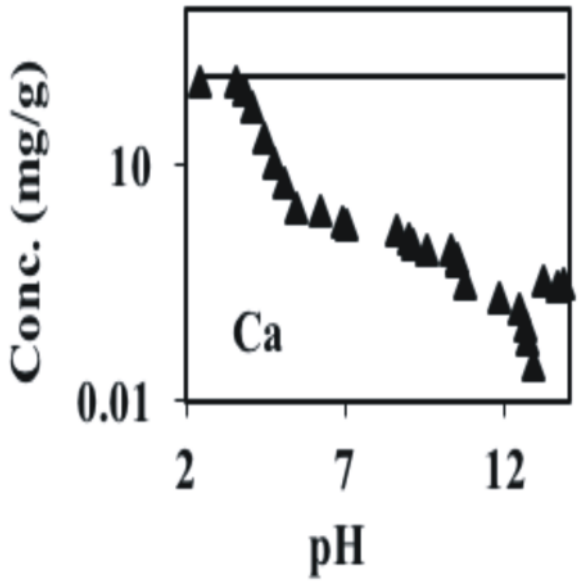
The pH dependent solubility of As and in some extent Se leachability can be related with the leaching behaviour Pb. Similarly, Se leachability at higher pH and Mo leachability from the SLG can be related with the Ca leachability behaviour. Thus minerals such as Pb3(AsO4)2, PbSeO3 (at low pH), CaSeO4 (at high pH) and CaMoO4 are the mineral phases which may control the dissolution and precipitation behaviours of these elements [2]. The similarities of leaching behaviours of SO42- with As, Mo and Se indicate the possibilities of presence of competitive effect of sulfate with the oxyanions of Mo and Se during their precipitations or sorption's on other mineral surfaces. For example, sulphate minerals such as PbSO3 and PbSO4 controlled the solubility of Pb at acidic pH.











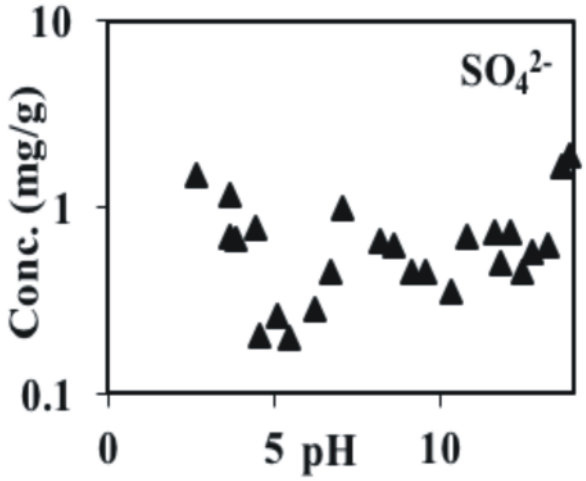


Fig.2. Leaching of some elemental/molecular species during pH dependent leaching test (solid line: total amounts in SLG; broken line: permissible level; open red triangle: the DIN test data).

4. Conclusions

Leaching of higher amounts of Pb indicates the hazardous nature of Pb-slag. Most of the elements liberated from slag precipitated in the pH range of 6-12. The leaching of oxyanion forming elements can be related with the leaching behaviour of Pb and Ca. However, presence of SO42- can compete with these oxyanions during the sorptions byminerals or precipitation of these species.

5. References

1. Garrabrants, A.C., Sanchez F., and Kosson, D.S., 2004. Changes in constituent equilibrium leaching and pore water characteristics of a Portland cement mortar as a result of carbonation, Waste Management, 24(1), 19-36.
2. Cornelis, G., Johnson, C.A., Van Gerven, T., VandecastelleC., 2009. Leaching mechanisms of oxyanionic metalloid and metal species in alkaline solid wastes: A review, Applied Geochemistry, 23 (5), 955-976

Arbuscular mycorrhizal fungi alleviates drought stress on growth and yield of soybean (Glycine maxL.)

A.G.D. Pavithra[1]*, P.N. Yapa[2], T.C. Bamunuarachchige[3] and P.T. Jayasooriya[4]
[1,2,3,4]Department of Biological Sciences, Faculty of Applied Sciences,
Rajarata University of Sri Lanka, Mihintale (50300), Sri Lanka.
*E-mail:dhanushi.pavithra@gmail.com

ABSTRACT:

Water is an integral component of all living creatures. Only 0.3% water can be consumed though 75% of earth's surface is covered by water. With the climatic changes, water scarcityhas become a major problem in agriculture which leads to droughtthat negatively affects thephysiological responses of plants. Water stress at reproductive stage of soybean greatly affects its yield. Asymbiotic relationship between arbuscular mycorrhizal fungi (AMF) and plants, which is an adaptation strategy, helps them to cope with water stress. Proline, an amino acid is involved in cell osmotic adjustment and protection of cell componentsduring dehydration.Proline accumulation is associated with the improvement of drought tolerance where mechanisms are unknown. Objectives of this researchwere to study the effect ofAMF inoculation on physiological plant responses and on leaf proline concentration in response to drought stresscaused by climatic changes on soybean (Glycine max L.) growth and yield. Pot experiments were carried outby adding AMF and without adding AMF at the plant house under natural light conditionsin the dry zone of Sri Lanka where plants experience a high temperature and will be important in increasing growth and yield of plants against drought. Four levels of water treatments were applied daily which were 50 ml, 100 ml, 150 ml and 200 ml. Statistical analyses revealed that treatments were significantly different for the number of leaves ($P=0.002$), number of pods ($P<0.05$), relative growth rates ($P=0.050$), leaf area index ($P<0.05$), rate of photosynthesis ($P=0.028$), total number of seeds ($P<0.05$), fresh weight of total number of seeds ($P<0.05$), dry weight of total number of seeds ($P<0.05$), dry weight of shoot ($P=0.003$), dry weight of roots ($P=0.027$), AMF colonization percentage ($P=0.003$),soil moisture ($P=0.001$), soil pH ($P=0.039$) and leaf proline concentration ($P=0.018$). Treatments were not significantly different for root phosphorous concentration ($P=0.170$),shoot phosphorous concentration ($P=0.493$) and also protein content of pods($P=0.517$). With the 50 ml of daily irrigation AMF added plants showed comparatively higher growth and yield than non-AMF added plants. Considering all the measured parameters it can be concluded that AMF could increasegrowth, yieldand drought tolerance of plants. AMF can be used as field inoculums to remediate water scarcity due to climatic change.

Key words:Drought tolerance, Glycine max, Arbuscular mycorrhizal fungi, Growth, Yield,

1. Introduction

Climate change is expected to cause more frequent and severe drought in large areas of the planet (Sheffield et al., 2012).Water deficit, one of the most important abiotic stresses has a negative impact ongrowth and yield of plants. It accounts for over 70 % of yield loss during crop production and is a major limitation in grain legume production which affects the productivity of grain legumes at all growth stages butmore critically in reproductive and grain development stages which results in significant loss in grain yield. AMFform symbioses with the roots of the plants including most important crops andimprove plant growth and harvest under drought conditions and various environmental stresses. In the prevailing drought conditions, AMF improves water uptake by plantsby changing plant water relations in water-stressed conditions (Auge et al., 2001). An increased productivity of mycorrhizal plants in soils under drought conditions has also been reported.This research is aimed at developing a strategy to make agriculture more resilient and to mitigate the adverse effects on crop yieldunder water scarcity due to climatic changes.It is currently accepted that the contribution of AMF symbioses to plant drought tolerance is the result of accumulative physical, nutritional, physiological, and cellular effects.

2. Materials and methods

Pot experiments were carried outfrom February to May 2017 inside the plant house at the Rajarata University of Sri Lanka, situated in the dry zone of Sri Lanka. Eight treatments with four replicates were used in the present study. Water application was done daily to respective pots accordingly. An equal amount of organic nutrient mixture was added to each pot. Mycorrhizae inoculum was prepared by trap culture method.

T1 – Soil + 50 ml of water
T2 – Soil + 100 ml of water
T3 – Soil + 150 ml of water
T4 – Soil + 200 ml of water
T5 – Soil + AMF inoculum + 50 ml of water
T6 – Soil + AMF inoculum + 100 ml of water

T7 – Soil + AMF inoculum + 150 ml of water
T8 – Soil + AMF inoculum + 200 ml of water
Magnified root intersection method (McGonigle et al., 1990), dry weight basis method of soil moisture analysis, proline assay protocol, spectrophotometer procedure and Kjeldahl procedure were followed and the percentage AMF colonization, soil moisture, leaf proline concentration, root and shoot phosphorus concentration and protein content of pods were estimated respectively. Soil pH was measured by using pH meter (HANNA instruments). Growth and yield parameters were measured in one month intervals by considering height, total number of leaves, pods and seeds, fresh weight and dry weight of total number of seeds, dry weight of shoots and roots.Rate of photosynthesis was measured by using the portable photosynthesis system (LI-6400XT). Leaf area index was measured by using laser area meter (CID Bio-Science, CI-202 LASER AREA METER, USA). Leaf analysis were done for randomly selected leaves of each replicate.

3. Results and discussion

Minitab 16.2.1 was used to analyse data at 0.05 significant level. Normally distributed data and not-normally distributed data were analysed respectively by using one-way ANOVA and Kruskal-Wallis test.Correlations were analysed usingthe Pearson correlation coefficient. Statistical analyses revealed that treatments were significantly different for number of leaves ($P=0.002$), number of pods ($P<0.05$), relative growth rates ($P=0.050$), leaf area index ($P<0.05$), rate of photosynthesis ($P=0.028$), total number of seeds ($P<0.05$), fresh weight of total number of seeds ($P<0.05$), dry weight of total number of seeds ($P<0.05$), dry weight of shoot ($P=0.003$), dry weight of roots ($P=0.027$), percentage AMF colonization ($P=0.003$), soil moisture ($P=0.001$), soil pH ($P=0.039$) and leaf proline concentration ($P=0.018$). The highest value for total number of pods, relative growth rate (Figure 1), total number of seeds, dry weight of total number of seeds, dry weight of shoot, percentage AMF colonization (Figure 2), rate of photosynthesiswere shown byT8. The highest value for number of leaves, leaf area index wereshown by both T8and T4.The highest value for fresh weight of total number of seeds was obtained by T8and T7.For soil moisture the highest value was obtained inT8, T7and T4. The highest value for soil pH and leaf proline concentration was shown in T1. Treatments were not significantly different for root phosphorus concentration ($P=0.170$), shoot phosphorus concentration ($P=0.493$) and for protein contents of pods ($P=0.517$). There was a positive correlation between water levels and percentage AMF colonization in both AMF added and non-AMF added plants. Plants with added AMF showed a positive correlation whilenon-AMF added plants showed a negative correlation between water levels and leaf proline concentration.

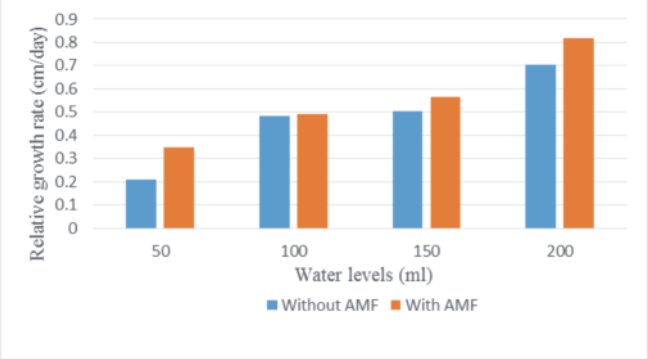


Figure 1.A comparison of relative growth rates of plants with the added AMF and non–AMF added treatments

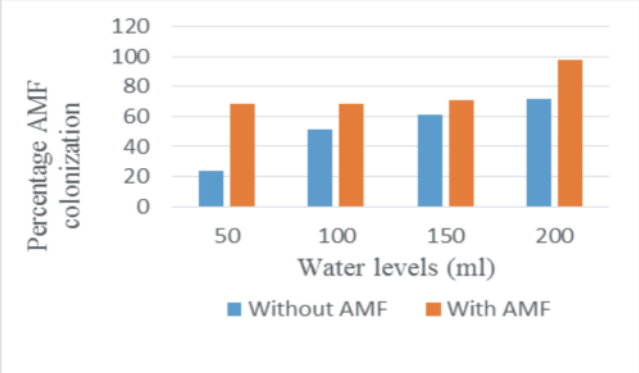


Figure 2.A comparison of percentage AMF colonization of plant roots with the added AMF and non-AMF added treatments

1. Conclusions

It was revealed thatAMF could increase growth, yield and drought tolerance of soybeanunder drought stress. Even under non-water stressed conditions also, AMF added plants could increase growth and yield compared to non-AMF added soybean plants. So, the overall results suggest that the arbuscular mycorrhizal fungi colonization affects the host soybean plant positively on growth and yield, thereby alleviates water stress. Therefore, arbuscular mycorrhizal fungi biofertilization may have great potential in growing soybean under drought stress.

2. References

1. Auge, R.M., Stodola, A.J.W., Tims, J.E. and Saxton, A.M. 2001.Moisture retention properties of a mycorrhizal soil, Plant Soil, 230: 87–97.
2. McGonigle, T.P., Miller, M.H., Evans, D.G., Feirchild, G.L. and Swan, J.A. 1990. A new method which gives an objective measure of colonization of roots by vesicular-arbuscularmycorrhizal fungi, New Phytologist, 115:495-501.
3. Sheffield, J., Wood, E.F. and Roderick, M.L. 2012. Little change in global drought over the past 60 years, Nature, 491: 435–438.

Assessment of physicochemical properties of drinking water used in Departments and Centers in Central University of Allahabad, Allahabad

[1]. Nirdesh Kumar Ravi*, [2.] Dr. Pawan Kumar Jha, [3.] Yaduvendra, [4.] Sutikchan
(Centre of Environmental Studies, Botany Department, University of Allahabad, Allahabad, 211002)
*Email_ ravinirdesh@gmail.com

ABSTRACT:

Pure water is most valuable and essential part of human and another living life organism. The country has 75.8 million people, at least 75% of its 1.25 billion populations, without access to clean water, the report by WaterAid agency of America. Pure water having some essential criteria which are made by WHO and other Nations, agencies like EPA, to control the quality of water regulatory guidelines for proper health and sanitation of peoples of that nation. Physico-chemistry of water including their nutrients(phosphate ion and nitrate ions), inorganic elements, hardness, pH andcation (Calcium, magnesium, potassium, sodium) or anions(bicarbonate, sulphate, chloride)are the parameters upon which water quality depends. The water which are being used for drinking purpose are purified by filtration technique(RO water purifier, Kent or Aquagaurd) but in some sites these purifiers are only showpiece i.e. not in proper working condition and contaminated water are directly supplied for drinking purpose for faculty members and students.

The value of TDS can be used for the basis for other parameters like hardness, electrical conductivity and play significant role in determination of water quality. Temperature measured by using glass thermometer and temperature/TDS meter of HM laboratories, pH value analyzed by using pH probe, Cation ions are analyzed by using flame photometer, nutrients like phosphate, sulphate and nitrate analyzed by using spectrophotometer, DO by using Winkler method, alkalinity, calcium value analyzed by using titrimetric method, total hardness determined by EDTA titration. Changes in the water quality of various sites due to variations in quantity of parameters were found.Total Dissolved Solids correlates to the ability of wate r to conduct electricity. It is also an index used to determine the concentration of dissolved minerals. The more minerals that are dissolved, the more conductive the water will be. A TDS meter is calibrated to read in parts per million (PPM). TDS is the concentration of a solution as the total weight of dissolved solids. (1 ppm = 1 milligram/l). TDS is a mass value and is dependent upon the total of nutrients as well as the concentration. Electrical conductivity (EC) is a unit to measurement of the ability of a solution to carry out current and depends on the total concentration of ionized substances dissolved in the water. Drinking water quality standards indicative value of the quality parameters recommended for drinking water.

From the analysis of water which is used in analysis, the following results are obtained. pH value are in same level in comparison to desirable value recommended by WHO, and BIS. Temperature is variable due to presence or absence of their proper place. TDS (total dissolved solid) are factor which affects a lot on conductivity, alkalinity and hardness of water. The value of TDS is quite similar to recommendation of WHO except in nanotech and psychology, where is quite low suspended solid and minerals, and this value lowers the conductivity and hardness. Total Dissolved Solids correlates to the ability of wate r to conduct electricity. TDS is a mass estimate and is dependent upon the mix of nutrients as well as the concentration. COD and BOD value specially used in case of sewage which are organic as well as non organic compound rich content

Development of new policy making strategies for sustainable water management for Guwahati City (Assam)

Payal Mazumder[1]*
[1]Centre for Environmental, Indian Institute of Technology Guwahati, Assam 781039.
*E-mail: payal.spinnersend@gmail.com

ABSTRACT:

Water management is indispensable due to increasing uncertainties caused by climate and global change. More attention has to be devoted to understanding and managing the transition from current management regimes to more adaptive regimes. The change towards adaptive management could be defined as "learning to manage by managing to learn". Policy makers and water resources managers should be aware of the evolving information on climate change impacts as an activity that is preparatory, but not central, to sound decision making on current water resources management actions. Policies that ensure effective contemporary water management will form the core of a "no regrets" strategy that will contemporaneously serve adaptation to climate change and uncertainty. Hence, an "adaptive management" approach rather than an "anticipatory strategy" is warranted for most water management actions. An effective water management system depends, to a large extent, on a well-functioning institutional framework and the treatment of water as an economic and social good, both of which are a prerequisite for adaptation to contemporary climate variability. It will also serve as the foundation for responding to uncertain climate change scenarios.

Keywords: Climate change, policy making, adaptive water management

1. Introduction

Climate change is a reality. Climate change impacts and responses are presently observed in physical and ecological systems. Potential impacts on water supply have received much attention, but relatively little is known about the concomitant changes in water quality. Projected changes in air temperature and rainfall could affect river flows and, hence, the mobility and dilution of contaminants. Increased water temperatures will affect chemical reaction kinetics and, combined with deteriorations in quality, freshwater ecological status. With increased flows there will be changes in stream power and, hence, sediment loads with the potential to alter the morphology of rivers and the transfer of sediments to lakes, thereby impacting freshwater habitats in both lake and stream systems. For millennia, India has been using surface storages and gravity flow to irrigate its crops. During the last 40 years, however, India has witnessed a decline in gravity flow irrigation and the rise of a booming "water-scavenging" irrigation economy through millions of small, private tube wells. For India, groundwater has become at once critical and threatened. Climatic change will act as a force-multiplier; it will enhance the criticality of groundwater for drought proofing agriculture and simultaneously multiply the threat to the resource. The policy landscape that guides climate change adaptation and disaster risk reduction in Assam is riddled with governance problems. Clashing narratives of blame between responsible governmental agencies, extension officers, local communities, and academics – ranging from utter faith in technology to political neglect and exclusion – further undermine transparency, trust, coordination, inclusivity, and cultural sensitivity in adaptive flood management. Struggles over disaster governance have to be seen as embedded in a long history of social and political exclusion, minority oppression, and contestation in most of Northeast India, going back to colonial policies and exacerbated by continuous economic stagnation, entrenched poverty, high unemployment, internal displacement and a large influx of people from neighbouring countries.

.2. Material and methods

a) Integrated assessment and policy making: Current integrated assessment projects have emerged principally from the research and modelling communities, seeking to develop assessment tools to advance their understanding of the human-climate system, and to be of use to policy makers. Current assessment projects, in their attempts to represent the human-climate system from end to end, show three particularly important weaknesses:

1. The first weak area is the projection of future emissions over decade to century time scales.
2. The second weak area is the description and valuation of impacts of climate change.
3. The third weak area is the formation and effects of policies.

One promising approach involves embedding integrated assessment models within simulation-gaming exercises, in which teams playing the roles of major agents pursue negotiations, policy and implementation choices, in a simulated world described by the integrated models.

b) Watershed management at the local level: The Brahmaputra crosses several countries and there is no integrated trans-boundary river basin planning approach.

Consideration of forward looking aspects (or future aspects) of vulnerability

c) LCA introduced in waste management: LCA on waste management offers a holistic approach to assess resource issues and emissions in waste management. From "bin-to-grave". The waste in itself is often considered a "zero-burden-boundary"

– Waste is the starting point, it exists

3. Results and discussion

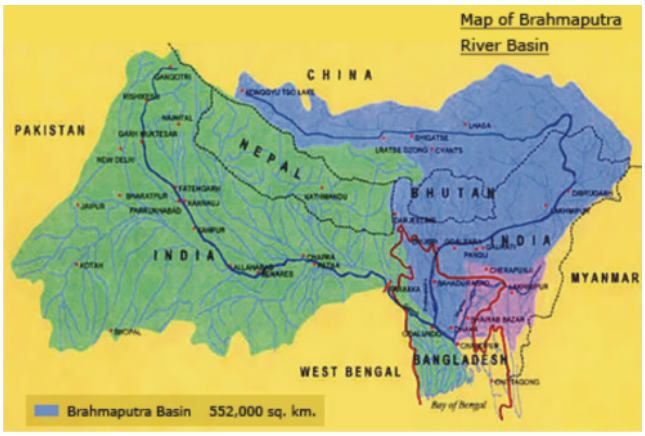


Figure 1. Brahmaputra river basin.

The city resilience strategy for the city of Guwahati should be essentially employed which is an integrated plan for the development of four major components: Housing, Ecologically sensitive urban planning and urban infrastructure and services.

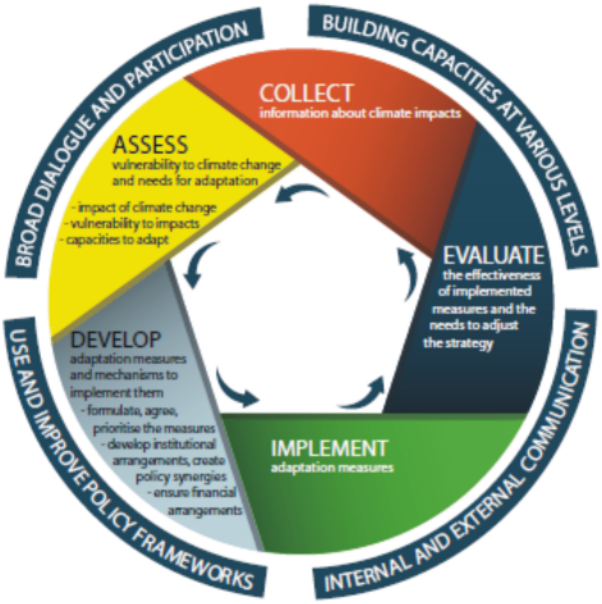


Figure 2. Framework for the development of a climate change adaptation strategy (Zoi, 2015).

Consideration of forward looking aspects (or future aspects) of vulnerability

c) LCA introduced in waste management: LCA on waste management offers a holistic approach to assess resource issues and emissions in waste management. From "bin-to-grave". The waste in itself is often considered a "zero-burden-boundary"

– Waste is the starting point, it exists

3. Results and discussion

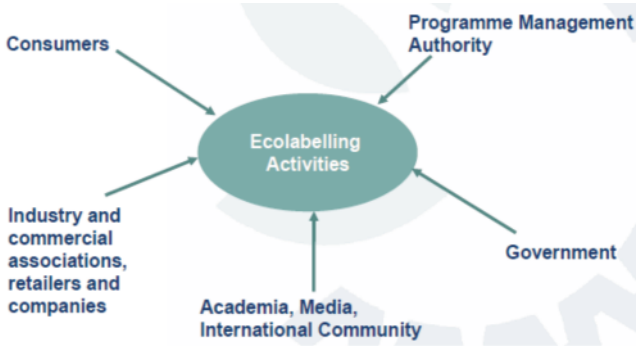


Figure 3. Stakeholders and Targeted public

4. Conclusions

Water is the primary medium through which climate change influences the Earth's ecosystems and therefore people's livelihoods and wellbeing. Climate change adaptation requires an integrated conservation and development programs together with focus on disaster risk reduction. The integrated programs become effective when implemented within a watershed boundary where the biophysical and socioeconomic systems are interlinked.

5. References

[1] Streamlined Life-Cycle Assessment: A Final Report from the SETAC North America Streamlined LCA Workgroup, Society of Environmental Toxicology and Chemistry (SETAC).

[2] Megdal, S. B., et al., Water Governance, Stakeholder Engagement, and SustainableWater Resources Management, Water, 9

Development of flower garden through waste supply water

Dhrubajyoti Nath [1]*, Nandita Medhi [2],and Bidisha Kashyap [3]
[1,3] ,Department of ECE, CIT, Kokrajhar,Assam 783370.
[2] Birjhora Mahavidyalaya ,Bongaigaon,Assam-783380
*E-mail: dhrubajyotinath66@gmail.com

ABSTRACT:

In Assam or in northeast, Brahmaputra and its tributaries do the work. The waters that are coming from mountains contain many gases and not fit for drinking and other purpose. The PHED which are public agency in India is responsible for rural water supply. In Assam the PHED had done a remote work to provide water supply to rural areas. But the water supplied by PHED is wasted, because every house in Assam depends on ground waters for their daily use. According to the concept of sustainable development there should be complete utilizations of resource without any loss. So, we can use this water, which is wasted, in flower gardens. This can solve the problems of irrigation, also the fund which are wasted should also utilized, but in other sense the last but not the least, advantage is that the water table of that area will also be wasting.

1. Introduction

The world population increasing every day and need of resources to satisfy the growing populations is also increasing. Water is a vital natural resource for existence o human race of 70% of globe is covered with water. But 1% is used for human daily use like drinking, washing clothes, farming etc. But due to unequal distribution o this resource and utilization it will face the problem of scarcity. India is a country rich in natural resources with population of 1.2 billion. And water from Himalaya and other mountains feed the thrust and fulfil the need of Indian population. Northern region, of we look, then will find that the Gangs and Brahmaputra are main rivers which are responsible for agricultural development, electricity generations and fulfilling daily human needs.

2. Material and methods

Required PVC pipe and water storage tank .Method is very simple and easy for
Everyday use.

3. Results and discussion

Large amount of water is saved and reused using this method .

4. Conclusions

The result indicates waste water save reuse ,with changing environmental conditions in AIF.

Green Nanochemistry for safe environment : Exploring Murraya koenegii Spreng. Leaf Extract An Efficient Green Multifuction Agent for the degradation of organic dyes from aqueous medium

Deepa Kumari[1,2]*, Pratap Kumar Padhy[2] and Nanzin Ara Begum[1]
[1]Department of Chemistry, Visva-Bharati (Central University), Santiniketan 731 235, India
[2]Department of Environmental Science, Visva-Bharati (Central University), Santiniketan 731 235, India
E-mail: deeparrl@gmail.com

ABSTRACT:

Energy, Environment and Human Health have emerged as strategic priories not in only research arena but in all respect of our lives. Rapid industrialization brought economic growth but it also raised concern regarding environmental pollutions and related health hazards. Organic dyes have extensive use in textile and paper industries, food products, cosmetics, and pharmaceuticals. These compounds are frequently found in industrial wastewater. The textile industry used the highest amount of aromatic and azo dyes in terms of both amount and variety. Thus, wastewater generated by the textile industries generally contains a high content these compounds, often considered to be highly carcinogenic. The color of many organic dyes is due to the chromophoric moieties containing N=N or C=N bonds which increases the difficulty of its degradation. Chemical degradation of these dyes to non-toxic compounds can be done in presence of metal nanoparticles as catalysts. In this connection, metal nanoparticles with their unique structure dependent catalytic properties are emerging as a good promise and it would be best if these metal nanoparticles with tailor-made catalytic properties are synthesized by energy efficient, cost-effective and eco-friendly convenient protocols. Plant based "green multifunctional agents (GMA)" are promising alternatives for developing such protocols. We report here the superb efficiency of such a GMA [aqueous extract of leaves of Indian Curry leaf plant (Murraya koenigii Spreng.)] in the synthesis of wide range of metal nanoparticles [monometallic Ag, Au and bimetallic Ag/Au alloy nanoparticles]. Formation and growth of these nanoparticles were studied with the help of UV-Vis spectroscopy whereas TEM studies were done to get an idea about their morphology. Our synthesized nanoparticles show excellent catalytic activity for the NaBH4 reduction of various environmentally hazardous dyes, like Methylene Blue, Nile Blue and Methylene Green. The reaction was studied spectrophotometrically. The catalytic efficiency of these nanoparticles was confirmed on the basis of the large decay in absorbance of the dye solutions instantly after the addition of these nanoparticles.

The kinetics of sorption of Cr(III) from aqueous solution onto powdered leaf biomass of Celosia argentea

RajatShubro Bose[1], Pronab Mudoi[2] , and Kali Prasad Sarma[1]*.
[1]Department of Environmental Science, Tezpur University, Napaam, (Tezpur)- 784028, Assam, India,.
[2]Department of Molecular Biology and Biotechnology, Tezpur University, Napaam (Tezpur)-784028, Assam, India,
*Corresponding author; email: sarmakp@tezu.ernet.in

Abstract
The intensification of industrial activity and environmental stress greatly contributes to the significant rise of heavy metal pollution. Heavy metals gets released in the environment mainly through anthropogenic activities and exerts a deleterious effect on various flora and fauna including humans. Biosorption is the most effective way to remove these heavy metals from water resources.Therefore the objectives of the study is to investigate the adsorption capability of leaf powder of Celosia argenteafor removal of Cr(III) from aqueous solution. The lowest contact time of Cr (III) was 48% at 10 minutes to 94 % at 50 minutes. The highest removal percentage is 94 % which was achieved for 0.5g dose at 10 mg L-1concentration of Cr (III) solution whereas the lowest removal percentage was 48 % which was achieved for 0.1g dose at 50 mg L-1concentration of Cr (III) solution. The highest metal uptake in this study was reported to be 93 % for pH 2 at 10 mgl-1 while the lowest uptake was 32 %, observed at pH 6 at 50 mgl-1. The adsorption isotherm follows both Langmuir and Freundlich models. The D–R isotherm model, was used to calculate the mean free energy indicating the mechanism of Cr(III) biosorption by C. argentea.

Keywords: heavy metal; Cr(III); biosorption; Celosia argentea; equilibrium;

1. Introduction:

The intensification of industrial activity and environmental stress greatly contributes to the significant rise of heavy metal pollution. Heavy metals such as chromiumgets released in the environment mainly through anthropogenic activities. Chromium exerts a deleterious effect on various flora and fauna including humans. Due to these deleterious effects, the removal of heavy metals like Cr from water resources are one of the most important issues nowadays, as fresh water reservoir is limited.

The present day supports many treatment methods for elimination of heavy metals from the environment however these technologies are either expensive or difficult to implement or else have lower removal efficiencies. Therefore, the main objective of this work is to identify a locally available plant which can be use as a biosorbent having high metal binding capacity, high efficiency, environmental sustainability and cost-effectiveness .

The objectives of the present work is to investigate the adsorption capability of leaf powder of Celosia argenteafor removal of Cr(III) from aqueous solution. Celosia argenteacommonly known as 'kurdu' belongs to the family Amaranthaceae [1]. The plant is distributed throughout the Tropical belt and it bears very brightly colored flowers (Pink to violet) that blooms during mid spring to summer. This plant has economic values as medicines for being used as a treatment for intestinal worms (particularly tapeworm), blood diseases, mouth-sores, eye problems and also as food. The kinetic studies of adsorption of Cr(III) from aqueous solution onto leaf powder of Celosia argenteahas been investigated to evaluate the performance of the adsorbent and to gain insight into the underlying mechanisms.

2. Material and methods

2.1. Preparation of the Adsorbent

Leaf samples from the plant Celosia argentea were collected and were cleaned thoroughly with double distilled water to remove any impurity. The leaves were then dried for 24 hours at 60°C in the oven[16]. The dried leaves were crushed and blended using a grinding mill and sieved. A fraction of average particle size of 0.2 mm was used for the experiments. The powdered leaf sampleswere stored in a desiccator to avoid contact with moisture and used for biosorption experiments.

2.2. Preparation of the Metal Solution

The stock solution containing 1000 mg of metal per litre was prepared by dissolving the metal salt in 1000 ml of millique water. The metal salt used for the preparation of stock solution was CrCl3. The solutions were further diluted as required to obtain the working solution. The pH of working solution was adjusted accordingly by addition of 0.1N HCl or 0.1N NaOH solution.

2.3. Experimental Set-Up

2.3.1. Batch Adsorption Experiments

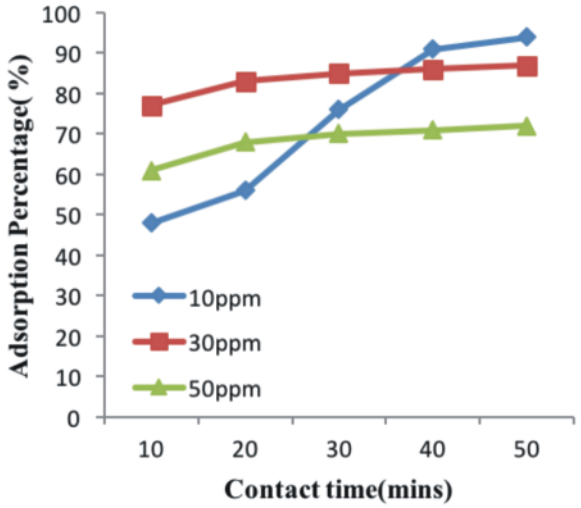
The experiments were carried out in batches of Erlenmeyer flasks (250 ml) in room temperature. 0.5g of adsorbent was added to 100 ml of the metal solution for a time interval of 50 minutes and the mixture was agitated at a constant speed of 120 rpm in a mechanical shaker. After an interval of 10 minutes samples were withdrawn and were filtered using syringe filter (Whatman-Puradisc) of 0.45 μm pore size. Filtered sample solutions were transferred to air tight sterile containers. The

concentrations of contained metal ions were determined in Inductively Coupled Plasma-Optical Emission Spectroscopy (Perkin Elmer Optima 2100 DV). Obtained data were used to calculate the equilibrium metal adsorptive quantity by (Eq. 1):

3. Results and discussion

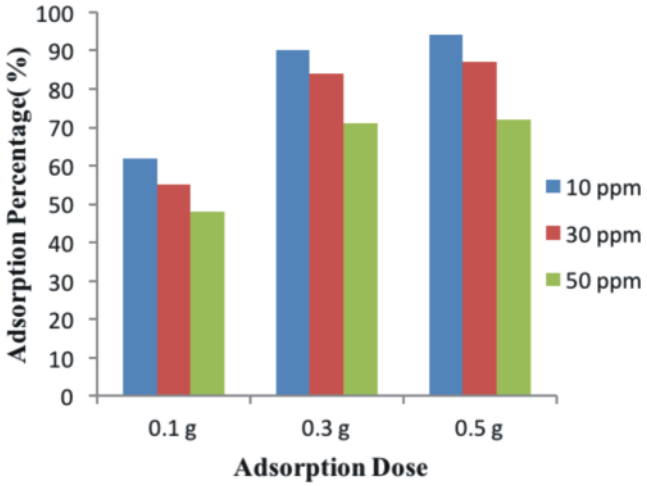
3.1. Effect of Contact Time

The adsorption percentage of Cr(III) for three different initial concentrations(10 mg L^{-1} , 30 mg L^{-1} and 50 mg L^{-1}) were used for a series ofcontact times(10 20,30,40 and 50 minutes)asshown in Fig.1 ,The experiment revealed that the removal percentage of Cr(III) increased with increasing contact time from 10 minutes to 50 minutes and after that it reached a point of equilibrium and hence no further adsorption was recorded. From the graph as shown in Fig.1., it was observed that at lower concentrations (10 mg $L^{-1}$and 30 mg L^{-1}) the adsorption efficiency was found to be higher as compared to that of higher concentration (50 mg L^{-1}) at different contact times.



3.2. Effect of adsorbent Dose

The removal of Cr(III) from aqueous solution by the sorbent was evaluated for three dosage of the sorbent species viz. 0.1 g, 0.3 g and 0.5 g for three different concentrations (10 mg L-1, 30 mg L-1and50 mg L-1). From Fig.2.it was revealed that the removal percentage of Cr(III) gradually increases with increasing adsorbent dosage.



3.3. Effect of pH

The highest metal uptake in this study was reported to be 93 % for pH ^{2} at 10 mg L^{-1},while the lowest uptake was 32 % , observed at pH 6 at 50 mg L^{-1}.The overall metal uptake of Cr(III) decreased as pH increased up to 6 as shown in Fig.3.

3.4. Effect of Initial Metal Ion Concentration

The effect of initial concentration of Cr(III) on the biosorption rate of C.argentea was investigated at three different concentrations viz. 10 mg L^{-1}, 30 mg L^{-1} and 50 mg L^{-1}. From Fig.4.it was observed that with increase in the in initial metal ion concentration from 10 mg $L^{-1}$to 50 mg L^{-1} the Cr(III) uptake capacity increased from 9.4 mg/g to 36 mg/g.However, the percentage of biosorption decreased from 94% to 72% respectively.

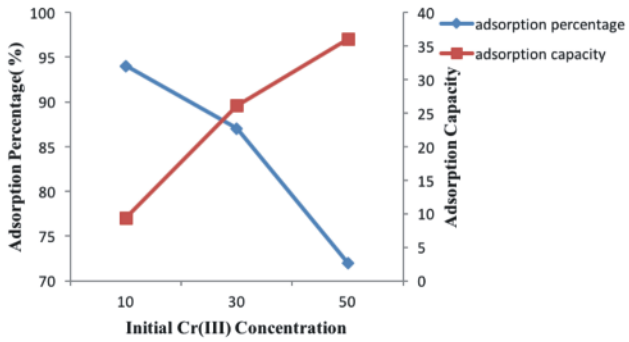


Fig.4.

3.5. Adsorption isotherm studies

The Langmuir isotherm model for the biosorption of Cr(III) onto C. argentea biomass has a correlation coefficient (R2) of 0.999 . This result indicated that the biosorption of Cr(III) is more fitted to the Langmuir isotherm model. RL values calculated were found to be 0.178, 0.067 and 0.041 for the initial concentrations10 mg L-1,30 mg L-1 and 50 mg L-1. The results obtained clearly

indicates that the biosorption of Cr (III) onto C. argentea was favourable at the studied conditions.

The Freundlich isotherm plot for the biosorption of Cr (III) onto C. argenteabiomass indicated that Cr (III) were fitted to Freundlich isotherm having R2 value 0.966 which is less than value of Langmuir isotherm as shown previously. However, the isotherm data calculated from Freundlich isotherm revealed that the 1/n values for Cr (III) is 0.436(Table 1.) which is less than one, indicating that the biosorption process for Cr (III) onto C. argentea biomass was favorable at the studied experimental conditions.

The Dubinin–Radushkevich isotherm model was used to predict the nature of adsorption processes as physical or chemical The sorption energy calculation was carried out and the mean biosorption value was found to be 0.99 KJ mol-1 from which it can be concluded that the adsorption of Cr(III) by C.argenteaoccurred dominately by physical sorption process. This is because if E= 8.0-16.0 KJ mol-1 then it correspondsto chemisorption and if E<8 kJ mol-1 then it corresponds to physical sorption [2].

4. Conclusion

Therefore, the simultaneous removal of Cr(III) by C argenteaproved the high effectiveness of this plant in removal of Cr(III) from aqueous solution. Experiment results showed that the adsorption of Cr(III) is satisfactory at pH 2, low solution concentration (10 mg L-1) and at high adsorbent dose (0.5g). Based on the results obtained it can be concluded that C.argentea can be used in removal of Cr(III) and the process is economically feasible and easy to carry out.

References

1. K.S.Mundhe, A.A. Bhave, R.C. Torane, N.R. Deshpande, R.V. Kashalkar, Removal of cationic dye from aqueous solution using raw agro wastes as non-conventional low-cost adsorbent.Orient.j.chem.25(2009), 953-959.
2. A.M.Abdel-Aty, N.S. Ammar, H.H. Abdel Ghafar, R.K. Ali,Biosorption of cadmium and lead from aqueous solution by fresh water alga Anabaena sphaerica biomass, J. Adv. Res. 4 (2013) 367-374.

Before and After rains investigation of water quality in lakes of IIT Guwahati, Assam, India

Abhishek Dixit, Arnab Kr. Pal, Anirudha Mahagaonkar*,
Chandan Mahanta, Lekshmi K, Suresh M
Department of Civil Engineering, Indian Institute of Technology Guwahati

Indian Institute of Technology (IIT) Guwahati, an educational institute established by Government of India under an act of the Parliament in 1994, was constructed on stretch of wetland belonging to the Brahmaputra Floodplain. Occupying a huge area of 700 acres, IIT Guwahati campus is encompassed by the river Brahmaputra towards its south and hills and hillocks covering the other sides. Located inside this natural campus are 7 beautiful lakes offering to host a span of aquatic life, also enhancing the beauty of IIT Guwahati. These wetlands and lakes together also host an array of migratory birds flocking the region during the winter months (DJFM); thereby playing a critical role in ecosystem sustenance. For the critical role of these lakes, it remains important to ensure the quality of water in the lakes is maintained. By this study, we made an attempt to study the water quality of these lakes, and analyse their health to sustain the aquatic fauna and avifauna. The results out of the first phase of this study are presented here. In-situ measurements were carried out in 4 of the 7 lakes on campus for their physical parameters using a multi-parameter meter. The parameters recorded were pH, Temperature, Total Dissolved Solids (TDS), Pressure, Salinity, Oxygen Reduction Potential (ORP), Electrical Conductivity (EC) and Dissolved Oxygen (DO). Utmost care was taken to ensure least contamination to the water samples collected while performing the tests. Upon analyses of the observed data, it was seen that all the 4 lakes had very poor amount of DO before the rains. <2.9 mg/L; Std: 5.0 mg/L; and after the rains the DO shot up to levels between 6.04 – 8.34 mg/L; other analysed parameters remained in the permissible limits. DO in water is the source of oxygen for aquatic fauna for its survival; and it is also a critical indicator of water quality of the system. It was startling to note that, in spite of precipitation event a day before in-situ analyses was carried out, the DO levels remained alarmingly low. Based upon this, we suggest more studies should be carried out to better understand the dynamics of the lakes and ensure their quality is maintained. We will continue this study and suggest measures to the administration of IIT Guwahati accordingly to ensure water quality in these lakes is maintained.

Keywords: IIT Guwahati; water quality; in-situ analysis; lakes; Dissolved Oxygen

(Author names are in alphabetical order)