



Journal of Environmental Science and Engineering

(<http://www.neeri.res.in>)

ISSN 0367-827 X

Volume 57

No. 3

July 2015

CONTENTS

Environmental System Design Modelling and Optimization

Equilibrium and Kinetic Modeling for the Biosorption of Reactive Red 120 by *Ludwigia peploides* Biomass ...183-189

N. Naveen, P. Saravanan, N. Nagendra Gandhi and S. Renganathan

Solar Induced Photo Degradation of Phenol Using Titanium Dioxide as Catalyst ...190-196

V R Sankar Cheela and Swaminathan G

Impedance and Photoaction Spectral Studies of Tungsten Diselenide Thin Films ...197-202

M D. Rashid Tanveer, Deepak Mishra and Aradhana Kashyap

Rapid and Green Synthesis of Gold Nanoparticles by the Use of an Otherwise Worthless Weed *Lantana camara* L.) ...203-213

J. Anuradha, Tasneem Abbasi and S. A. Abbasi

Environmental Monitoring

Anthropogenic Mercury Contamination of Vembanad Backwater, Western Coast, India – Evidence from Sediments ...214-224

Shylesh Chandran M.S., Jayasooryan K.K., Subin K. Jose, Mahesh Mohan and E.V. Ramasamy

Macrobenthic Invertebrates as Coastal Ecological Bioindicators of Environmental Health ...225-229

Mary Teresa P. Miranda, Rajeshl B. R, Sreelekshmy S. G, Udayakumar P and Jean Jose J.

Spatial and Temporal Characteristics of Flood in Kaithal District Haryana, India ...230-238

Pushpendra Singh Rajpoot, Ajay Kumar and R.K.Trivedi

Physico-chemical Properties and Heavy Metals Estimation in Drinking Water from Different Sources in and around Sindri (Dhanbad), Jharkhand, India ...239-245

Prashant Kumar Singh and Shashi Shankar Tiwari

Impact of pH on Cell Morphometry of *Scenedesmus abundans* ...246–250

Ruchi Acharya, Tayyab Saify, Jaswinder Mehta and Bhawna Sharma

Hazardous Waste Management

**Performance Evaluation of Developed Concrete through
Long Term Leaching, Durability and TCLP** ...251–262

Rubina Chaudhary and Smita Badur Karmankar

Review

Packing Media for Anaerobic Fixed Film Reactor – A Review ...263–270

Samir Vahora, Himmali Mehta and Nikita Chokshi

**A Review on Water Resources Availability and Management
Practices in India** ...271–286

Sushant B. Wath and Poonam Prasad

The journal is covered by the following leading abstracting, indexing and current awareness services:

- ♦ Chemical Abstracts Service
- ♦ Sci-Search - A Cited Reference Science Database
- ♦ Engineering Index
- ♦ Current Contents
- ♦ Research Alert
- ♦ Cambridge Scientific Abstracts
- ♦ INSPEC
- ♦ Biotechnology and Bioengineering Abstracts
- ♦ Biological Abstracts
- ♦ EMBASE
- ♦ Scopus
- ♦ IC Journals
- ♦ CAB Abstracts
- ♦ Elsevier Biobase - Current Awareness in Biological Sciences (CABS)
- ♦ Indian Science Abstracts
- ♦ BIOBASE
- ♦ BAILSTEIN
- ♦ IARAS
- ♦ Compendex
- ♦ ACM
- ♦ Ulrich's
- ♦ National Library of the Netherlands
- ♦ French National Library
- ♦ British Council Library
- ♦ British Council Libraries
- ♦ German National Library of Science and Technology
- ♦ National Library

Equilibrium and Kinetic Modeling for the Biosorption of Reactive Red 120 by *Ludwigia peploides* Biomass

N. NAVEEN, P. SARAVANAN, N. NAGENDRA GANDHI AND S. RENGANATHAN*

Biosorption of Reactive Red 120 from an aqueous solution using *Ludwigia peploides* biomass was investigated. Biosorbent dosage (0.2 to 1.0 g/L), initial solution pH (1–7) and initial dye concentration (15 to 110 mg/L) for the maximum uptake of dye removal by *L. peploides* was studied. The maximum dye uptake capacity was found to be 132 mg/g at an initial dye concentration of 110 mg/L. Equilibrium data were analyzed by Langmuir and Freundlich adsorption isotherm. Freundlich model fitted very well for equilibrium data obtained. Kinetics data fit well with pseudo-second order when compared to pseudo-second order models. The functional groups present in the *L. peploides* were analyzed by FTIR spectra. The surface morphology of the *L. peploides* biomass was analyzed by scanning electron micrograph.

Key words: *Biosorption, Ludwigia peploides, kinetic modeling, adsorption isotherm*

Solar Induced Photo Degradation of Phenol Using Titanium Dioxide as Catalyst

VR SANKAR CHEELA¹⁺ AND SWAMINATHAN G²

The present study investigates the photo degradation of phenol using titanium dioxide as catalyst. The key focus is on the utilization of solar radiation in treating phenolic waste for degradation after discounting for evaporation due to solar heat. Titanium dioxide was observed to be good catalyst in solar radiation induced degradation of phenol. The optimum time for initial adsorption by TiO₂ was observed to be 30 minutes. The optimum contact time and dosage were found to be 8h and 3 g/L for initial concentrations of 25ppm and 100 ppm with a removal efficiency of 98 % and 70%. The study reveals that the thermal degradation of phenol does not take place under the conditions of experiment and maximum degradation of phenol is due to the photocatalytic process only.

Key words: *Evaporation, photocatalysis, solar radiation, phenol, titanium dioxide*

¹Assistant Professor, Department of Civil Engineering, MVGR College of Engineering, Chinthalavalsa, Vizianagaram – 535 005, A.P. (India)

² Professor, Department of Civil Engineering, NIT Tiruchirapalli, Tiruchy – 620 015, Tamil Nadu (India)

⁺ Corresponding author : vrsankarcheela@gmail.com

Impedance and Photoaction Spectral Studies of Tungsten Diselenide Thin Films

MD. RASHID TANVEER*, DEEPAK MISHRA AND ARADHANA KASHYAP

Titanium supported photoelectroactive semiconductor electrodes based on thin films of tungsten diselenide have been prepared by electrochemical codeposition technique through galvanostatic route. The deposited films were then subjected to thermal treatment at 300^o C for two hours in the inert environment. These thin films were also characterized by studying their capacitance characteristics and electrochemical corrosion behaviour on the basis of impedance spectral studies. Tungsten diselenide thin films were found to be most photoelectroactive and exhibit substantially high resistance towards electrochemical corrosion when deposition was carried out galvanostatically at 5mA current. The capacitance studies show that the thermally treated tungsten diselenide deposited thin films exhibit n-type of semiconductivity. Photoaction spectral studies of these films were carried out for the determination of band gap.

Keywords: *Electrosynthesis, galvanostatic deposition, impedance, Photoaction spectral studies, semiconductor, band gap, corrosion*

Rapid and Green Synthesis of Gold Nanoparticles by the Use of an Otherwise Worthless Weed *lantana* (*Lantana camara* L.)

J. ANURADHA¹, TASNEEM ABBASI² AND S. A. ABBASI^{3*}

The phyto-fabrication of gold nanoparticles utilizing the highly invasive terrestrial weed, *Lantana camara*, is presented. In an attempt to utilize the entire plant, the extracts of all its parts – leaves, stem and root – were employed in various proportions with the gold precursor, HAuCl₄ solution, for the synthesis. The reduction of gold ions to nanoparticles was tracked using UV-Vis spectroscopy. The electron micrographs of the synthesized nanoparticles revealed the presence of particles of monodispersed spherical and polydispersed triangular, pentagonal, rod and truncated triangular shapes in sizes ranging 15–55 nm and 7–100 nm respectively. The presence of gold atoms was confirmed from the EDAX and X-Ray diffraction studies. The FT-IR spectral study indicated that the alkanes in the plant extract could have been responsible for the reduction of the gold ions to gold nanoparticles.

Key words: *Phyto-fabrication, Lantana camara, gold nanoparticles, monodispersed particles, TEM*

⁽¹⁾PhD Research Scholar, ⁽²⁾Assistant Professor, ⁽³⁾Professor,
Centre for Pollution Control and Environmental Engineering, Pondicherry University, Puducherry – 605 014.
*Corresponding author: prof.s.a.abbasi@gmail.com

Anthropogenic Mercury Contamination of Vembanad Backwater, Western Coast, India – Evidence from Sediments

SHYLESH CHANDRAN M.S., JAYASOORYAN K.K., SUBIN K. JOSE, MAHESH MOHAN
AND E.V. RAMASAMY *

Mercury concentration and its pollution profile in the sediments of polluted (Mulavukadu) and less polluted (Kumarakom) regions of Vembanad Backwater, a Ramsar site were studied. Sediment core samples and surface sediment samples were collected seasonally from these sites and analyzed for total mercury (THg), organic carbon and pH. Mean THg concentrations in the surface sediments ranged from 61.1 to 2054.3 ng/g. High THg content was observed in the sediments collected from the Mulavukadu region with an average value of 1238 ng/g. The high concentration of THg was observed during pre-monsoon season. Kumarakom (less polluted) region showed comparatively lower values (20.9ng/g – 370 ng/g). THg in surface sediments showed significant correlation with pH and organic carbon. The high concentration observed in the Mulavukadu region was a clear indication of anthropogenic contamination. The core samples collected from Mulavukadu region exhibited higher values than the core taken from the Kumarakom region. The core sediment samples showed that THg values were much higher in the subsurface sediment than that of surface sediments. These low concentrations in the upper few centimeters of the sediment suggest that recent mercury inputs were substantially low in these areas. High mercury content in the subsurface sedimentary region might be due to the historic discharges from a chloralkali plant which had stopped the use of mercury cell process few years ago.

Key words: *Aquatic systems, mercury, pollution profile, sediment*

Introduction

Mercury, a global pollutant ¹, is an extremely toxic trace metal, naturally occurring in air, water and soil ² and is one of the most studied pollutants ³. Because of its transboundary nature, mercury popping up in places where it was never expected before and it burdens in sediments and other non-biological materials are estimated to have increased up to five times pre-human level; primarily as a result of human activities ^{4,5}. A lot of studies have been undertaken on mercury contamination⁷⁻⁹, speciation⁹, bioavailability¹¹⁻¹² and bioaccumulation¹³ in various ecosystems. A very recent study showed that at least 150 tons of mercury being released annually to the estuaries around the world¹⁴. Earlier studies estimated a global natural mercury emission of 1920.6 tons/year ^{1,6,15,16}. Out of the total global anthropogenic release of mercury into the atmosphere, two third appear to come from Asian sources, with China as the largest contributor worldwide¹⁷. The United States of America and India

are the second and third largest emitters, but their combined total emissions are only about one third of China's. Mercury deposition significantly increased for the given period in East and South Asia, 26% and 8% correspondingly¹⁸. Burning of fossil fuels is the largest single source of mercury emissions from human sources, accounting for about 45% of the total anthropogenic emissions followed by artisanal gold mining (18%), mining and metal production (10%) and others such as cement production, industrial gold production etc. (27%)¹⁷.

The presence and behavior of Mercury in aquatic systems are of great interest and importance since it is the only metal which bioaccumulates and magnifies through all the levels of aquatic food chain ¹⁹. Sediments can act as both sink and source of mercury. The accumulated mercury in the sediments can be remobilized or re-enter in to the water column through bioturbation or dredging. Hence it is important to study the mercury accumulated in the subsurface

Macrobenthic Invertebrates as Coastal Ecological Bioindicators of Environmental Health

MARY TERESA P. MIRANDA, RAJESH B. R⁺, SREELEKSHMY S. G,
UDAYAKUMAR P AND JEAN JOSE J.

The distribution of zoobenthic organisms in relation to the textural characteristics of the sediments in five stations (Veli, Varkala, Alappad, Neendakara and Cochin) was studied along the southwest coast of India. Sampling was done during the post monsoon of the year 2011 followed by the pre monsoon and monsoon seasons of the year 2012. The importance of zoo benthic communities in pollution studies is well established. Results revealed that the sediment texture for Veli, Varkala, Alappad and Neendakara was in the order sand > silt > clay while in Cochin it was silt > sand > clay. Organic carbon varied throughout the study and was expressed in the sequence Cochin>Alappad>Neendakara>Varkala>Veli. Wide variations in zoobenthic species diversity was also observed. The sinking range of coastal surface water received pollutants routed from fresh water input and these were estimated through the evaluation of bottom water nutrient characteristics. The present study thus focuses on the concept that the seabed acts as a sink for most of the pollutants entering the marine ecosystem, and the more stable sediments along with their inhabitant fauna give a clear picture of the severity of contaminants. The study has identified *Littorina scabra*, *Modiolus metcalfei* and *Trochida* sp as indicator organisms along south west India.

Key words: *Macrobenthos, sediment, organic carbon, bio-indicator*

Introduction

Macrobenthos play an important role in aquatic communities as they are involved in mineralization, promotion and mixing of sediments, flux of oxygen into sediments, cycling of organic matter and for assessing the quality of inland water¹. Abundance and distribution of macro benthos is affected by various physical and chemical conditions of the water body such as depth, organic contents of the sediments, contamination of bed sediments, toxicity of sediments and rapid sedimentation. These appear to cause shifts towards lower abundance of macro benthic species. Opportunistic species will dominate in a pollution stressed environment and the conservative species may become rare or may disappear. Therefore, both these species can serve as pollution indicators².

Bays and harbours are mostly exposed to pollution because of anthropogenic activities, industries

and harbourage operations. Often, the effects of pollution are reinforced by natural features of bays as the organic and inorganic pollutants tend to deposit in the fine sediments, limited circulation of water and the reduced tidal flux³. Marine pollution management is based on monitoring various physico-chemical and biological parameters to detect changes in the environment. Recent studies carried out in the coastal waters of India reveal that the coastal belt including the water and sediment is continuously being threatened by various pollutants discharged directly from industrial plants⁴. Zoo benthos are relatively sessile and sensitive to environmental changes such as nutrient level and oxygen concentration. Benthic communities usually have a long life cycle and stable community composition and can therefore often be used as a monitoring index for pollution⁵. The objective of the present work was to study the preference of habitat and seasonal abundance of benthic fauna along the Kerala coast,

Department of Zoology, Fatima Mata National College, Kollam – 691 001, Kerala, India

*Corresponding author : brrajeshnair@gmail.com

Spatial and Temporal Characteristics of Flood in Kaithal District Haryana, India

PUSHPENDRA SINGH RAJPOOT⁺, AJAY KUMAR^{**} AND R.K.TRIVEDI^{***}

Floods are reoccurring natural hazard. Major part of Kaithal district of Haryana, is drained by Ghaggar River and its tributaries and faces the problem of flood. All the tributaries of Ghaggar River meet in this region and brings huge amount of sediments and blocks the drains. Present study presents the outcome of flood frequency analysis using rainfall data and by integration of different parameters (slope, landform, soil, drainage and land use/land cover). Flood risk zone spatial analysis showing high, moderate and low flood risk zone is done using Remote Sensing & GIS techniques and discharged data is also considered. Frequency and recurrence interval shows that low to moderate flood risk is a regular phenomenon and extreme moderate to high flood occurs three or four times in two decades. High flood risk zone is found in northern part (Guhla block) and covers an area of about 19%, a large northern part of Kaithal district. Moderate flood risk zone is found in north along with the high flood risk zone and covers about 7% area. Remaining 74% of the study area is characterized by no/low flood risk zone.

Key words: *Spatial, temporal, land use/land cover, flood distribution, Kaithal and Ghaggar river*

Introduction

Floods are a natural phenomenon that occur when water from rainfall, snow melt, dam failure or any combination of these is released into a stream at rates that exceed the transfer and storage capacity of the channel. Flooding is responsible for both annual loss of large number of life and huge amount of property. In Kaithal district of Haryana in Ghaggar river basin, flood is one of the regularly occurring disaster and its effects are getting worse.

Ghaggar basin is also characterized with number of palaeo channels which are in the low-lying part of the alluvial plains within basin; they act as conduits and become instrumental in carrying the floodwaters¹. Studies on flood risk assessment in the part of Kosi River basin are conducted by integrating hydrological, geomorphological, land cover, topographic and social (population density) parameters using RS

& GIS technique to obtain the Flood Risk Index (FRI)². Present study is an attempt to analyze the temporal and spatial characteristics and impact of flood risk in Kaithal district to help the administrators and planners for making development plan to minimizing the losses due to flood.

Kaithal district is situated between 29° 51' 49" to 30° 12' 40" N latitude and 76° 10' to 76° 29' 10" E longitude. It is a part of Ghaggar River and its major tributaries i.e. Markanda, Tangri and Patialewali basin Saraswati, Pachhisdhara are the few important tributaries. Total basin area of Ghaggar is 8024.06 sq km. The normal annual rainfall is 563 mm and about 85% of annual rainfall is contributed by south-west monsoon during last week of June and end of September. July and August are the wettest months. Rest 15% rainfall is received during non-monsoon period.

⁺ Research Scholar, Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot, M.P. India

^{**}HOD (Geology), Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot, M.P. India

^{***}HOD (Geology), Dr. H. S. Gour Vishwavidyalaya Sagar, M.P. India

Corresponding author : prajpoot179@gmail.com

Physico-chemical Properties and Heavy Metals Estimation in Drinking Water from Different Sources in and around Sindri (Dhanbad), Jharkhand, India

PRASHANT KUMAR SINGH AND SHASHI SHANKAR TIWARI*

Water resource shortage and pollution have seriously threatened the survival and development of developing countries. Because of India's specific economical and social circumstances, complete adoption of developed countries experience is unrealistic. At present, India needs to develop strategies and technologies in source water pollution control and industrial and municipal environmental remediation that embrace the country's specific need to battle the water resource problem. This study was aimed to estimate physico-chemical properties and heavy metals in drinking water samples collected from different sources in and around Sindri (Dhanbad), Jharkhand, India. A total number of 30 water samples were collected from different sources like hand pumps, wells and taps. The gross appearance, pH, EC, total hardness, Ca, Mg, total alkalinity, Na, K, Cl, SO₄, NO₃, F, TDS and heavy metals like Cu, Pb, Zn, Ni, Cd, Cr, Mn and Fe were analyzed. The results of physico-chemical parameters and heavy metal estimation of all water samples were found to be within permissible limit and safe for drinking purpose.

Key words: *Water resource, physico-chemical properties, hardness, heavy metals*

Impact of pH on Cell Morphometry of *Scenedesmus abundans*

RUCHI ACHARYA¹*, TAYYAB SAIFY², JASWINDER MEHTA³ AND BHAWNA SHARMA⁴

Global climate change is expected to dramatically impact the structure and function of freshwater aquatic ecosystems. Regional climate change in the upper and lower lake of Bhopal, India is expected to increase air and stream temperatures, modify hydrologic regimes, and increase the amount and frequency of disturbance events (debris flows, landfill, and human encroachment to the catchments area). These climatic changes combined with species-specific tolerances to regime extreme (e.g., pH variability) will likely result in significant changes in the distribution, abundance, and diversity of many aquatic species, particularly *Scenedesmus* species, a phenotypic plastic microalga. In the present study, the effect of pH on cell morphometry *Scenedesmus abundans* var. *brevicauda* was investigated. In the low pH (below 5.0) range, no growth of *Scenedesmus abundans* var. *brevicauda* was detected and the measured cell dimensions were 6.0×2.7µm. The coenobium became almost colourless and lost its obvious green colour. The cells were shrunken and perforated. The cells became quadratic in their outline. At the alkaline pH, the cell dimensions increased to 7.5×3.3µm with an increase in chlorophyll content.

Key words: *Scenedesmus*, pH, phenotypic plastic

¹ Assistant Professor, Department of Botany, Career College, Bhopal (M.P.) – 462 023, India

² Professor & Principal, Gandhi P R College, Bhopal (M.P.) – 462 011, India

³ Professor & Head, Department of Botany, Career College, Bhopal (M.P.) – 462 023, India

⁴ Assistant Professor, Department of Botany, Career College, Bhopal (M.P.) – 462 023, India

* Corresponding author : rch.acharya@gmail.com

Performance Evaluation of Developed Concrete through Long Term Leaching, Durability and TCLP

RUBINA CHAUDHARY^a AND SMITA BADUR KARMANKAR^b

Solidification/Stabilization is a common practice for the treatment of hazardous waste containing heavy metals before it is disposed of in a secure landfill or for reuse. In order to evaluate the stability of the solidified waste for utilization, EPA Solids Water Leaching Test (SWLT) 846-1311, long term durability and leaching (NEN 7345) methods were used. Weight loss from the freeze/thaw (FT) durability test ranged from 0.37 – 0.98% and heat- thaw (HT) durability test ranged from 0.28 – 0.42% after 4 cycles. The obtained values were less as compared to the 30% weight loss standard. L1 and L2 concrete samples were soiled during FT & HT durability test. Iron Leaching was found less than other metals (Cu, Zn) due to formation of high iron complex. FT was found to be more deteriorating as compared to HT. During diffusion test conductivity increased with the increase in the waste content in the mix design and higher for the extractions with longer contact period. Diffusion was obtained in the start path and middle path of all concrete samples. The leaching mechanism showed low leaching of copper and zinc as compared to iron. Iron release decreased with increase in waste/binder ratio. Chromium, nickel and manganese were completely stabilized in concrete matrix. The order of fixation of metals on the basis of their leachability index are Fe>Zn>Cu>Cr>Ni>Mn. The TCLP result proved that the developed materials were in the permissible limits of Hazardous Waste (Management & Handling) Rules.

Key words: Durability, diffusion, TCLP, lechability index, concrete

^aAssociate Professor, School of Energy and Environmental Studies, Devi Ahilya University, Takshashila Campus, Khandwa Road, Indore-452 001, M.P., India.

rubina_chaudhary@yahoo.com

^bAssistant Professor, Institute of Engineering and Science, IPS Academy, Indore (India)

*Corresponding author : smita_badur@yahoo.co.in

Packing Media for Anaerobic Fixed Film Reactor – A Review

SAMIR VAHORA^{1*}, HIMALI MEHTA² AND NIKITA CHOKSHI³

One of the most important aspects in the anaerobic fixed film reactor design is the selection of efficient support material. It has been reported that the organic matter removal efficiency in these reactors is directly related to the characteristics of the support materials used for the immobilization of anaerobes. Anaerobic fixed film reactors have displayed better performance than any other type of anaerobic reactors. They not only work as anaerobic biological treatment for organic matter in the wastewaters but also trap passage of active biomass out of the reactor. This paper reviews the use of fixed-bed reactors in various fields reported by different researchers using variety of packing media.

Key words: *Anaerobic fixed film, organic loading rate, packing media, wastewater treatment*

¹ Associate Scientist, Sardar Patel Renewable Energy Research Institute, Vallabh Vidyanagar, Gujarat, India – 388 120

² Principal Scientist, Sardar Patel Renewable Energy Research Institute, Vallabh Vidyanagar, Gujarat, India – 388 120 (e-mail: bio@spreri.org)

³ Assistant Professor, Institute of Technology, Nirma University, Ahmedabad, Gujarat, India – 382 481 (e-mail: nikita.chokshi@nirmauni.ac.in).

* Corresponding author: samir_vahora@yahoo.co.in

A Review on Water Resources Availability and Management Practices in India

SUSHANT B. WATH AND POONAM PRASAD*

Conservation and management of water resources is critically important for a vast and fast developing country like India. However, rapidly increasing population and continuous betterment of lifestyle has put tremendous pressure on water resources around major cities leading to alarmingly reduction in per capita water availability. Moreover, increasing fluctuations in precipitation over the country has only aggravated the problem. This paper presents the current and future water scenario in India and also discusses the impacts of various factors like population, pollution, mismanagement, climate change, government laws and regulations etc. on water resources and its availability. While emphasis has been laid on water productivity and various government initiatives, the paper also discusses and analyzes limitations in water management. Based on study and analysis, the paper finally recommends Best Management Practices (BMP) and Best Available Technologies (BAT) used and practiced worldwide for effective and efficient water management in India. The paper also highlights the importance of Public Private Community Partnership (PPCP) along with the recently developed monitoring tools and data information systems for sustainable and effective water resource management to meet present requirements without compromising the future needs.

Key words: *Water resources, management, pollution–point and non–point sources, public private partnership*