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Adsorption Kinetics and Equilibrium Studies of Heavy Metals Removal Using *Musa Sapientum* Stems – A Low Cost Agro Waste Biosorbent

VIPIN KUMAR¹⁺, AVANTIKA CHANDRA², ARABINDA BEHERA³ AND M K JAIN⁴

The contamination of water by toxic heavy metals is a worldwide environmental problem. The sustainable removal of heavy metals has become a major challenge for scientists. Biosorption is one such emerging technology which utilized naturally occurring waste materials to sequester heavy metals from industrial wastewater. The potential of locally available *Musa sapientum* stems as a low-cost adsorbent for the removal of Zn(II) and Pb(II) ions from aqueous solution was investigated in this study. The influences of contact time, initial metals ion concentration, pH, biosorbent dosages, particle size and temperature were studied in batch experiments. The results showed that the *M. sapientum* stems was an effective biosorbent for the biosorption of Pb(II) and Zn(II) from aqueous solution. The biosorption performance was strongly affected by studied parameters such as initial concentration, pH, biosorbent dosages, and biosorbent, particle size. The maximum metal biosorption occurred at pH 6 and percentage biosorption was increased with an increase in biosorbent dosage. Experimental data were well interpreted by Langmuir and Freundlich model with maximum biosorption capacity of 19.78 mg/g for zinc and 19.02 mg/g for lead on *M. sapientum* stems. For both the metals kinetic data were properly fitted with the pseudo-second order kinetic model.

Key words: Adsorption, agro-waste, biosorption, *Musa sapientum* stems, lead, zinc

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Introduction of Fixed-Film Bio-reactor (FFBR) for Treatment of Nitrogenous Wastewater with Variable Concentration and Hydraulic Retention Time under Ambient Conditions

ANJALI BARWAL AND RUBINA CHAUDHARY*

In this paper, the results of experimentation performed in a laboratory scale fixed film biological reactor (FFBR) treating the wastewater having variable nitrate concentration, are presented and discussed. Removal efficiency for different nitrate concentration ranging from 100 to 2500 mg L⁻¹ was observed at constant (12 h) and variable (24 - 36 h) hydraulic retention time. Methanol was used as a carbon source. The main objective was to obtain nitrate concentration below 10 mg L⁻¹ in effluent. The study was also carried out to establish other parameters that affect the performance of FFBR. The results show that the removal rate increases linearly with increasing loading rate and the hydraulic retention time is one of the important parameter in removing nitrate concentration from the wastewater with removal efficiency up to 98 - 99%.

Key words: *Denitrification, bio-growth media, fixed film bio-reactor, nitrate, hydraulic retention time, wastewater*

Vegetation Index over Kerala, India in Relation to the Rainfall Pattern

SHAJIMON K JOHN^{1*} AND T K MANI ²

The rain pattern and vegetation are showing variation over the last decade. This affects the biodiversity of Kerala. In this paper, a systematic study of vegetation with the help of satellite images over the past three years was done to find out the variations in vegetation index and the related rainfall pattern .

Key words: *Vegetation Index, change detection, image registration, Kerala, monsoon, remote sensing*

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Evaluation of Fluoride Zonation Using GIS Techniques in Dudu Tehsil, Rajasthan, India

DAISY SABAL¹, M. VERMA^{2*}, N. JAIN³ AND K.C. SHARMA⁴

In many parts of India, especially in the arid and semi-arid regions, due to the failure of the monsoon and scarcity of surface water, dependence on the groundwater resources has increased tremendously in recent years. To understand the geological behavior of fluoride (F) in natural water resources in relation to the local hydrogeological, climatic condition, a typical semi-arid terrain in northwest part of India was chosen. The present work is an attempt to assess the origin and genesis of fluoride in groundwater and to map its spatial variation in terms of suitability for drinking and irrigation purpose. 50 ground water samples were collected randomly during pre-monsoon period from Dudu tehsil of Rajasthan (India) and analyzed for fluoride ion, which gave a concentration in the range of 0.45 to 11.2 mg/L. The highest value of F was found at Mozmabad tube well which is located at central part and is related to the occurrence of fluoride rich rocks. Almost 84% of the locations fall in moderate to high endemic zones where fluoride concentration was above the maximum permissible limit of 1.5 mg/L. Majority of people living in these villages have health hazards and are facing fluorosis. In this study, the area is divided in five zones having different potential for their vulnerability in relation to hazardous effects of fluoride with possible precision and accuracy. The spatial map reveals that southern and southeastern region of the study area comes under high contamination. Further favorable prospective zone found in a very small pocket at the northern region which can be helpful in better planning and management of groundwater resources, especially in hard rock terrains.

Key words: *Groundwater, fluorosis, zonation mapping, GIS, Dudu tehsil*

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Assessment of Soil Quality of Harij Taluka of Patan District (North Gujarat, India)

R. T. VASHI[†], K. S. CONTRACTOR, P.Y. DAVE AND K. K. PATEL

Assessment of soil quality of Harij Taluka of Patan district (Gujarat, India) was undertaken. Nitrogen, phosphorus and potassium are essential components of every living organism. In plants, nitrogen deficiency causes stunted growth and chlorosis or yellowing of the leaves due to decreased leaves of chlorophyll. In case of excess nitrogen uptake, plant will have dark green overly vigorous foliage which may have increase susceptibility to disease and insect attacks. Potassium deficiency may cause necrosis or interveinal chlorosis while excess potassium may cause deficiencies in magnesium and possibly calcium. Phosphorus is an important nutrient in crop production, since many soil in their native state do not have sufficient available phosphorus to maximize crop yield. The soil samples were analyzed for various parameters like pH, electrical conductivity, nitrogen, organic carbon, phosphorus and potash content.

Key words: *Soil quality, Harij taluka, Patan district*

Rainwater Harvesting and Greywater Reutilisation in Modern Homes A Case Study of Four Major Metropolitan Cities

TIRTHANKAR CHAKRABORTY¹+AND INDRANIL MUKHERJEE ²

With the continuous rise in the world's population along with the development of the nations as a whole, the per capita demand for water supply has increased substantially globally. This needs proper addressing as it is exerting tremendous pressure on the limited fresh water sources available. Considering the importance of water on human activities and human development, this water scarcity problem can serve as a basic hindrance to the sustainability of life, as is the case in several places in the world. Moreover, a large part of the water supplied to meet the demand is wasted due to inefficient usage, thereby increasing the water consumed as well as the pressure on the water supply systems. In this context, two main methods of conservation of water resources – rainwater harvesting and greywater reutilization have been discussed in the paper with emphasis on their viability in modern rural and urban homes of India. Case studies have been done for four major metropolitan cities, Kolkata, Mumbai, New Delhi and Bangalore to emphasize the efficacy of these processes in providing sufficient rainwater to the population. The money saved by adopting such a process has also been calculated for the different cases.

Key words: Water scarcity, rainwater harvesting, greywater reutilization, sustainability, environmental management

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Eco-friendly Model for Aerobic Meso Thermophilic Composting of Muncipal Solid Waste

D V WADKAR¹⁺ AND A S KOTE²

Composting process is comprised of three stages. The first stage is the mesospheric phase, the second stage is the high temperature stage, and third stage is the maturity stage. Aerobic composting depends largely on microorganisms that thrive in an oxygen rich environment. In this study a cylindrical aerobic bio-reactor (ABR) was made where aeration was continuously provided with the help of a fan attached to pipe arrangement in such a way that air reached all corners of the reactor. A solar panel was connected to the fan for its working. *Bacillus megatherium* and *Pseudomonas fleurescens* bacteria cultures were used as compost accelerator. The characteristics of compost like pH, moisture content, temperature, C/N ratio and volume reduction were studied for the period of 32 days of composting time was low as compared to conventional composting period (40 to 90 days). The mature organic compost had pH near to neutral, moisture content (22.36%), volume reduction (45.43%), C/N ratio (16.5–20%) and phosphorous (2.2 to 2.5%). It can be concluded that these values are within the desired limits and compost is suitable for ornamental plants. The setup of ABR is eco-friendly, effective and economical.

Keywords: *Aerobic, thermophilic, organic waste, bio-reactor, composting, solar energy*

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Use of Garbage Enzyme as a Low Cost Alternative Method for Treatment of Greywater – A Review

FAZNA NAZIM¹ AND MEERA V²⁺

Use of garbage enzyme, a fermentation product of kitchen waste, water and brown sugar, is emerging as an effective method of treating greywater. Grey water is the water resulting from washing clothes and kitchen utensils, shower or bath and other domestic water not containing excreta. The garbage enzyme is prepared from fruits dregs, kitchen waste, molasses and water and capable of having reinforcing and cleaning function to work with nature. It can be utilized as a low cost alternative to improve wastewater treatment processes. The review focuses on study of enzymes, role of enzymes in wastewater treatment processes, description of garbage enzyme and its use in treating greywater. The review reveals that it is an effective method in treating greywater and thus providing the scope for reusing it for various purposes.

Key words: *Garbage enzyme, wastewater treatment, fermentation*

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Impact of Human Activities on River Water Quality – Indian Scenario

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Nearly all major cities and towns in India are located on the banks of rivers. In recent years, there has been a swift increase in the urban areas along the rivers due to rapid progress in communications and commerce and these rivers have been transformed into a channel for receiving and transporting the urban domestic and industrial wastes away from towns. River pollution has become a natural phenomenon, which is triggered by anthropogenic activities. Discharge of wastes beyond assimilative capacity of the river, due to continued human activities has resulted in accelerated pollution, eventually rendering the river to a virtual wastewater. When any wastewater is discharged into natural waters, its organic matter gets oxidized by the dissolved oxygen present in natural water. The deficiency of dissolved oxygen thus created is replenished by the absorption of atmospheric oxygen. This phenomenon which occurs in all natural waters is known as “Self Purification”. An attempt is being made in this review paper to collate and compile the findings of researchers on stream pollution caused due to point and non-point sources. The research findings on physico-chemical and biological analysis of river water, sediment analysis, agricultural runoff, self – purification and Streeter Phelps model are presented.

Key words: *Wastewater, self-purification, dissolved oxygen*

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