Journal of Environmental Science & Engineering (JESE)

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Ammonia Removal from Wastewater by Using Indian Natural Zeolite and Synthetic Zeolite

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Abstract

Three factors to evaluate the efficiencies of zeolites for ammonia removal were particle size, contact time and concentration in wastewater. Synthetic zeolite showed better efficiency than natural zeolite, due to its purity compared to natural one, although the later showed to be more effective in terms of total cost of the ammonia removal. The smaller particle size showed higher efficiency. The adsorption capacity of 4.6 and 9.7 mg NH_4^+/g of natural zeolite and synthetic zeolite was obtained, respectively. The adsorption of ammonium ion increased with increasing concentration. The adsorption capabilities were 5.2, 7.5, 9.1, 9.2, and 9.2 mg NH_4^+/g by synthetic zeolite (5A) and 2.5, 3.6, 4.3, 4.3, 4.3 mg NH_4^+/g by natural zeolite for treating wastewater of 7.2, 14.2, 25.4, 32.3, 40.0 mg NH_4^+/l00 ml concentration, respectively. The ammonium adsorption increases with increase contact time. Adsorption at 90 minutes of contact time was 4.0 and 8.9 mg NH_4^+/g of natural and synthetic zeolite, respectively. Synthetic zeolite showed better efficiency then natural zeolite for ammonia removal. Natural zeolite is cost effective and is naturally available in the earth crust. Both Indian natural zeolite and synthetic zeolite can be used for ammonia removal from wastewater with natural zeolite as preferred one.

Keywords : *Indian natural zeolite, synthetic zeolite (5A), XRD and SEM analysis, ammonia removal.*

1 Introduction

Ammonia is a highly poisonous and available in the environment in numerous forms. In fresh water bodies, ammonia is discharged through wastewater generated due to different industrial activities (Singh and Prasad 1997). The widely available removal techniques of ammonia from wastewater include, recovery of ammonia by concentration technique (chemical precipitation, ion exchange or reverse osmosis), air stripping or steam stripping, or converting it into nitrogen (biological nitrification-denitrification and breakpoint chlorination) (Prasad and Singh 1990, Metcalf and Eddy, 2003). Ion exchange technique of ammonia removal has advantages like good efficiency for ammonia removal at atmospheric temperature, compact size of the treatment plant and its easy maintenance. Removal of ammonia by ion exchange using natural and synthetic zeolites have advantages because of their easy availability, low cost, easy disposal and high selectivity for metals and ammonium ion (Du et al. 2005; Erdem et al. 2005). Margeta et al. 2013 explained that characterization of synthetic and natural zeolites was needed to understand the relation of structure-properties and their possible application. Metropoulos et al. 1993 utilised natural zeolites like clinoptilolite, ferrierite and mordenite, and zeolite-A for ammonia removal. In a study clinoptilolite was fused with sodium hydroxide and converted to modified zeolite Na–Y which showed higher ammonium removal capacity then the clinoptilolite (Wang et al. 2007). Ji et al. 2007 utilised modified natural clinoptilolite Ca^{2+}-formed clinoptilolite (CaY) to remove ammonia from water. Yin et al. 2018 have removed ammonia from 6.64 to 7.27 mg. N/g by natural zeolite clinoptilolite in a batch study. Sánchez-Hernández et al. 2018 evaluated the efficiency of NaP1 zeolite for the removal of ammonia from aqueous medium in batch experiments. Xue et al. 2018 compared the efficiency of different zeolites for removal of ammonia from aqueous solution and found mordenite as the most suitable one. Wu et

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Estimation of Groundwater Quality using Water quality Index in Nanjangud Industrial Area

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ABSTRACT

Water Quality Index (WQI) is one of the indicators and technique preferred to quantify the pollution levels of water referring to some Standards such as WHO, ICMR and BIS. Thirty-five groundwater samples were collected and analysed for routine physico-chemical parameters during pre-monsoon and post-monsoon periods. The lowest and highest WQI of 8.45 and 198.12 was recorded at sampling stations S17 and S1 respectively. 37% of sampling stations fit 'Excellent' category and 23% fall under 'Good' category during pre-monsoon, whereas 46% of sampling stations fall under the 'Excellent' category and 26% fits 'Good' category during post-monsoon. The study revealed that the variation in groundwater quality of study area for two seasons are comparatively not large. Groundwater quality can be improved by proper management, cleaning and chlorinating open wells regularly, recharging groundwater sources through rainwater harvesting. WQI as a tool provides accurate information about the suitability of water for drinking purpose and a simple interpretation which helps in monitoring groundwater for improving the quality.

Keywords : *Groundwater, Water quality index, Physico-chemical parameters, Pre-monsoon, Post-monsoon, Sampling stations*

1 Introduction

Water Quality Index (WQI) is referred to as indicator of water quality and an important technique preferred to quantify the pollution levels of water referring to some Standards like WHO, ICMR and BIS (Vasanthavigar M et al., 2010). WQI provides influence of each individual parameter on overall quality of water used for human consumption (Laxmi Prasad Chourasia, 2018). Groundwater is one of the important sources of water supply throughout the world. Majority of people in India, rely on groundwater for drinking purpose (Abhishek Kumar Chaurasia et al., 2018). Usually, groundwater represents source for safe drinking water. But, due to over-extraction and other man-made activities, its quality is declining (Janardhana Rao D et al., 2016). This problem is more acute in densely populated areas, industrial zones and with shallow groundwater tube wells (Anbazhagan S et al., 2014). The other activities affecting the quality of groundwater sources are: use of pesticides and fertilizers in agriculture, discharge of domestic wastewater or industrial effluent to the environment and excessive pumping of water from aquifers. (Sajal Singh and Athar Hussian, 2016). The groundwater quality is further deteriorated through various anthropogenic activities at various stages of hydrological cycle which includes rainfall, runoff and infiltration (Chinwendu Emeka et al., 2020). In the recent past, many health problems have been diagnosed due to drinking water containing arsenic, fluoride, nitrate, boron etc., (Vasant Wagh et al., 2020). Due to massive decline in both quantity and quality of groundwater, it is imperative to implement an effective monitoring and management strategies to overcome the problem. (Ganesh, K. M et al., 2015). In this context, an attempt is being made in this research work to assess the quality of groundwater using water quality index (WQI) and to know the suitability of groundwater for drinking purpose in Nanjangud industrial area.

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Introduction of Method of Partial Sums for finding B.O.D First stage constants

MANU DEVASSY[1]

ABSTRACT

Biochemical oxygen demand (B.O.D) is widely adopted as a first-order reaction and several methods like least square, Thomas graphical, Fujimoto, daily difference method, etc. have been introduced for solving the equation based on experimentally determined B.O.D data. In all these methods tedious calculations are involved in the determination of B.O.D velocity constants and hence have deterred many researchers in expressing their results in terms of the velocity constants. It is for this reason a new approach to this problem is introduced, where the partial sums of applied B.O.D in successive intervals of time are made use in arriving an expression for velocity constants. The paper examines whether there is considerable variation in the velocity constant values predicted by the least square, Thomas graphical, Fujimoto, daily difference, and method of partial sums(MPS) for the Willamette River, Ohio River, and raw domestic wastewater, in addition to ranking the models using Nash-Sutcliffe model efficiency coefficient(NSE).The results of ANOVA tests indicate that there is no significant variation in the predictive power of the models as well as the velocity constant values of Willamette & Ohio River. The study revealed that the least square method is the best for predicting velocity constants and there is a close similarity of predictive skill of Thomas graphical and MPS methods.

Keywords: Biochemical Oxygen demand; Daily difference method; Fujimoto method; Least Square method; MPS method; Nash-Sutcliffe model efficiency coefficient; Thomas Graphical method

1 Introduction

The Biochemical oxygen demand of organically polluted wastewater is the amount of oxygen used up by the aerobic bacteria in stabilizing the organic matter present. The oxygen demand is found to be directly proportional to the amount of organic matter present. Thus, a larger B.O.D value of wastewater is an indication of the strength of organic matter present. In a standard B.O.D test the amount of oxygen used up by the diluted wastewater sample is found out by incubating the sample for 5 days at 20^0 C. The B.O.D has many important applications in the field of sanitation like 1. Measurement of sewage strength 2.Measurement of treatment plant efficiency. 3. Measurement of the amount of pollution added to or in a stream. 4. Design of sewage and waste treatment units. 5. Establishment of stream and effluent standards for stream pollution regulatory agencies. 6. Establishment of sewage charge [Orford and Ingram, 1953].The biological oxidation rates of various sewages, wastes, effluents, and streams vary significantly, according to studies conducted over the last 20 years using the B.O.D test [Orford and Ingram, 1953]. The B.O.D test provides only a limited amount of information about the strength of organically polluted water. The amount of oxygen necessary for complete oxidation of the carbonaceous part of organic matter, ultimate B.O.D (Lo), and rate of decomposition (k) must be determined to obtain complete information about the strength and pace of decomposition [Marske and Polkowski,1972]. A series of long-term B.O.D data, preferably taken at one-day or two-day intervals, must be generated for a period of up to 5 days or 10 days to estimate the de-oxygenation constant and ultimate B.O.D[Marske and Polkowski,1972].The resulting B.O.D curve is usually described by a first-order expression, given by Streeter-Phelps in 1925. The first stage of biochemical oxygen demand as a uni-molecular reaction is based on the following differential equation [Theriault, 1927]:

$$\frac{dL_{T_i}}{d_T} = k\left(L_o - L_{T_i}\right) \qquad L_{T_i} = B.O.D\ exerted\ in\ time, T_i$$

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Morphological, Physical and Chemical Characteristics of Commercial Bamboo Species for Phyto-management of Polluted Sites in India

ANKUSH SAWARKAR[1], DEEPTI SHRIMANKAR[1], EKTA SINGH[2], AMAN KUMAR[2] AND LAL SINGH[2*]

Abstract

Phyto-management is a system for the management of contaminated and degraded sites by using plants and associated microorganisms. The aim of Phyto-management is to decontaminate/ redevelop the infected soil using different plants like bamboo. This technique is completely environment friendly and cost-effective because it uses all the parts of the plant from root to leaves. To achieve this goal, bamboo plants are used owing to more commercial value, vast diversity, and its availability across the world. It has excellent morphological, physical, and chemical properties and is considered one of the best plants having international commercial importance. Bamboo species possess good survival capacity and a high growth rate at contaminated sites like fly ash, mining dump, landfill site, etc.

In this study, 10 key attributes have been analyzed that describe the physical and morphological characteristics of 20 commercial species from 9 genera which has a high contribution in phytoremediation. This article presents a brief idea about commercial bamboo species for the Phyto-management of polluted sites in India.

Keywords : *Bamboo, Phyto-management, Fly ash (FA), Greenhouse gases (GHGs), Phytoremediation*

1 Introduction

Bamboo is the largest size form of the grass family *Poaceae,* which is recognized as one of the greatest sources of food and, an alternative of wood. It grows in about 3% of the world's forests [Kumar et al., 2011]. Globally, there are 1,575 species where India is the second-biggest country with 180 species that cover 16 Million hector (Mha) bamboo forests. Bamboo has unique properties and massive variety among all the species. It shows rapid growth (30-100 cm/day for some species) with excellent physico-chemical and mechanical properties. These exceptional properties make it a more demanding crop in the international market [Akwada and Akinlabi, 2020b]. In 2017, the international trade value of bamboo was evaluated as 1.7 billion USD that provides incomes and subsistence to almost 2.5 billion people around the world. Therefore, people called bamboo as 21st century 'green gold' [Dwivedi et al., 2019; INBAR, 2019a; Sawarkar et al., 2020].

Bamboo belongs to1500 documented application from many sectors out of which some have good international trade values as pulp & paper industry (USD 23 million), food (shoot: USD 323 million) construction/building material (USD 101 million), fuel (charcoal: USD 57 million), woven product (USD 246 million), flooring (USD 228 million), panels (USD 135 million), furniture (USD 163 million), non-residential, agriculture, packing, transport, adornment, others including ladders, etc. [INBAR, 2019b]. With a potential of 370.106 GW. In the year 2019, around 195,809.50 MW is generated by thermal power plants in which coal is used as a principal source of electricity [Chikkatur et al., 2009; Central Electricity Authority, 2020].

During coal combustion, the huge amount of residue is generated which contains about 15-30% of fly ash. Fly ash

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Role of Bamboo and Other Sustainable, Commercial Plant Species for Controlling Soil Erosion in the Degraded Area

ANKUSH SAWARKAR[1], DEEPTI SHRIMANKAR[1], EKTA SINGH[2], AMAN KUMAR[2] AND LAL SINGH[2*]

Abstract

Soil erosion is a grave environmental concern in which the land loses its soil and as time passes, the entire world has to face this critical problem in a bigger form. Erosion affects the ecosystem by disturbing the whole food chain. The impact of erosion can also be on pastures and forests which then leads to the serious issue of global warming. The reason behind erosion can be any (physical, mass, water, wind, etc.) but the result is the same i.e., the land loses its fertility, nutrition, and production. Among all the agents of erosion, water erosion is intense, and globally it affects nearly 1094 Million hectares land area in which 751 Million hectares land is severely affected. Erosion has a wide impact on those who live near the banks of the river or where the river erosion is the highest. It affects the livelihoods of billions of people around the globe. To control soil erosion, the best option is the plantation of the selective crop which can have a high survival rate in that local surrounding environment. These plants can be grass or tree but it must have good soil holding capacity and can show a high growth rate in the local climate. Due to bamboo's unique characteristics, it has dual use, first for the ecosystem and second for people. The present article gives a brief idea about the role of bamboo species for controlling soil erosion in the degraded area.

Key words : *Soil erosion, bamboo, desertification, ecosystem, degraded land.*

Introduction

Soil is a dynamically complex or heterogeneous mixtures of air, water, minerals, organic matter supporting plants, and limitless organisms that decompose as remains of once-living things. It is the topmost layer of the crust of the earth and it is a vital material for plant growth and its survival. It can perform a key role for life on earth. The soil formation is a very slow process that includes many factors like parent material, the surrounding climate, biotic, and time .

On the other hand, erosion of soil is a very rapid action which results soil losing its minerals and productivity. It is nothing but the beginning of the destruction of the soil. The erosion of soil is a natural process or geological processes correlated with running water, winds, coastal waves, and glaciers. It describes the method of detachment and transportation of soil particles or sediment migration by a geomorphic negotiator. Detachment results in obtruding of small soil dust particles that from the soil mass and transportation is the drive of those particles (sediment) separated from the original site. These modes of soil/sediment migration are known as leaching .

This process continues since time antiquated but now it has become a grave issue due to increased anthropogenic activities intervention over the period of time. That is the reason soil preservation and management are compulsory to achieve the goal of sustainable development. For this first

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An Optical Scattering Based Cost-Effective Approach towards Quantitative Assessment of Turbidity and Particle size Estimation in Drinking Water using Image Analysis

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Abstract

Contaminated water consumption primarily for drinking purposes is the cause of approximately 502,000 global deaths every year mostly in economically challenging countries indicating the need for a cheap, easy to use, yet robust and scientifically proven method for determination of water quality. In this work, we have characterized the water quality utilizing the principles of optical scattering by the suspended particulate matter using a low-cost wireless-enabled camera. The images grabbed by the camera on an optically lit cast screen on a red and a blue dot were allowed to arrive through a "model scattering medium". An estimate of the amount of light reaching the detector camera essentially provide Optical Density of the medium. Edge blurring of the captured images reveals information of the suspended particulates (sizes) in the medium. The individual pixel information was analyzed and the 'edge blurring' phenomenon was shown on an RGB intensity curve. The average diameter of the dominant suspended particles presents in the model scattering medium is also estimated from the fitting parameters and compared with that from commercially available Dynamic Light Scattering (DLS) instrument. The system is effective in measuring bacterial growth and the acquired data have been compared with that of the growth curve obtained from the gold standard method. Limit of Detection (LOD) of the set-up was found to be 48 ppm. The extremely cost-effective nature of the set-up, the innovative method of analysis, and easy availability of components would expectedly make water quality assessment very easy and user friendly.

Key words: *Water quality, RGB analysis, Bacterial growth in water, Particle size determination.*

Introduction

Increasing environmental pollution is a matter of grave concern in modern society . Pollution extends from air to sound and water . Among these, water pollution has shown a significant increase with the growing population index particularly in Low and Middle-Income Countries (LMIC) . A worldwide minimum of 2 billion people consume water for drinking contaminated with fecal matter . Contaminated water is the root cause of deadly diseases such as diarrhea, cholera, dysentery as well as typhoid and its consumption results in 502,000 diarrheal deaths annually . These data indicate the urgent need for quantitative assessment of water quality including lakes and bigger water bodies with online determination of results indicating the readiness of consumption of available drinking water. Water quality is determined by its chemical, physical, and biological content .

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