Journal of Environmental Science and Engineering (JESE)

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Started in 1958, Journal of Environmental Science and Engineering (JESE) is a peer reviewed quarterly journal published by the National Environmental Engineering Research Institute (NEERI, CSIR), Nagpur reporting various significant achievements in the field of environmental science and engineering, according to the R&D thrust areas of the Institute. The journal is providing communication links among the members of the scientific community engaged in research in India and abroad covering all the major aspects of environmental science and engineering.

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Identification and Implications of Hypsometric Integral through Geographic Information System, Sasti River Basin, India

MANISH S. DESHMUKH[1+] AND NALANDA G. TAKSANDE[2]

Hypsometric analysis (HA) facilitates to monitor erosion status of river basin and is essential for integrated watershed management, including soil conservation, water conservation and selecting suitable sites for groundwater recharge structures. It also explains the stages of geomorphic development, stages of geomorphic evolution and stage of development of a river basin. It also explains the relationship between horizontal cross-sectional area and elevation of the watershed. This study is focused on identification and implications of hypsometric integral (H_{si}) of Sasti River Basin, Central India through Geographic Information System. Hypsometric analysis has been carried out using ARC-MAP 10.2 software, SRTM-DEM and Survey of India topographical maps.The hypsometric integral is calculated using elevation relief ratio method. Result shows that the calculated value of hypsometric integral is 0.28 indicating monadnock stage and geomorphologically stable river basin. Also the hypsometric curve derived for Sasti river basin has concave downward shape, representing peneplain and monadnock stage of the river basin which is less susceptible to erosion.

Keywords: *Geology, digital elevation model (DEM), hypsometry, basin*

Introduction

Assessment of erosional status of any watershed is an essential prerequisite for integrated watershed management which not only assists in checking out suitable soil and water conservation measures to arrest erosion and conserve water, but also helps in devising best management practices to enhance biomass production in watershed[11]. The hypsometric analysis refers to the relative proportion of an area at different elevations of the Earth surface[10].The hypsometric curve (HC) and hypsometric integral (H_{si}) represents the receptiveness of the basin and stage of river development. It also explains the relationship between horizontal cross-sectional area of the watershed and its elevation in a dimensionless form that permits comparison of watershed irrespective of scale[1]. The comparison of shape of the hypsometric curve for different watersheds, developed under similar geologic and geomorphic conditions, provides a relative insight into the history of hill slope processes[3]. The shape of the hypsometric curve (HC) and hypsometric integral (H_{si}) values provide valuable information not only about the erosional stage of the basin, but also on the tectonic, climatic and lithological factors controlling it[7,12]. All the river basins of Maharashtra State, India have been divided into 1505 watersheds[4]. The Sasti river basin is one of these basins which ultimately joins Godavari river, flowing towards East.The Sasti river basin has been considered for hypsometric analysis specially to understand the stage of geomorphic development and relationship between horizontal cross-sectional area and elevation of the watershed.

Study area

The area of Sasti river basin, Chandrapur district, Maharashtra state, India has been considered for the study which lies between Latitude 19°38'54" to 19°53'45" N and Longitude 79°09´30" to 79°20´45"E covered under Survey of India toposheets 56M/1,56M/2,.56M/5 and 56M/6 of 1:50.000 scale (**Fig.1**).The watershed covers an area of about 298 km^2.

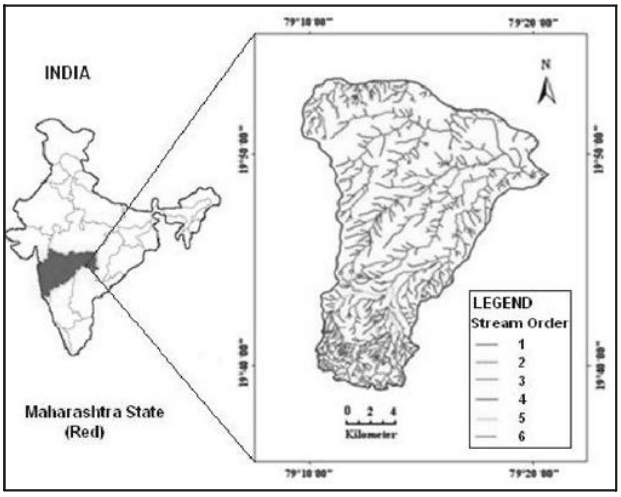

Fig 1: Location map of Sasti river basin.

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Assessment of Groundwater Quality for Drinking Purpose in Deccan Basaltic Aquifers, Part of Central India

MANISH S.DESHMUKH[1*], MANALI M.APARAJIT[2] AND NIKHIL M.APARAJIT[3]

Present study elucidate the hydrogeochemical characteristics of shallow as well as deep drinking water sources in Deccan Basaltic aquifers of Rui-Panjri area, Nagpur district, Maharashtra, India.The study area is entirely covered by the Deccan basalt lava flows with granitic gneisses basement.The sampling and hydrogeochemical analysis of major drinking water sources (dug wells,bore wells and dug cum bore wells) of Rui-Panjri area has been carried out to understand the distribution of chemical elements and high concentration of contaminants in groundwater, hazardous for drinking purpose.Results shows that the values of chemical parameters like p^H (7.7 to 7.8 mg/l), TDS (474 to 1882 mg/l), Ca^{2+} (74 to 200 mg/l), Mg^{2+} (21 to 127 mg/l), Na^+ (12 to 190 mg/l), K^+ (1 to 10 mg/l), HCO_3^- (244 to 344 mg/l), Cl^-(28 to 352 mg/l) and SO_4^{2-} (52 to 178 mg/l) are within permissible limits. On the other hand, values of chemical parameters like EC (740 to 2940 µS/cm), NO_3^-(29 to 306 mg/l) and F^- (0.80 to 1.62 mg/l) exceeds the permissible limits as per drinking water standards.The value of EC from bore well of Kharsoli village exceeds the permissible limit,probably due to dissolve matter in groundwater at deeper levels.Secondly,the excess values of NO_3^- from bore well of Kharsoli village,exceeds the permissible limit,probably due to the anthropogenic activity, presence of sewage,leakage of septic tanks,waste disposal and decaying of organic matters nearby drinking water sources.The excess value of F^- from the dug cum bore well of Rui village,exceeds the permissible limit due to the presence of fluoride bearing minerals present along the contact zone of basalt and granitic gneisses.It can also be concluded that the values of chemical parameters of shallow drinking water sources are within permissible limits, whereas deep drinking water sources exceeds the permissible limit for drinking purpose, indicating suitablility of shallow drinking water sources for drinking purpose as compaire to deep drinking water sources.

Key Words: *Deccan Basalt, Hydrogeology, Hydrogeochemistry,Piper Trilinear Plot*

Introduction

Basaltic lava flows are ubiquitous in our solar system, observed on terrestrial planets[22].The Deccan Basalt Volcanic Province (DBVP) of India are presently occupying 5,00,000 Sq. km. area of Western and Central India[16].In India, problem of groundwater quality became severe,especially in the state like Maharashtra where 80% of the area is covered by the Deccan basalts.The basaltic lava flows has different hydrogeological characteristics due to multy layered aquifer system.The simple basalt flows are composed of alternate layers of massive and vesicular basalts.The groundwater assessment for the Maharashtra state reveals that poor quality area has increased from 3,05,308 hectare to 3,36,801 hectare[12].The hydrogeochemical studies can be helpful in knowing the residence time, flow paths and aquifer characteristics as the chemical reactions are time and space dependent[7].The groundwater sources are depleting in quantity due to unregulated extraction of water and reduced replenishment also deteriorating quality of the existing groundwater sources[6].

In India, 68.84% population is living in rural area and 31.16 % population in the urban areas[23], depends mostly on groundwater resources.In India more than 85% of rural and about 50% of urban domestic water supplies are depending on ground water sources.Increase in population,rapid urbanization, industrialization, deforestation and excessive use of chemical fertilizers not only depleting groundwater levels but also deteriorating quality as well. Aim of the present study is to assess groundwater quality of major drinking water sources in Deccan basaltic aquifers of Rui-Panjri area, Nagpur district, Maharashtra on pilot basis. Present study elucidate the distribution of chemical elements in shallow as well as deep aquifers, high concentration of the contaminants in groundwater and their relationship with the lithological characteristics, responsible for the origin and distribution of chemical elements.

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Effect of Noise Pollution on Haemolymph of *Dysdercus koenigii*

SONIYA ROSE JOSEPH AND SUDHIR BHARGAVA

The effect of noise pollution on Haemolymph of Red cotton bug or *Dysdercus koenigii.* Experiments were conducted to evaluate the total haemocyte count ,differential haemocyte count and blood volume. The insect were exposed to sound 10db power. This is the initial dose as seen by the weight of insect. An insect were treated for 1 hr. daily and this was done for 3 days and then killed after 24 hr, 48 hr, 72 hr, 96hr.It was observed that total haemocytes count was always higher in the case of females compared to male. In the normal males the haemocytes count cell/mm3 was more or less steady during the course of experiment, though it showed a slight decrease initially however, in the normal female these was a gradual decline in the haemocytes count .When insect were treated by sound they were observed after 24 hrs the T.H.C. initially in both sexes. After 24hrs.TheT.H.C. in male was 12,000 cell/mm3 and in female was 71,000 cell/mm3.

Key words : *Red cotton bug. Haemolymph,THC*

INTRODUCTION

Haemolymph is a fluid circulated in haemocoel,baths all the visceral organs in it.The blood or haemolymph consist of haemocytes suspended in blood plasma.The extra cellular fluid may be colorless or tinged with yellow but is never red.The quantity of plasma and haemocyte vary in various insect species or even in the same insect it may vary depending upon various condition.

This fluid corresponds in some aspects to both lymph and blood of higher animals and is designated by the term 'haemolymph'(Florkin and Jeuniaux,1974),though the term 'blood' and 'perivisceral fluid' have also been used for it by some authers.Jones (1970) has been followed for classifying haemocytes in the present work. Several different types of haemocytes have been recognized by Jones(1970)in the haemolymph of insect of which most of them can be distinguished in the haemolymph of *D.koenigii.*These includes prohaemocytes,granular haemocytrs,cystocytes and plasmatocytes.

MATERIALAND METHOD

Experimental insect Red cotton bug *Dysdercus koenigii* was cultured in laboratory raised from a single pair of adult collected from cotton field of Tabiji and Dorai agriculture farm at Ajmer. The colony was maintained at a temperature of 28° ±2°C and a photoperiod of 14 to 16 hrs.of day length. The insect were reared in bottles size 30x10x10cm. Air dried cotton seed soaked in water were provided as food. These bottles were covered with the muslin cloth by a rubber band. Some adults were allowed to lay eggs. Eggs were collected in petri dishes with the help of brush. The haemolymph was collected in capillary tubes from the antenna after cutting their tips.The capillary tubes are earlier rinsed with 10% aqueous sodium citrate solution.The haemolymph was pooled up in a test tube to which a crystal of thiourea were added for various studies.

1. Total Haemocyte Count (T.H.C.)

The following two methods were used for the studies of total haemocytes counts:-

A. Live Haemolymph Method

The antenna were served at the base and haemolymph quickly drawn up to the 0.1 mark in a Thoma white blood cell dillution pipette.The sample was then diluted 100 times with gentian violet solution. Haemocyte in the four corner and square of a Levy and Levy Hausser, Haemocytometer with 'Fuchs Rosenthal Pattern 'were counted. The average number of Haemocyte per chamber was multiplied by 100 x 10 to get the haemocyte count.

B Heat Fixation Method

Experimental insects were placed at 60 C for one minute in an incubator for fixation, a metathoracic leg was then served from the coxa-sternal joint and haemolymph quickly drawn up to the 0.1 marka in a Thoma white blood cell dillution pipette. The sample was then diluted 100 times with gentian violet solution. Haemocyte were counted and calculation were done as described below.

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Mycoremediation of Oil Spill using Hair as Absorbent Material

RUCHI LAD

Today oil pollution is a global threat, and to deal with it we have come up with a new combining technology scheme, which is not only environmentally friendly but also economically beneficial. Here in we are using human hairs as an absorbent material which is otherwise sent as a waste to be dumped, and the mycoremediation technique, i.e. using organisms from the class *fungi* from the treatment of the complex hydrocarbons. As crude oil and other motor oils have high density and also a complex bond to breakdown, which take years and years to be degraded. But using of this technique will make our work of degradation possible in just 12 weeks. And this project not only foresees the ecological benefits but also reaps in the future in the form of mushroom production and gaining economical benefits.

Key words: Crude oil, human hairs, booms, *fungi* (mushroom), oil pollution, marine environment.

INTRODUCTION

Oil spill has become one of the major concerns due to the reason it has greater impact on marine ecosystem. The oil spillage is of an accidental cause but cost up to a lot of worth both in terms of environmental costing and monetary terms. The oil after spillage also forms emulsified globules which possess a threat to the deep water organisms. The greater delay in cleanup of spilled oil, greater is the harm cause to the environment. The attention here is drawn towards the solution of the oil pollution being more feasible than the existing techniques. The conventional ones only thought of cleaning the spill without thinking of the after effects. The consequences of open burning lead to air pollution, where as spraying of chemical adsorbents/absorbents made that portion of ecosystem dead. Physical booms used foam as the material for collection of oil were not apt for emulsified oil and also if once their lifetime was over they were literally thrown away as waste. The modification we have done is the change the materials of the boom and their supporting medium. Material is substituted by *'human hairs'* which have a greater efficiency to collect oil from water even the emulsified one. The advantage of using hair is that they probably degrade within a span of 2 years. And hair is the probably the greatest producing organic material and never ending one. According to the survey done by us we have found that almost 70% of the hairs go straight towards dumping. So why waste such a benefactor and not use it in a socio- environmental cause.Centre of attraction of this project is the mycoremediation of the spilled oil. *Mycoremediation* is the term defining the bioremediation of the oil by fungi (mushroom). '*Myco'* is adapted from the Greek word meaning fungus; and the other word '*remediation*' refers the method of rejuvenating the environment from pollution using biological methods. As the oil collected over here is through human hairs which provide supporting material, likewise oil will also be the good substrate for the mushroom growth. Thus the collected oil is there by used by the mushroom for its growth.

AIM

The aim behind this project is to clean up the oil spill in a more biological method possible rather than existing chemo-physical methods. The idea of using mushroom is to consume all the oils in order to leave behind no toxicity in the environment. To biodegrade the heavy crude oil which was once spilled there in the marine environment, and give it back to the nature in the form of mushrooms. Actually what we borrow from nature eventually return back to it in a more eligible form.

OBJECTIVE

The objective of our work is to analyze our method and see its effectiveness in terms of how much quantity of oil can be absorbed by a given quantity of hair, from water. Since hair has greater affinity towards oil rather the water when in emulsion, so there is a possibility of great absorption through our chosen material.

The time period required for the growth of the mushroom on a different substrate like this of human hair is challenging. To study the growth pattern of the oil eating mushroom the hair- oil based substrate and resulting characteristics of the mushroom.

MATERIALS AND METHODOLOGY

MATERIALS: The materials used for the formation of boom structure gives the efficiency of the oil collection and the durability to withstand ocean currents. The various materials used by us to perform the experiment were:

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Removal of Xanthene class – Rose Bengal dye through polymer based adsorbent prepared from *Calotropis gigantea*: Kinetics and Thermogravimetric studies

ASWIN SRIRAM[1], GANAPATHIRAMAN SWAMINATHAN[2*]

This research study focuses on the removal of a high molecular weight- xanthenes class dye - Rose Bengal through sorption onto activated carbon prepared from *Calotropis gigantea*. The prepared activated carbon was amalgamated in to polymeric alginate beads and coated with aniline to enhance the adsorption characteristics. The adsorption sites were studied under Scanning Electron Microscope (SEM) and Fourier Transform Infrared Spectroscopy (FTIR) to differentiate before and after adsorption. Langmuir adsorption was found to be a good fit when compared to Freundlich isotherm thus indicating a monolayer adsorption only. The equilibrium conditions were optimized at 4 ppm of initial dye concentration, 60 min adsorption time and at pH 7. More often, desorption is the only suggested and viable option for recovery of common dyes. Rose Bengal being a hazardous dye in high concentrations, desorption is neither viable nor recommended. Since the beads have high carbon content trapped in the pores, a feasibility study was taken up for utilizing the carbon as a low cost - sustainable catalyst in the boilers and incinerators. Thermogravimetric analysis (TGA), Differential Scanning Calorimetry (DSC) and Elemental analysis (C, H, N, S and O) were carried out for the activated carbon and the dye adsorbed beads. The results favorably indicate and set precedence that the beads can be used in the boilers along with feed fuel to minimize the ignition time and to increase the combustion efficiency.

Key Words : *Rose Bengal dye, Calotropis gigantea, Activated carbon, Adsorption, Thermo gravimetric analysis, Differential scanning calorimetry.*

Introduction

The removal of dye and colour due to dye in water poses economic implication in choosing an appropriate treatment. Different classes of dye require different treatment methodologies to remove dye from the aqueous solutions. Acid Red 94, commonly known as Rose Bengal is a disodium salt belonging to Xanthene class water soluble dye[1] with molecular weight 1017.65 g/mol. The dye finds application in staining human body tissues[2] but it is highly toxic and causes irritation to human skin on contact. Prolonged contact with Rose Bengal dye can cause permanent damage to skin[3-4]. Over the period of time numerous treatment methodologies have been developed for the decolourization and degradation of dyes. Physico-chemical treatment of wastewater containing dyes have been proposed and found to be efficient by many researchers[5]. Several methods like chemical destabilization followed by flocculation[6], chemical precipitation[7] followed by sedimentation[8], electrochemical, ozonation[9] and advanced oxidation process[10]. Time and time again, adsorption of dye colours onto an adsorbent has been and is being proved to be efficient, cost saving and eco-friendly robust method by the researchers[11]. One such method is utilizing activated carbon as an adsorbent and the dye solution as the adsorbate. Many adsorption models have been developed in order to fit the experimental values in order to plot calculated values for the unknown concentrations[12].

The source and activation agents for activated carbon are relevant in optimizing the cost of the treatment. In the present study, *Calotropis gigantea* that is abundant in the southern parts of Tamil Nadu, India is used as the raw material. There have been research findings for utilizing the extract as a probable analgesic[13]. Also, the ash from the seeds of the *C. gigantea* plant has been suggested for the treatment of asthma[14]. Since the raw material is available in plenty, the material cost of activated carbon can be greatly reduced. Majority of the literature suggests the usage of KOH, H_3PO_4, Na_2CO_3, and $ZnCl_2$ as activating agents in the ratios 5:1 to 10:1 (activating agent: raw material). This leads to two main disadvantages – i.e. high cost of chemicals[15] and presence of inorganic elements in the activated carbon. The removal of activated carbon from the treated water does also pose a serious problem as the powdered activated carbon is suspended in the aqueous solution. Further, trace elements may also be present in the treated water hence requiring a tertiary treatment for their removal. In the present study, the activated carbon is infused in alginate polymeric beads. The

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Groundwater Resources in North-East India: Strategic Evaluation

ARINDAM CHAKRABARTY[1] TENZING NORBU[2]

The present research has attempted to unearth important outcome which includes present status of groundwater reserves in the country in general and in North-Eastern states in particular. The paper has reflected the usage pattern of groundwater in our day-to-day lives for domestic, agriculture as well as industrial purposes. The study has also highlighted the malusage or fluctuations of groundwater resources which could be detrimental for the very existence of citizens of the country. The growing demands of groundwater in proportion with population explosion, massive industrialization and urbanization have also been showcased. The paper has, eventually, suggested appropriate strategies to minimize the usage of groundwater in the spirit of sustainability. This study would essentially contribute to the academicians, researchers, policy makers, policy implementing agencies, industries and the people in general so that it could be the pathfinder for all the stakeholders in terms of formulating new policies and its meaningful implementation.

Keywords : *Groundwater, sustainability, appropriate strategies and North-East India.*

Introduction

Groundwater has become a focal point of global concern as far as water resources are concerned. Increasing population, growing needs for habitat, infrastructure development, rapid industrialization, agriculture etc., are responsible for exodus usage of groundwater around the world. It has reached at its critical limit. The greed of modern societies compels to create increasing number of aquifers for easily accessing groundwater. And the World Bank's estimates forecast, if such trends are allowed to continue for next two decades, the availability of groundwater cease to exist. The story of India is more critical and detrimental. India happens to be the largest user of groundwater to the tune of 25% of the global use. In spite of adequate rainfall, most of the regions, still India depends on groundwater for 60% of irrigational purposes and it is also surprising that around 85% of our drinking water is collected from groundwater itself. Last few decades, there have been massive urbanizations across the length and breadth of the country. Adequate housing facilities have emerged real state sector in cities and urban areas. The local administration fails to meet the growing requirement of water. As a result, people are exploring and utilizing water aquifers indiscriminately. Moreover, rapid industrialization and infrastructural development have added flavor to this crisis. Uncontrolled deforestation and man-made constructions of concrete have made the situation vulnerable. The discharge area has been decreasing as the modern civilization are more fascinated on cementing, construction, as a result of that, the aquifers under the soil have not been adequately discharged by the rain water. This has been severely impacting on agriculture, food security, and livelihood and essentially poses serious threats to the essence of sustainability. The situation has been worsening day by day and it is crossing the threshold limit. If this is not resolved or immediately addressed, it might invite complete disaster of human races particularly in the study region. This paper has attempted to address all these aspects through logical and rational approaches.

The United Nations have identified 17 goals which are popularly known as Sustainable Development Goals (SDGs) that needs to be achieved by the year 2030. Among these 17 goals, Clean Water and Sanitation is one of the important agenda which deserves special attention to the world community.

Literature Review

Groundwater is the main source of fresh water in many parts of the world. Some regions are very much reliant on it as they consume groundwater faster than it is naturally restocked thereby resulting in decline in water tables (Rodell et al, 2009). Jha (2006) also found that groundwater is being overexploited which threatens our ecosystem and future generations. Agarwal et al. (2009) analyzed the problem of declining water table, possible factors responsible for this and suggested suitable strategies for arresting declining water table for

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