Journal of Environmental Science & Engineering (JESE)

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Started in 1958, Journal of Environmental Science & 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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The scope of this journal covers Environmental Science and Engineering and the related areas. The journal intends to timely disseminate information related to monitoring of the environmental status across the country and abroad, innovative and effective S&T solutions to environmental and natural resource problems, significant R&D activities in the field of environmental science and technology, environmentally sound technologies and policy analysis. The journal aims at publishing both review and research articles in the field of environmental science and engineering. Case studies and short communications are also published to inform about the hazards and risks likely to occur to the people and environment due to certain materials, and the ways of controlling these hazards and associated risks. Various topics covered in the journal include: air quality monitoring, modeling and management; air pollution control; source management and apportionment studies; carrying capacity based developmental planning; soil and water chemistry, monitoring and management of land degradation; river and lake ecosystem studies; application of fly ash, sewage, sludge and mine tailing on land; ecological approaches to improve ecological and socio-economic values of land-use systems; integrated natural resource management; conservation and sustainable management of under ground biodiversity, remote sensing applications in environmental geo-science; ground water and rain water harvesting; water and waste water treatment; solid and hazardous waste management; eco-friendly technologies; waste land management; biodiversity assessment; biogeochemistry of rivers and estuaries; pollution chemistry, particularly metal speciation and bioavailability in water and soil systems; PAHs and volatile organics in atmosphere; environmental analytical methodologies; monitoring and modeling of urban noise; environmental impact and risk assessment studies; environmental audit studies; chemical process simulation and development; environmental policies; bioremediation and biodegradation studies; environmental biotechnology and genomics studies; research on environmental materials, etc.

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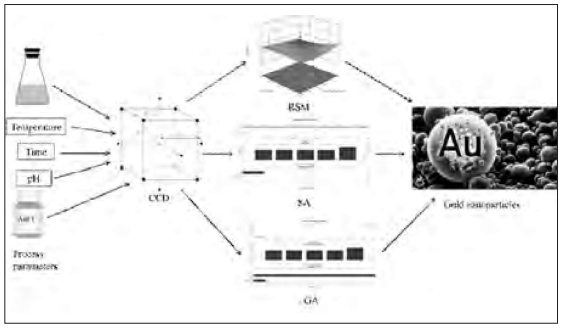
Biological aspects of gold nanoparticle synthesis by *Brevibacillus borstelensis*: a comparative study using CCD-RSM, simulated annealing and genetic algorithm

ADITYA LAWERENCE TOPPO[1], SWASTI DHAGAT[1] AND SATYA ESWARI JUJJAVARAPU[1*]

Abstract :

The use of biological agents, i.e. microorganisms, in nanoparticle synthesis emerges as an eco-friendly and low-cost technique for the synthesis of gold nanoparticles (AuNPs). The supernatant produced by thermophilic bacteria of *Brevibacillus borstelensis*. were used for the reduction and stabilization agent of auric salts to synthesize gold nanoparticles. In our work we study and compare the gold nano particle synthesis of *Brevibacillus borstelensis* using response surface models (RSM), RSM linked genetic algorithm (RSM-GA), RSM linked simulated annealing (RSM-SA). Several experimental variables, including the amount of Auric chloride concentration (A), time (B), temperature (C), pH (D) and volume of supernatant (E). were enhanced utilising the response surface methodology (RSM), and absorbance (Y) as the output parameters. The optimized values for different parameters obtained were 1.25 mM of auric chloride, 22 hours at 45°C, 5 pH and 7.5 ml of bacterial supernatant. The emulsification index of the supernatant i.e. E_2 = 50% and E_{24} = 40% indicates the production of biosurfactant by the organism. The initial analysis of the AuNPs was done using UV-Visible Spectroscopy. The analysis done using Scanning Electron Microscopy (SEM), and X-Ray Diffraction confirmed the synthesized AuNPs. The gold nanoparticles showed a characteristic Surface Plasmon Resonance (SPR) band between 530 - 550 nm respectively in the UV–Vis spectrum. The AuNps formed were spherical and the range of size was 50 to 150 nm. The crystalline structure of gold nanoparticles was revealed in the X-ray diffraction analysis. The Bragg reflections corresponding to gold were (111), (200), (220), and (311), revealing the face-centered cubic (fcc) structure of crystalline gold. The EDS spectrum also confirmed the presence of gold in the respective sample.



Graphical Abstract :- Optimized gold nano particle synthesis of *Brevibacillus borstelensis* using response surface models (RSM), RSM linked genetic algorithm (RSM-GA), RSM linked simulated annealing (RSM-SA).

Keywords : *Thermophilic bacteria, Biosynthesis, Gold nanoparticles, Biosurfactant, Central composite design, Response surface model;*

1. Introduction

Biosynthesis of gold nanoparticles (AuNPs) is an environmentally friendly method as their synthesis by conventional methods like chemical and physical methods are high in cost and produce toxic wastes that can cause damage to the environment . The gold nanoparticles

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Two Dimensional Unsteady Hydrodynamic Modelling of Flood of River Mayurakshi at Downstream Courses of Tilpara Narrage Section, Suri, Birbhum Using Open Source Data and Tools

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Abstract :

Flooding is a recurrent phenomenon in the Mayurakshi river basin. Particularly, downstream areas of the Tilpara barrage are prone to frequent flooding, which causes considerable damages. The present study is undertaken to focus on flood modelling using open-source earth observation data and geospatial modelling tools.The HEC-RAS two-dimensional unsteady hydrodynamic modelling of flood inundation scenarios for the above said reach of the Mayurakshi river is evaluated. The model produces flood inundation extent and depth maps of the flood event of 2015 (9thAugust). Depth of inundation varies from 0.25 to 3.24 meters with 124.56 sq. km of flood extent. The maximum depth is found near the Kandi and Bharatpur region of the Murshidabad district. The output of the HEC-RAS model has been verified by MODIS, Landsat 8 and Sentinel 1 images.

Key words : *Mayurakshi river basin, 2D HEC-RAS model, Flood inundation map, MODIS*

1. Introduction

Flood is a regular phenomenon in the lower Gangetic plain; the Mayurakshi basin is not an exception in this regard. The area, particularly downstream of the Tilpara barrage, is frequently prone to flooding. Generally, in the monsoon season due to continuous and heavy rainfall over a short period of time in the above region causes an extra amount of water discharge in the river course. The above volume of water potentially increases further due to channel inflow, and the dam (Massanjore dam) released water when it is out of capacity. This whole amount of water flows towards the Tilpara barrage. Primarily, the surplus river water is stored in the barrage reservoir and then diverted to the irrigation canals taking-off from either side of the barrage. Even after such storing and diversion of water, barrage gates are opened to release river water in the downstream courses when rising river water is alarming on the gauge or the same crosses danger level. It releases a sizeable volume of water when the barrage is beyond capacity causing flood in the downstream. Records of such flood incidents can easily be found from the available flood literature of this region (Ghosh and Pal, 2015 & Ghosh and Mukhopadhyay, 2015). Flood causes heavy loss of life, property, and settlement almost in every rainy season in this basin. The damage count is high. The local community, non-governmental organizations (NGOs), Govt. authorities from the panchayat level to the ministry level is concerned about these dreadful phenomena over the said region. To reduce the losses, they have to plan and devise strategy for early warnings, alerts, and awareness regarding the event. Research works are in progress to model and forecast this extreme hydrological event. Flood model varies from physical process-based/ lumped hydrological, hydraulic/ hydrodynamic model to data-driven techniques coupled with remote sensing and GIS data (Teng et al., 2017). These models can predict the flooding phenomena early with sufficient lead time for the planners from the point of view of its magnitude, frequency, severity, and extent. Generally, flood models can be analyzed properly when required data are sufficient in amount. In many cases, the researchers in this field face scarcity of field river data. So the model suffers from its limitations to predict the same. In such a situation, satellite-based open-source data and imageries can be beneficial. Nowadays, different data and imageries are obtained openly, free of cost from the source of NASA, ESA, and USGS Earth Explorer. These are very beneficial in calibrating, testing, and validating any such flood model. Different open and freely available software like HEC-RAS, HEC-GeoRAS, and QGIS, is used to manage the database and imageries to model flood phenomenon. The current study uses the openly available

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Optimization of Process Conditions for Quality Evaluation of Fish Fortified Extruded Snacks

[A]PRADEEP R*, [B]RATHNAKUMAR K, AND [C]KARTHICKUMAR P, [A]AYESHA JASMIN S

Abstract

The present study focused to optimise the process conditions of fish-fortified extruded snacks produced in a traditional Twin screw extruder which helps in development of highly nutrious healthy snacks of present market need. The 28 experimental trails and products were made using a twin screw extruder and machine parameters that were altered. The quality of the product obtained is examined using established techniques interms of responses such as product weight, colour, texture, expansion ratio, and true and bulk densities. In order to predict the best possible process variables for manufacturing of high-quality and well-liked extruded snacks, the optimization procedure is carried out using the data collected. Following the discovery of the two input parameter combinations with the highest accuracy of 95.31 percent and 93.68 percent for producing high-quality, highly-acceptable extruded snack products, replicas of optimised variable items with commercial acceptance were produced and compared with the RSM results. The results found suitable and two best combination values of process variable can now be suggested to incorporate in actual production process. This helps the commercial extruded snack manufacturer to prepare highly acceptable commercial product with high consumer preference.

Key words: *Twin screw extruder, Extruded snacks, Box-Behnken mechanism, Optimization, Process variables.*

1. Introduction

The fisheries production in india being a highly significant and potential economic source due to reason that country's coastline stretches over 8,118 kilometres. In the financial year 2019-2020, the value of seafood exports from India was estimated to be Rs. 44368.44 crores, with the volume of 13.92 lakh tonnes including fish, shell fish, crustaceans, molluscs and other aquatic invertebrates (MPEDA, 2020). The export pattern has demonstrated an upward tendency, with a volume growth rate of 1.1 percent and a value growth rate of 3.28 percent. Fish is an important part of the human diet (Kinsella and Melachouris, 1976). More than half of the Indian population eats fish, and in some states, such as Kerala, Goa, West Bengal, Odisha, Assam and other North-Eastern states, fish is consumed by more than 90% of the population. Fish has a low carbohydrate content and is abundant in protein and other nitrogenous components, as well as lipids, minerals, and vitamins. The protein content of fish varies from 15 to 20 percent of their live body weight. The majority of essential amino acids are found in the right amounts in fish proteins, which improves the cumulative protein quality of the diet. The high nutritional value of fish lipids is strongly known. Fish lipids differ substantially from mammalian lipids, which contain up to 40% long-chain fatty acids (C14-C22), are highly unsaturated, have 5 or 6 double bonds, and contain up to 40% long-chain fatty acids (C14-C22) (C14-C22). Fish is a good source of fat-soluble vitamins including vitamin A and D, and fish with a lot of liver oils are a good source of them. At the same time, a number of governmental and non-governmental organisations are praising and recognising micro and small food processing firms for their contributions to the country's long-term food supply and nutritional stability (Avermaete et al., 2003). Since it allows beginners to start a viable enterprise, Industry 4.0 will assist companies in automating processes and introducing improved management strategies to such a firm. (Corallo et al., 2018). Despite their

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Ganga River Water Quality at Various Ghats of Varanasi City with Reference to Physico-Chemical Parameters

ANIL KUMAR*

Abstract

The people of Varanasi city and nearby villages are widely using Ganga River water for bathing, some instances for drinking, industrial, agricultural purposes, etc. At festival time many people of all states of country (India) come and take bath, wash their clothes, throw earthen lamps (diyas), garland and flowers at various ghats of holy river Ganga. The river Ganga receives pollution load due to sewage discharge, industrial effluent, disposal of solid waste and agricultural runoff from the nearby areas. These waste water percolate to cause river water pollution as well as ground water pollution. Therefore, to know about the potability of Ganga River water at different ghats of Varanasi city, the present study was carried out with reference to physico-chemical parameters and water quality index (WQI) of Ganga River water that was measured in winter seasons at different ghats of Varanasi city. The water samples were collected at seven different sampling sites of various ghats that are Assi Ghat to Rajghat (1-7) and their physico-chemical properties such as temperature, colour, pH, turbidity, conductivity, DO, BOD, COD, TS, TDS, TSS, chloride, fluoride, sulphate, iron, nitrate, total hardness, total alkalinity, sodium and potassium were analyzed. The values thus obtained were compared with WHO, ISI, USPH, ICMR and European standard. Out of twenty analyzed parameters, sixteen were considered for the computation of water quality rating and water quality index. Except colour, conductivity, COD, TSS and total alkalinity, other parameters were found within the permissible level at various ghats of Varanasi city of river Ganga. Water quality index were measured as colour (104-125), conductivity (78.53-86.20), COD (238.6-363.6), nitrate (140.15-229.48) and total alkalinity (48.19-65.6). These values clearly indicate that poor to very poor water quality index of river Ganga at various Ghats. The values of water quality indices were found high for Dashaswamedh ghat in comparison to other ghats. This might be due to high anthropogenic activities. Human habitats are mainly responsible for affecting the water quality parameters of Ganga River and causing water pollution.

Keywords : *Ganga River, ghats, water quality index, sewage water, physico-chemical*

1.0 Introduction

Ganga river is a holy and perennial river which flow from Gomukh Glacier above Gangotri (Uttarakhand) and after travelling the distance of 2525 km joins the Bay of Bengal. The various ghats of Varanasi city (Uttar Pradesh) situated at the bank of river Ganga. The name of Varanasi city is combination of two words that are 'Varuna' and 'Assi'. It means the area of actual Varanasi city is between Varuna River and Assi river. The old name of Varanasi is 'Kashi' or 'Banaras'. It is one of the popular cities situated along the bank of Ganga River. Varanasi is among the oldest living city in the world. The Ganga River has a very special status regarding the cultural and religious life in our country. Varanasi is also known as the city of Ghats. It is only in Varanasi that direction of flow of Ganga River is from south to north as an auspicious phenomenon and hence called as 'uttar wahini'.

Appropriate quality of water is essential for all living being because it is directly linked with their survivals. It is well known fact that a large number of persons in every country suffer from water borne diseases due to inappropriate quality. Water pollution due to discharge of domestic sewage and effluents from small-scale industries is an issue for a variety of

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Urban Forestry and Biofuel: A Note on Complementary Strategy for Urban Sustainability

DEBALINA SAHA

Abstract

Environmental hazard from piling up of urban wastes is on the rise for the past few years, brought about by rapid urbanization. A complementary strategy of production of fuel from urban wastes and conversion of landfills to urban forestry can solve the problems of rising pollution from wastes and vehicular emissions and environmental hazards created from leachate from landfills contaminating water bodies and soil. In this paper we make a multicriteria based cost-benefit analysis to incorporate the social, environmental and economic effects of merging two complementary strategy of biofuel production and conversion of landfills to forests.

Keywords: *Biofuel, Urban Forestry, Complementary Strategy, Multicriteria Analysis, Value Transfer, Cost Benefit Analysis*

1. Introduction

Rapid urbanization in the present world has created a number of environmental issues like vehicular pollution, loss of green cover, depletion of aquifer level and such others. A major problem is the generation and disposal of urban wastes which has become a major threat to the environment. According to the World Urbanization Prospects, 2018 [United Nations 2019], the percentage of world population living in the urban areas has increased from 30% in 1950 to 55% in 2018 and is estimated to become 68% by 2050. Though North America and Europe constitute the most urbanized regions in the world, it is estimated that three countries of the developing world, India, China and Nigeria are going to account for 35% of the growth in urban population between 2018 and 2050. Thus urban sustainability is a prime concern for the world in general and for the developing countries in particular.

Increase in urban population, improvement in standard of living, increase in the number of nuclear families, change in lifestyle have all contributed to proliferation in the amount of waste generated in the cities. This huge quantity of waste affects the environment, health and also has socio-economic implications in the long-term as large area of land is wasted for landfill purposes. Segregation of urban waste and recycling through bio-gas and electricity production and composting can solve multiple issues arising from urban wastes. The large landfill areas can be converted into forestry while biogas (CNG) produced from waste can be used for low-pollution mobility and electricity generation for street lighting. The by-product of biogas plant can be used as fertilizers for forestry and agriculture. Both forestry and pollution free mobility can lead to better air quality

Production of biogas from urban solid wastes has potential for providing a solution to waste management along with clean energy production [Kasap, Aktas and Dulger 2012]. A first step towards this is waste segregation. Many countries in Europe have developed a mechanism of separation of waste at source. A study in Croatia shows that citizens are aware of environmental and social benefits of waste separation and are willing to separate organic waste [Voca and Ribic 2020]. This paper reveals that source separated biowaste can be utilized in the production of biofuel which can result in cleaner air and provide digestate as a substitute for fossil fertilizer.

A research related to biofuel refinery in Sardinia, Italy suggests that production of biofuel has positive impact on the environment by improving biodiversity as well as ecosystem services [Anejionu, Lucia and Woods 2020]. Biofuel production is likely to put pressure on water supply system requiring recycling of water to solve the problem. This study applies multicriteria and multi-stakeholder analysis based on five scenarios. Comparison of costs and benefits between scenarios give valuable policy directions.

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Efficacy of Laterite soil mixed with Bentonite and Fly Ash as liner in Ash Pond

SHYAMAL KUMAR DUTTA MAZUMDAR[1*], AVISHEK ADHIKARY[2], SUPRIYA PAL[3]

Abstract

In the present study, the efficacy of highly permeable and moderate shear strength Laterite soil (3.74 x 10^{-5} cm/s), Bentonite and Fly Ash mixture as a liner in Ash Ponds to restrict subterranean movement of metal contaminants like Chromium (Cr), Antimony (Sb), Cadmium (Cd), Nickel (Ni), and Zinc (Zn) was examined. Batch adsorption test results reveal removal efficacy of amended soil at about 97% for Ni. The findings of the laboratory fixed-bed column test setup show that mixed soil has outstanding heavy metal adsorption potential. The breakthrough plots developed using the HYDRUS-1D fit the experimental data well. The mixed soil is thus a natural, cost-effective, and easy to manufacture on a largescale commodity that proves to be worthy of consideration as a liner material for ash ponds and landfills, which can be applied to arrest other heavy metals.

Keywords: *Heavy Metal; Laterite Soil; Ash Pond; Bentonite; Fly Ash; Liner Material; Groundwater Pollution; HYDRUS-1D.*

Introduction

Coal-based thermal power plants have long been a significant source of electricity generation in India, accounting for 75 per cent of total power generation. The ash percentage of Indian coal is typically around 35 per cent, ensuing in a substantial quantity of fly ash production. The coal ash from the power plant is generally dumped in the ash pond as a slurry. In India, a sizeable land portion of roughly 263 square kilometres has been engaged, to offer nonstop dumping of a massive amount of boiler coal ash, estimated to be around 110 million tonnes (Pu and Fox, 2016). Despite significant growth in the use of fly ash in building engineering, backfilling, road sub-base, agriculture, and construction materials from 6.6 million tonnes in 1996-97 to 168.4 million tonnes in 2018-19 (CEA 2019, Surabhi 2017, Udoeyo et al. 2010) fly, ash disposal stays a challenge for power plants. Heavy metals in fly ash, such as Zn, Cd, and Ni, move below the subsurface medium and posea possible environmental danger (Prasad 2008, Pu 2016). Fly ash's physical and chemical qualities are principally dependent on thequality ofcoal used, its ash content, and the burning method.

Researchers have investigated the engineering qualities of laterite soil and bentonite mixtures to see if they may be used as liner material in engineered landfills (Parveen et al. 2017). With increasing bentonite concentration, soil mixtures produced higher Atterberg limits and shrinkage potential but lower hydraulic conductivities and reduced strength (Chakradhar et al. 2016, Muhsina et al. 2019). This prompted the researchers to investigate the efficacy of a cost-effective, reasonably permeable locally available lateritic soil (LS) blended in the company of fly ash (FA) and commercially procured Bentonite (B) in a predetermined percentage as composite liner to prevent the movement of metal contaminants existing in leachate of ash ponds into the adjacent environment via the adsorptive mechanism. (Dhadse et al. 2008).

It was also shown that as the quantity of ash in a fly ash-bentonite blend increases, the engineering properties of mixed soil like permeability, plasticity, shrinkage and swelling properties drop while the shear strength and dry unit weight increase (Kumar 2004). According to EU directives, hazardous waste landfill liners should have a hydraulic permeability of the order of $<1x10^{-7}$ cm/s and a depth of no less than 5 m, whereas non-hazardous waste should have the same permeability but a thickness of 1 m. However, for inert waste, a permeability of $1x10^{-5}$cm/s is necessary and a thickness of at least 1 m (Chakradhar et al. 2016).

One-dimensional HYDRUS numerical modelling of vertical migration of contaminant through sub-surface soil as performed to simulate the flow pattern of aqueous metal

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