

3.4.3 RESEARCH PUBLICATION

Sl.No	Title of paper	Name of the author/s	Department of the teacher	Name of journal	Year of publication	ISSN number	Is it listed in UGC Care list/Scopus /Web of Science/other, mention	Page No
1	Cellulose nanocrystals from orange and lychee biorefinery wastes and its implementation as tetracycline drug transporter	Thulasisingh A., Kannaiyan S., Pichandi K.	BT	Biomass Conversion and Biorefinery	2021	21906815	Scopus	11
2	Production and characterization of exopolysaccharide from the sponge-associated Bacillus subtilis MKU SERB2 and its in-vitro biological properties	Sathishkumar R., Kannan R., Jinendiran S., Sivakumar N., Selvakumar G., Shyamkumar R.	BT	International Journal of Biological Macromolecules	2021	1418130	Scopus	12
3	Quantum Chemical Investigation, Drug-Likeness and Molecular Docking Studies on Galangin as Alpha-Synuclein Regulator for the Treatment of Parkinson's Disease	Priya M., Zochedh A., Arumugam K., Sultan A.B.	BT	Chemistry Africa	2022	25225758	Scopus	13
4	Synergistic effect of fast extrusion furnace (FEF) black on viscosity and rheological properties of ethylene propylene diene monomer vulcanizate	Sivakumar A.R., Baskaran R., Babu B.G., Murugesan A.	BT	Fullerenes Nanotubes and Carbon Nanostructures	2022	1536383X	Scopus	14
5	Use of activated Chromolaena odorata biomass for the removal of crystal violet from aqueous	Soosai M.R., Moorthy I.M.G., Varalakshmi P., Syed A., Elgorban A.M., Rigby S.P., Natesan S.,	BT	Environmental Science and Pollution Research	2022	9441344	Scopus	15

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6	Spectroscopic Investigation, DFT Calculations, anti-Inflammatory Activity and Molecular Dynamic Simulation Study on Fagaramide Alkaloid	Priscilla J., Arul Dhas D., Hubert Joe I., Ronaldo Anuf A.	BT	Polycyclic Aromatic Compounds	2022	10406638	Scopus	16	
7	Novel acrylate copolymer based on 4-(2-bromo-3-(4-bromophenyl)-3-oxo prop-1-enyl) phenyl acrylate: Synthesis, characterization, biological and drug releasing studies	Sudhakar C., Suresh J., Balaji K., Rajendran C., Manibalan S., Arun A.	BT	Materials Today: Proceedings	2022	22147853	Scopus	17	
8	Spectroscopic and topological analysis and in vitro antimicrobial activity of phenothiazine	Michael Mary M.S., Geetha R.R.J., Amalanathan M., Robert H.M., Anuf A.R.	BT	Spectroscopy Letters	2022	387010	Scopus	18	
9	Statistical modeling and optimization for the production of secondary metabolites by lichen mycobiont isolated from Parmotrema austrosinense	Poornima S., Rajivgandhi G., Maruthupandy M., Mothana R.A., Noman O.M., Nasr F.A., Ponmurugan P., Moorthy I.G., Sivarajasekar N.	BT	Physiological and Molecular Plant Pathology	2022	8855765	Scopus	19	
10	ZnAl ₂ O ₄ supported on lychee-biochar applied to ibuprofen photodegradation	Siara S., Elvis C., Harishkumar R., Velayudhaperumal Chellam P.	BT	Materials Research Bulletin	2022	255408	Scopus	20	
11	Microplastics in mangroves and coral reef ecosystems: a review	John J., Nandhini A.R., Velayudhaperumal Chellam P., Sillanpää M.	BT	Environmental Chemistry Letters	2022	16103653	Scopus	21	
12	Process optimization and characterization of pectin derived from underexploited pineapple peel biowaste as a value-added product	Shivamathi C.S., Gunaseelan S., Soosai M.R., Vignesh N.S., Varalakshmi P., Kumar R.S., Karthikumar S., Kumar R.V., Baskar R., Rigby S.P., Syed A., Elgorban A.M., Ganesh Moorthy I.M.	BT	Food Hydrocolloids	2022	0268005X	Scopus	22	
13	Agricultural waste materials for adsorptive removal of phenols, chromium (VI) and cadmium (II) from wastewater: A review	Othmani A., Magdouli S., Senthil Kumar P., Kapoor A., Chellam P.V., Gökkuş Ö.	BT	Environmental Research	2022	139351	Scopus	23	
14	Comparative study of different catalysts mediated FAME conversion from macroalga Padina	Vimali E., Gunaseelan S., Chitra Devi V., Mothil S., Arumugam M., Ashokkumar B., Ganesh Moorthy	BT	Chemosphere	2022	456535	Scopus	24	

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17	Optimization of electrocoagulation process for treatment of rice mill effluent using response surface methodology	Anuf A.R., Ramaraj K., Sivasankarapillai V.S., Dhanusuraman R., Maran J.P., Rajeshkumar G., Rahdar A., Díez-Pascual A.M.	BT	Journal of Water Process Engineering	2022	22147144	Scopus	27	
18	Titanium dioxide nanoparticles fabrication from Parmotrema austrosinense (Zahlbr.) Hale extracts and its antimicrobial efficacy against plant pathogens	Ali Alasmay F., Rajaram S.K., Rajabathar J., Innasimuthu G.M., Sankar K., Stephen Muthaiah S., AlKahtani A.M.A., Salem Almalki A., Mohammed Alhajri H.	BT	Inorganic Chemistry Communications	2022	13877003	Scopus	28	
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21	An endophytic Streptomyces sp. DARP-7 isolated from coastal lichen and enhancement of its	David M.L.R., Innasimuthu G.M., Rajaram S.K., Nooruddin T.	BT	South African Journal of Botany	2022	2546299	Scopus	31	

	antibacterial metabolite production using response surface methodology								
22	Quantum chemical evaluation, QSAR analysis, molecular docking and dynamics investigation of s-triazine derivatives as potential anticancer agents	Gomathishankkar K., Joseph Yesudian D.M., Thiraviam C., Anuf Alexander R.	BT	Structural Chemistry	2022	10400400	Scopus	32	
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25	Treatment of municipal solid waste landfill leachate by aeration assisted electrochemical peroxidation process using aluminium and iron electrodes	Jegadeesan C., Somanathan A., Jeyakumar R.B., Sharmila V.G., Arafath K.A.Y.	CIVIL	Desalination and Water Treatment	2021	19443994	Scopus	35	
26	Corrosion resistance behaviour of concrete containing treated used foundry sand	Gurumoorthy N., Rajesh Kumar K., Vinod Kumar M., Hariharan Kannan K.	CIVIL	European Journal of Environmental and Civil Engineering	2022	19648189	Scopus	36	
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28	Prediction of Bitcoin Price Using Machine Learning Algorithms	Dr.G.Nirmala	CSE	International Journal of Ymer	2022	0044-0477,	Scopus	38	
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34	Rag-bull rider optimisation with deep recurrent neural network for epileptic seizure detection using electroencephalogram	Johnrose P.J., Muniasamy S., Georgepeter J.	ECE	IET Signal Processing	2021	17519675	Scopus	44
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36	Blockchain-Enabled Smart Surveillance System with Artificial Intelligence	Jain P., Dwivedi S., Alharbi A.R., Sureshbabu R., Singh D.P., Jamal S.S., Krah D.	ECE	Wireless Communications and Mobile Computing	2022	15308669	Scopus	46
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39	Weighted 1D-local binary pattern features and Taylor-Henry gas solubility optimization based Deep Maxout network for discovering epileptic seizure using EEG	Jaffino G., Sundaram M., Prabin Jose J.	ECE	Digital Signal Processing: A Review Journal	2022	10512004	Scopus	49
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46	Bypass diode and photovoltaic module failure analysis of 1.5kW solar PV array	Dhakshinamoorthy M., Sundaram K., Murugesan P., David P.W.	EEE	Energy Sources, Part A: Recovery, Utilization and Environmental Effects	2022	15567 036	Scopus	56
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48	Investigational study on improving the yield from hybrid PV/T modified conventional solar still with enhanced evaporation and condensation technique - An experimental approach	Ganesan K., Winston D.P., Ravishankar S., Muthusamy S.	EEE	Energy Sources, Part A: Recovery, Utilization and Environmental Effects	2022	15567036	Scopus	58
49	Thermal, mechanical, and electrical properties of difunctional and trifunctional epoxy blends with nanoporous materials	Ganesan J., Jeyadevi S., Siva Kaylasa Sundari S., Arunjunai Raj M., Pitchaimari G., Vijayakumar C.T.	EEE	Journal of Elastomers and Plastics	2022	952443	Scopus	59
50	Techno-economic analysis of a hybrid solar wind electric vehicle charging station in highway roads	Nishanth J., Charles Raja S., Praveen T., Jeslin Drusila Nesamalar J., Venkatesh P.	EEE	International Journal of Energy Research	2022	0363907X	Scopus	60
51	Analysis of Grid-Interactive PV-Fed BLDC Pump Using Optimized MPPT in DC-DC Converters	Oliver J.S., David P.W., Balachandran P.K., Mihet-Popa L.	EEE	Sustainability (Switzerland)	2022	20711050	Scopus	61
52	A comparative analysis of polycrystalline and bifacial photovoltaic module under various partial shading condition	Hariharasudhan T., Prince Winston D., Palpandian M., Pravin M.	EEE	Energy Conversion and Management	2022	1968904	Scopus	62
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66	Physico-chemical and Tensile Properties of Green Bio-films from Poly (Vinyl Alcohol)/Nano Ground Nutshell Filler	Loganathan L., Saravanakumar S.S.	MECH	Journal of Natural Fibers	2022	15440 478	Scopus	76
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69	Characterization of New Cellulosic Fiber from the Bark of Acacia nilotica L. Plant	Kumar R., Sivaganesan S., Senthamarai kannan P., Saravanakumar S.S., Khan A., Ajith Arul Daniel S., Loganathan L.	MECH	Journal of Natural Fibers	2022	15440 478	Scopus	79
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73	Investigation of physico-mechanical, thermal, morphological, optical and biodegradation properties of polyvinyl alcohol films reinforced with alkali treated Limonia acidissima shell powder	Loganathan L., Saravanakumar S.S., Murugan R.	MECH	Polymer Composites	2022	27283 97	Scopus	83
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76	Mechanical and physicochemical properties of green bio-films from poly(Vinyl Alcohol)/ nano rice hull fillers	Ganesh Babu A., Saravanakumar S.S.	MECH	Polymer Bulletin	2022	17008 39	Scopus	86

77	Use of Pennisetum glaucum stem powder waste as reinforcement in epoxy composites	Senthil S., Murugananthan K.	MECH	Polymer Composites	2022	27283 97	Scopus	87
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85	Low-temperature processable glass fiber reinforced aromatic diamine chain extended bismaleimide composites with improved mechanical properties	Srinivasan S., Saravanamuthu S.K.S., Syed Mohammed S.R., Jeyaraj Pandian D., Chinnaswamy Thangavel V.	Chem, PT	Polymer Composites	2022	27283 97	Scopus	95



Cellulose nanocrystals from orange and lychee biorefinery wastes and its implementation as tetracycline drug transporter

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Abstract

Cellulose nanocrystals (CNC) possess many advanced applications such as enzyme immobilization, synthesis of antimicrobial drugs, and drug carriers in therapeutic and diagnostic medicine due to its mechanical, liquid crystalline nature and rheological properties. The present study focuses on the usage of cellulose nanocrystals extracted from organic waste biorefineries like orange and lychee peels, as a drug transporter for the tetracycline antibiotic drug. Since cellulose nanocrystals are nontoxic, they could be used as a potential drug transporter for tetracycline. CNC was obtained from natural products following steps like delignification, bleaching, and hydrolysis of cellulose part of orange and lychee peels. To characterize the extracted CNC, from the fruit peels of orange and lychee, TGA, DSC, SEM, and FTIR analyses were carried out. The acidic pH around 2.0 was maintained for drug adsorption procedures of tetracycline uptake by CNC. Langmuir, Freundlich, Temkin, and Dubinin isotherms were employed to fit the adsorption experimental data, $q_{max} = 139.6$ mg/g and 179.1 mg/g for orange and lychee peel-extracted CNC respectively. The in vitro discharge of tetracycline from CNC was supported in phosphoric buffer medium at a pH of 7.2. The maximum tetracycline release was 67.41% for orange peel and 73.19% for lychee peel respectively within a period of 72 h. Thus, the procedure of tetracycline adsorption and desorption from cellulose nanocrystals confirms to be safe without exhibiting any harmful impacts on health.

Keywords Cellulose nanocrystals · Biorefineries · Orange · Lychee peel · TGA

1 Introduction

Cellulose is the most abundantly available natural polymer on earth, which is an important structural constituent of the cell

Highlights • Extraction of cellulose nanocrystals from orange and lychee peel
• Characterization of cellulose nanocrystals like TGA, DSC, SEM, and FTIR
• Adsorption of tetracycline drug on cellulose nanocrystals
• Release of tetracycline drug

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walls of various plants. Cellulose is present in a wide range of living species like algae, bacteria, and fungi [1]. Cellulose possesses many excellent properties such as biodegradable, biocompatible, and renewable natural polymer and thereby considered as a better alternate to non-biodegradable polymers [2, 3]. Cellulose is a high molecular weight linear homopolymer, made up of β -1,4-linked glucopyranose units; each monomer is connected to its nearby monomer unit at 180° [4, 5]. The strong hydrogen bonds formed due to the presence of hydroxyl groups are the key factor for the exhibited properties as micro-fibrilled structure, crystalline and amorphous fractions of hierarchical organization, and highly cohesive nature [6, 7]. Cellulose is composed of highly ordered crystalline arrangements along with disordered amorphous regimes in diversified proportions based on the nature of source [6].

Nanocellulose is getting more focus nowadays due to the adaptability in its physical and chemical characteristics [8, 9]. CNC-based aerogels are gaining its attraction in pharmaceutical industrial applications owing to their highly porous structure and surface area, which in turn impart enhanced drug bioavailability and superior drug-loading capacity [10–12].



Production and characterization of exopolysaccharide from the sponge-associated *Bacillus subtilis* MKU SERB2 and its in-vitro biological properties

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ABSTRACT

In this study, the sponge-associated a potential endosymbiotic bacterium, *Bacillus subtilis* MKU SERB2 was identified and optimized the production of exopolysaccharide (EPS) by using response surface methodology (RSM). The central composite rotatable design (CCRD) exhibited the highest yield of EPS (617.81 µg/mL) obtained from the optimized medium containing 11.5 g/L of sucrose, 3.5 g/L of yeast extract, 3.0 g/L of peptone, and 2.5 g/L of calcium chloride. Fourier transform infrared (FTIR) spectrum of purified EPS indicated that the presence of carboxyl, hydroxyl, and amide as functional groups, and their structural composition was confirmed by ¹H and ¹³C nuclear magnetic resonance (NMR) analysis. Moreover, the fibrous, porous and semi-crystalline nature of EPS was confirmed by SEM and X-ray powder diffraction (XRD) analysis and the EDX inferred demonstrated the presence of C, Na, O, N, S, and Cl respectively. Further, the isolated EPS exhibited potent antioxidant activity and moderate anticoagulant efficacy whereas there was no hemolytic and lymphocytes toxicity. Overall, our result suggests that the functional and biological properties of the EPS imply the potential applications in food and pharmaceutical industries in the future.

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1. Introduction

Exopolysaccharides (EPS) is the high-value added biopolymer produced by microorganisms, which is widely used for many biomedical applications that bring interest in innovative investigation of new bioactive EPS [1,2]. EPSs are long-chain branched biopolymer containing different classes of biological macromolecules comprises various simple sugars in different composition and side-chain along with some inorganic constituent like sulfate [3], that gives unique structural and physicochemical properties. EPS offers suitable applications such as stabilizing, viscosifying, emulsifying or gelling agents in food industries [4,5]. Generally, EPS produced by bacteria, cyanobacteria, and yeast are mainly composed of simple carbohydrates, usually hexose and pentose sugars in various combinations [6,7]. Among the various microbial EPS, bacterial EPS have a simple structure, easily biodegradable and harmless to human as well as the environment. Recently, EPS are widely used various biomedical applications, including immunomodulatory activity, antioxidant, anticoagulant, anti-inflammatory, antithrombotic and drug delivery agents [8–10]. Commercially important EPS were isolated from few bacterial species, including *Xanthomonas campestris* (Xanthan gum), *Paenibacillus polymyxa*

92 (Levan), *Sphingomonas paucimobilis* (Gellan), and *Pseudomonas* sp. (Alginate) are used in the food and pharmaceuticals [11–13]. In this context, searching a new EPS source with potent bioactivity from the marine origin has gained interest in recent years. Marine sponge-associated bacteria are currently recognized as a rich source of biopolymer with potential interest for various industrial applications [14]. Among the sponge-associated bacteria, Gram-positive bacteria (*Bacillus* sp.) have been proven to be a potent source of EPS production and also being used extensively in many industries [15,16]. Hence, this study aimed to investigate the production of EPS from the marine sponge-associated bacterium *Bacillus subtilis* MKU SERB2 using RSM-CCRD and to characterize the chemical properties of EPS using analytical techniques. Further, the antioxidant, anti-thrombotic, hemolytic and lymphocyte toxicity of the isolated EPS were evaluated using in vitro assays.

2. Materials and methods

2.1. Isolation and screening of EPS producing bacteria


Necessary permission and approval (Ref. No. WL(A)/33,102/2018) was obtained from the Chief Conservator of Forests and Chief Wildlife Warden, Government of India for sponge collection from the Southeast

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Synergistic effect of fast extrusion furnace (FEF) black on viscosity and rheological properties of ethylene propylene diene monomer vulcanizate

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ABSTRACT

An investigation is made on vulcanizates based Ethylene propylene diene monomer (EPDM) rubber which is prepared by incorporating 30 phr of cellulose short fibres along with different loading levels of fast extrusion furnace black (FEF) at an increment level of 20 phr in two roll mill. EPDM rubber was found as an attractive candidate for the thermal insulation of case-bonded SRM due to the advantages such as low specific gravity, improved ageing properties, and longer shelf life. This research provides theoretical and experimental characterisation for the friction behaviours of EPDM rubber. The effect of FEF on viscosity and rheological properties of various EPDM compounds such as C1–C8 were fairly investigated using the Monsanto moving die Rheometer (MDR 2000), and Mooney viscometer. The curing characteristics like TS2, TS5, ML, MH, cure time (TC90), and viscosity of various EPDM compounds were extensively determined and the results were critically compared. It was fairly observed that the reinforcement of FEF along with cellulose short fibres in the EPDM compounds has made a greater impact on improving the rheological properties and showed the synergistic effect between the fillers and the rubber matrix. The increase in temperature causes a decrease in the friction coefficient.

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KEYWORDS

Cure time; cellulose short fibres; carbon black; fillers; vulcanizate; viscosity

1. Introduction

Elastomer plays an important role in modern times of industrialisation. The renewable materials and recycling materials are used for fresh applications. EPDM rubber is reported in early literatures for its excellence, for example it is used in the automotive seal system^[1] and the white side walls of tires.^[2] When compared with Polytetrafluoroethylene (PTFE) and/or metal, EPDM rubber (Ethylene propylene diene monomer (Keltan-512) rubber) is an example of a synthetic elastomer.^[3,4] EPDM rubber is used in the production of tyres for truck & car off the road tyres (OTR), tire treads, V-belts and tubes in the automotive industry.^[5–10] Due to its properties like high resistance to ozone, weather influences etc. Introduction of Fillers in the form of either powder or fibre increases its viscosity and rheological properties.


In recent years, the manufacture of elastomeric compounds has increased distinctly due to their well-balanced viscosity, rheological and surface morphological properties, processing capability and comparatively low cost.^[11] The majority usage of elastomers would not be viable without reinforcing it with certain black fillers, like carbon blacks (CBs) and structured cellulose short fibres. The reinforcement can be defined as the improvement in viscosity,

rheological properties like ML, MH, TS5, T_{c90} , stiffness due to orientation of short fibres and dispersion of vulcanised compounds through the incorporation of finely divided porous particles.^[12,13] Today the most smart investigation techniques are used to characterise the reinforcing black and white mineral fillers and also to understand the incredible origin of interactions between the rubber- fillers.^[14–16]

Rheology is deals with the study of deformation of materials and relating the important concepts such as shear stress, deformation rate, and viscosity. When rubber compounds are filled with different variety of additives it exhibits different rheological properties.^[17] Reinforcement of rubber filled by carbon blacks was reported.^[18] It is associated with the chemical and physical interactions between the polymer matrix and carbon blacks.^[19–23] This is due to the presence of active polar groups such as phenol, carboxyl, and quinone on the carbon black surfaces.^[24–26] These polar groups on the carbon black surfaces bonds with rubber because of its polar- polar interaction.^[27] The degree of reinforcement depends on the concentration of carbon black and its properties like particle size, surface area, aggregate structure, distribution and its interaction.^[28] The interaction can be improved by the introduction of polar groups by means of loading of several fastidious additives.^[29] Particulate fillers increase the strength of an EPDM



Synergistic effect of fast extrusion furnace (FEF) black on viscosity and rheological properties of ethylene propylene diene monomer vulcanizate

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ABSTRACT

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1. Introduction

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Use of activated *Chromolaena odorata* biomass for the removal of crystal violet from aqueous solution: kinetic, equilibrium, and thermodynamic study

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Abstract

In the present study, biomass from the *Chromolaena odorata* plant's stem was activated using sulfuric acid to adsorb crystal violet (CV) dye. The adsorption operation of CV dye was studied considering the effect of variables like pH, initial dye concentration, time, adsorbent dosage, and temperature. The pseudo-second-order equation best fitted the kinetic study. The thermodynamic parameters such as activation energy (9.56 kJ/mol), change in Gibbs energy (81.43 to 96.7 kJ/mol), enthalpy change (6.89 kJ/mol), and entropy change (-254.4 J/mol K) were calculated. Response surface methodology estimated that at pH (4.902), adsorbent dosage (8.33 g/L), dye

Spectroscopic and topological analysis and in vitro antimicrobial activity of phenothiazine

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ABSTRACT

The vibrational spectral analysis of phenothiazine is done by experimental results and theoretical investigation for identifying its pharmaceutical nature. The experimentally observed vibrational wavenumbers are compared with the calculated vibrational frequencies. Natural bond orbital analysis interprets the intramolecular contacts of phenothiazine molecules. Ultraviolet-visible spectra of the phenothiazine have also been recorded and the electronic properties. The ¹H and ¹³C nuclear magnetic resonance chemical shifts of the molecule have been calculated by the Gauge Independent Atomic Orbital method and compared with the experimental outcome. The interpreted frontier molecular orbital energies indicated the chemical stability of the molecules. Fukui function and Mulliken analysis on atomic charges of the phenothiazine have been discussed. Docking studies were performed for phenothiazine using the molecular docking software with 3 fungicidal active proteins. The stability of the title compound has been investigated via molecular dynamics simulations. The in-vitro analysis had done with fungal and bacterial pathogens, *Aspergillus niger* and *E.Coli*.

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KEYWORDS



Antimicrobial activity; density functional theory; molecular dynamics simulation; normal coordinate analysis; vibrational spectroscopy


Introduction

Phenothiazine derivatives are highly bioactive and have widespread use and rich history. More than a hundred derivatives of Phenothiazine exhibited promising antibacterial, antifungal, anticancer, anti-viral, anti-inflammatory, antimalarial, antifilarial, trypanocidal, anticonvulsant, analgesic, immunosuppressive, neuroleptic, and multidrug resistance reversal properties.^[1,2] The Phenothiazine ring system has been chemically modified to exhibit various activities like anti-inflammatory agents, anti-bacterial, anticonvulsants,^[3] anti-histaminic, anthelmintics,^[4,5] neuroleptics, tranquillizers, anti-cholinergic, anti-allergic, anti-carcinogenic.^[6] Phenothiazine is a prototypical pharmaceutical lead structure in medicinal chemistry. Several phenothiazines were identified to not only synergise with

antibiotics but also possess their own intrinsic antibacterial activity.^[7] Synthesis and antimicrobial activity of some new N-acyl substituted phenothiazines have been reported Bansode Tanaji et al.^[8]

So many researchers explain the structure-activity relationship of organic molecules with the help of DFT calculation and in vitro evaluations. The structure-activity and DFT calculations are interrelated. For example; the frontier molecular orbital lowest energy gap shows the highest chemical reactivity of organic compounds which leads the molecule toward bio-activity. Some atomic construction and spectral investigation of phenothiazine-related derivatives are recorded here. Zohreh Parsaee et al.^[9] reported in vitro evaluation and DFT study of novel phenothiazine derivatives.^[9] Optical properties of

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Novel acrylate copolymer based on 4-(2-bromo-3-(4-bromophenyl)-3-oxo prop-1-enyl) phenyl acrylate: Synthesis, characterization, biological and drug releasing studies

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ABSTRACT

Novel copolymer poly(DBA-co-GMA) and poly(DBA-co-MA) was synthesized by utilizing synthesized 4-(2-bromo-3-(4-bromophenyl)-3-oxo prop-1-enyl) phenyl acrylate (DBA), Glycidyl methacrylate and Methacrylic acid. Solution polymerization technique is used for the above said polymer preparation, ¹H NMR, FT-IR and UV spectrophotometer confirms the formation of copolymer. The presence of functional groups confirms by the FT-IR spectrum. The UV-visible spectrum shows two absorption peak around 250 and 340 nm. The polymerized proton peak which is present around 1 to 1.5 ppm in the ¹H NMR confirms the formation of the product. Synthesized polymer having weight average molecular weight around 8000 g/mol was confirmed by gel permeation chromatography technique. Polymers showed two stage decomposition patterns when subjected to thermal treatment. All polymeric compounds are highly active on both gram positive and gram negative bacteria. Antimicrobial activity is high for the tested bacteria especially for *E. coli* (3.91 µg/mL). The drug releasing behavior of the copolymer is studied by the UV-visible spectroscopic technique and the drug releasing behavior of the polymer was found that it follows Fickian model.

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1. Introduction

Acrylate-based polymers are employed in a variety of industries, including dye, paint, adhesives, and medicine carriers [1,2]. Because of its superior antibacterial activity, chalcone-based acrylate polymer was manufactured in huge quantities. Acrylate monomer is a highly versatile molecule that may be utilised to make a variety of copolymers. Acrylate monomer is responsible for a variety of amazing polymer properties, including flexibility and stiffness, functionality, and both hydrophobic and hydrophilic properties. Antibacterial medicine [3] often contains chalcone based acrylate polymers with glycidyl methacrylate (GMA) or Methacrylic acid (MA). The thermal stability of the chemical is improved by using an acrylate copolymer with a phenyl ring. GMA containing polymers are commonly employed as high tem-

perature thermal adhesives and to bind drug carriers. Because of its wide range of applications in industries such as coatings, outdoor appliances, and adhesives, methacrylic acid has been utilised to synthesis copolymers for a long time. Glycidyl methacrylate, which is also utilised in powder coating and various appliance finishes, was employed to create a variety of epoxy resins. The acrylate copolymer is a crucial component of the leather coating process. A variety of printing plates and electrical gadgets were also made with an acrylate polymer with an epoxy group. Methacrylic acid polymer is commonly utilised in industries for top coating preparation [4,5]. Some acrylate polymers with halogenated chalcone have been utilised to treat cancer cell lines and in tissue engineering [6,7]. According to literature reviews, the polymer with the chalcone moiety has excellent biological characteristics and can be employed as a drug carrier as well as an internal drug molecule [6].

As a result, this type of polymer was able to effectively regulate bacterial activity. Due to these reasons, we opt to make a chalcone

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Spectroscopic Investigation, DFT Calculations, anti-Inflammatory Activity and Molecular Dynamic Simulation Study on Fagaramide Alkaloid

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ABSTRACT

Fagaramide (FA) alkaloid was investigated experimentally using FT-IR, FT-Raman and NMR (¹H and ¹³C) spectra, also theoretically studied using density functional theory (DFT) calculations. To obtain the ground state geometry and vibrational frequencies of FA molecule, DFT calculations were performed at the B3LYP/6-31++G(d,p) level. The potential energy distribution (PED) analysis of the title molecule was obtained with the help of normal co-ordinate analysis (NCA) and these assignments were compared with the experimental FT-IR and FT-Raman spectrum. The natural bond orbital (NBO), reduced density gradient (RDG) and Hirshfeld surface analysis were applied to evaluate the relative strength of hydrogen bond interaction and to represent their effect on the stabilization of molecular arrangements. Electron localization function (ELF) and localized orbital locator (LOL) maps were generated to show electron delocalization in the molecule. The reactivity of the molecule was studied by the investigation of frontier molecular orbital analysis, density of states (DOS), molecular electrostatic potential (MEP) and chemical reactivity descriptors. Furthermore, through molecular docking, the anti-inflammatory activity of FA was studied and discussed. A molecular dynamic simulation (MDS) was employed to explore biomolecular stability.

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KEYWORDS

Fagaramide; FT-Raman; ELF; anti-inflammatory activity; MDS

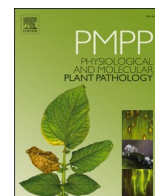
1. Introduction

Fagaramide (3-(1,3-benzodioxol-5-yl)-N-(2-methylpropyl)-prop-2-enamide) is the major constituent of butylamide alkaloid in the plant *zanthoxylum gillettii* and *zanthoxylum zanthoxyloides* (Rutaceae).¹ The molecular formula of fagaramide (FA) is C₁₄H₁₇NO₃. It was possessing a wide spectrum of biological activity such as anti-inflammatory,² antiplasmodial,³ insecticidal⁴ and antiviral.⁵ It was also effective against the carrageenan-induced paw edema in rats and effective against the prostaglandin phase of acute inflammatory response.¹ Trans-fagaramide was showed significant antimycobacterial activity against the susceptible TB strain and MDR-TB strain.⁶ Proton affinity and bond energy of fagaramide and related amide alkaloids were observed by Fokoue et al.⁷ The crystal structure of fagaramide compound was reported by Scott Bohle et al.⁸ The literature review revealed that there was no complete description of experimental and computational techniques on fagaramide have been performed. This encouraged us to do the

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Statistical modeling and optimization for the production of secondary metabolites by lichen mycobiont isolated from *Parmotrema austrosinense*

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Parmotrema austrosinense

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ABSTRACT

Lichens produce range of secondary metabolites which exhibit multifarious biological potential. The present work highlights the effect of media components for the production of secondary metabolites by lichen *Parmotrema austrosinense*. Mycobiont was isolated by lichen tissue culture method. One variable at a time approach exhibited that, Malt yeast extract media supplemented with glucose (4 mg/L), asparagine (1 mg/L), MnSO₄ 4H₂O (20 mg/L), ZnSO₄ 7H₂O (20 mg/L) and H₃BO₃ (4 mg/L) enhanced the growth of lichen mycobiont with improved total phenol production. The major influencing media components on total phenol content was screened through Plackett-Burman experimental design. Yeast, glucose and MgSO₄ 4H₂O have been observed as effective media components. The screened variables have been further optimized by response surface methodology. The optimum media composition was found as 4.04 g/L glucose, 3.15 g/L yeast and 21.43 mg/L MnSO₄ 4H₂O resulted with the maximum total phenol content of 1.80 ± 0.1 µg/g. Thus, the study established a suitable media component for the enhanced production rate of secondary metabolites in terms of total phenol content.

1. Introduction

Lichens comprise of many organic compounds that predominantly belong to secondary metabolites. Mycobiont partner of symbiont produce secondary metabolites. Aposymbiotic fungi produces the same secondary metabolites as like natural lichen thallus in some cases [28]. Wide spectrum of secondary metabolites with antibiotic, antiviral, antimycotic properties are produced by lichens [20]. These lichen secondary compounds are produced by acetate–polymalonate pathway, shikimic acid pathway, and mevalonic acid pathways. Moreover, most of the secondary metabolites are phenolic compounds [10]. Phenolic hydroxyl groups are responsible for the antioxidant nature of polyphenols, which are having high free radical scavenging potential [9]. Estimation of total phenol gives a direct indication of secondary metabolites present in lichen. Lichen mycobiont requires a suitable media

composition for their proliferation. Growth of mycobionts depend on carbon source, vitamins and amino acids [27]. Factors such as pH, light/dark cycle and temperature influences the growth of lichen mycobionts as well [16]. Secondary metabolite production of lichens was enhanced by the addition of carbon and nitrogen sources [24]. Nitrogen sources such as sodium nitrate and ammonium nitrate enhanced the secondary metabolites production in fungus [12].

Media optimization studies are considered as preliminary and mandatory study for executing large scale secondary metabolites production [25]. Mycobiont exhibit different growth rates in different media [2]. To improve the production of the metabolites researchers screened the nutritional requirements of the media. Behera & Makhija (2011) studied the effect of *Bulbothrix setschwanensis* culture conditions for the salazinic acid production [31]. reported that mannitol and ribitol supported the growth of lichenicolous fungi [22]. supplemented 20 g/L

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Research Papers

ZnAl₂O₄ supported on lychee-biochar applied to ibuprofen photodegradation

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ABSTRACT

In this study, composites of biochar-ZnAl₂O₄ produced by the pyrolysis of the lychee waste biomass were synthesized. The composites were characterized by XRD, FTIR, SEM, BET, and BJH. The biochar-ZnAl₂O₄ composite was successfully formed and the efficiency was tested in adsorption and photocatalysis experiments. The adsorption equilibrium was obtained with a contact time of 60 min. Data on modeling and optimization of ibuprofen removal by statistical approach were fitted to quadratic equations using multiple regressions and analysis of variance (ANOVA). An RSM-CCF has been proposed for the enhanced removal of ibuprofen by adsorption followed by photocatalysis. The composite reached 100% efficiency of degradation of ibuprofen (20 mg L⁻¹) in 120 min, under conditions of pH = 6.5, 25 °C, 1 g L⁻¹ of composite. The ZnAl₂O₄ supported significantly increased the composite adsorption performance and factors such as specific surface area (111.69 m² g⁻¹), pore volume and pore size (mesoporous region) of the biochar synergistically promoted the photocatalytic activity of ZnAl₂O₄, with $k = 0.0093 \text{ min}^{-1}$. The adsorption and photocatalytic efficiencies were confirmed to contribute to the degradation of the ibuprofen aqueous solution by the radicals •OH and O₂• in lower molecular weight by-products. The composite developed in this work showed that the support of ZnAl₂O₄ in the biochar is essential to increase photoactivity, therefore, it has shown to be a promising material for adsorption and degradation of emerging pollutants such as the ibuprofen, avoiding transfer of pollution to another environmental medium.

Introduction

The development model of society over the years has caused manifold negative impacts on the environment, whether they are air, soil, or water resources pollution. Since one of the emerging concerns has aroused interest of the scientific community, it is the contamination of water sources by drug residues [1]. Since these products are considered genes extremely necessary for the population, these products have the function of combating diseases to the extent of human longevity [2]. The diversity of medicines leads to different biological activities that can be maintained after metabolism and excretion in the environment, this fact can bring risks to public health and the environment, since its residues have resistant and difficult to decompose components that can contaminate the soil and the water [3,4]. A range of active principles has characteristics of stability and resistance to external factors such as pH, temperature, and humidity, which are essential for the drug to be able to

exercise its functions in the body. However, they make these substances to remain in the environment as biologically active compounds. In addition, its intrinsic, lipophilic characteristics and low biodegradability have great potential for bioaccumulation, biomagnification, and persistence in the environment [5]. The main route of entry of drugs into the aquatic environment is sewage treatment plants since conventional technologies present a limitation in the treatment of drugs. In addition to these, there may be other sources of drug dispersion in the environment. There is growing concern about the possible toxic and adverse effects of these compounds on exposed aquatic organisms, as well as the various links in the food chain that can feed on these contaminated organisms [5]. A critical point in this matter is the possibility of enough level to have adverse effects on living beings. The contamination of springs by pharmaceutical compounds has occurred in several places and, consequently, it has become a challenge for the systems that produce and distribute water. Among the water pollutants, pharmaceutical

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Microplastics in mangroves and coral reef ecosystems: a review

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Abstract

Microplastic pollution has recently been identified as a major issue for the health of ecosystems. Microplastics have typically sizes of less than 5 mm and occur in various forms, such as pellets, fibres, fragments, films, and granules. Mangroves and coral reefs are sensitive and restricted ecosystems that provide free ecological services such as coastal protection, maintaining natural cycles, hotspots of biodiversity and economically valuable goods. However, urbanization and industrial activities have started contaminating even these preserved ecosystems. Here we review sources, occurrence, and toxicity of microplastics in the trophic levels of mangrove and coral reef ecosystems. We present detection methods, such as microscopic identification and spectroscopy. We discuss mitigating measures that prevent the entry of microplastics into the marine environment.

Keywords Microplastics · Ecosystems · Mangroves · Coral reefs · Pollution · Toxicity

Abbreviations

AcHE	Acetyl cHoline Esterase	FESEM	Field Emission Scanning Electron Microscopy
ATR	Attenuated Total Reflection	FTIR	Fourier Transform Infrared
BaP	Biofilm-associated Protein	gadd45ba	Growth arrest and DNA-damage inducible, beta protein
BP3	Binding Protein 3	GC–MS	Gas Chromatography–Mass Spectroscopy
casp3b	Caspase 3 protein	H ₂ O ₂	Hydrogen peroxide
CO ₂	Carbon dioxide	Km ²	Square kilometre
COVID-19	Corona Virus Disease 2019	KOH	Potassium hydroxide
DOE	Diffractive Optical Element	LASER	Light Amplification by Stimulated Emission of Radiation
EDX	Energy Dispersive X-ray spectroscopy	LDPE	Low density polyethylene
		m ³	Cubic metre
		mm	Milli metre
		µgL ⁻¹	Microgram per litre
		MPs	Micro Plastics
		MT	Metric Tonnes
		NOAA	National Oceanic and Atmospheric Administration
		p53	Protein 53
		PBS	Polybutylene succinate
		PE	Polyethylene
		PET	Polyethylene terephthalate
		PHA	Poly hydroxy alkanooate
		PLA	Polylactic acid
		PP	Polypropylene
		PPCPs	Personal care products
		PPE	Polypropylene ether
		PS	Polyester

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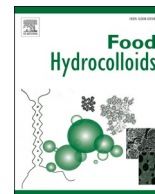
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Process optimization and characterization of pectin derived from underexploited pineapple peel biowaste as a value-added product

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Pectin
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Response surface methodology

ABSTRACT

Biowastes generated from the food processing industries cause environmental issues due to nitrogen, phosphorous, macronutrients, and water contents. These nutrients make the wastes more susceptible to fermentation, thus causing pollution. However, these biowastes contain a high level of marketable bioproducts extracted for value-added products like pectin. The current study deals with the pectin extraction from pineapple peel (PP) waste employing the ultrasound-assisted extraction (UAE) technique. Further, response surface methodology (RSM) was employed to determine the optimum conditions for maximum pectin extraction using independent variables like ultrasonication time (15–30 min), liquid to solid (LS) ratio (10–20 mL/g), temperature (50–80 °C) and pH (1–2). A maximum pectin yield (16.24%) was attained at 15.20 mL/g of LS ratio, 21.88 min of ultrasonication, 70.83 °C and pH 1.0. The extracted pectin was purified using anion exchange chromatography (DEAE cellulose), and the purity index was 89.5–90%. The purified pectin fractions were analyzed through thin-layer chromatography and characterized by SEM, FT-IR, TGA, XRD, 1D and 2D NMR. The polysaccharide content was quantified using the phenol-sulfuric assay. Other functional properties like emulsification, oil and water holding capacity were also measured. In addition, based on antinutritional and antioxidant properties, the extracted PP pectin was confirmed to be a toxic-free compound. A detailed structural and physio-chemical properties study confirmed the pectin from PP was of good quality and could be utilized as a value-added product in the pharmaceutical industry.

1. Introduction

Over the last few years, there has been a growing awareness of environmental preservation and resource sustainability. As a result, natural resource management is regaining prominence in material technology as a viable alternative to non-renewable reserves. Fruit processing industries generate many highly perishable biowastes that are set down in the environment, adding significantly to the

accumulation of solid wastes and leading to pollution. Thus, a greater concern is needed for processing these wastes by the relevant industries and that the disposal of wastes is also properly monitored by pollution monitoring authorities (Minjares-Fuentes et al., 2014).

Pineapple (*Ananas comosus*) is amongst the most prominently traded tropical fruits globally after avocado, mango, and bananas. Moreover, it is considered as one of the most popular fruit juices after orange and apple. Globally, pineapple is harvested over 1.12 million hectares, yielding 28.17 million tonnes of fruit, with 1.71 million tonnes produced

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¹ Equal contribution.



Agricultural waste materials for adsorptive removal of phenols, chromium (VI) and cadmium (II) from wastewater: A review

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ABSTRACT

Management of basic natural resources and the spent industrial and domestic streams to provide a sustainable safe environment for healthy living is a magnum challenge to scientists and environmentalists. The present remedial approach to the wastewater focuses on recovering pure water for reuse and converting the contaminants into a solid matrix for permanent land disposal. However, the ground water aquifers, over a long period slowly leach the contaminants consequently polluting the ground water. Synthetic adsorbents, mainly consisting of polymeric resins, chelating agents, etc. are efficient and have high specificity, but ultimate disposal is a challenge as most of these materials are non-biodegradable. In this context, it is felt appropriate to review the utility of adsorbents based on natural green materials such as agricultural waste and restricted to few model contaminants: phenols, and heavy metals chromium(VI), and cadmium(II) in view of the vast amount of literature available. The article discusses the features of the agricultural waste material-based adsorbents including the mechanism. It is inferred that agricultural waste materials are some of the common renewable sources available across the globe and can be used as sustainable adsorbents. A discussion on challenges for industrial scale implementation and integration with advanced technologies like magnetic-based approaches and nano-technology to improve the removal efficiency is included for future prospects.

1. Introduction

Environmental pollution is a challenge particularly when industrial effluents are present in water bodies. The majority of waste from industries is easily transported into wastewaters, and they contain organic and inorganic contaminants. Organic species including phenol and metal ions like chromium(VI), cadmium(II), etc. are toxic to humans either being carcinogenic or affecting the physical-motor functioning of the body. Phenol is discharged by many industries including refineries and organic chemicals manufacturing as it is used as a precursor and an intermediate (Mohammadi et al., 2015). Chromium(VI) is contained in

the industrial discharges of dyes and tanneries and is carcinogenic (Rosales et al., 2016). Cadmium(II), along with its compounds, can be found in the industrial discharges related to pigments, mining, plastics, corrosion resistance steel, metal plating, phosphate fertilizer, alloy industries, and the battery industry. Cadmium(II) is highly toxic and suspected to be carcinogenic (Jayakumar et al., 2021; Rahimzadeh et al., 2017).

World health organization (WHO) sets global norms for potable water quality that provide guidance to various regulatory bodies for establishing standards. The guidelines primarily aim at public health protection in relation to drinking water safety. The permissible phenolic,

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Comparative study of different catalysts mediated FAME conversion from macroalga *Padina tetrastromatica* biomass and hydrothermal liquefaction facilitated bio-oil production

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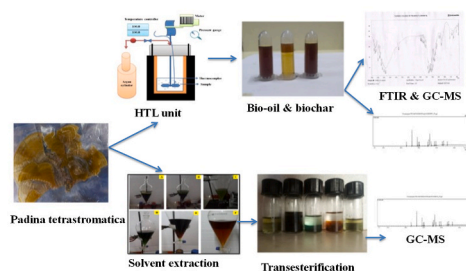
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HIGHLIGHTS

- *Padina tetrastromatica* was employed for biofuel production using transesterification and hydrothermal liquefaction.
- Oil extraction by PE and DCM resulted in increased yield than the other solvents in liquid-liquid extraction.
- Maximum 92.3% of FAME recovery was achieved by TiO₂ nanocatalyst than conventional catalysts.
- Bioactive metabolites were identified from bio-oil through HTL reaction.
- Biofuel quality parameters of *Padina tetrastromatica* met the international standards specifications.

GRAPHICAL ABSTRACT



ARTICLE INFO

Handling Editor: Derek Muir

Keywords:

Macroalgae
Nanocatalysts
Hydrothermal liquefaction
Biodiesel

ABSTRACT

Marine macroalgae offer an enduring source of renewable biomass, which do not require cultivable area, fertilizers for cultivation for bioproducts production. In this study, marine brown macroalga *Padina tetrastromatica* as an alternate sustainable feedstock for the production of liquid fuels. *Padina tetrastromatica* biomass was collected from Mandapam; the coastal region of Rameswaram, Tamil Nadu, India. and the algal oil was extracted using sequential extractions using various solvents. Petroleum ether (PE) and dichloromethane (DCM) solvent fractions were found to have high lipids and further utilized for biodiesel production, wherein four different

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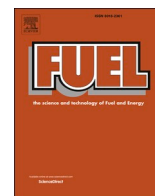
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Microwave-assisted pyrolysis for carbon catalyst, nanomaterials and biofuel production

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Lignocellulosic biomass
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ABSTRACT

The current scenario of environment urgently needs alternative biologically synthesized fuels, value-added products, and preparation of catalyst to create a pollution free environment. Usually, several methods are available for the synthesis of various commodities from many biological resources. Microwave-assisted pyrolysis (MAP) is a relatively new process and has emerged as a promising technique to transform biomass feedstock into biofuels, including bio-oil, syngas and biochar. This paper provides a state-of-art review on MAP of several wastes such as lignocellulosic biomass, waste oils, municipal solid waste and electronic waste, discussing on the biofuels produced (bio-oil, syngas and biochar) as well as the synthesis of carbon nanomaterials (carbon nanotubes and carbon nanofibers). The use of microwave adsorbent and catalyst in MAP process are reviewed, including utilization of biochar as one of the microwave absorbers. Life cycle analysis and scale-up process with the global view of MAP are presented to contribute to the further advancement and commercialization of this technology. Although there are several challenges to be resolved, MAP has a high energy efficiency and is an increasingly feasible technique to be scalable, economical and environmental friendly.

1. Introduction

Globally, waste biomass has been associated with disposal challenges that has caused significant environmental pollution. This has resulted in ongoing research for the development of a useful product obtained from biomass conversion. Pyrolysis is an effective method for the thermochemical conversion of biomass which involves heating of the biomass in an anaerobic environment resulting in devolatilization of the biomass to yield solid, liquid and gaseous products [1,2]. Besides the advantage of an efficient conversion of the feedstock, the products obtained are useful, high-value end products, thus attracting increased research interest [3]. Various research into microwave-assisted pyrolysis (MAP) has

proven that microwave heating offers more advantages to conventional heating methods due to low power consumption, higher heating rates being achieved and uniform heating of the feedstock material [4,5]. The mechanism behind the microwave method is an incursion of microwave radiation into the substrate and the process of conversion of microwave energy into thermal energy is usually occurred. Following this, the process of heat exchange from in and out of the particle leads to easier end-product formation.

Three main products formed during the MAP process are bio-oil, syngas and biochar, which are potential for power heat and bioenergy generation. MAP process generally yields a higher quantity of bio-oil than the conventional process (CP). The electromagnetic wave directly

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Integrated global optimization and process modelling for biodiesel production from non-edible silk-cotton seed oil by microwave-assisted transesterification with heterogeneous calcium oxide catalyst

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ABSTRACT

Second generation feedstock like non-edible seed oil, used cooking oil, and animal fats for biodiesel production has huge potential, yet these feedstocks have been underutilised. In this current study, non-edible *Ceiba pentandra* seed oil (CPSO) was used to produce biodiesel. *Ceiba pentandra* seed yielded an oil content of 18.6% after extraction. CPSO had 6.87% free fatty acid, 0.911 specific gravity, 98.9 g I₂/100 g oil iodine value, 1.47 refractive index, 189.14 mg KOH/g oil saponification, 13.67% acid value, and 3.29 meq O₂/kg oil peroxide value. CPSO was characterized using Fourier transform infrared spectroscopy (FT-IR) and gas chromatography-mass spectrometry (GC-MS) analysis. The free fatty acid value of CPSO was reduced to 0.83% using the esterification process at 60 °C for 60 min with a 3:1 methanol to oil volumetric ratio, 5% sulfuric acid. The microwave-assisted transesterification process (MATP) was carried out by CPSO and methanol as reactants and calcium oxide (CaO) as a catalyst. CaO was characterised using FT-IR, scanning electron microscope, energy dispersive X-ray analysis, and Brunauer–Emmett–Teller analysis. To optimise the process variable of the MATP, response surface methodology was used, followed by an artificial neural network coupled with a genetic algorithm. At 270 W and 114 s reaction time, 0.3 wt.% CaO, and 18:1 alcohol to oil molar ratio, 97.4% biodiesel yield was obtained. FT-IR, GC-MS, ¹H & ¹³C Nuclear magnetic resonance, Heteronuclear single quantum coherence spectroscopy, and Heteronuclear multiple-bond correlation were used to characterise the biodiesel. In conclusion, CPSO has the potential to produce a large quantity of quality biodiesel by the application of the CaO catalyst.

1. Introduction

Modern civilisation's energy needs are mostly fulfilled by fossil fuels. In the year 2020, diesel (30.4%) and gasoline (28.8%) were the most consumed fuels (Dale, 2021). Petroleum diesel creates pollution of CO, CO₂, NO_x, SO_x, solid particulate matter, and other hydrocarbons. Biodiesel, or fatty acid methyl esters, is made from renewable sources via transesterifying triglycerides and is a better alternate to petroleum diesel (Michael Rahul et al., 2020). Biodiesel reduces CO₂ emissions by 78%, SO_x emissions by 100%, CO emissions by 35%, and particulate matter by 32% when compared to fossil fuel-based diesel (Oyetola and Noor, 2021). In the year 2020, 12,250,000 bbl/d of diesel was consumed

worldwide, while only 716,000 bbl/d of biodiesel was produced (Dale, 2021). The amount of biodiesel produced is very small as compared to the amount of diesel consumed worldwide. The improvement in the existing technology for producing large quantities of biodiesel is the need of the hour.

The quality of biodiesel produced from different biomass varies depending on the composition of the feedstock. The use of third (microalgae) and fourth generation (genetic engineered microalgae) renewable feedstocks for producing biodiesel has gained wide attention in recent years (Michael Rahul et al., 2020). On the other hand, second-generation feedstock (non-edible seed) is underutilised. Non-edible seed crops are commonly found on marginal soil or

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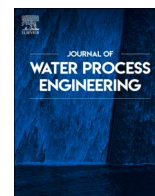
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Optimization of electrocoagulation process for treatment of rice mill effluent using response surface methodology

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ARTICLE INFO

Keywords:

Electrocoagulation
Electrode
Effluent
Box-Behnken design

ABSTRACT

The present work explores the impact of electrocoagulation (EC) method on the treatment of waste from rice mill industries using two different electrode materials (Iron (Fe) and Aluminum (Al)). The influence of different parameters such as inter-electrode distance (4–7 cm), effluent pH (6–8), current density (10–30 mA/cm²) and treatment time (20–40 min) on the reduction of chemical oxygen demand (COD), total dissolved solids (TDS) and total soluble solids (TSS) of rice mill effluent (RME) was evaluated through batch experimental runs using Box-Behnken design. Results reveal that the percentage removal of COD, TDS and TSS increased up to an inter-electrode distance of 6 cm, pH of 7, current density of 20 mA/cm² and treatment time of 30 min and then decreased for both electrodes. In addition, mathematical models were developed for both electrodes in order to predict the experimental data. A numerical optimization method was applied to find out the optimal operating parameters to treat RME, and the percentage removal of COD, TDS and TSS was found to be 94.79, 96.62 and 88.76 %, using the Al electrode, as well as 76.63, 78.51 and 72.03 %, for the Fe electrode, respectively. The comparison of the results attained demonstrate that the Al electrode is more suitable to treat RME than Fe using EC method.

1. Introduction

The tremendous progress in industrialization has greatly accelerated the release of pollutants into the environment. This could cause negative effects to the society and has now turned to be a major threat to the environmental sustainability [1]. The release of industrial effluent into the nearby water bodies could lead to severe effects like eutrophication and eventually contribute to mortality of the aquatic life [2]. Rice serves as the major feeding crop throughout the world. In India, rice is considered as the staple food and is the integral part of the diet. Production of edible rice involves a process called milling to remove husk and rice bran from paddy rice. Prior to milling, parboiling is performed to reduce grain breakage and to avoid nutritional loss [3], which is a

water consuming process, and soaking of paddy requires a huge quantity of water. Approximately six hundred billion liters of nutrient rich effluent was released from rice mill in every year to produce nearly 500 MMT of paddy [4]. Release of this effluent directly into the nearby aquatic bodies or land without appropriate treatment strategy is a most common practice which was a severe concern for the last two decades. This leads to deterioration of ground water quality and can have many adverse effects on the environment [5]. The water discharged into irrigated fields after soaking and cleaning can lead to health risk and can also impose threat to the quality of the crop plants due to the presence of high organic and inorganic content [6]. Due to the alkaline nature of the effluent with higher content of chemical oxygen demand (COD), total soluble solids (TSS) and organic matter, it cannot be used for any

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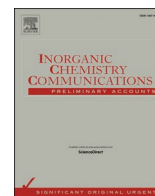
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Short communication

Titanium dioxide nanoparticles fabrication from *Parmotrema austrosinense* (Zahlbr.) Hale extracts and its antimicrobial efficacy against plant pathogens

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ABSTRACT

Green chemistry adoption in biosynthesis of nanoparticles has revolutionized the realm of phyto-medicine. Lichens that comprise the symbiotic association of fungi and either algae or cyanobacteria render eco-friendly and biocompatible applications. A plethora of secondary metabolites with redox potentials from lichens have wide applications as bioactive incumbents and bio-indicators of pollution. The present study reports, the synthesis of titanium dioxide nanoparticles (TiO₂-NPs) using an ultra-sonicated aqueous extract of the lichen *Parmotrema austrosinense* (Zahlbr.) Hale. The physico-chemical properties of TiO₂-NPs were characterized using UV-Visible spectroscopy, Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD) and Scanning electron microscopic (SEM) techniques. Bio-synthesized TiO₂-NPs exhibited an average particle size of 10–80 nm indicating structural variability. Phytochemical properties were estimated prior to assessment of antibacterial efficacies elicited by the synthesized by testing it against selected bacterial and fungal plant pathogens such as *Bacillus subtilis*, *Erwinia chrysanthemi*, *Xanthomonas phaseoli*, *Fusarium oxysporum*, *Rhizoctonia solani*, and *Sclerotium rolfsii* respectively using agar well diffusion method. The results revealed that as prepared TiO₂ nanoparticles from lichens owned significant antimicrobial activity against *X. phaseoli* and *F. oxysporum*.

1. Introduction

Titanium dioxide (TiO₂) represents the dielectric component responsible for energy production using photocatalytic activity and electrochemical properties [1–3]. TiO₂ nanoparticles accounts for key component production in various fields posing significant applications in bio-catalysis, pharmaceutical applications along with cosmetics production [4]. Nevertheless, potential utility of nanoparticles in both key realms of agriculture and medicine show escalated research and product development for commercialization aspects too [5]. Response Surface Methodology (RSM) has been reported for biosynthesis of silver nanoparticles (AgNO₃) employing green chemistry in the lichen *Cetraria islandica* (L) Ach, showed biocompatible nanoparticles under increased temperature conditions and decreased nanoparticles size [6]. Methodologies for characterization and optimization for escalated bio-medical

activities pose as a significant arena of research [7–9]. Titanium dioxide synthesized from *Phaseolus vulgaris* have been proved effective in phyto-toxicity, seed yield and morphometric augmentation that reveals plant growth promotion [10].

Titanium dioxide has been assessed for affirmed plant growth promotion activities in *Vicia faba* [11]. Moreover, titanium dioxide nanoparticles have been proved for versatile mechanisms in plant growth properties, chromosomal variations and cytotoxic activities in combating DNA damage and environmental safety [12], compared with silver nanoparticles (AgNPs) and also much more explored. Titanium dioxide nanoparticles synthesized from the lichen *Protoparmeliopsis muralis* showed that metal and metal oxide nanoparticles effectively combated multidrug resistant *Staphylococcus aureus* efficiently through inhibition of quorum sensing and antioxidant properties [13]. The titanium dioxide nanoparticles owing to its potent bactericidal and other

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Recent advances in biogas production using Agro-Industrial Waste: A comprehensive review outlook of Techno-Economic analysis

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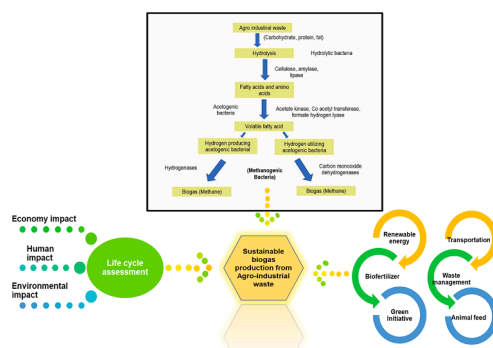
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HIGHLIGHTS

- Agricultural wastes are important sources for the production of biogas.
- Biogas or biomethane generation relieves the negative impact of fossil fuels and agrowastes.
- Biogas can be generated from agro-industrial wastes with lignin, cellulose and hemicellulose.
- Significant biogas production (>94 %) from agrowastes can be produced.

GRAPHICAL ABSTRACT



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ABSTRACT

Agrowaste sources can be utilized to produce biogas by anaerobic digestion reaction. Fossil fuels have damaged the environment, while the biogas rectifies the issues related to the environment and climate change problems. Techno-economic analysis of biogas production is followed by nutrient recycling, reducing the greenhouse gas level, biorefinery purpose, and global warming effect. In addition, biogas production is mediated by different metabolic reactions, the usage of different microorganisms, purification process, upgrading process and removal of CO₂ from the gas mixture techniques. This review focuses on pre-treatment, usage of waste, production

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A comprehensive review on analytical and equation derived multivariate chemometrics for the accurate interpretation of the degradation of aqueous contaminants

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ABSTRACT

Preciseness in pollutant analysis and optimizing a process required to remediate wastewater are essential in environmental engineering. The chemometric approach is used to analyze pollutant molecules from actual samples with maximum accuracy quantitatively. Various calibration models like Principal Component Regression, Partial Least Squares, Cluster analysis, Parallel Factor Analysis, and Artificial Neural Networks are employed to compute the pollutant concentration. In this review, the application of chemometrics in aqueous pollutant degradation processes is explained to understand better how accurate and what kind of information can be extracted from the pollutant degradation processes using chemometrics. The reaction rate-determining ability of Multivariate Curve Resolution–Alternating Least Square, a second-order chemometric model, is explained. Understanding the degradation profiles of a mixture of components and analyzing the by-product evolution are benefits of employing chemometrics. This review describes studies where chemometrics and response surface methodology-based techniques are used to gain insights into process optimization and resolve issues on the accurate determination of pollutant concentration profiles. Suitable examples of advanced oxidation methods, namely photocatalytic degradation, and gamma-ray mediated pollutant deterioration, are discussed to understand better the application of Canonical and Ridge analysis. This review gives the readers a good view of various applications of chemometrics in accurate assessment of pollutants in multi-component systems and process optimization of pollutant degradation.

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An endophytic *Streptomyces* sp. DARP-7 isolated from coastal lichen and enhancement of its antibacterial metabolite production using response surface methodology



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ABSTRACT

Actinomycete DARP-7 was isolated from the coastal foliose lichen *Dirinaria aegilota* (Afzel.ex Ach.) B.J.Moore and identified as *Streptomyces* sp. using 16S rRNA sequencing. Among the eight culture media used for antimicrobial metabolite production, the peptone yeast extract iron medium (ISP-6) showed higher production with the maximum zone of inhibition (12 mm) against *Staphylococcus aureus*. Further, the ISP-6 medium components were optimized through the Plackett-Burman design (PBD) followed by Response Surface Methodology (RSM). Yeast extract, sodium thiosulphate, and ferric ammonium citrate would play a significant role in antibiotic production. Further, the significant variables from PBD were optimized through Central Composite Design (CCD) of RSM for enhanced antibiotic production. The optimal medium components were found to be peptone - 15 (g/L), protease peptone - 5 (g/L), yeast extract - 2.915 (g/L), ferric ammonium citrate - 0.651 (g/L), K₂HPO₄ - 1 (g/L) and Na₂S₂O₃ - 0.155 (g/L), respectively. The optimized result was validated and the antibacterial activity against *S. aureus* increased upto 19.9 mm (66.7%). The resazurin dye based quantification of minimum inhibitory concentration of the DARP-7 crude extract was found to be 41.34 μg and 46.44 μg against *S. aureus* and *E.coli*, respectively. Further, the compound profiling was done using UV-VIS, FTIR, EEM and GC-MS confirming the presence of polyene conjugates. Thus, the study delivers coastal lichen could be promising source for isolating bioactive metabolites producing rare actinobacteria. Furthermore, the use of a statistical optimization tool to improve bioactive metabolite yield is discussed.

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1. Introduction

The development of multidrug resistant pathogenic organisms has become a major threat for humans worldwide. The leading public health agencies and the World Health Organization also enlighten the need for natural and potential drugs against such resistant pathogens (Korichi et al., 2021). The unique and novel drug discovery is highly associated with the type of sources screened for clinically relevant agents. Actinomycetes are gram positive, filamentous, spore producing bacteria, well known for their promising metabolite production (Jose et al., 2021). Rare actinomycetes are continuously screened and isolated from special habitats such as marine sponges, termite gut, fish gut, insects, mangroves and medicinal plants. Such isolates are promising in a unique type of metabolite production with

several biological properties such as anticancer, antihelminthic, anti-inflammatory, antioxidant and antimicrobial (Mangamuri et al., 2016). Similarly, coastal lichens are an underutilised and little understood niche that provides a large home for numerous bacteriomes. Recently, a few novel actinomycete taxa isolated from lichens, as well as several specific metabolites of lichen-associated actinomycetes, have proven that lichens could be a promising source for novel actinomycete isolation (Liu et al., 2017; Motohashi et al., 2010).

Lichens are the products of the symbiotic association between a single mycobiont (fungi) and one or more photobiont (Algae or Cyanobacteria). Lichens are also reported to be huge producers of unique secondary metabolites with several biological activities. At the same time, lichens harbour a rich diversity for prokaryotes in their thallus tissues (Kumar et al., 2010; Vishnu Raja et al., 2022). A very few studies witnessed the presence of lichen associated actinomycetes living inside the lichen thalli as endophytes. The first attempt was made by González et al. (2005) to evaluate the diversity and spatial distribution of actinomycetes in lichens collected from the tropical areas of

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Quantum chemical evaluation, QSAR analysis, molecular docking and dynamics investigation of s-triazine derivatives as potential anticancer agents

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Abstract

Recent studies have shown that 1,3,5-triazine (s-triazine) derivatives are potent anticancer agents. The optimized geometry and vibrational frequencies of three 1,3,5-triazine derivatives (2,4,6-triallyloxy-1,3,5-triazine, 2-chloro-4,6-dimethoxy-1,3,5-triazine and 2-butoxy-4,6-dichloro-1,3,5-triazine) have been computed using density functional theory (DFT) method. The intramolecular interactions of the title molecules have been analyzed using natural bond orbital analysis. The calculated frontier molecular orbitals have affirmed the charge transfer interaction takes place within the molecules. The quantitative structure–activity relationship (QSAR) has been analyzed for a set of ALK inhibitors and the externally validated QSAR model has theoretically predicted the inhibitory power of the title molecules. The molecular docking calculation has predicted the binding ability of the title compounds with the non-small cell lung cancer target. The molecular dynamic simulation study has validated the stability of the protein–ligand complexes. Furthermore, the drug-likeness and bioavailability of the title molecules has been assessed through *in silico* approach. The present investigation could help identify the 1,3,5-triazine family as an efficient anticancer drug candidate in drug discovery.

Keywords 1,3,5-triazine · DFT · QSAR · Docking · Anticancer

Introduction

Cancer is a serious life-threatening disease. Cancer differs from other diseases because it can form at any stage of life in any organ of the body. Globally, deaths from cancer are very high and it accounts for an estimated 10.0 million deaths in 2020 [1, 2]. Several bioactive compounds are being designed to meet the need to cure cancer. Among them, triazine is

regarded as an essential pharmacophore of cancer research. Triazine derivatives have been renowned for their wide pharmacological applications such as anticancer, antimalarial, anti-HIV, antileishmanial, antitubercular, antihypertensive, anti-inflammatory and antimicrobial activities [3–6]. In particular, s-triazine core is used in a broad range of biologically active natural and synthetic compounds [7–9]. Among the various s-triazine derivatives reported, trisubstituted s-triazine derivatives were found to show more potency against several types of cancer cells [10, 11]. Most of the marketed drugs such as palbociclib, chloroquine, isoniazid, nitrofurantoin and methotrexate constitute nitrogen based heterocycles, as they have the tendency to interact with DNA through hydrogen bonding [12–14]. The symmetrical shape of s-triazine is a key factor for its high medicinal activity. Since, 1,3,5-triazine is a monocyclic, symmetric molecule, it has been used as a kinase inhibitor scaffold [15], which provides a great affirmation for future development of new anticancer agents.

Many 1,3,5-triazine analogs exhibit significant anticancer activity through different mechanisms, and hence, it is

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Synthesis of macromolecular brush and its thermal degradation studies

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ABSTRACT

The di-1,2-propanediol ester of fumaric acid (Diol) is synthesized and polymerized to yield the macromolecular brush (PDiol). The structure of monomers and their polymer is confirmed by Fourier transform infrared spectroscopy (FTIR) studies. The PDiol material shows the number average molecular weight (M_n) as 951 g/mol, weight average molecular weight (M_w) as 4,378 g/mol, and a polydispersity index (PDI) of 4.6. The hydroxyl value for PDiol is 471 (mg KOH/g). The thermal degradation property of the brush is investigated using thermogravimetric analysis (TGA). The cyclic intra and inter loops are formed while annealing at a temperature of around 200 °C. Using the TG curves recorded at different heating rates and by applying advanced isoconversional methods by model-free kinetics, the apparent activation energy for the thermal degradation (E_a -D) at different reaction extents (α) are calculated and discussed. Advanced methods are also used to refine the apparent activation energy data. The E_a -D values for PDiol range from 100 to 155 kJ/mol. For a lifetime of 20,000 h, the 20% degraded PDiol can withstand a temperature of 39 °C.

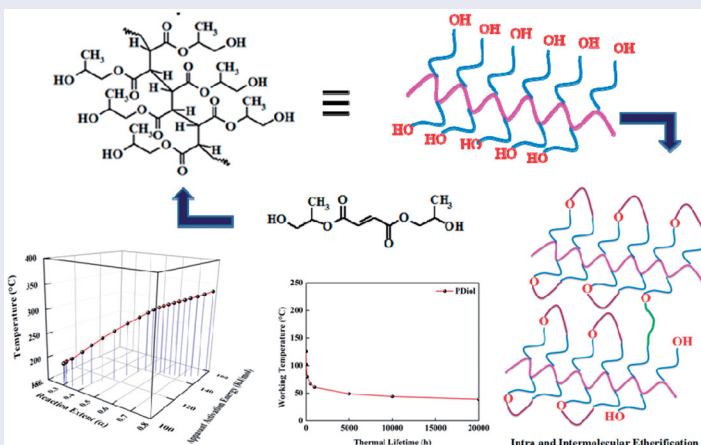
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Macromolecular brushes; diol fumarate; cyclic loops; TGA; model-free kinetics

GRAPHICAL ABSTRACT





HIGHLIGHTS


1. Synthesis of fumaric acid and 1,2-propane diol-based biodegradable ester diol applicable for tissue engineering applications.



Improvement in electrical and mechanical properties of di/trifunctional epoxies-based hybrid composites having metal organic frameworks (MOFs) as nanoparticulate filler

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Abstract

Metal organic frameworks (MOFs) nanoporous innovative materials as particulate reinforcing materials for high-temperature epoxy resins are designed and fabricated. Aqueous synthesis of MOFs is always the need of this hour. This paper focuses on the synthesis of aluminum-based MOFs in gram quantities by optimizing both the reaction temperature and time. The MOFs are annealed at different temperatures. The structures are characterized by several analytical techniques. The structural rearrangement during thermal treatment leads to increase in particle size and decrease in crystallinity. The improvement in mechanical (3.5%) and electrical properties for hybrid aluminum MOF-based di/tri-epoxy composites was discussed.

Introduction

Epoxy refers to a broad group of reactive compounds that are characterized by the presence of oxirane or epoxy ring. It is a thermosetting polymer known for its excellent adhesion, thermal stability, chemical resistance, and mechanical properties.^[1] In order to overcome the brittleness, incorporation of thermoplastic as secondary phase has proven without affecting the mechanical properties of epoxy.^[2] The plan of this research work is to incorporate the metal organic frameworks (MOFs) as particulate nanofillers for epoxy coatings.^[3] MOFs are cage-like structures, is one of the most promising materials in recent years due to its tailorable properties. MOFs are crystalline networks usually comprising bi-, tri-, or multidentate organic compounds coordinated to a metal ion to form the skeleton of the MOF.^[4] The rational design and synthesis of MOFs are strongly attributed to the coordination interactions between metal ion and ligand. These metal and the ligand interactions ensure the good chemical stability of the MOFs.^[5–7] Hence, it is widely used in variety of applications like gas storage,^[8] gas separation, catalysis, hydrogen storage,^[9–13] ion-exchange, biomedical applications,^[14,15] and capacitors.^[16] MOFs have emerged as novel synthetic materials^[17] in catalysis such as Lewis acid catalysis, Bronsted acid catalysis, redox catalysis, and electro-catalysis. Even though it has wide range of applications, its synthesis without harsh solvents at optimum temperature and time is lacking. The author already studied the detailed aspects of synthesis and procedure optimization of aluminum fumarate and its isothermal model-free^[18] and model-fitting kinetics. Based on our previous experience, the authors introduce the aromatic group as organic linker

and aluminum salt as metal salt because of its easy availability and water solubility. Hence for the successful development of speciality epoxy coatings, the proper selection of MOFs and its design—synthesis procedure optimization and its characterizations are necessary. Therefore, this work presents the aqueous synthesis of aluminum isophthalate and terephthalate MOFs at most favorable temperature and time. The correct evacuation of the template or solvent from the cages is necessary in order to obtain the solids with accessible pores or tunnels. Most importantly, the activation of as-synthesized has drastic influence on the adsorption and catalytic properties. Therefore, the work also focuses on the effect of thermal treatment for synthesized MOFs in thermal stability, particle size, morphology, and crystallinity.

Experimental Materials

Aluminum sulfate octadecahydrate was purchased from NICE Chemicals Pvt. Ltd., Kochi-682024, India. Sodium hydroxide was purchased from Avantor Performance Materials India Ltd., Thane-400607. Isophthalic acid and terephthalic acid were purchased from Kemphasol, Mumbai-400002 and Central Drug House Pvt. Ltd., New Delhi-110002, India, respectively. The materials Araldite LY556 is an unmodified bisphenol-A and epichlorohydrin-based liquid epoxy resin (DGEBA) and the hardener Aradur HY951 is a low viscosity aliphatic amine were purchased from Ms. Herenba Instruments and Engineers, Chennai, and was used as received. All the characterizations done for the materials are presented in the “Methods” part of the Supplement.

Treatment of municipal solid waste landfill leachate by aeration assisted electrochemical peroxidation process using aluminium and iron electrodes

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ABSTRACT

The present work aims to assess the degradation and mineralization of organic and inorganic components of solid waste landfill leachate. The main consequential problem of generation of leachate from municipal solid waste landfills is in form of strong colour, their highly dissolved contaminant nature and multifaceted composition of pollutants which must be treated for the safe disposal into the natural streams and other resources. So as to achieve this intention, this lab research study was carried out to observe the fulfillment and effectiveness of batch aerated electrochemical peroxidation process by applying the voltage between iron and aluminium electrodes in electrochemical cell. In addition, the various combinations and arrangement of iron and aluminium electrodes have been chosen and implemented in order to achieve chemical oxygen demand (COD) degradation while simultaneously improving colour removal in solid waste landfill leachate. The effects of pH (2–6), H₂O₂ dosage(0–6 ml/L), Fe²⁺ dosage(0–2.5 mg/L), voltage(0–6 V), various groups of iron and aluminium electrodes pairs on COD and colour removal capability were investigated in order to determine the best experimental settings and design. The findings of the treatment results indicated that the aerated electrochemical peroxidation processes (ECP) was very resourceful in achieving 91% COD and 95% colour from solid waste landfill leachate under optimal circumstances of treatment period of 120 min, pH = 3, voltage = 6 V, Fe²⁺ = 1.5 g/L, H₂O₂ = 3 ml/L and Fe-Al electrode pair respectively. Additionally, the acidic pH state of solid waste landfill leachate and the provision of external supply of aeration were vital throughout the treatment to enrich the efficiency of the aerated ECP process as well as to enhance the action of electrocatalytic generation of reactive hydroxyl radicals (*OH) with a low energy consumption value of 3.6 kWh/m³. Besides, the outputs of the aerated electrochemical peroxidation process demonstrated as a well-organized and specific practice for diminishing the concentration of COD and colour by implementing the combined action of electro-Fenton and electro-coagulation unit process for conversion of non-bio-degradable solids into H₂O and CO₂ with some simple inorganic end substances. Furthermore, the application of RSM software has been adopted to do the optimization of aerated ECP treatment process, for minimization of experimental runs and trials by calculating the number of experiments with an empirical model approach for the outputs.

Keywords: Aerated electrochemical-peroxidation; Iron and aluminium electrodes; Optimization; RSM; Solid waste landfill leachate

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Corrosion resistance behaviour of concrete containing treated used foundry sand

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ABSTRACT

In the last two decades, the scientific community, by the efforts of researchers, has witnessed many attempts to find alternative materials for natural sand using industrial waste materials instead of natural river sand, with a major goal of preserving the natural environmental resources. One of the industrial waste materials, is Used Foundry Sand (UFS), which is processed and used in concrete as a partial replacement for fine aggregate as Treated Used Foundry Sand (TUFS). The precise and all-inclusive investigation on the corrosion resistant characteristics of TUFS blended concrete is very scant. Therefore, experimentations were conducted to study the corrosion resistance performance of TUFS as partial replacements for fine aggregate. TUFS were substituted for fine aggregate in different weight percentages. The reinforced concrete specimens were casted to 5% NaCl under accelerated corrosion process. Apart from half-cell potential measurement, impress current techniques were employed to assess rebar corrosion, and microstructural analysis was carried out using X Ray Diffraction (XRD). According to test results, TUFS concrete has better corrosion resistance qualities than control concrete, paving the way for high-quality concrete production.

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Industrial waste material; high-quality concrete production; treated used foundry sand; impress current technique; X Ray diffraction

1. Introduction

The cost of construction materials has risen dramatically in recent years. Furthermore, there is a necessity for construction supplies to be always available as our natural resources (such as rocks for coarse aggregate and river sand for fine aggregate) are being depleted due to construction processes. In 2014, fine and coarse aggregate production consumed approximately 40 billion tones (Xiao et al., 2017). Fine aggregates make 20–35% of the volume of concrete mix. Fine aggregates used in manufacturing of concrete are generally natural river sand which is becoming more costly and considerably limited. On the other hand, hazardous waste materials are thrown into our natural environment without proper treatment, which affects the prosperous of nature. Hence there is an essential need to find an alternative way for protecting natural environment from the disposal of hazardous waste and from over exploitation of natural resources. To meet these needs, we can utilize waste products as alternate materials for fine aggregate. One of these materials is, high quality silica sand by product from the manufacturing of both ferrous and nonferrous metal casting industries, Used Foundry Sand (UFS) (Gurumoorthy & Arunachalam,

Original Research

Effect of Artificial Fibers and Corn Cob Ash on Mechanical Behavior of High Performance Concrete

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Abstract

In this research work, Corn Cob Ash is partially utilized as supplementary cementitious material (SCM) for cement and addition of different percentage of artificial fibers as micro reinforcement has been used to find the effect on fresh, mechanical and microstructural properties of HPC through testing. Firstly, the mechanical properties of HPC with different Corn Cob Ash (CCA) contents of 5, 10, 15, 20 and 25% by weight of cement were tested and the results showed that HPC with 15% CCA is the most economical replacement and it exhibits the better mechanical properties close to the reference concrete. Subsequently, 15% CCA was taken constant for PP and PS series mixes with 0.1, 0.2, 0.3 and 0.4 % addition of artificial fibers (polypropylene and polystyrene fiber by weight of binders) into HPC to evaluate its effects on slump, compressive strength, split tensile strength, flexural strength, modulus of elasticity, ultrasonic pulse velocity and microstructure. The results revealed that 15% of CCA replaced mixes along with 0.4% of artificial fibers showed better in mechanical properties and microstructure. However, above 15% of Corn Cob Ash replacement was showed poor on mechanical properties of HPC, compared to the control mix (C0) without CCA and fibers.

Keywords: Corn Cob Ash, polypropylene fiber, polystyrene fiber, high performance concrete, workability, mechanical properties, microstructure

Introduction

High Performance Concrete (HPC) is one of the most promising types of concrete and now is widely preferred for infrastructure projects around the world [1]. The need for HPC is increasing day-by-day due to

rapid development of urbanization and industrialization. The fabrication of billions of tones of concrete throughout the world emits significant amounts of carbon dioxide (7%) during production of cement [2]. Accordingly, the partial replacement of cement is expected to meet the increasing demand for concrete production [3]. Using agricultural wastes in concrete production is an eco-friendly way of disposing of the large amounts of waste, which would otherwise

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PREDICTION OF BITCOIN PRICE USING MACHINE LEARNING ALGORITHMS

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Abstract

This project is implemented to predict the Bitcoin price accurately taking into consideration various parameters that affects the Bitcoin value. Bitcoins are put away in an advanced wallet which is essentially similar to a virtual financial balance. it is important to anticipate the estimation of Bitcoin so right venture choices can be made. The cost of Bitcoin doesn't rely upon the business occasions or mediating government not at all like securities exchange. Most measurable procedures pursue the worldview of deciding a specific probabilistic model that best portrays watched information among a class of related models. Likewise, most AI systems are intended to discover models that best fit information. By gathering information from different reference papers and applying in real time. Each and every project has its own set of methodologies of bitcoin price prediction. Machine learning models can likely give us the insight we need to learn about the future of Crypto currency. It will not tell us the future but it might tell us the general trend and direction to expect the prices to move.

Keywords-svm algorithm, knn algorithm, dataset.

1. Introduction

1. Virtual currencies

Virtual currencies are a form of cryptocurrency which is an impressive technical achievement in digital marketing, nevertheless. Virtual currencies live on, and they couldn't fully replace fiat or conventional currencies. In the current study, we are trying to show an interesting new perspective from which view of economics questions surrounding currency governance, the characteristics of money, political economy of financial intermediaries, and the nature of currency computation Virtual currencies become the most favorable and used for commercial enterprise transactions all over the world [1, 2]. The popularity is due to its innovative characteristics such as transparency, simplicity, and increasing acceptance through the world. In the current time, bitcoin is the popular flourishing virtual currency.

Optimal path planning for mobile robot using Preference based Evolutionary Qlearning algorithm

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Abstract

An efficient Preference based Evolutionary Qlearning algorithm (PEQL) for mobile robot path planning method is proposed that finds optimal path between source to destination using an improved policy evaluation with adaptive reward and policy switching process, the proposed mobile robot path planning algorithm is unique and novel since it finds the optimal path using policy switching and better success index than the conventional methods.

Keywords: *mobile robot, path planning, adaptive reward, policy switching*

Introduction:

Preference based Qlearning algorithm based mobile robot path planning finds an optimal path from a source and destination in a given environment and has become popular for emerging complex mobile robot applications such as robot soccer and planet exploration, surveillance [1, 2]. As a result of the stochastic property, Qlearning algorithm suffer from the convergence time of learning the environment; The path may not be optimal after termination [3, 4]. Since a Qlearning must run repeatedly until it finds an optimal path, low success rates increase the total execution time of the algorithm. To circumvent being surrounded into convergence time, both the evaluation and the natural selection step must be designed intelligently to obtain a well converged population [4]. However, conventional Qlearning methods focus mainly on the policy improvement steps, instead of on the evaluation and selection steps, by incorporating problem specific operations.

The key features of this proposed Evolutionary Qlearning method are,

Performance Analysis of Various Parameters in Sensitive Association Rule Hiding For Privacy in Distributed Collaborative Data Mining

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Abstract

Privacy preserving or Data and knowledge hiding is a novel research area in distributed collaborative data mining to protect the privacy of confidential or sensitive information of individuals. Many of the researchers have been proposed methods in Privacy Preserving Data mining (PPDM) to hide sensitive information in association rule mining. Association rule hiding is the process to modify the original database for vanishing sensitive association rule while generating rules using rule mining algorithms. The better rule hiding methods are not affecting the quality of the database and non-sensitive rules. In this paper, privacy preserving association rule hiding methods in the literature are studied in detail to find the problem in each method and metrics used for evaluating these methods. The performance of metrics, merit and demerit of every method are thoroughly compared. Finally, the remarkable future direction is suggested in the association rule hiding area based on the problems has been found from the literature.

Keywords: Privacy Preserving Data Mining, Sensitive Itemset Hiding, Association Rule Hiding

1. Introduction

In state-of-the-art scenario of internet world, the security and privacy has to be given more attention while information sharing among organizations. The association rule mining discovers the relationship among item sets which helps to

improve the business of enterprises. The sharing of relationship among itemsets between organizations helps them to acquire extraordinary business knowledge. However, information of sensitive itemsets or items to be preserved while sharing between organizations. The methods for hiding of sensitive items from frequent itemset or associations rules were proposed by many authors in the literature. The reducing support value of sensitive item Atallah et al. [1] was the general idea for providing security and privacy of itemsets in association rule mining. The sensitive item hiding was achieved by the modifying support value of items to decrease below the minimum support values. However, it was

Leaf Disease Detection and Automatic Pesticide Suggestion using Deep Learning

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Abstract – Diseases that are caused by fungus are developed through soil-borne, above-ground infections. Pest and insect feeding causes the transmission of fungus. However, the existing research lacks an accurate and fast detector of leaf diseases for ensuring the healthy development of the agricultural industry. This project proposes a novel approach for developing an effective method for identifying the plant leaf diseases. Based on the identification of diseases, suggestion for the pesticide is also given. A deep learning approach which is based on Multilayer Deep convolutional neural networks (CNNs) for the real-time detection of leaf diseases is used in the work. It also detects the types of leaf diseases with high accuracy. In addition, the proposed approach can handle the images of the diseased leaves. The results showed good improvement in identifying the plant leaf diseases.

Keywords – Deep Learning, Leaf Disease, Convolutional Neural Networks, Leaf Disease, Food Productions.

I. INTRODUCTION

Food production in India driven by pressure from an increasing human population uses 90000t per year of technical-grade pesticide. It is very important to detect the plant disease and to increase the food production. Plant diseases may be due to bacteria, nematodes, fungi, phytoplasmal and viruses^{1–4}. Diagnosing the symptoms of plant diseases is very crucial. Since limited number of plant pathologists is available, it is very difficult to identify the diseases in many regions in India. The plantation area of plants is so large to provide a solution. It also leads to difficulty in obtaining disease evidence.

It is important to remember that plants that are healthy and properly cared for will often show more resistance to plant disease, so ensuring your crop has ample moisture and healthy, fertile soil is a must. Recently, a deep study on plant diseases and their biological characteristics is going on. Since there are many plant diseases, it is challenging to identify the diseases and it is required to put a special attention on plant diseases. If the diseases are identified earlier, the quality of the products can be maintained. Traditionally, disease inspection, disease identification, and dealing with these diseases in plants are done manually.

The recent growth in the study of deep learning helps to detect plant diseases. In the proposed work, an efficient convolutional neural network (CNN)-based plant disease detection method is experimented which identifies the diseases in plants. CNNs are able to learn representative features of disease classes.

Deep learning is a type of machine learning and Artificial Intelligence. It consists of three or more layers. The layers simulate the human brain behavior.

In deep learning, a CNN/ConvNet is a class of deep neural networks, most commonly applied to analyze visual imagery in which a technique called Convolution is used. The mathematical operation on two functions that produces a third function is known as convolution.

The proposed system, a new web based work, analyzes the leaves of the plant and predicts the affected disease. It also provides the solution by suggesting the appropriate pesticide to be given to the plants. The work presents an automated system integrated with machine vision techniques that assists the farmers to get the accurate information about their Plants Leaf Disease. It also reduces the time consumed by the farmers.

II. RELATED WORK

It is crucial to improve the quality and quantity of agricultural products. The basic need of the people is satisfied. Growth of agriculture also supports the economic growth of any country. Smart farming is recently used to support the growth of agricultural products. If the plants are disease free, agricultural products can be produced with good quality and

Efficient method for mining High Average Utility Itemset

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ABSTRACT

In recent years, high-utility itemset mining (HUIM), an extension of the well-known frequent itemset mining (FIM), has become a big topic. In a given dataset, HUIM aims to find an entire set of itemsets with high utilities. High average utility itemset (HAUI) mining is an improvement over high-utility itemset mining, which uses an unbiased measure called average utility to relate the utility of itemsets to their length. To retain pruning methods, some current HAUI mining algorithms use upper bounds such as average-utility upper bound, revised tighter upper bound, and looser upper bound. These upper bounds, on the other hand, overestimate the average usefulness of itemsets, causing the mining process to slow down. To resolve this problem, the proposed algorithm uses the values of TMU and AUUB to find Reorganized Utility based Database by scanning the dataset only once. Additionally, rather than computing the IMU value for only 2-itemsets, the IMU value for 1-itemset of all transactions is used to compute the IMU value for extended itemsets. By adding improved upper bounds and many effective pruning algorithms, the process of determining the High Average Utility Itemset avoids the processing of unpromising candidate itemsets. In terms of runtime, memory usage, the proposed technique shows significant improvement over existing HAUI mining algorithms.

Keywords: High Average Utility Itemsets Mining, Average Utility, Upper Bounds, Pruning Strategy

1. Introduction

In the field of data mining, pattern mining [Han et al.(2011), Fournier et al.(2017), Borah et al.(2019)], is a major research subject. Pattern mining techniques are used in a wide variety of applications for data processing and decision making. Pattern mining is the process of finding interesting, useful, and valuable data objects from which crucial and usable information can be deduced. Frequent itemsets, association rules, periodic patterns, sequential patterns, and so on are all examples of patterns. Frequent Itemset Mining (FIM) [Fournier et al.(2017)] is a basic method for finding frequently occurring itemsets in a transaction dataset. When an itemset's frequency (also known as 'support') does not fall below a user-defined support threshold, it is considered frequent.

Apriori [Agarwal et al.(1994)] is the first FIM algorithm to generate frequent itemsets by iterative level wise searching. The weak candidate itemsets are pruned using a downward closure (DC) property called the "Apriori property". Any superset of a non-frequent itemset cannot be a frequent itemset,

according to the apriori property. However, apriori has two major drawbacks: first, each iteration pass requires a large number of database scans; second, a large number of candidate itemsets are created, i.e., 2^n total candidates for n objects. Several algorithms, such as FP-growth [Grahne et al.(2004)], ECLAT [Zaki (2000)], and HMine [Pei et al.(2001)], have been proposed to address these drawbacks. These algorithms make use of a better data structure as well as a pruning technique. FIM has a big flaw in that it only considers frequency when mining trends, which might not be enough in certain cases. Two essential measures that can add more value to the discovered trends are the purchase quantity and benefit per item.

The quantity and unit profit of itemsets are combined in High-Utility Itemset (HUI) mining [Pillai et al(2010)] to make patterns more important and usable in real-world applications. The profit of an itemset is determined by both the quantity of the itemset (internal utility) and the profit per unit (external utility). If the utility of an itemset exceeds a

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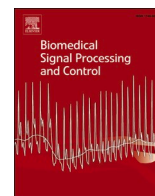
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Adaptive rag-bull rider: A modified self-adaptive optimization algorithm for epileptic seizure detection with deep stacked autoencoder using electroencephalogram

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ABSTRACT

Electroencephalogram (EEG) signal is widely adapted for monitoring epilepsy to rejuvenate the close-loop brain. Various conventional techniques are devised for identifying seizures that depend on visually analyzing EEG signals that are an expensive and complicated process if there is a rise in numbers of the channel. A new technique, namely Adaptive rag-Rider optimization algorithm (Adaptive rag-ROA) is presented to train deep-stacked autoencoder (Deep SAE) for discovering epileptic seizures. Initially, the EEG signals are given to the pre-processing module, in which noise has been removed by the bandpass filter. Then, the noise removed signals are provided as an input wherein the EEG is divided into various channels and each channel performs the extraction of features. Here, the features such as Taylor-based delta AMS, Holoentropy, fluctuation index, relative energy, tonal power ratio, spectral features, and linear prediction coefficient (LPC) are acquired from each channel. Furthermore, the Probabilistic principal component analysis (PPCA) is adapted to diminish the dimensionality of features. The obtained feature vectors are fed to Deep SAE for epileptic seizure recognition. The Deep SAE training is carried out with Adaptive rag-ROA that is devised by incorporating the Adaptive concept in rag-ROA. Thus, the output generated from the proposed Adaptive rag-ROA-based Deep SAE is adapted to detect seizures from EEG. The proposed Adaptive rag-ROA-based deep SAE outperformed revealing the highest accuracy of 91.5%, the sensitivity of 85.2%, and specificity of 86%.

1. Introduction

The infirmity of the nerve occurs because of the electrical expulsion of cortical neurons contained in the brain and is commonly known as Epilepsy that is susceptible to produce various types of seizures. These types of seizures are unexpected, unforeseen, and unprovoked because of its instant factors. There exist individuals over 65 million who experience these kinds of disorders. There exists a 75% seizures case that is diagnosed using therapies [9]. With residual 25% cases, the seizures ruin despite drugs, and it impudent patients surviving with seizures [10]. The patients suffering from epilepsy is typically inaccessible overnight and prone to different corporeal pain or suffocation that are caused because of the barren airway. There exists a need for support with small delays after the initiation of seizures that urge rupture. The seizure is generally risky at nighttime while patients are alienated and

could not call for assistance. There exist some nighttime seizures that are not spotted by patients and may cause several therapeutic obstructions or may lead to death. There exist requirements to discover seizures in real-time that can promote notice to the individuals who reside close whenever the seizure is determined. The stipulation of appropriate assistance can reduce the rate of mortality and prevent intricacy [6].

Epilepsy is diagnosed medically by performing different evaluations considering positron emission tomography (PET), magnetoencephalogram (MEG), computed tomography (CT), EEG, and magnetic resonance imaging (MRI). The EEG is termed as the best modality in contrast to other techniques because of high resolution in temporal data and cost-effective property. The stipulation of undeviating capacity is achievable by EEG because of certain actions of the brain. The EEG is an effective modality that is used to observe and detect epileptic seizures that regularly produce divergence in evaluated EEG. Several techniques

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Rag-bull rider optimisation with deep recurrent neural network for epileptic seizure detection using electroencephalogram

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Abstract

Electroencephalogram (EEG) signal is mostly utilised to monitor epilepsy to revitalize the close loop brain. Several classical methods devised to identify seizures rely on visual analysis of EEG signals which is a costly and complex task if channel count increases. A novel method, namely, a rag-Rider optimisation algorithm (rag-ROA) is devised for training a deep recurrent neural network (Deep RNN) to discover epileptic seizures. Here the input EEG signals are splitted to different channels wherein each channel undergoes feature extraction. The features like Holoentropy, relative energy, fluctuation index, tonal power ratio, spectral features along with the proposed Taylor-based delta amplitude modulation spectrogram (Taylor-based delta AMS) are mined from each channel. The proposed Taylor-based delta AMS is designed by integrating the delta AMS and Taylor series. The probabilistic principal component analysis (PPCA) is employed to reduce the feature dimension. The dimensionally reduced feature vector is classified with Deep RNN using rag-ROA, which is designed by integrating rag-bull rider along with the four other riders available in the Rider optimisation algorithm (ROA). Thus, the resulted output of the proposed rag-ROA-based deep RNN is employed for EEG seizure detection. The proposed rag-ROA-based Deep RNN showed improved results with maximal accuracy of 88.8%, maximal sensitivity of 91.9%, and maximal specificity of 89.9% than the existing methods, such as Wavelet + SVM, HWPT + RVM, MVM-FzEN, and EWT + RF, using the TUEP dataset.

1 | INTRODUCTION

The illness in nerve caused due to electrical ejection from cortical neurons present in the brain is called epilepsy, which is vulnerable to generate different kinds of seizures. Such seizures are unanticipated, unpredicted, and motiveless due to instantaneous aspects. There are peoples over 65 million who suffer from such disorders. There are 75% of cases of epileptic seizures that are treated with therapy [1]. In the remaining 25% cases, the seizures remain in spite of antiepileptic drugs, and such drug insolent patients should survive with seizures [2]. Epilepsy affected patients are usually separated throughout the night and are susceptible to various corporeal injuries or suffocation caused by blocked airway after swallowing their tongues. There is a requirement of assistance in short delays after the inception of seizures, which cascade rupture and Sudden Unexpected Death in Epilepsy (SUDEP). Seizures are

mostly hazardous at night time while patients are separated and could not call for help. There are some night-time seizures which may not be noticed by patients and might lead to various medical impediment or even death. There is a requirement to devise a real-time seizure detection model which can elevate warning for people residing nearby when a seizure is discovered. The provision of proper help may lead to a reduction in mortality and avert complexities [3].

Epilepsy is treated medically by undergoing various assessments like computed tomography (CT), EEG [4], positron emission tomography (PET), magnetic resonance imaging (MRI), or magneto-encephalogram (MEG). The EEG is considered to be one of the best as compared to other methods due to its elevated temporal resolution and is termed to be inexpensive. The provision of direct measurement is possible by EEG due to the electrical activities of the brain. The EEG is the leading technique which is utilised for

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Content based video retrieval system based on multimodal feature grouping by KFCM clustering algorithm to promote human–computer interaction

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Abstract

Content Based Video Retrieval (CBVR) is so popular these days, because of the increased utilization of video based analytical systems. Video based analytics is quite effective than image analysis, as a series of actions are captured by the video. This ends up with better decision making ability. The CBVR systems play an important role in boosting the human–computer interaction. This paper presents a multimodal CBVR that takes both the visual and audio information into account for retrieving relevant videos to the user. Two modules are employed by this work to deal with video and audio data. The video data is processed to detect the significant frame from shots and is achieved by Lion Optimization Algorithm (LOA). The features are extracted from the visual data and with respect to the audio data, MHEC and LPCC features are extracted. The extracted features are clustered by Kernelized Fuzzy C Mean (KFCM) algorithm. Finally, the feature database is formed and is utilized in the query matching process during the testing phase. The performance of the proposed work is tested in terms of precision, recall, F-measure and time consumption rates. The proposed CBVR system proves better performance than the existing approaches and is evident through attained results.

Keywords Human–computer interaction · Content based video retrieval (CBVR) · Video analysis · Feature extraction · Significant frame detection

1 Introduction

The exploitation of digital videos is extremely increasing, due to the advent of smart phones, digital cameras and so on. Besides numerous applications such as healthcare, marketing, surveillance and entertainment deal with video data for analysis and decision making. For instance, several advanced medical applications record the health status of the patients in a live mode and store the video for future analysis. The surveillance applications strongly rely on the video footages for tracking the objects. All the captured videos are stored in the database for further analysis and the volume of the database is quite bigger.

The main objective of video storage is to analyse the videos with respect to decision making or comparison. For effective data analysis, video retrieval is more significant, as it helps in extracting relevant videos and better decision making can be done. Traditionally, the required videos are extracted by means of text based queries, such that the videos associated with the query are retrieved for the user. For instance, the title, description or comments of the video are considered, when the text query is passed. However, the text query based video retrieval cannot extract relevant videos from a pool of videos, as the video retrieval completely depends on the query text and the text being utilized to describe or comment the videos (Hu et al. 2011; Veltkamp et al. 2013).

Additionally, the text query based video retrieval system involves more computational and time complexities, as mentioned by Jawahar et al. (2005). The issues faced by the text query based video retrieval system are surmounted by the Content Based Video Retrieval (CBVR) system. In CBVR, the term ‘content’ refers to the features of the videos, which can be colour, texture, shape and so on. The CBVR system

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Research Article

Blockchain-Enabled Smart Surveillance System with Artificial Intelligence

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Through the use of blockchain technology, sensitive information may be securely communicated without the need to replicate it, which can assist in decreasing medical record mistakes and saving time by eliminating the need to duplicate information. Furthermore, the information is timestamped, which further enhances the security of the data even further. The deployment of blockchain technology in a range of healthcare situations may enhance the security and efficiency of payment transactions. In this way, only those who have been allowed access to patient medical information can see or modify such information. It is proposed in this study that blockchain technology be used to provide an accessible data storage and retrieval mechanism for patients and healthcare professionals in a healthcare system that is both safe and efficient. As of 1970, a variety of traditional knowledge-based approaches such as Personal Identification Recognition Number (PIRN), passwords, and other similar methods have been made available; however, many token-based approaches such as drivers' licenses, passports, credit cards, bank accounts, ID cards, and keys have also been made available; however, they have all failed to establish a secure and reliable transaction channel. Because they are easily misplaced, stolen, or lost, they are usually unable to protect secrecy or authenticate the identity of a legitimate claimant. Aside from that, personally identifiable information such as passwords and PINs is very prone to fraud since they are easily forgotten or guessed by an imposter. Biometric identification and authentication (commonly known as biometrics) are attracting a great deal of attention these days, particularly in the realm of information security systems, due to its inherent potential and advantages over other conventional ways for identifying and authenticating. As a result of the device's unique biological characteristics, which include features such as fingerprints, facepalms, hand geometry (including the iris), and the device's iris, it can be used in a variety of contexts, such as consumer banking kiosks, airport security systems, international ports of entry, universities, office buildings, and forensics, to name a few. It is also used in several other contexts, including forensics and law enforcement. Consequently, every layer of the system—sensed data, computation, and processing of data, as well as the storage and administration of data—is susceptible to a broad variety of threats and weaknesses (cloud). There does not seem to be any suitable methods for dealing with the large volumes of data created by the fog computing architecture when normal data storage and security technologies are used. Because of this, the major objective of this research is to design security countermeasures against medical data mining vulnerabilities that originate from the sensing layer and data storage in the Internet of Things' cloud database, both of which are discussed in more depth further down. A key allows for the creation of a distributed ledger database and provides an immutable security solution, transaction transparency, and the prohibition of tampering with patient information. This mechanism is particularly useful in healthcare settings, where patient information must be kept confidential. When used in a hospital environment, this method is extremely beneficial. As a result of incorporating blockchain technology into the fog paradigm, it is possible to alleviate some of the current concerns associated with latency, centralization, and scalability.

Research Article

Human-Computer Interaction for Recognizing Speech Emotions Using Multilayer Perceptron Classifier

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Human-computer interaction (HCI) has seen a paradigm shift from textual or display-based control toward more intuitive control modalities such as voice, gesture, and mimicry. Particularly, speech has a great deal of information, conveying information about the speaker's inner condition and his/her aim and desire. While word analysis enables the speaker's request to be understood, other speech features disclose the speaker's mood, purpose, and motive. As a result, emotion recognition from speech has become critical in current human-computer interaction systems. Moreover, the findings of the several professions involved in emotion recognition are difficult to combine. Many sound analysis methods have been developed in the past. However, it was not possible to provide an emotional analysis of people in a live speech. Today, the development of artificial intelligence and the high performance of deep learning methods bring studies on live data to the fore. This study aims to detect emotions in the human voice using artificial intelligence methods. One of the most important requirements of artificial intelligence works is data. The Ryerson Audio-Visual Database of Emotional Speech and Song (RAVDESS) open-source dataset was used in the study. The RAVDESS dataset contains more than 2000 data recorded as speeches and songs by 24 actors. Data were collected for eight different moods from the actors. It was aimed at detecting eight different emotion classes, including neutral, calm, happy, sad, angry, fearful, disgusted, and surprised moods. The multilayer perceptron (MLP) classifier, a widely used supervised learning algorithm, was preferred for classification. The proposed model's performance was compared with that of similar studies, and the results were evaluated. An overall accuracy of 81% was obtained for classifying eight different emotions by using the proposed model on the RAVDESS dataset.

1. Introduction

Fewer emotions are critical in human-computer interaction [1]. Past years had increased interest in speech emotion recognition (SER), which uses speech cues to analyze emotion

states. Nonetheless, SER remains a challenging endeavor due to extracting practical emotional elements. SER is handy for investigating human-computer identification. This indicates that the system must comprehend the user's feelings to define the system's activities appropriately. Numerous activities,



Miniaturized four port MIMO antenna for automotive communications

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Abstract

This paper presents the design, fabrication and testing of a novel circular slot antenna with an arc-shaped feed line for industrial scientific and medical (ISM) applications. The antenna is developed on a flexible, low loss substrate with a small footprint of $15 \times 15 \text{ mm}^2$. The proposed antenna is evolved from an arc slot radiator operating at 4.5 GHz. The structural modifications are performed to decrease the operating frequency to 2.45 GHz without increasing the antenna footprint. The antenna element is replicated along the four sides to develop a four-port MIMO antenna. The performance of the MIMO antenna is evaluated and the results are presented. The MIMO metrics such as Envelope Correlation Coefficient (ECC), Diversity Gain (DG) and Mean Effective Gain (MEG) are calculated and presented for isotropic, semi-urban and urban vehicular scenarios. The prototype MIMO antenna is fabricated and tested in real-time. The on-car performance of the antenna and the MIMO metrics computed indicate that the proposed antenna is suitable for automotive wireless communications.

Keywords Automotive antenna · MIMO antenna · Slot antenna

1 Introduction

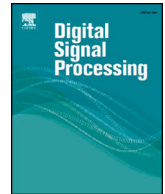
Automotive communications are receiving wider attention in recent years owing to the development in information and communication technologies. The car manufacturers are trying to improve the internet based facilities in automobiles to enable the drivers and passengers to get connected to the outside world during the movement. Some of the communication technologies in automobiles include AM/FM radio, Global System for Mobile communication (GSM), Global Positioning System (GPS) to the most recent Internet of Things (IoT). The IoT in automobiles enables the realization of next-generation connected car systems by adopting predictive maintenance [1, 2]. The IoT incorporated semi-autonomous cars helps to arrive at on-spot decisions and this also partly helps in controlling the vehicle. Thus preventing accidents and reducing the load of the driver. IoT works on several standards such as WiFi,

Bluetooth, LoRaWAN, Zigbee and Thread. WiFi, Bluetooth, Zigbee and Thread work in the ISM band while LoRaWAN can work in any unlicensed frequency spectrum and hence it can be designed to work in any spectrum as per the desire of the automotive vendors [3]. Therefore, 2.45 GHz, which is common to the aforementioned standards, is chosen as the frequency spectrum for realizing IoT in automobiles.

Antennas are integral parts of any wireless communication systems and designing an efficient antenna will help achieve the research targets in automotive communications. This paper is devoted to the development of a small-sized, low profile antenna for embedded automotive IoT systems in the automotive scenario. In literature, several antenna solutions are reported for miniaturization and MIMO technology. This research is attempted to realize both miniaturization and diversity reception. Miniaturization will help to deploy more antenna elements in a smaller space to improve the standards of communication technology. To the best of the authors' knowledge, 2.45 GHz monopole antennas are predominantly discussed for wireless body area networks, wireless sensor nodes operating in the ISM band and the number of works targeting only on 2.45 GHz for the automotive environment is limited. The automotive antenna research is attributed to multiband and

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Weighted 1D-local binary pattern features and Taylor-Henry gas solubility optimization based Deep Maxout network for discovering epileptic seizure using EEG



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ABSTRACT

Epilepsy represents chaos in nerves which can affect the world's population. Such type of abnormal activities of the brain can lead to seizures. Hence, precise and timely treatment of seizures is important to minimize financial and living costs. Electroencephalogram (EEG) is considered an imperative tool for analyzing epilepsy to diagnose epilepsy. This paper devises an optimization-aware deep model for detecting epilepsy using EEG signals. Here, the EEG signals undergo feature extraction wherein several features like relative amplitude, spectral entropy, logarithmic band power, power spectral density, Multiple kernel weighted Mel frequency cepstral coefficient (MKMFCC), tonal power ratio. The proposed weighted one-dimensional Local Binary Pattern (1D LBP) is obtained by combining weighted function in 1D-LBP are extracted. After extraction of features, data augmentation is carried out by flipping the EEG signal with the circular shift. The training of the Deep Maxout network is trained is done by the devised Taylor Henry gas solubility optimization (Taylor HGSO), by merging the Taylor Series and HGSO. The developed Taylor HGSO-based Deep Maxout network offered enhanced performance with high accuracy of 93.6%, sensitivity of 94.7%, and specificity of 93.4%.

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1. Introduction

The brain of humans operates the sensory data obtained by exterior or interior stimuli. The brain is considered an unprocessed workstation as neurons utilize chemical effects for producing electricity. The EEG is a graph-based signal that records the fragmentary activities of electricity that evaluates different electrodes located on the brain. In terms of the clinic, the major treatment of EEG is to determine the tasks of brain abnormalities known as epileptic seizures. The seizure happens whenever the neurons produce clumsy electrical pardons. Epilepsy becomes a persistent disorder of seizure occurred with irregular discharges through the brain cells. EEG also diagnoses coma, sleeping pattern disorder, brain death, and encephalopathy. In addition, the EEG can be utilized in several domains like recognition of emotion, quality of video assessment, measurement of alcoholic utilization, detection of sleep stage, alterations in brainwaves by increased usage of mobile phones, and smoking [24]. Therefore, EEG is considered a crucial part of determining epilepsy. It evaluates the difference amongst the changes of voltage between electrodes and scalp of subjects by sensing the ionic currents flowing through the brain's neurons and offers spatial and temporal data regarding the brain. However, the discovery of EEG needs an undeviating assessment by physicians and considerable effort and time. In addition, the experts having varying levels of experience in diagnostic report opinions on the diagnostic results. Hence, the design of an automatic technique for epilepsy is required [23].


The attributes obtained from the EEG signal [29] are beneficial for an epilepsy diagnosis. The spectral assessment is a widespread method utilized for assessment of EEG signal as discloses frequencies contained in the signal. A basic supposition of Fourier transform is considered, but the signal was evaluated with variance, mean, and frequency which changes concerning time [25]. EEG is extensively utilized for examining the diseases of the brain as EEG signal comprises prosperity of information regarding the functions of the brain as

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RESEARCH ARTICLE

Hybrid Grey Wolf Optimization with Cuckoo Search-based optimal channel estimation for energy efficient massive multiple input multiple output

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Summary

The massive multiple input multiple output (mMIMO) provides reliable base station (BS) for the mobile users (MUs) with CSI (channel state information) and jointly offers spectral efficiency (SE) and energy efficiency (EE). Conversely, because of the existence of multiple transceivers at both the transmitter and receiver side, the channel estimation (CE) issue is increasingly complex and expensive in terms of hardware and energy utilization. Hence, we have proposed an effective Hybrid Grey Wolf Optimization with Cuckoo Search (GWO-CS) based optimal channel estimation for developing energy efficient mMIMO. The proposed GWO-CS selects the optimal channel by jointly optimizing the spectral efficiency and reduces the SINR (signal to interference plus noise ratio). Experimental analysis of the performance of the proposed approach is carried out using existing approaches. The results obtained show that, the EE of the proposed GWO-CS based CE provides 15–37 Mbits for varying quantization bits, 22.5–25 Mbits for different user equipment (UE) ranges and 7–24 Mbits for various SE. However, the existing approaches fail to provide such EE and this proves the efficiency of proposed approach.

KEYWORDS

base station (BS), channel estimation (CE), channel state information (CSI), Hybrid Grey Wolf Optimization with Cuckoo Search (GWO-CS), massive MIMO (multiple input multiple output), mobile users (MUs), remote antenna unit (RAU), signal to interference plus noise ratio (SINR), uplink channel

1 | INTRODUCTION

Because of the more number of cell phones and rising applications, the requests for remote data services have been definitely expanding in recent years. Those universal communication services need higher information transmission rates. In this manner new difficulties in future wireless communications are presented. Subsequently, the massive multiple input multiple output (mMIMO) emerges with the deployment of enormous antenna arrays at the base stations (BSs), which can aid a large number of user terminals (UTs) around a similar time/frequency resources.¹

Profiting by aggressive spatial multiplexing, mMIMO frameworks can experience asymptotically orthogonal channels, random minor transmits power and insignificant noise, subsequently giving huge performance gains by means of spectral efficiency (SE), energy efficiency (EE), security and consistency when contrasted with traditional MIMO.^{2,3} In

Article

Identification of Fibre Content in Edible Flours Using Microwave Dielectric Cell: Concise Review and Experimental Insights

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Abstract: The quality of edible intake decides the health of the human body and is also responsible for building a healthy immune system in the body. A healthy immune system can protect the body even from invisible attacks of viral or bacterial infections. The assessment of the quality of edible items is not well defined and standardized in many developing countries due to quality assessment difficulties in practice. An alternative well-defined quality assessment approach for edible flours is presented in this paper. Every edible substance has dielectric properties, and it varies from material to material in nature. Edible flours and liquid have different microwave absorption capabilities, based on their natural molecular structure. Based on the microwave energy absorption characteristics of materials, the attenuation constant of edible flours is derived by the waveguide method in this work. In this approach, microwave energy absorption of the edible samples of different types of wheat, rice and millets are observed, and the attenuation constant factors of the samples are then calculated from the tabulated values. The work focuses on the identification of fibre content present in the edible flours. Inferences are made based on the attenuation and its variations with the number of samples, dielectric loss and dielectric constant of the samples. A systematic and concise review of the topic is also included for the benefit of future researchers.

Keywords: attenuation; edible flours; microwaves; substances



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1. Introduction

The human health care industry is trying a lot to save human life by fighting against various diseases. All the ancient traditional medical literature says that lifestyle and food habits are the significant factors to cause disease in the human body and they teach us that prevention is better than cure. To achieve the prevention of disease, one of the best practices is to take healthy foods regularly as our intake. The quality of the food intake should be properly defined and its quality assessment is the most important one in achieving disease-free life. The quality assessment of edible items can also be attained by the application of engineering conceptions in addition to the biochemical tests that are available in practice.

The electrical properties of agricultural materials have been of interest for many years. The interest in the dielectric properties of materials has historically been associated with the design of electrical equipment [1]. The study of the thermal behaviour of these edible products requires the accurate determination of the complex permittivity and permeability when the temperature varies and when the materials are irradiated in specific conditions [2]. The dielectric properties of a material are intrinsic electrical properties that describe its polarization states when subjected to an electric field.



Enhanced Method of Mitigating Voltage Sags and Swells Using Optimized Fuzzy Controlled DVR

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Abstract

Recently, power quality becomes a major concern in Power Distribution System. To maintain power quality, the occurrence of voltage disturbances has to be detected and compensated. Disturbances such as voltage swell, voltage sag, and transients will cause severe problems to the electrical devices. In this paper, a fuzzy-based Dynamic Voltage Restorer tuned using particle swarm technique was proposed to mitigate the above disturbances. The performance of Dynamic Voltage Restorer is enhanced by the fuzzy controller to control the direct and quadrature voltage components. Optimized tuning through particle swarm optimization helps to achieve an accurate compensation under various fault conditions and nonlinear loads. This proposed scheme shows an ultimate performance in quick detection and mitigation compared to the existing methodologies. Also, the Total Harmonic Distortion caused by the power electronic components gets reduced considerably. Finally, simulations are carried out using MATLAB/SIMULINK platform and the effective results are validated.

Keywords Dynamic voltage restorer · Fuzzy logic controller · Point of common coupling · Total harmonic distortion · Particle swarm optimization

1 Introduction

Electric Power Quality (PQ) is defined as the ability of the power system to deliver quality power to the consumers within the specified limits. If any deviation occurs in the pure sinusoidal waveform it is categorized into different PQ disturbances such as Sag, Swell, Harmonics, Transients, and Flicker (Babaei et al. 2012). According to the IEEE standard 1159, Sag is defined as the decrease in RMS value of voltage or current from 0.9 to 0.1 per unit at the power frequency not exceeding a time duration of 1 min. Similarly, Swell is defined as

the increase in RMS value of voltage or current from 1.1 to 1.8 per unit at the power frequency not exceeding a time duration of 1 min (see reference IEEE std 1986). Normally, in power distribution system disturbances will occur due to various faults at the load side such as short circuit fault, load shedding and load switching. Moreover, Harmonics are caused due to nonlinear loads like semiconductor devices, solid-state switching devices, microcontrollers, switched mode power supplies and inverters. Therefore, eliminating such problems is essential and it can be done in two ways (Shringi et al. 2018), either by reducing the cause for the fault or by compensating the disturbances using suitable devices. In second category of elimination custom power devices such as DSTATCOM, Dynamic Voltage Restorer (DVR) and UPQC are recently used to inject the voltage required for compensating PQ disturbances (Farooqi et al. 2019) Among those devices, DVR has a quick response feature and it became the most effective and suitable tool for compensation in distribution networks (Soomro et al. 2020). DVR is a series-connected power electronic device made up of multi-level Voltage Source

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Research Article

Environmental Fault Diagnosis of Solar Panels Using Solar Thermal Images in Multiple Convolutional Neural Networks

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Every year, each solar panel suffers an efficiency loss of 0.5% to 1%. This degradation of solar panels arises due to environmental and electrical faults. A timely and accurate diagnosis of environmental faults reduces the damage caused by faults on the panel. In recent years, deep learning precisely convolutional neural networks have achieved wonderful results in many applications. This work is focused on finely tuning pretrained models of convolutional neural networks, especially AlexNet, GoogleNet, and SqueezeNet. Based on the performance metrics, SqueezeNet is used for training thermal images of solar panels and for the classification of environmental faults. The results obtained show that SqueezeNet has a significant testing accuracy of 99.74% and F1 score of 0.9818, which make the model successful in identifying environmental faults in solar panels and help users to protect the panels.

1. Introduction

Photovoltaic systems are one of the most distinguished and clean sources of energy which generate power by converting solar energy from the sun into direct current electricity. In 2019, solar power delivered was 2.7% of total worldwide electricity production. The International Energy Agency has stated by 2050, solar power would contribute up to 16% of the world's electric energy production with solar being the largest renewable source of energy. Electric power generated by a 1 KW system of solar panels is roughly around 850 KWh per year. However, each year the solar panels suffer an efficiency loss of 0.5% to 1% resulting in reduced output power generation. This power loss in solar panels arises due to environmental and electrical faults [1].




Environmental faults like shading, soiling, and snowing tend to cause a significant power loss in PV modules. Solar panels are expensive and require proper maintenance throughout the year. Hence, it is necessary that faults in the solar panels are detected and rectified in the preliminary stage [2].

The goal of this research is to detect environmental faults in the solar panels accurately. For this purpose, different convolutional neural networks (CNN), namely, AlexNet, GoogleNet, and SqueezeNet are trained and their performance metrics are obtained. Based on the results, a suitable network is opted for training thermal images of solar panels and for the precise determination of environmental faults in solar panels.

S.K. Firth conducted a survey and found that annually the different faults in photovoltaic systems reduce the power output by 19% [3]. To detect these faults, W. Chine proposed



Square dynamic reconfiguration for the partial shaded photovoltaic system – simulation and experimental analysis

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ABSTRACT

The solar photovoltaic system often encounters partial shading issues which invariably affect the output power generation from the PV array. Partial shading conditions cannot be discarded but able to be diminished using reconfiguration techniques. A new square dynamic reconfiguration algorithm is critically analyzed in this paper for the partial shaded Photovoltaic System. However, several other dynamic reconfiguration algorithms exist, the proposed square dynamic reconfiguration technique extracts maximum power from the PV array using a feasible switching circuit. In this method, an 8×8 PV array splits into four quadrants of each 4×4 matrix is investigated and a switching matrix is introduced between the quadrants in this proposed square dynamic reconfiguration algorithm. Each quadrant possesses an equal number of rows and columns. The row current in terms of the short circuit current of each row is utilized to categorize the different cases. The simulation work of this proposed SDR method is conducted in MATLAB Simulink software for 8×8 matrices and the experimentation is accomplished using a test setup of a 4×4 PV array. Randomly seven shading types are considered to verify the effectiveness of our work. In the switching matrix, only 16 switches are taken to extract a maximum power of 136 W out from the 160 W experimentation 4×4 PV array test set up under partial shading. The herein conducted research work provides an innovative and simpler reconfiguration algorithm because of its lesser number of switches in the switching circuit with a convenient operation to generate power during partial shading conditions.

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Square-based dynamic reconfiguration; photovoltaic (PV) array; reconfiguration algorithm; switching matrix; partial shading

Introduction

Renewable solar energy resources are cherished and treated as an everlasting asset for the upcoming generation across the world. It's appreciated as a clean energy resource because it has no potential damage to the environment. The bountiful quantity of solar energy from sunlight provides security for future development and growth in the energy sector. Even though solar energy has many advantages over other renewable resources like biomass, wind energy, and hydroelectric energy, partial shading is the main drawback of solar PV. Partial shading occurs by virtue of moving clouds, birds, building shadows, and sometimes faulty panels in the PV array. In the PV array, reduction in output values can be related to the estimation of the percentage of shading that occurred. Accordingly, the PV panels should be connected/disconnected to perform the topology reconfigurations (Tabanjat, Becherif, and Hissel 2015). The solar Photo-Voltaic array of various interconnections such as Total-Cross-Tied



Bypass diode and photovoltaic module failure analysis of 1.5kW solar PV array

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ABSTRACT

Solar photovoltaic (PV) is the widely preferred power generation source to meet the growing energy demands. Solar PV system must be made highly reliable and effectively utilized during the availability of the source. System reliability is the predominant factor to be considered because of the possibilities of various faults and various operating conditions to which PV system is subjected. The present work addresses three major faults that commonly occur in solar PV system, namely, failure of bypass diode, failure of PV module, and power generation mismatch due to panel replacement. This proposed work deals with the detection and clearance of these three faults. The failure of PV module results in a higher power reduction of 82% in the PV array. The switching matrix circuit is proposed to enhance the power obtained from PV system under the module failure fault. The faults are manually created in a typical 1.5 kW grid-connected PV system and rectified to enhance the power production in the PV array. An average power enhancement of 14% is obtained after the clearance of the power mismatch due to panel replacement. With the help of double bypass diode technique, output power is enhanced to 55.2% higher compared to before fault clearance at the same irradiance level. The experimental results obtained in 1.5 kW grid-connected solar PV system are studied and validated.

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KEYWORDS

Solar PV; module fault; maximum power extraction; bypass diode fault; mismatch panel fault

Introduction

The occurrence of a fault on the solar photovoltaic (PV) array was mitigated by residue signals that got it from each PV string (Dhoke, Sharma, and Saha 2019). An undecimated wavelet transform is used to diagnose the faults that occur on the plant in real time (Yılmaz and Bayrak 2019). Partial shading has influenced a high impact on the efficiency of PV systems. Maximum power point tracking technique was used to enhance power output under partial shading. But its effectiveness is unstable due to the various global maxima caused by the shading (Balasubramanian, Ganesan, and Chilakapati 2014). The dynamic performance of the distribution network of the grid-connected PV array with single-phase fault in the UK was analyzed (Bhagavathy et al. 2019). A random forest machine learning algorithm is used to detect the line to line (LL), degradation, partial shading, and open circuit fault in the PV array (Chen et al. 2018). An automatic fault detection technique is implemented in a grid-connected PV system to mitigate partial shading and aging of PV panels in an array (Chine et al. 2014). Open-circuit and short-circuit fault can be detected by using the

The adjuvant role of acupuncture to treat the diabetes mellitus and its analysis using thermogram

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Abstract: This work describes the effects of acupuncture in glycemic control and validates the results using infrared thermography. Two groups of patients undergoing diabetes mellitus treatment, are considered for experimentation. Group A is treated with both drugs and acupuncture, while group B is treated with drugs alone. The patient's blood sugar and surface temperature of the foot



Investigational study on improving the yield from hybrid PV/T modified conventional solar still with enhanced evaporation and condensation technique - An experimental approach

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ABSTRACT

Renewable energy source is insisted in all areas of technology, especially the adaptation of solar power for various purposes. The present investigational study is carried out to improve the efficiency of PV/T solar still using enhanced evaporation and condensation technique. A DC-powered blower is fixed inside single slope solar still which increases the turbulence of evaporated vapor from the saline water inside the solar still while the condensation is improved using the cover cooling technique. The experiment is conducted on a constant water depth of 1 cm with three different blow rate periods (5 min, 10 min, and 15 min). The blower runs and stops for 30 seconds time period in all blow rates. To improve the efficiency of the photovoltaic system, an inorganic phase change material (PCM) (Glauber salt ($\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$)) is used underneath the PV panel for cooling the panel. To obtain a higher production rate of distilled water, a nickel-chromium (NiCr) heater is placed in the solar still which is powered by the integrated solar PV system. This proposed work helps to enhance the freshwater production process from saline water and also solar power production. From this investigation, it is observed that the proposed PV/T solar still gives an improved overall thermal and electrical efficiency of almost 12.5% and 11.5% respectively, and is superior as compared to the conventional solar still.

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Solar still; hybrid photovoltaic/thermal (PV/T); thermal efficiency; electrical efficiency; blower; scraped metals

Introduction

In the current scenario, renewable energy resources are the most emerging one, especially solar PV system as it is eco-friendly. In the 20th century, the need for improving solar energy utilization has been improved in all developed countries owing to the exhaustion of fossil fuels and the desire to reduce greenhouse gas emissions (Arunkumar et al. (2022); Thakur et al. (2022), Thakur et al. (2022a), 2022b, 2022c); Prasad et al. (2022), Prasad et al. (2022a)); Omara, Abdullah, and Dakrory (2017); Smirnov, Malugin, and Bakanov (2017)). Nearly 5–25% of solar radiation is converted into electrical energy and the remaining energy is transformed into heat, which increases the external temperature of the PV element. Correspondingly, it reduces the open-circuit voltage, energy conversion efficiency, and output power of the PV cell due to an increase in internal charge carrier recombination rates

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Thermal, mechanical, and electrical properties of difunctional and trifunctional epoxy blends with nanoporous materials

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Abstract

In the present study, the aim is to synthesize the particulate nanocomposites with difunctional and trifunctional epoxy blend as matrix and synthesized nanoporous materials as fillers. Organic/inorganic hybrid networks were prepared by the novel solvent free method. Viscoelastic, thermal, and electrical properties of di- and trifunctional epoxy and the effect of different nanoparticles in the particulate nanocomposites have been studied by dynamic mechanical analyzer, thermogravimetry (TGA), and dielectric strength. Epoxy mixed with different compositions of TGPAP and particulate nanocomposites by the addition of different types of nanomaterials shows higher storage modulus than the pure epoxy. The addition of TGPAP and nanofillers decreases the thermal stability of epoxy matrix. The evolved gas analysis (TG-FTIR) was also done in order to study the products formed during degradation. An increase in dielectric strength and impact strength (4%) was also observed in the particulate nanocomposites.

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Techno-economic analysis of a hybrid solar wind electric vehicle charging station in highway roads

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Summary

Renewable energy resources have a remarkable landmark across the world to provide electricity to the consumers without any inadequacy in the energy market. The utilization of renewable energy sources in electric vehicle charging stations is among the most prominent area of research in developing countries. This paper analyses techno-economic and environmental factors of hybrid solar wind vehicle charging stations at the highway of Southern Tamil Nadu, India. The sensitivity analysis is performed in the design of a charging station at the following highway locations at Madurai, Virudhunagar, Sattur, Kayathar, and Tirunelveli. The locations are chosen in such a way that, wind and solar potentials are having contradictory nature in the specified locations. The charging station is designed and optimized as ON-grid strategy using the hybrid optimization model for electrical renewable tool. The designed system is capable of charging 17 electric vehicles at day from forenoon 6:00 AM to evening 6:00 AM. The attainment of the proposed designed system proves that Virudhunagar shows less net present cost with \$303 291.26 and cost of energy as \$0.072/kWh with 50% reduction in emission. Moreover, with a focus on economic analysis and Madurai produces 70% more electrical energy than other selected locations. Further, the performance analysis of the system is also studied and it shows more reliable results and is feasible considering both economic and technical studies.




KEYWORDS

HOMER tool, hybrid solar wind vehicle charging stations, net present cost, renewable energy resources, sensitivity analysis

Abbreviations: A, area of the panel; $A_{intrinsic}$, D intrinsic area of the panel; b , breadth of the panel; C_A , self-discharge rate of the battery; $C_{capitalann}$, annual total capital cost; CO_2 , carbon dioxide; COE, cost of energy; C_p , co-efficient of power; CRF, capital recovery factor; $C_{t,ann}$, annual total cost; E_{served} , electrical energy served; EV, electric vehicle; GHI, global horizontal irradiation; HEV, hybrid electric vehicle; HOMER, hybrid optimization model for electric renewable; HSWEVCS, hybrid solar wind electric vehicle charging station; I , annual rate of inflation; l , length of the panel; LF, life time; N , rate of interest; NASA, national aeronautics and space administration; NO, nitrous oxide; No , nominal rate of interest; NPC, net present cost; NREL, national renewable energy laboratory; O&M, operating and maintenance; P , density of wind; PI, profitability index; PV, photovoltaic; RES, renewable energy sources; SO_2 , sulfur dioxide; TRNSYS, transient energy system simulation program; V , wind blowing speed; Wh_{load} , watt hour load.

Article

Analysis of Grid-Interactive PV-Fed BLDC Pump Using Optimized MPPT in DC–DC Converters

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Abstract: In solar photovoltaic (PV) system-based Brushless DC (BLDC) motors for water pumping application, the role of DC/DC converters is very important. In order to extract the maximum power from the PV array, an efficient DC/DC converter is essential at the intermediate stage. In this work, different DC/DC converter topologies suitable for BLDC motors are proposed. The converters are supported by an optimized maximum power point tracking system to provide a reliable operation. Recent optimization algorithms such as fuzzy logic, perturb and observe, grey wolf, and whale optimization are implemented with the PI controller in maximum power point tracking to maximize the conversion efficiency. The obtained results using SEPIC, LUO, and interleaved LUO converters provide a comparative study in the case of converter output, motor parameters, and grid output. The performance analysis on three different converters and multiple optimization methods are carried out. By analyzing the performance of different converter topologies, the interleaved LUO converter outperforms the other two converters with the results of a voltage gain ratio of 1:22, conversion efficiency of 98.3%, and grid current THD of 2.9%. Moreover, regarding the power quality aspect, the total harmonic distortion of the grid current is maintained below the IEEE-519 standard. In addition, the developed system has an advantage of operating both in stand-alone and grid-connected operation modes.

Keywords: solar photovoltaics; brushless DC motor; maximum power point tracking; DC–DC converter



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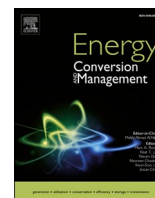


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1. Introduction

Due to the increased population and global warming, the conventional energy sources are decreasing rapidly, and people are shifting toward the usage of renewable energy sources [1]. The PV modules are widely used in many applications, which can be used as a grid-interactive system or standalone system. The PV system converts the energy received from the sun into dc power. The output of the PV array is affected due to different atmospheric conditions such as temperature, intensity, and shading of clouds. The output of the PV is tested under standard test conditions. To obtain the desired voltage level, the PV cells are connected in series, and in order to increase the current level, the PV cells are connected in parallel. The operating voltage of the PV array is maintained at a rated value using MPPT. The model of a PV cell consists of a battery, shunt resistance, diode, and a series resistance. The load is connected across the cell and the operating point is at the intersection point of the load and volt-ampere characteristics of the cell.

Normally, water pumps are used to raise the water to a higher altitude. In our work, a Brushless DC motor (BLDC) is utilized for a DC water pumping application [2]. It has several advantages such as simple construction, less maintenance, operation in synchronous



A comparative analysis of polycrystalline and bifacial photovoltaic module under various partial shading condition

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ABSTRACT

A bifacial photovoltaic module (BPVM) has gained prominence over the last decade due to its high efficiency due to the arrangements to grab the photon on both sides of the module. It has been shown that partial shading substantially affects the performance of polycrystalline photovoltaic module (PPVM) and BPVMs. A comparison of the performance of PPVM and BPVMs under different partial shading conditions is presented in this paper. Experiments were conducted on polycrystalline and BPVM with 320 W and 395 W, respectively. Module performance is analyzed in terms of percentage power extraction, percentage power loss, and power extraction per square meter. A partial shading for the front and rear side of BPVM has been developed and the results are presented. Based on the results, the average loss due to frontside partial shading is 26% lower in BPVM than in polycrystalline.

1. Introduction

The extensive use of fossil fuels and greenhouse gases has polluted the environment which in turn promotes the development of renewable energy sources such as solar, wind, tidal. Aside from its affordability, solar photovoltaic (PV) power generation has gained considerable attention because of subsidies from governments and innovative business models that have allowed prices to drop [1]. PV modules made from silicon have the largest market share of 95% among commercialized technologies [2]. In comparison to traditional PV modules, BPVM can perform better because solar irradiation is absorbed from both sides of the cells [3].

The installation of PV has attained an exponential increase and reached a total installed capacity of 402.5GWp by the end of 2017. In 2017, the contribution of PV systems was about only 2.14% of total electricity demand worldwide and its share keeps increasing [4]. By 2030, the total installed capacity of PV systems is expected to be between 1760GWp and 2500GWp [5]. Over 90% of PV cells available in the current market are made up of Si crystalline (IEA, 2016). This can be categorized into the aluminum back surface field has a market share of 70% followed by the Passivated Emitter and Rear Contact (PERC) / Passivated Emitter with Rear Locally Diffused Cells (PERL)/ Passivated Emitter Rear Totally Diffused- Cells (PERT) technologies by 20% [6].

The PPVM is composed of AL-BSF and the BPVM is prepared by PERC/ PERL/ PERT technologies. The BPVM has gained attraction because of light absorption occurring on the front and rear sides of the module.

Polycrystalline cells collect the photons from the sunlight only from the front side of the module. In the BPVM, photons are collected on the front and rear sides of the module. A transparent back sheet allows partial sunlight to reach the module from the rear side as it is reflected from the ground surface. This phenomenon of bifacial cells can increase the energy yield and thereby reduction in the cost of energy is achievable [7]. Luque et al, has developed an experimental setup using a concentrator device to collect the incident and albedo light to improve the power generation. The results showed that the albedo light improved the output power by 50%. Because of higher energy density in the BPVM, it generates higher output power compared to the PPVM for the same area. Because of the higher energy yield, the BPVM has a lower payback period. The lifetime of the BPVM with is improved because of the lesser sign of degradation due to moisture, light-induced and potential induced degradation [8]. The main advantages of the BPVM are the lower operating temperature due to the increase in open-circuit voltage. By reducing parasitic absorption and increasing recombination at the interface of the aluminum back surface field, losses are decreased. The absenteeism of metallization on the back surface of the cell lowers the infrared absorption and reduces the operating

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EXPERIMENTAL INVESTIGATION ON BIFACIAL SOLAR PV MODULE USING DIFFERENT REFLECTIVE MATERIALS UNDER ALBEDO VARIATION

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Abstract

Bifacial panels are ideally suited for commercial or utility-scale solar installations, but they can also be employed in some household applications. Bi-facial panels can be used in free-standing structures like the pergola to provide some shade while also generating energy. Bifacial panels can also be used in any other situation where the solar panels are not directly facing the sun. Awnings and canopies made of bifacial solar panels, for example, allow reflected light to reach the panels' backside. Bifacial photovoltaic (PV) is a potentially developed technology that uses absorptivity from the albedo to enhance the amount of power produced per square meter of the PV module. Because both sides of the cell, front and back, can absorb solar radiation, bifacial solar cells may provide a higher energy output than monofacial solar cells. Improved cell efficiency, module reliability, and deployment design of bifacial arrays in a PV plant should continue to be emphasized in bifacial PV efforts to co-optimize front-to-backside energy output for fixed and tracking systems throughout the day. The efficient thermal flow for front, rear, and combination irradiance was determined using these spectra. Single-cell laminates exposed to indoor irradiance had their power output, bifacial gain, and module operating temperature measured. Aluminium foil is a common component of laminates and is widely used in food packaging. It has a higher barrier function against the migration of moisture, oxygen and other gases, volatile fragrance, and light than any plastic laminate material. Recently, plastic-derived products have become a vital commodity for various purposes. It has three reflecting materials for comparison of reflectivity; first the typical surface readings, then the different reflective materials at various irradiance levels. A white paint reflector, plastic film, and aluminium foil sheet components are used. The aluminium foil sheet material has a high power density of 1000W/m² in Standard Test Conditions. Aluminium foil sheet is a highly reflective material with a maximum voltage of 38 V and a maximum current of 12.3A. This enhances the power of the reflective material 466W. The regular surface increases the power by 1.166%, whereas the aluminium foil layer increases the maximum power by 1.3%.

Keywords: Albedo Variations, Aluminium Foil sheet, Bifacial Solar Panel, Reflectors

On the products of group vertex magic graphs

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ABSTRACT

Let $G = (V(G); E(G))$ be a simple undirected graph and let A be an additive Abelian group with identity 0. A mapping $l : V(G) \rightarrow A \setminus \{0\}$ is said to be a A -vertex magic labeling of G if there exists a μ in A such that $w(v) = \sum_{u \in N(v)} l(u) = \mu$ for any vertex v of G . If G admits such a labeling, then it is called an A -vertex magic graph. If G is A -vertex magic for any non-trivial Abelian group A , then G is called a group vertex magic graph. In this paper, we consider A -vertex magic and group vertex magic labeling of different products of graphs.

KEYWORDS

A -vertex magic; group vertex magic; tensor product; lexicographic product

1. Introduction

The concept of group vertex magic graphs was motivated by the V_4 magic labeling for edges, which was introduced by Lee [5] and it was proved that “A tree T is V_4 -magic if and only if all its vertices have odd degrees”. Here, V_4 denotes the famous Klein’s four group. Low and Lee [6] extended the study of V_4 -magic labeling for the product graphs by considering an arbitrary Abelian group instead of V_4 . By getting motivated by this concept, analogously the concept of group vertex magic graphs was introduced and studied in [3]. Also, in [3], the authors have obtained a characterization of all A -vertex magic trees of diameter up to 4, where the group A is V_4 . In [4], Kollaran et al. have characterized the trees of diameter 5, which are V_4 vertex magic. In this paper, we use group elements to label the vertices of a graph and we have extended the study of group vertex magicness of a graph by considering an arbitrary Abelian group. It is interesting to use the ideas of algebraic structure in graph theory. Here, we focus on group vertex magicness of join and tensor product of graphs, and we carefully use the remarkable theorems from group theory, namely Cauchy’s theorem, Sylow’s first theorem and fundamental theorem of finite Abelian groups in a fruitful way.

All graphs considered in this paper are simple finite graphs, and A denotes an Abelian group, not necessarily finite. For a graph G , we use $V(G)$ (or simply V) for the vertex set of G . The open neighbourhood $N(v)$ of a vertex v is the set of all vertices adjacent to v in G . For basic graph-theoretic ideas, we refer to Bondy and Murty [1]. Let R be a commutative ring with unity, we denote the multiplicative group of all units in R by $U(R)$. For concepts in group theory, we refer to Herstein [2].

2. Main results

In this section we discuss the A -vertex magicness of join of two graphs.

Definition 1. [3] A mapping $l : V(G) \rightarrow A \setminus \{0\}$ is said to be a A -vertex magic labeling of G if there exist a μ in A such that $w(v) = \sum_{u \in N(v)} l(u) = \mu$ for any vertex v of G . The element μ is called the magic constant of the labeling l . A graph G that admits such a labeling is called an A -vertex magic graph. If G is A -vertex magic graph for any non-trivial Abelian group A , then G is called a group vertex magic graph.

Theorem 1. A graph G is \mathbb{Z}_p -vertex magic for all primes p if and only if G is A -vertex magic for all finite Abelian groups A .

Proof. Let A be any non-trivial Abelian group. Assume that G is \mathbb{Z}_p -vertex magic, for all primes p . By Cauchy’s theorem, A has a subgroup isomorphic to \mathbb{Z}_p , for some prime number p . Hence G is A -vertex magic for all finite Abelian groups A . The converse part is trivial. \square

Observation 1. A graph G is \mathbb{Z}_2 magic if and only if degree of every vertex in G is of same parity.

We prove the following theorem which is analogous to Lemma 1 in [7].

Theorem 2. Let l be a A -vertex magic labeling of a graph G . Then $\sum_{v \in V(G)} \deg(v)l(v) = n\mu$, where n is the number of vertices of G and μ is the magic constant.

Proof. For each vertex $v \in V(G)$, we have $w(v) = \mu$. Clearly, $\sum_{v \in V(G)} w(v) = n\mu$. This sum counts the label of v exactly $\deg(v)$ times. Thus, the equation holds. \square

Review Article

Adoption of Blockchain Technology for Privacy and Security in the Context of Industry 4.0

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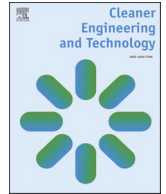
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Compared to centralized and decentralized models, distributed models have the potential to dramatically expand the scalability of existing IoT and Industry 4.0 solutions while maintaining participant organizations' security and privacy. This is partly because participating firms are not required to rely on or trust other services or third parties to manage the data they gather and transfer, out of concern that these parties could misuse the data or, in the worst-case scenario, share it with mass surveillance programs. However, until blockchain technology (BCT) demonstrates its viability as a means of developing security solutions in decentralized, collaborative, and trustless environments, the vast majority of these use cases will struggle to meet the requirements for integrity, immutability, traceability, and notarization. By utilizing BCT, it is possible to eliminate intermediaries, enabling individuals and devices to manage their data independently of third parties and most significantly to achieve a high level of traceability with information flow harmony. This technology enables transaction, transparency, and traceability by enabling for the interchange of historical data. The fundamentals of blockchain are examined in this research paper, along with an investigation of its operation and a discussion of some of its most fundamental aspects and concepts. A concise overview of smart contracts enables us to completely reimagine how network members create and automate transactions. Finally, several IoT and Industry 4.0 application possibilities that leverage blockchain are investigated, as is the blockchain's future trajectory.

1. Introduction

BCT is one of the upcoming digital technologies that will be utilized during the Fourth Industrial Revolution (Industry 4.0). Security, privacy, and data transparency may all be improved by implementing BCT into the operations of both small and large-scale businesses. Industry 4.0 is a collection of innovative manufacturing techniques that enable enterprises to accomplish their goals more quickly. Additionally, it is referred to as Industry 4.0. Numerous studies on various

Industry 4.0 technologies, including artificial intelligence (AI), the Internet of Things (IoT), big data, and blockchain, have been done in recent years to establish whether or not these technologies have the potential to cause substantial disruptions. These technologies provide a slew of possibilities in the manufacturing and supply chain management industries, respectively. BCT has garnered considerable attention and has the ability to significantly improve industrial and supply chain environments. Numerous unique insights into the benefits of BCT in a range of sectors are



A sustainable dual-channel inventory model with trapezoidal fuzzy demand and energy consumption

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Lagrangean multiplier

ABSTRACT

Most of the consumers relied heavily on e-commerce for products and services for the past few years due to the recent COVID-19 pandemic. This kind of an unexpected behaviour among the consumer society has taken every industry by surprise so that many industries have begun operating online and offline businesses to ensure future competitiveness. Firms introducing online sales are deplorably facing many challenges in terms of logistics and delivery processes, such as short lead times, flexible delivery, capacity of warehouse, and the production process for controlling carbon emissions. Keeping these challenges in mind, a sustainable dual-channel vendor-buyer supply chain model has considered for a controllable emission under fuzzy demand and energy consumption. The model deals with limitation on warehouse floor-space area, and the warehouse divides into two stages such as one for satisfying online orders and the other for satisfying offline orders. The demand rate and energy consumptions are treated as the trapezoidal fuzzy number, and we use the signed distance method to defuzzify the fuzzy joint expected total cost. The objective focuses on obtaining a trade-off between cost and emissions, thereby determining the optimal production-distribution strategy and a proper sustainable plan for handling both online and offline orders. The aforesaid scenario is mathematically formulated in the form of constrained non-linear programme (NLP) and derive a Lagrangean multiplier method to solve it. An iterative solution algorithm is designed, and for better illustration of the developed theory, numerical analysis is carried out followed by a wide discussion on the sensitivity analysis for various parameters. Our results indicate that the optimal solutions of the sustainable fuzzy model slightly fluctuate from the solutions of the sustainable crisp model. According to results, considering the uncertainty in the system is a crucial factor to achieve the economic and environmental sustainability of the production sector. The research reveals that the practitioners should be careful in accounting flexibility in the input factors demand and energy to tackle the uncertainties that always fit the real situation.

1. Introduction

The lockdown had hit almost all the businesses hard. But now with the relaxations from the government for them to operate again, it is a big relief for all the sellers. As good as this news is, it's also a reminder to re-evaluate the business strategies. For private customers worldwide, the outstanding type of 'internet business' mainly falls into the 'business to customer' category, which incorporates online retail or online shopping. It alludes online purchases from blocks and-mortar retailers, for

example, Walmart, as well as from web-only online retailing corporations, like Amazon. In 2017, an estimated of 1.66 billion people purchased goods online, globally. During that period, the e-retail deals, worldwide, added up to \$2.3 trillion. Predictions too have been made to accelerate the same to about 4.88 trillion U.S. dollars by 2021. Consequently, online shopping is one of the trendiest online actions, globally. Till date, we could sell pretty much anything and earn profit. Rivalry was insignificant, innovations weren't as moderate as they are today and access to items was always restricted. Few of the most common

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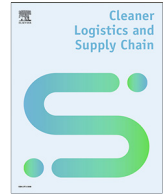
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A cleaner EPQ inventory model involving synchronous and asynchronous rework process with green technology investment



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ABSTRACT

The amount of carbon emission in the atmosphere continues to grow, and production, storage and transportation are major contributors that are repeatedly unnoticed when it comes to solving the problem. A carbon levy and cap EPQ model has been explored in this study for a controlled carbon emission in view of cleaner production under imperfect production processes where a fraction of the products is faulty. The model incorporates emissions from transportation, production, and storage activities, which are meant to be decreased by green investment. The manufacturer employs a rework approach to rectify the faulty products. Flexible rework allows the manufacturer to choose the rework rate, which can differ from the manufacturing rate, as well as the process of rework, which can be asynchronous or synchronous. A linear rework cost function of the rework rate is assumed. We sought to obtain the lowest cost with respect to optimal lot size, and backorder under the effect of controlling carbon emissions by applying the exponential form of green investment. Keeping these in mind, several mathematical models derived for various rework rate and rework process assumptions with the objective emphases on gaining a trade-off between cost and emissions, thereby finding the optimal production-distribution inventory strategy and an appropriate sustainable plan for handling both synchronous and asynchronous rework process. We show a constrained non-linear programme (NLP) and derive a calculus optimization technique to solve it. An iterative solution technique is used to arrive at the optimal decisions, which are shown analytically and numerically. The results validate the impacts of controlled carbon emissions on the production strategies. The findings mainly suggest that increasing the carbon levy reduces emissions. The firm has more options to decrease emissions caused by industrial activity with the help of green technologies. Although green technology has a higher upfront cost, the producer will reap the advantages of lower emissions.

1. Introduction

Industry's supply chains are focusing on environmental performance by adding on service and cost. For a company or an industry, the most important factor is lot sizing or ordering quantity. In production scheduling, the manufacturer must be known when to stop the production and utilize the items stacked up in the inventory to meet the continuous demand. In order for the plans to be used, irregularities in manufacturing processes must be considered while planning production. In the manufacturing industry, for example, the flawed quality of items is common during the production process. Many causes contribute to defective products, including machine failure, broad tolerances, human mistake, misuse, and inaccurate raw material requirements. All of the industries employ a strategy of discarding the


defective items once they are identified. As we know that greenhouse gas emissions normally associated with scrap items, the resources of the manufacturing process can be better utilized if the defective items are repaired. Instead of scraping them to continue meeting the demand or reentered into manufacturing as raw materials. Today the greenhouse gas effect, which is produced by rising pollution levels, is the primary driver of global warming. Production, food processing, mining, and construction account for around one-fifth of all greenhouse gas emissions. Direct emissions are produced by a range of activities, including on-site fossil fuel combustion for heat and power, non-energy fossil fuel consumption, and chemical processes used in the manufacture of iron, steel, and cement. Indirect emissions are produced by industry as a result of the centrally generated power it uses. About a quarter of total electricity sales come from the industrial sec-

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Article

Development of Eco-Friendly Cutting Fluid for Machining of AISI 1010 Steel in Automotive Industry

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Abstract: In spite of better performance, the disposal of used petroleum-based cutting fluids threatens our environment. Thus, it is essential to develop eco-friendly cutting fluids for performing machining operations in industries. The main contribution of this paper is to develop an eco-friendly cutting fluid for the plain turning of AISI 1010 steel which is used in the automotive industry. In the present work, boric acid (H_3BO_3) was mixed with the neem seed. Neem seed oil is easily available in many countries including India. The effectiveness of the proposed cutting fluid was evaluated by conducting different tests as per the standards. The mean biodegradability value of the developed cutting fluid is 97% which is better than other cutting fluids. The average cutting force required by the proposed cutting fluid is only 127.2 N which is much less than the cutting force requirements of dry machining and conventional cutting fluids. The average surface roughness of the machined component using the proposed cutting fluid is 122.9 μm . The mean flank wear of the tool is only 289 μm . The flash point of the proposed cutting fluids is more than 250 °C which is better than the conventional cutting fluids. The fire point of the neem oil-based cutting fluids is 300 °C. The results of the stability test and the microhardness test revealed the effectiveness of the proposed cutting fluids. The results obtained in this work are superior to several other cutting fluids reported in the existing literature. Hence, it is suggested to replace the existing petroleum-based metal cutting fluid with this eco-friendly cutting fluid in the automotive industry in Hosur, India.

Keywords: cutting fluid; machining; neem seed oil; boric acid; AISI 1010; eco-friendly

1. Introduction

In the automotive industry, several machining operations are carried out. Many types of cutting fluids are used during machining operations. Cutting fluids progress the lifetime of a cutting tool by reducing the tool wear. Cutting fluids also increase the value of the machined components and reduce the power consumption [1]. The cost of cutting fluids contributes approximately 15% of the manufacturing cost. To reduce the cost of cutting fluids, researchers proposed dry machining processes. Dry machining processes would affect the characteristics of the components and reduce the tool lifespan. Hence, the usage of cutting fluids is inevitable in machining industries. Synthetic oil-based metal fluids



Development of hybrid composite materials for machine tool structures

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ABSTRACT

Several types of machine tools are used in industries to produce a variety of components. As the speed of these machine tools is increased, is developed. The vibrations developed by these machines should be controlled as it would affect the quality of the parts produced and the life of the machine tools. Hence, in this paper a hybrid composite material is proposed to manufacture a gear hobbing machine column with the aim of improving the dynamic characteristics of the machine. Cast iron is made as outer casing and glass fibre reinforced epoxy is made as inner core. A finite element model of the gear hobbing machine column is developed to carry out the investigations. The proposed model is validated by conducting experiments. The results show an improvement in natural frequency of the hybrid column by 40%.

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1. Introduction

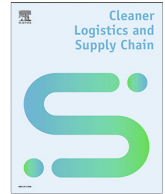
Machine tools play an important role in manufacturing industries. High static stiffness for bending and torsion, good dynamic characteristics, good dimensional stability, low coefficient of expansion, low cost and low material requirements are the some of the properties required for a machine tool to perform well [1]. During the machining process, vibration is the most important problem which affects machining performance, surface finish and tool life. To overcome the above problems, the machine tool structures should have high stiffness and damping capacity. The requirement of high specific stiffness with high damping for high speed machine tool structures could be attained by employing fiber reinforced polymer composite materials [2]. Therefore, these materials are used in automobile structures and machine tool structures due to their high specific strength, high stiffness and damping. Generally, the structural components are made of cast iron (CI) due to its higher damping capacity. However, casting process requires open box structures with small wall thickness, which implies low natural frequencies that limit the machining conditions. Several research works were carried out to find a suitable replacement to cast iron [3]. Chang et al. [4] proposed a column

made of adhesively bonded glass fiber reinforced epoxy composite and the damping capacity was calculated with respect to the fiber orientation and thickness of the composite laminate plate and compared to the measured damping capacity. It was found that the damping capacity of the hybrid column was 35% more than that of the CI column. Chen et al. [5] investigated the structure performance of the artificial granite material for machine tool structure. They proved that the artificial granite has superior dynamic stiffness than the CI. Rangasamy et al. [6] developed a mini lathe bed with laminated hybrid composites, carbon, and glass/epoxy and attained superior dynamic properties with less weight. Murugan and Thyla [7] presented a detailed review on the mechanical and dynamic properties of alternate materials proposed for machine tool structures. They reported that there is a scope for the development of new materials for machine tool structural applications. Dunaj et al. [8] developed a composite steel–polymer concrete frame and hence increased the stability of a lathe machine. Yin et al. [9] investigated the effect of particle type and its surface characteristics on the mechanical properties of particle filled polymer composite for precision machine tools.

In this work, an attempt is made to improve the dynamic behaviour of a gear hobbing machine with the help of polymer composites. The design modification proposed in this work is to replace the conventional CI column of the machine with a hybrid structure. In this work, cast iron is used as outer case of the column and glass fiber reinforced epoxy stacking are used as inner core. The glass

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A cleaner EPQ inventory model involving synchronous and asynchronous rework process with green technology investment



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Odd Vertex Equitable Even Labeling of Duplication and Product Graphs

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Abstract: Let G be a graph with p vertices and q edges and $A = \{1, 3, \dots, q\}$ if q is odd or $A = \{1, 3, \dots, q + 1\}$ if q is even. A graph G is said to admit an odd vertex equitable even labeling if there exists a vertex labeling $f : V(G) \rightarrow A$ that induces an edge labeling f^* defined by $f^*(uv) = f(u) + f(v)$ for all edges uv such that for all a and b in A , $|v_f(a) - v_f(b)| \leq 1$ and the induced edge labels are $2, 4, \dots, 2q$ where $v_f(a)$ be the number of vertices v with $f(v) = a$ for $a \in A$. A graph that admits an odd vertex equitable even labeling is called an odd vertex equitable even graph. In this paper, we find some new results on odd vertex equitable even labeling and establish that some standard graphs admit odd vertex equitable even labeling.

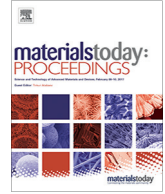
Key Words: Vertex equitable labeling, odd vertex equitable even labeling, odd vertex equitable even graph, Smarandachely k -vertex equitable labeling, Smarandachely odd k -vertex equitable even labeling.

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§1. Introduction

All graphs considered here are simple, finite and undirected. Let $G(V, E)$ be a graph with p vertices and q edges. We follow the basic notations and terminology of graph theory as in [2]. We denote the vertex set and edge set of a graph by $V(G)$ and $E(G)$ respectively. A graph labeling is an assignment of integers to the vertices or edges or both, subject to certain conditions. A pioneering paper on graph labeling problems was published in 1967 by Rosa [9]. Over the last five decades, many types of graph labeling techniques have been introduced and studied by several authors. All these graph labeling techniques are beautifully classified and updated in his survey by Gallian [1]. Vertex equitable labeling, introduced by Lourdusamy and Seenivasan [7] is one among the labelings and it is classified under miscellaneous labelings in Gallian survey.

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Delamination study on glass/carbon hybrid composite laminates for structural applications

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ABSTRACT

Fiber reinforced polymer (FRP) composite laminates are widely used in engineering applications covering from aerospace to household appliances due to their high strength-to-weight ratio. In all these applications, the use of mechanical fasteners in assembling process necessitates the drilling of composite panels. Drilling the composite panels, on the other hand, poses a serious threat to the quality of the holes and thereby joint strength. The goal of this research is to improve the quality of holes drilled in glass/carbon hybrid composite laminates, which are widely used in engineering. The hand layup method was used to fabricate all of the preferred laminates. A vertical machining centre was used to drill holes in composite laminates (AMS MCV-350). The L9 orthogonal array was employed to obtain the best results for three preferred drilling process control parameters: drill bit diameter, spindle speed and feed rate. For the delamination analysis of glass/carbon hybrid composite laminates, the equivalent delamination factor (F_{ed}) is used. The equivalent delamination factor of each drilled hole was measured using the digital image analysis method. Based on the experimentally determined values of the equivalent delamination factor, an effective layering arrangement was also proposed in order to achieve a quality hole with the least amount of delamination in glass/carbon hybrid composite laminates. An analysis of variance (ANOVA) was also performed on the experimental results to find the best process parameters for drilling the glass/carbon hybrid laminates with minimum delamination. The ANOVA results revealed that drill bit diameter has a greater impact on delamination than spindle speed and feed rate when drilling glass/carbon hybrid composite laminates.

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1. Introduction

FRP composite materials are employed in a wide range of engineering applications ranging from aerospace systems to consumer products [1]. FRP structures are developed as tailor-made materials in many applications to replace metal components used in corrosive environments. Because of research and innovation, many new composite materials are being developed in recent years for using different fields [2]. Glass fiber and carbon fiber composite materials (GFRP/CFRP) are the most recent examples of such materials, with the polymer matrix embedded with fibers or particles [3]. Structural fastening of FRP laminates requires precise and defect-free drilling to ensure precision and strong joint strength

[4]. Delamination is the most common problem encountered when drilling FRP laminates. Many studies have been conducted to determine the influence of machining parameters such as drill diameter, spindle speed, and feed rate on delamination during the drilling of FRP composites [5–7]. It is found that drilling thrust force to be the main reason for delamination [8]. Several methods for reducing delamination in composites have been developed over time, including: (i) drilling with a pilot hole (ii) active backup force drilling (iii) ultrasonic vibration-assisted drilling (iv) high-speed drilling (v) drilling with a back-up plate [9–12].

Researchers used a variety of methods to measure the level of delamination on the laminate [9,13,14] and proposed many terms to assess delamination around the hole [10,15,16]. Many researchers have used digital image analysis to determine the delamination damage of drilled holes [13,17,18]. Tom Sunny et al discovered that the area of delamination damage (F_{ed}) is more significant than the

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Investigation of Mechanical, Thermal, and Moisture Diffusion Behavior of *Acacia Concinna* FIBER/POLYESTER Matrix Composite

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ABSTRACT

Acacia concinna is a climber shrub commonly found in the warm plains of central and south India, and it is an excellent herbal remedy for hair. In this investigation, fiber has been extracted from the stem portion of the *Acacia concinna* plant through the retting process; subsequently, the fibers were cut into 40 mm length. A part of extracted fibers were treated with 3% alkali concentration, and the remaining was kept as an untreated form. Composites were fabricated with raw and treated *Acacia concinna* fibers separately using a compression moulding process. During composite fabrication, five different fiber weight fraction was maintained, such as 10%, 20%, 30%, 40%, and 50%. Tensile, flexural, impact, hardness, moisture diffusion, and thermal properties were analyzed on the alkali-treated, and untreated fiber reinforced composites. The alkali-treated composite with 30% fiber weight fraction showed good tensile strength (129.38 ± 5.3 MPa), tensile modulus (1.986 GPa), flexural strength (137.31 MPa), flexural modulus (2.86 GPa), impact property (18.61 J/cm²), hardness property (95 HRRW) and water absorption characteristics (4.9%). SEM analysis confirms the improved surface of the alkali-treated composite material.

摘要

金合欢是一种攀缘灌木，常见于印度中南部温暖的平原，是一种很好的治疗头发的草药。在本研究中，通过脱胶过程从相思植物的茎部提取纤维；随后，将纤维切割成40mm长。一部分提取的纤维用3%的碱浓度处理，其余的保留为未处理的形式。采用压缩成型工艺，分别用生的和处理过的刺槐纤维制备复合材料。在复合材料制造过程中，维持了5种不同的纤维重量分数，例如10%、20%、30%、40%和50%。分析了碱处理和未处理纤维增强复合材料的拉伸、弯曲、冲击、硬度、水分扩散和热性能。纤维重量分数为30%的碱处理复合材料具有良好的拉伸强度(129.38 ± 5.3 MPa)、拉伸模量(1.986 GPa)、弯曲强度(137.31 MPa)、弯曲模量(2.86 GPa)、冲击性能(18.61 J/cm²)、硬度性能(95 HRRW)和吸水特性(4.9%)。SEM分析证实碱处理复合材料的表面得到了改善。

KEYWORDS

Acacia concinna fiber; tensile strength; flexural strength; impact strength; hardness; moisture diffusion

关键词

金合欢纤维; 抗拉强度; 弯曲强度; 冲击强度; 硬度; 水分扩散

Introduction

The demand for natural fiber reinforced composite structures increases exponentially due to their optimum strength, non-corrosive nature, low specific strength, and eco-friendly. It will be essential to identify novel fibers and convert them as composites to alleviate such demand. Layth et al. proved that



Characterization of Raw and Alkali Treated Cellulosic Filler Isolated from *Putranjiva roxburghii* W. Seed Shell Roadside Vegetative Residues

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ABSTRACT

A natural cellulosic filler extracted from the seed shells of the *Putranjiva roxburghii* W. has been investigated for its suitability in reinforcement of fiber reinforced polymers. The physicochemical, morphological, structural, and thermal properties of untreated and alkali-treated *Putranjiva roxburghii* seed shell filler (PRSSF) particles are investigated for the first time. The particle size and morphology of PRSSF particles have been analyzed using laser particle size analyzer and field emission scanning electron microscopy. Energy-dispersive X-ray spectroscopy was used to validate the elements present on the untreated and treated PRSSF particles. The structural features were investigated using X-ray Diffraction, nuclear magnetic resonance, and Fourier transform infrared spectroscopy analysis, which revealed the reduction of the amorphous contents and noncellulosic components. Thermogravimetric analysis was employed to determine the thermal stability of both untreated and treated PRSSF particles. The results indicated that alkali-treated PRSSF particles have higher thermal degradability and stability than untreated PRSSF particles.

摘要

羊绒是柔软, 奢华和昂贵时尚服装的代名词。识别和可能量化回收羊绒的客观和定量方法对于阻止将优质原始羊绒与廉价回收纤维掺假至关重要。目前, 用于识别再生纤维和未再生纤维的可用分析方法仅限于主观分析。这项工作研究了客观可靠的方法, 根据再生纤维和原始纤维的不同染料吸收能力, 量化再生羊绒与原始羊绒的混合量。纯天然羊绒纤维和再生羊绒纤维用不同量的C.I.染色。采用紫外-可见光谱法对不同条件下的直接红7和排气染液进行分析, 以量化残留的未吸收染料。然后, 将该方法应用于不同比例的原始羊绒和再生羊绒的混合物, 相关系数。

KEYWORDS

Putranjiva roxburghii; natural fiber; alternative renewable filler material; alkali treatment; structural characterization; TGA

Introduction

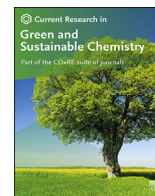
With growing awareness of environmental issues, the automobile industry needed alternative lightweight materials. Material substitution has been driven by problems about cost and environmental impact (Abdel-Shafy and Mansour 2018). Ecological concerns and worldwide standards are aimed at attracting people's attention to the need of using materials derived from natural sources including agricultural/industrial wastes; as a result, researchers are concentrating on alternate materials, which is cost-effective and biodegradable (Abdel-Shafy and Mansour 2018). Natural resources make up the majority of the alternative materials. According to current research, roadside vegetation, agricultural, and agro-industry waste could be valuable for alternative materials (Cholake et al. 2017). In the context of the global ecological economy,



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Extraction and development of starch-based bioplastics from *Prosopis juliflora* Plant: Eco-friendly and sustainability aspects



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ABSTRACT

As synthetic or petroleum-based plastics create a severe environmental impact, it is very essential to produce eco-friendly bioplastics to meet the needs of both the commercial and industrial sectors. Several starch-based bioplastics were already developed by researchers. However, most of them were produced from food grains such as corn, potato, rice, and so on. In this paper, an attempt is made to extract starch from *Prosopis juliflora* and to develop sustainable bioplastics from the extracted starch. Six samples with different compositions are prepared. Each sample is replicated 10 times and hence a total of 60 samples are prepared. Various tests such as tensile test, water solubility test, water absorption test, water contact angle test, biodegradability test, and morphological analysis were conducted. The test results reveal that the proposed starch-based bioplastics would be a better alternative material to be used in packaging industries. Further, the usage of *Prosopis juliflora* would also reduce the environmental impact significantly.

1. Introduction

Prosopis juliflora is an invasive plant species available in the hot region. It was introduced in many countries for 150 years. It is widely used as fuelwood in many developing countries such as India [1]. *Prosopis juliflora* is hard and withstands different environmental conditions such as temperature, water/soil quality, humidity, etc. They are growing at a faster rate as they have a higher success rate of germination success. They also prevent the growth of other plants. They extract more amount of water from the ground and hence kill other plants. The intrusive growth of *Prosopis juliflora* would affect biodiversity and many other impacts [2]. Researchers have extracted fibers from *Prosopis juliflora* and analyzed their properties [3–6]. The characterization of Galactomannan from *Prosopis juliflora* was studied and the impact grinding machine with a high-speed domestic grinder was used to seclude the Endosperm by eliminating the seed coat and germ [7]. Researchers proved that tree

wood has a sufficient quantity of starch [8] and a simple method was proposed to determine the quantity of starch in the wood [9]. Though several researchers carried out their research work on *Prosopis juliflora*, none of them have focussed on starch extraction from *Prosopis juliflora* for bioplastics applications. *Prosopis juliflora* is available abundantly in many countries like India. Hence, the objective of the present work is to extract starch from this *Prosopis juliflora* to produce a sustainable bioplastic.

Around 50% of the bioplastics are made from starch as they have several advantages like better tensile strength, biodegradability, ease of manufacturing [10]. Pure starch is available in white color. It does not have any explicit taste or smell, is biologically absorbable, non-toxic, semi-permeable to carbon dioxide, and insoluble in cold water or alcohol. Mainly starch consists of two types of molecules namely amylose and amylopectin [11]. Based on the nature of the plant, the amylose composition would differ from 20 to 25% and the amylopectin content varies from 75 to 80% by weight. Amylopectin is a larger molecule than

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Physico-chemical and Tensile Properties of Green Bio-films from Poly (Vinyl Alcohol)/Nano Ground Nutshell Filler

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ABSTRACT

Totally six composite bio-films were produced through a simple solution casting technique by varying the weight percentage (0, 5, 10, 15, 20, 25 wt.%) of the filler material (ground nutshell (GNS) powder) and matrix (Polyvinyl Alcohol (PVA)). Before making the bio-film GNS was characterized through particle size analysis and chemical analysis. Composite biofilms were characterized by X-ray Diffraction analysis, Fourier-transform infrared spectroscopy, Thermogravimetric analysis and tensile testing. The Fourier-transform infrared spectroscopy analysis results established that complete dispersion of GNS in PVA. X-ray Diffraction analysis results pronounced that the crystallinity index of the films was improved when increasing in the filler content. Derivative thermogravimetric curve was also visualized that maximum degradation temperature of the films was improved from 287°C (Controlled PVA) to 337°C (25% GNS/PVA Film). The tensile strength of the bio-films was increased and elongation at break of the bio-films was decreased while increasing the GNS content. The obtained results were clearly showed that the PVA/GNS composite bio-films were suitable materials to produce packaging applications.

摘要

通过改变填充材料(花生壳粉)和基质(聚乙烯醇)的重量百分比(0,5,10,15,20,25wt.%)制备了六种生物复合膜。在制备生物膜之前,通过粒度分析和化学分析对GNS进行了表征。采用X射线衍射分析、傅立叶变换红外光谱、热重分析和拉伸试验对复合生物膜进行了表征。傅立叶变换红外光谱分析结果表明GNS在PVA中完全分散。X射线衍射分析结果表明,随着填料含量的增加,薄膜的结晶度指数提高。微分热重曲线显示,薄膜的最高降解温度由287°C(控制聚乙烯醇)提高到337°C(25%GNS/PVA膜)。随着GNS含量的增加,生物膜的拉伸强度提高,断裂伸长率降低。结果表明,PVA/GNS复合生物膜是一种适合于包装应用的材料。

KEYWORDS

Ground nutshell powder; Poly vinyl Alcohol (PVA); TGA analysis; FT-IR; tensile strength; solution casting

关键词

果壳粉; 聚乙烯醇(PVA); 分析; 抗拉强度; 溶液浇铸

Introduction

In recent times, the usage of polymeric material is increased day to day in our life. Polyvinyl chloride, Polyethylene, and Polypropylene are the frequently used Polymers that are derived from petrochemical products (Jawaid and Abdul Khalil 2011). These synthetic polymers are utilized nearly 359 million tonnes/per year worldwide for many applications. In that more than 60% of the polymeric materials were used for packaging usage. Researchers try to find an alternative solution for the usage of plastics, especially its packaging applications on account of nonbiodegradability and depletion of petrochemical products as well. Bio-films made by using agricultural residues (filler) and polymer may be replaced the polymeric materials (Balavairavan, Saravanakumar, and Manikandan 2020). The advantages of bio-films are bio-degradability, easy processing, and lower cost. Currently, several bio-materials such as



Mechanical and Thermal Properties of *Cloris barbata* flower fiber /Epoxy Composites: Effect of Alkali treatment and Fiber weight fraction

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ABSTRACT

Untreated and alkali-treated (5% NaOH) *Cloris barbata* flower fibers (CBFFs) were used to fabricate the composites by hand lay-up method. Novel composite plates were manufactured by changing fiber weight fraction (5 wt.%, 10 wt.%, 15 wt.%, 20 wt.%, and 25 wt.%), raw and 5% NaOH treated fibers. The impact of NaOH treatment and fiber weight fraction on tensile, flexural, impact, morphological, and thermal properties of CBFF reinforced epoxy composites were examined and reported for the first time in this article. The tensile, flexural, and impact properties of the composites were increased up to 20 wt. % fiber additions and after that dropped. After the tensile testing, broken cross-sections of the composites were analyzed by scanning electron microscopy (SEM), which showed that NaOH treated CBFF reinforced composite has better interfacial bonding and lesser voids. Thermogravimetric analysis (TGA), Fourier transform infrared analysis (FTIR), and Atomic force microscope (AFM) analysis of composites also pointed out that alkali-treated CBFF is a suitable material for reinforcement with the epoxy polymer matrix.

摘要

以未经处理和碱处理的（5%NaOH）氯代巴巴多斯花纤维（CBFFs）为原料，采用手糊法制备了复合材料。通过改变纤维质量分数（5%、10%、15%、20%和25%）以及未加工和5%氢氧化钠处理的纤维，制备了新型复合板。本文首次研究了NaOH处理和纤维质量分数对CBFF增强环氧复合材料拉伸、弯曲、冲击、形态和热性能的影响。纤维添加量达到20wt%时，复合材料的拉伸性能、弯曲性能和冲击性能都得到了提高，然后下降。拉伸试验后，用扫描电镜（SEM）分析了复合材料的断裂截面，结果表明，NaOH处理的CBFF增强复合材料具有较好的界面结合性能和较小的空隙率。复合材料的热重分析（TGA）、傅立叶变换红外光谱（FTIR）和原子力显微镜（AFM）分析表明，碱处理CBFF是一种适合环氧树脂基体增强的材料。

KEYWORDS

Cloris barbata flower (CBF); alkali-treatment; mechanical properties; FT-IR analysis; interfacial bonding; surface topography

关键词

半枝莲花（CBF）；碱处理；机械性能；红外光谱分析；界面粘结；表面形貌



Introduction

Current environmental policies and laws lead the material researcher toward natural fibers to replace the synthetic fibers (Koronis, Silva, and Fontul 2013). Based on the source of origin, natural fibers are categorized into three types, such as plant fiber, animal fiber, and mineral fiber. Among this, plant fibers

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Mechanical Properties of Alkali-Treated *Carica Papaya* Fiber-Reinforced Epoxy Composites

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ABSTRACT

This investigation aimed at finding the effect of weight fraction (10 wt.%, 20 wt.% and 30 wt.%) and fiber orientation (0°, 45° and 90°) on mechanical properties (Tensile, Flexural and Impact) of *Carica papaya* fiber/epoxy (CPFE) composite. Totally nine composite samples were fabricated by hand layup followed by compression molding method. Testing results revealed that composites containing 20 wt.% and 0° fiber orientation exhibited better mechanical properties such as tensile strength (122 MPa), flexural strength (118.9 MPa) and impact strength (7.8 J) when compared to composite samples with other weight fraction and orientation. The scanning electron microscope (SEM) analysis was used to analyze the fractured surfaces of the composite specimens. The thermal stability of CPFE composites was evaluated by the Thermo Gravimetric (TG) and Differential Thermo Gravimetric (DTG) curves. All the findings led to the conclusion that the CPFE composites are suitable material to make the light weight industrial applications.

摘要

本研究旨在探讨木瓜纤维/环氧树脂 (CPFE) 复合材料的重量分数 (10wt%、20wt%和30wt%) 和纤维取向 (0°、45°、90°) 对复合材料力学性能 (拉伸、弯曲和冲击) 的影响。共制备了9个复合材料试件, 分别采用手糊法和模压法。测试结果表明, 与其它重量分数和取向的复合材料相比, 含20wt%和0° 纤维取向的复合材料具有更好的力学性能, 如拉伸强度 (122mpa)、弯曲强度 (118.9MPa) 和冲击强度 (7.8J)。采用扫描电镜 (SEM) 对复合材料试样的断口进行了分析。用热重 (TG) 和差热重 (DTG) 曲线评价了CPFE复合材料的热稳定性。结果表明, CPFE复合材料是一种适合于轻量化工业应用的材料。

KEYWORDS

Carica papaya fibers/epoxy composites; tensile testing; flexural testing; impact testing; scanning electron microscope; thermogravimetric analysis

关键词





番木瓜纤维/环氧树脂复合材料; 拉伸试验; 弯曲试验; 冲击试验; 扫描电子显微镜; 热重分析

Introduction

Natural fiber-reinforced composite is one of the alternative solutions for the environmental issues. Natural fiber-based materials attract the composite industry owing to their own advantages such as availability of bio-fibers, light weight, low cost, high stiffness, eco-friendly nature and biodegradability (Nijandhan, Muralikannan, and Venkatachalam 2018). In recent years, natural fiber composites are used for various industrial and domestic applications such as pedestrian bridges, roofs, beams, to insulate passenger cabins in automobiles from vibration and noise, toys, safety helmets and packaging materials, etc. (Sinha, Narang, and Bhattacharya 2017). Many of the plant fibers (sisal, kenaf, oil palm, hemp, bamboo, banana and pineapple leaf) were already proved as an alternative for synthetic fibers (Hanan, Jawaidd, and Md Tahir 2018). Epoxy



Characterization of New Cellulosic Fiber from the Bark of *Acacia nilotica* L. Plant

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ABSTRACT

The present work is planned to investigate the fundamental properties of the novel plant fiber extracted from the bark of *Acacia nilotica* L. tree. The various chemical compositions of the *Acacia nilotica* L. fiber (ANF) such as cellulose (56.46 wt. %), hemicelluloses (14.14 wt. %), lignin (8.33 wt. %) and ash content (4.95 wt. %) were identified through the chemical analysis. The maximum degradation temperature of ANF (339°C) was determined by the thermogravimetric analysis. The crystallinity index (44.82%) and crystalline size (3.21 nm) of the ANF were calculated by the X-ray diffraction analysis. The surface topography of ANF was estimated through the atomic force microscope. The density of ANF was identified as a value of 1165 kg/m³ which is comparatively lower than the other renowned fibers such as *Acacia leucophloea* (1385 kg/m³) and Jute (1460 kg/m³); this would be confirmed with all above characterization results that is an appropriate material to fabricate the green composites.

摘要

本研究旨在探讨从金合欢树皮中提取的新型植物纤维的基本性质。通过化学分析，确定了 *Acacia nilotica* L. (ANF) 的纤维素 (56.46 wt.%)、半纤维素 (14.14 wt.%)、木质素 (8.33 wt.%) 和灰分 (4.95 wt.%) 等多种化学成分。用热重分析法测定了 ANF 的最高降解温度 (339°C)。通过 X 射线衍射分析计算了 ANF 的结晶度指数 (44.82%) 和晶粒尺寸 (3.21 nm)。利用原子力显微镜对 ANF 的表面形貌进行了表征。ANF 的密度为 1165 kg/m³，比其它著名纤维如相思树 (1385 kg/m³) 和黄麻 (1460 kg/m³) 的密度要低，这与上述表征结果一致，是一种合适的绿色复合材料。

KEYWORDS

Acacia nilotica L.; chemical analysis; thermogravimetric Analysis; Fourier transform-infrared spectroscopy; x-ray diffraction and Atomic Force Microscopy

关键词

化学分析; 热重分析; 傅里叶变换红外光谱法; X射线衍射和原子力显微镜

Introduction

Nowadays, due to increased environmental awareness, the researchers are giving high priority to invent eco-friendly materials. Currently, many of the researchers are trying to replace the synthetic fiber reinforced composites by the bio-composites (Chandrasekar et al. 2017). Generally, natural fibers are gathered from the various portions of plants such as leaves, stems, roots, seeds, and fruits. Among this, due to the higher thermal stability and tensile properties, bark fiber is getting first preference to use as reinforcement in the composites (Manimaran et al. 2018c).

The fiber reinforced plastics are broadly utilized in various fields such as military, aerospace, food packaging, automobile, etc (Mohammed et al. 2015; Pradeep et al. 2017). Recently, due to the new

Surface Topography: Metrology and Properties



PAPER

Surface and subsurface investigation of Al-Mg-MoS₂ composite on performing wire electrical discharge machining

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Keywords: WEDM, peak current, surface roughness, overcut, recast layer

Abstract

Metal matrix composites (MMCs) give challenges during machining because of the reinforcements present in them as this ultimately leads to increased tool wear and a poor surface finish. Considering this, Al-Mg-MoS₂ composite samples prepared using powder metallurgy process are employed under unconventional machining process like wire electrical discharge machining (WEDM), since the composites prepared to possess a higher hardness and strength compared to that of pure aluminium. The machining is done under 3 different factors operated at 3 levels, peak current (10 A, 15 A & 20 A), pulse on time (60 μ s, 90 μ s & 120 μ s), and gap voltage (40 V, 45 V & 50 V) to analyze the material removal rate (MRR), surface roughness (SR) and overcut (OC). The surface texture of the machined samples is analyzed with scanning electron microscopy (SEM) and the recast layer so formed has also been analyzed. It is detected that the recast layer is found larger for larger surface roughness due to the higher spark energy at high-level peak current. Also, an optimal parameter of 15 A peak current, 45 V gap voltage and 90 μ s pulse on time and 4% of MoS₂ is determined through main effect plots for better machinability of the samples to obtain a better MRR, SR and OC. A better MRR, an improved surface finish and a reduced OC is seen in Al – 4%Mg - xMoS₂ composite samples than that of pure Al and Al – 4% Mg materials.

1. Introduction

Nowadays, industries have focused on non-conventional machining processes for MMCs. Because net near shape could be obtained without any post-machining process. Moreover, any complex shape could be attained with good geometrical accuracy. The residual stress obtained in the samples through the non-conventional machining process is lower when compared to the samples obtained through the conventional machining process. Hence, the machining of sintered samples is carried out using an unconventional machining process namely the WEDM process. Advancement in the electrical discharge machining (EDM) process is the wire electrical discharge machining process (WEDM). This process is

also said as a spark erosion process. Here electrical energy is used as the source of machining. Hence, there will be a negative terminal to which the tool (electrode wire) is connected (cathode), and to the positive terminal workpiece is connected (anode). Material removal takes place in both the electrodes i.e. work-piece and tool.

Pramanik and Littlefair (2015) deliberated that whenever the size of the particle was increased the MRR was diminished. This occurred due to that the larger particles have protected the matrix material from being melted further and hence the MRR was reduced. Zhang (2014) worked on TiN/Si₃N₄ nano-composites fabricated through the powder metallurgy process. An increase in the MRR was found when increasing the single pulse energy. This was happened



Synthesis of Silver Nanoparticles Through Orange Peel Powder for Antibacterial Composite Filler Applications

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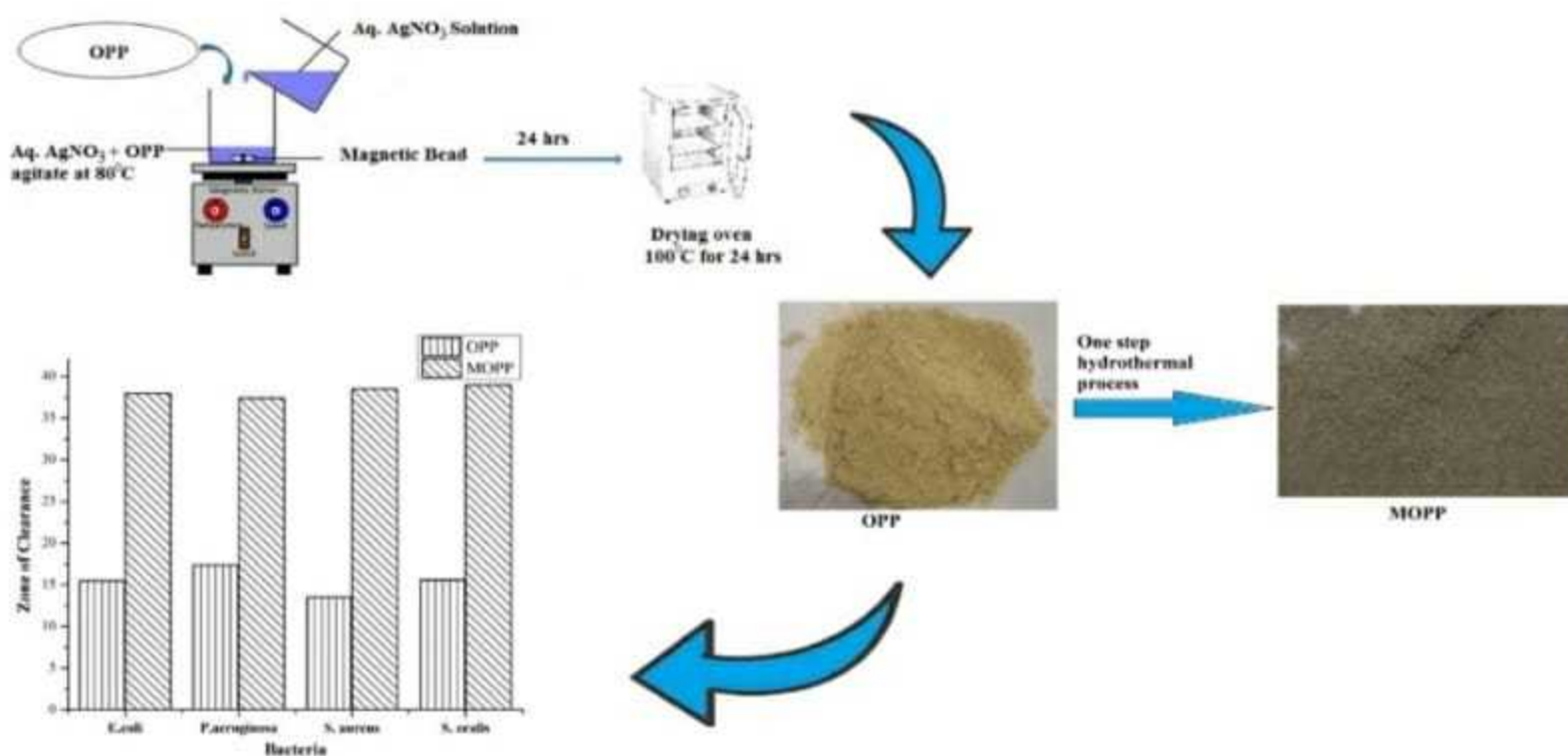
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Abstract

Environmental concerns and the positive aspects of biowaste materials gained the attention of researchers to use them as filler materials in fabricating of green composites along with polymer matrices, but most of them are not suitable for extensive applications in high thermal applications. In most of the natural particulate materials are not having the ability to fight against pathogens. To overcome such barriers, a modification of biowaste—orange peel powder (OPP) by the generation of silver nanoparticles (AgNPs) is prepared with the one-step hydrothermal process. The modified Orange Peel Powder (MOPP), is then characterized by FESEM, EDX, FT-IR, XRD, and Thermal analyses. The presence of AgNPs in the MOPP is confirmed through FESEM & EDX analysis. FT-IR spectral analysis pronounced the non mutate functional groups in MOPP as compared with OPP. The generation of AgNPs in MOPP is confirmed through the XRD peaks of reflection planes at (1,1,1), (2,0,0), (2,2,0) & (3,1,1). Thermal Analysis results of TGA and DSC show the MOPP has increased thermal stability up to 363 °C. Antibacterial test against Gram-negative and Gram-positive bacteria for OPP & MOPP shows the inclusion of Ag strongly objects the pathogens. Eventually, the MOPP can be utilized as filler material along with the polymer matrix in high thermal as well as antibacterial composite filler applications.

Graphic Abstract



Keywords Orange peel powder (OPP) · Antibacterial property · Silver nanoparticles · Filler material · Thermal property

Extended author information available on the last page of the article

Influence of silver nanoparticles on mechanical, thermal and antibacterial properties of poly (vinyl alcohol)/rice hull powder hybrid biocomposite films

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Abstract

Earth produces 2.12 billion tons of total wastes annually and nearly 2 million tons of petroleum-based synthetic polymers each day. The majority of synthetic polymers were obtained by packaging applications. Biodegradable films (biofilms) can be a good alternative for pollution-creating synthetic polymers. Rice hull powder (RHP) as reinforcing fillers, polyvinyl alcohol (PVA) as matrix along with silver nanoparticles (AgNPs) were used to prepare the biofilms. By using the solution casting method, five samples of PVA/RHP (1–5 mM) AgNPs biofilms were fabricated and characterized using Fourier transform infrared (FT-IR), X-Ray Diffraction Analysis (XRD), field emission scanning electron microscope (FESEM), Thermogravimetric Analysis (TGA) and differential scanning calorimetry beyond testing for their mechanical and antibacterial activities. The small spherical shape elements in the FESEM images clarify the presence of AgNPs. The intensities of observed peaks in the FT-IR spectrum keep decreasing with the inclusion of AgNPs. The X-ray diffractogram confirms the strong peaks at $2\theta = 38.2^\circ$, 49.1° , 60.8° , & 78.3° due to the presence of the AgNPs. The tensile strength and tensile modulus reached a maximum value of 35.5 and 871 MPa respectively. The presence of heat-stable metallic silver made the biofilms thermally stable up to 371°C and also improved the antibacterial activity exhibited by a better inhibition zone. The improved results clarified that biofilms can be suggested for packaging applications.

KEYWORDS

antibacterial activity, bio-films, mechanical property, polyvinyl alcohol, rice hull powder, silver nanoparticles

1 | INTRODUCTION

Nowadays, the usage of synthetic polymers was significantly increased due to its huge demand in packaging,^[1] food,^[2] textile,^[3] construction,^[4] industrial machinery,^[5] and other sectors. Most of the synthetic materials were made for single-use purposes that cause difficulties while disposal and recycling.^[6,7] Hence the improper disposal

or dumping of waste in landscapes leads to cause serious environmental problems like overflow at landfills,^[8] emission of greenhouse gas, etc.,^[9] So the researchers focus their attention to introduce a novel material that contributes similar attributes to synthetic polymers.^[10] The rise in environmental consciousness and community interest has led to improved use of natural fibers. The natural fibers are eco-friendly that also possess good

Investigation of physico-mechanical, thermal, morphological, optical and biodegradation properties of polyvinyl alcohol films reinforced with alkali treated *Limonia acidissima* shell powder

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Abstract

Polyvinyl alcohol (PVA) and various concentrations of (5–25 wt%) alkali treated *Limonia acidissima* shell powder (LASP) was utilized to develop bio composite packaging films by solution casting method. The alkali treatment (5%NaOH) of the LASP particles were carried out to improve the interface adhesion between filler and PVA matrix and also remove non cellulosic contents from LASP. The biofilms were characterized by Fourier-transform infrared spectroscopy, X-ray diffraction analysis, thermogravimetric analyzer, field emission scanning electron microscopy, Tensile test, UV–vis spectroscopy analysis, water uptake, water vapor permeability, and soil burial test. The bio composite films reinforced with alkali treated LASP particles and compatibilized matrix lead to notable increase in the mechanical, optical, and biodegradation properties when compared to the neat PVA film. The increase in thermal stability (13.49%) of (332.06°C) PVA/alkali-treated LASP biofilm compared to that of pure PVA film (287.24°C). Tensile stress and young's modulus were enhanced to 57.03% and 83.35%, respectively, with the inclusion of alkali-treated LASP (up to 20 wt%) in PVA film. Scanning electron microscope micrographs showed that, beyond the 20 wt% of the filler the irregularities emerged on the surface of the biofilms, consequently the mechanical and water barrier properties were diminished. However, the PVA/alkali-treated LASP biofilms absorb less water than pure PVA films. The increased water transport with in the films facilitated the biodegradation behavior (32.11% of weight loss in soil) of composite film. Hence the results suggested the composite films developed in the study to be an ideal material for packaging and cosmetics industries as well as adding the value to wood apple (*Limonia acidissima*) waste.

KEYWORDS

alkali treatment, *Limonia acidissima* shell powder, packaging, WVP

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Original Article

Alkali treatment influence on cellulosic fiber from *Furcraea foetida* leaves as potential reinforcement of polymeric composites



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ABSTRACT

The present study explores the potential of the alkali-treated *Furcraea foetida* (FF) fibers as reinforcement materials in polymeric composites. The fibers were treated and soaked for 3 h in an alkali solution of different concentrations (3, 6, 9, 12, and 15 wt.%). The untreated and alkali-treated fibers were characterized, and their physical and mechanical properties were determined. The results revealed that the 9 wt.% alkali-treated FF fiber yielded superior mechanical strength and Young's modulus because of its relatively high cellulose fraction after removing non-cellulosic materials. The twisting behavior and increasing microfibril angle of the FF fiber were attributed to a non-linear region in the stress–strain curves after the alkali treatment. The Fourier-transform infrared and X-ray diffraction studies endorsed the removal of non-cellulosic materials on optimally treated fiber. Thermogravimetric analysis of the 9 wt.% alkali-treated FF fiber confirmed the increase in the degradation temperature (358 °C) and activation energy (145.29 kJ/mol). Scanning electron microscopy results confirmed that the fiber surface roughness is proportional to the alkali solution concentration. Then the results were compared with others previous studies. Thus, treating FF fibers with optimized alkali concentration at specified soaking period can enhance their performance as a viable reinforcement material in polymeric composites for low-load applications.

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Evaluation of mechanical and wear properties of AA6063/(Si₃N₄)_{6%}-12%/(CuN₂O₆)_{2%}-4% composite via PM route and optimization through robust design technique

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Keywords: AA6063 alloy composite, powder metallurgy, hardness, wear analysis, inorganic reinforcement, taguchi design of experiments

Abstract

The study is to investigate the physical, mechanical, and tribological properties of Al6063 alloy reinforced by Silicon Nitride (Si₃N₄) & compound Copper Nitrate (CuN₂O₆) processed via Powder Metallurgy (PM) Techniques. Incorporation of reinforcement in matrix material ranged from 6 to 12% Si₃N₄ in a 6-step interval, and 2 to 6% CuN₂O₆ in a two-step interval. The characterizations were made on the PM produced specimens using OM, EDS, XRD and hardness. The reinforcement particles were distributed uniformly is attributed by homogeneous mixer of matrix and reinforcements. The tests were carried out in accordance with ASTM Standards on the Al6063 alloy and its composites. The test findings show that as the reinforcing percentage of ceramic and inorganic compound is increased, properties such as hardness and density rise monolithically and considerably. The dispersion of Si₃N₄ and CuN₂O₆ reinforcement in the AA6061 matrix was ensured by x-ray diffraction patterns. In comparison to the base alloy, the hardness of AA6063/12%Si₃N₄/6% CuN₂O₆ improved by 88% due to the mismatch of thermal expansion between the Al matrix and reinforcement causes huge internal stress, causing the aluminium matrix to deform plastically to lodge the smaller volume expansion of Si₃N₄ and CuN₂O₆ particles. The dry sliding wear test was carried out on a tribometer with a pin-on-disc arrangement, and the findings show that the composite has a higher wear resistance. The Taguchi design of experiments was used to investigate the solution containing parameters employing an orthogonal array, the signal-to-noise ratio, and analysis of variance. The weight percentage of Si₃N₄/CuN₂O₆ compound and the relationship between wt% of reinforcement and applied load had the highest impact on composite wear resistance, accounted for 31.66%. Before and after the wear morphology during the wear test, images from a scanning electron microscope and energy dispersive microscopy were used to examine the manufactured composites.

1. Introduction

In the recent decades, Hybrid Aluminum matrix composite (HAMC) has been used for many applications such as aerospace, automobile, marine and light weight components due to their attractive properties such as good specific strength, specific modulus. Because of its light weight and great strength, aluminium is widely employed



Mechanical and physicochemical properties of green bio-films from poly(Vinyl Alcohol)/ nano rice hull fillers

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Abstract

On the total earth wastes, nearly one-third was packaging wastes. Most of the packaging materials are non-biodegradable and non-recyclable. To overcome these issues, researchers turned their attention to develop biodegradable films(bio-films). In this article, through the solution casting method bio-films were developed by using water-soluble polyvinyl alcohol (PVA) and various proportions (5–25wt%) of rice hull powder as reinforcement filler. The effect of RHP on the PVA matrix was investigated by fourier-transform infrared spectroscopy (FTIR), x-ray diffraction (XRD), thermogravimetric analysis, differential scanning calorimeter, tensile test, surface morphology studies, water vapor permeability, and antibacterial testing. FTIR result revealed the proper bonding between PVA/RHP in bio-films via strong hydrogen bonds. XRD result reveals a slight increase in the intensity of bio-films and the crystalline size was reported between 5.53 and 13.28 nm. The infusion of RHP in the matrix shows that tensile strength and tensile modulus increases gradually and reaches the maximum value of 23.32 MPa and 684 MPa respectively at 25% of RHP in PVA. Thermal behavior proved that the bio-films were strong enough to withstand the temperature up to 350 °C. The lower values of WVP possess a higher interaction of polymer chains. The bio-film samples form a good inhibition zone against both gram-positive and gram-negative bacteria and display remarkable antibacterial activity. From the microstructure images, it is visible that bio-films were homogenous, away from cracks and phase separation. By this evidence, RHP added PVA can be used as a packaging material.

Keywords Rice hull powder (RHP) · Bio-films · Polyvinyl alcohol (PVA) · Water vapor permeability · Thermal analysis · Solution casting method

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Use of *Pennisetum glaucum* stem powder waste as reinforcement in epoxy composites

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Abstract

The physicochemical, thermal, and tensile characteristics of *Pennisetum glaucum* stem powder (PGSP) are described in this article. According to chemical analysis, PGSP contains a larger percentage of cellulose (58.43 wt%) and lower percentages of hemicelluloses (12.86 wt%) and lignin (14.34 wt%). PGSP has a crystallinity index of 56.8%, with a crystallite size of 22.37 nm. A scanning electron microscopy and an atomic force microscopy were used to analyze the external morphology of PGSP. The thermogravimetric analysis of the PGSP exhibited a thermal constancy of 230°C and kinetic activation energy of 88.3 kJ/mol, indicating that it might be used as a filler material in thermoplastic resins with processing temperatures up to 230°C. Mechanical testing of PGSP-reinforced epoxy composites signified that 9 wt% reinforcement is optimal to achieve improved properties. All the above findings of this investigation proved that PGSP can be used as a suitable primary and a secondary filler in polymer matrixes and it can also be used to make fused deposition modeling filaments for 3D printing.

KEYWORDS

epoxy resin, mechanical testing, particle size analysis, *Pennisetum glaucum* stem powder, SEM analysis, thermogravimetric analysis, X-ray diffraction analysis

1 | INTRODUCTION

Natural fibers are being given greater significance in the present global situation owing to environmental concerns. Human-made fibers (carbon, glass, nylon, aramid, etc.) create environmental issues, such as landfill contamination, air pollution, and water pollution, when they are used as reinforcement in applications.^[1] Many researchers have successfully used natural fibers in composites to solve this issue. Compared with synthetic fibers, natural fibers offer several advantages, including being readily accessible, being cost-effective, having a low specific mass, being simple to process, and being environmentally safer.^[2] Like artificial fibers, they also have similar mechanical strength. Plant fibers are now used in making bumpers, windshields, sitting headrests, seat covers, roofs, door panels, stands, and other applications.^[3,4]

Cellulosic fibers are gathered from various fragments of the tree, including the stalk, leaf, and roots. Many natural cellulose fibers have been studied in the literature, including *Dracaena reflexa*, *Acacia nilotica* L., *Sida mysorensis*, *Bauhinia vahlii*, *Cocos nucifera* L., *Phaseolus vulgaris*, and ground nutshell fibers.^[5–9] Many techniques, such as water retting, mechanical extraction, and chemical extraction, are used with the aim of extracting plant-based fibers with higher crystalline and reduced amorphous content. However, the characteristics of cellulosic fibers are determined by two factors: the portion from fiber taken from the plant and plant grown environment.^[10] To get better outcomes, it is always essential to have fewer amorphous components in the reinforcement. Despite the fact that numerous fibers have been investigated, the need for novel cellulose fibers in the fields of composites and textiles has intensified the search for new cellulose fibers.^[11]

Utilization of *Mucuna atropurpurea* stem fiber as a reinforcement in fiber reinforced plastics

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Abstract

This research investigated the scope of using a fiber harvested from *Mucuna atropurpurea* (MAF) plant as reinforcement in fiber-reinforced plastics. An optical microscope and a pycnometer were used to calculate the diameter ($289 \pm 21 \mu\text{m}$) and density ($1082 \pm 29 \text{ kg/m}^3$) of the MAF. Using chemical compositional analysis, $58.74 \pm 5.74 \text{ wt\%}$ cellulose and $16.31 \pm 3.21 \text{ wt\%}$ hemicellulose, and $14.22 \pm 3.36 \text{ wt\%}$ lignin and $0.38 \pm 0.08 \text{ wt\%}$ wax components were found in the MAF. Numerous chemical stretching in the MAF were checked using Fourier transform infrared spectroscopy. Briodo analysis (68.08 kJ/mol) showed the kinetic activation energy of the MAF. Surface morphological inspections suggested surface treatments of MAF due to contaminations and wax on the fiber surface. The statistical analysis conducted for determining the tensile properties of MAF revealed that MAF is a suitable candidate to produce fiber-reinforced plastics. Characterization of MAF-reinforced polyester composites showed that 40 mm fiber length and 30 wt% fiber enhanced tensile strength ($109.51 \pm 2.1 \text{ MPa}$), flexural strength ($156.62 \pm 3.1 \text{ MPa}$), and hardness ($94 \pm 4 \text{ HRRW}$). Fractography images of composites with fiber pull-outs in the MAF-reinforced plastics were taken for analysis. Less cavities and voids in the 30 wt% MAF-reinforced composites were found along with reduced water absorption.

KEYWORDS

chemical analysis, crystallite index, mechanical properties, *Mucuna atropurpurea* stem fiber, single fiber tensile strength, thermal stability, unsaturated polyester resin

1 | INTRODUCTION

Today material researchers are focusing on developing new eco-friendly materials as most environmental regulatory bodies restrict the use of non-biodegradable materials.^[1] Artificial fiber-based polymer composites are one of the non-biodegradable materials hugely used in various sectors, namely automobile, construction, military, packaging, and electrical. Therefore, an alternate material needs to be developed to replace artificial fiber-based composites.^[2] Cellulosic fiber-based polymer composites

are one of the excellent substitutes for artificial fiber-based composites because they provide similar properties like artificial fiber-reinforced plastics such as lightweight, easy to fabricate, corrosion-free nature, and lesser tool wear during manufacturing.^[3] In addition, plant fiber-reinforced plastics are partially biodegradable, and plant fibers are gathered from renewable sources through eco-friendly extraction methods.

The demand for plant fiber-reinforced composites is increasing day by day, which in turn increases the demand for plant fibers. The discovery of a new plant



Extraction and characterization of natural lignocellulosic fibres from *Typha angustata* grass

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ABSTRACT

In recent years, efforts have been made to reduce deforestation to conserve the ecosystem. In the current scenario, agro-cultivated products are used instead of wood for engineering applications. Thus, natural lignocellulosic fibres are used as a reinforcing material and have been extremely attractive to industries and the scientific community during the past few decades. This study aimed to examine the use of natural fibres extracted from *Typha angustata* grass as reinforcement in polymer matrix composites. The density of the fibres was 1.015 g/cc. Chemical analysis confirmed that *T. angustata* fibres (TAFs) have a cellulose content of 73.54 wt%, a hemicellulose content of 10.11 wt%, a lignin content of 6.23 wt% and a wax content of 0.23 wt%. The crystallinity index (65.16 %) and crystalline size (6.40 nm) were identified by X-ray diffraction (XRD) analysis. The presence of functional groups in the TAFs was examined by employing Fourier-transform infrared spectroscopy (FTIR). The presence of cellulose at peak intensities of C2, C3 and C5 in the TAFs was confirmed using ¹³C nuclear magnetic resonance (NMR) spectroscopy. The single fibre tensile test revealed that the tensile strength was 665 ± 7 MPa and Young's modulus was 27.45 ± 3.46 GPa. The thermal stability of the TAFs was examined by thermogravimetric analysis (TGA), and the prominent peak was observed at 298.48 °C, with a kinetic activation energy of 67.99 kJ/mol. The surface roughness of the fibres was analysed by atomic force microscopy (AFM) with an accuracy of 1 nm. The above-mentioned outcomes indicated that the TAFs have desirable properties that are comparable to existing natural fibres and suggested to be utilised as the possible reinforcement to fabricate the fibre-reinforced polymer matrix composites.

1. Introduction

In recent decades, non-renewable energy sources have been rapidly exhausted caused the bio-based composites were to be used in engineering applications, such as automobiles, aviation, construction, mechanism, consumer goods, sporting goods, marine and electronic industries, etc. [1–3]. The current situation regarding climatic and environmental conditions is influencing the scientific and research

community to develop eco-friendly, renewable and sustainable materials [4]. In comparison to synthetic fibres, natural fibres provide numerous advantages, such as their biodegradability, low cost, abundant availability, good thermal stability, lightweight aspect, low specific weight, higher specific strength, stiffness, renewability, non-toxic aspect, ease of production, low CO₂ emission and minimum energy consumption required for extraction [5,6]. The commonly available lignocellulosic natural fibres, such as sisal, jute, flax, coir, and kenaf, can

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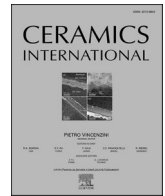
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Microstructure and tribological properties of microwave-sintered Ti_{0.8}Ni–0.3Mo/TiB composites

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ABSTRACT

In this study, the Ti–0.8Ni–0.3Mo/XTiB (X = 5, 10, 15, and 20 wt%) composites were prepared using the microwave-sintering assisted powder metallurgy technique, and tribological properties were investigated. X-ray diffraction and scanning electron microscopy (SEM), with the microscope capable of energy dispersive spectroscopy (EDS), were used to characterize the mixed powder. The density and microhardness of the Ti–0.8Ni–0.3Mo/TiB composites were examined. The Ti–0.8Ni–0.3Mo/TiB composites exhibited a hardness of 260 HV, which is a 20% improvement over Ti–0.8Ni–0.3Mo. Tribological properties were studied by conducting experiments using a pin-on-disc wear tester at varying loads, sliding distances, and speeds. The Ti–0.8Ni–0.3Mo/TiB composites exhibited a reduction in wear loss and coefficient of friction values owing to TiB hardness and good bonding with the matrix. The tribological properties of the Ti–0.8Ni–0.3Mo/TiB composites were enhanced by the addition of TiB particles, which resist wear and friction.

1. Introduction

Titanium is the fourth most abundant structural metal in the Earth's crust-iron, aluminum, and magnesium being the first three [1]. Titanium is a ductile solid metal that is more potent than low-carbon steel and is 45% lighter than it. Despite being twice as strong as aluminum alloys, it is 60% heavier [1]. Titanium and its alloys are widely used in the industry owing to their excellent properties. Titanium exhibits poor surface shear strength and abrasion resistance prohibits its application in high dry sliding wear conditions [2–4]. Adding strong ceramic reinforcements to the titanium matrix phase is a feasible strategy to boost the bulk mechanical and tribological characteristics of titanium-based components [5]. Ceramic particle-rich regions play a vital role in enhancing the matrix material strength owing to their reinforcing effect. Several researchers [6–8] have explored the mechanical properties (such as tensile, fatigue, and creep) and manufacturing processes (e.g., powder metallurgy, extruding, and in situ processes) of titanium matrix composites (TMCs). Ti–Mo–Mn alloys are developed through liquid metallurgy methods for biomedical applications [9]. According to Ma et al. [10], TiC particles can enhance the grain refining and load-bearing strength of the Ti matrix. Most hard ceramic-reinforced titanium composites have been examined using mechanical tests, such as hardness,

tensile strength, and compression. TiC, Al₂O₃, SiC, CaTiO₃, GO, TiB, B₄C, and Y₂O₃ are the traditional reinforcements. These materials exhibit excellent strength and resistance to wear at high temperatures [10–16]. The effect of the TiB content on the microstructural evolution and mechanical response of the as-rolled fiber-like structural TMCs was systematically studied [17].

Powder metallurgy (PM) provides considerable benefits by physically shaping powders using various compaction and sintering processes [18]. PM is a cost-effective method for producing high-performance titanium components with improved mechanical behavior and corrosion resistance [19,20]. The utilization of TiC, TiB₂, B₄C, GNO, TiB, TiCN, and TiN reinforcements has been demonstrated in previous research using the powder metallurgy method, which is effective for improving the microstructural, mechanical, and tribological characteristics [21–25]. Titanium alloys and composites can be sintered to recreate inexpensive wrought-equivalent alloys, formulate unique low-cost compositions, and obtain completely dense materials. Considering the nature of the alloy, the selected sintering method can be optimized to fine-tune the microstructural features thereby achieving improved physical and mechanical properties for a wide range of industrial applications [26].

Many studies have been conducted on titanium and its alloys to

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Application of Partial Differential Equations in Multi Focused Image Fusion

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-----ABSTRACT-----

Image Fusion is a process used to combine two or more images to form more informative image. More often, machine vision cameras are affected by limited depth of field and capture the clear view of the objects which are in focus. Other objects in the scene will be blurred. So, it is necessary to combine set of images to have the clear view of all objects in the scene. This is called Multi focused image fusion. This paper compares and presents the performance of second order and fourth order partial differential equation in multi focused image fusion.

Keywords - Depth of field, Image Fusion, Multi focused image Fusion, Partial Differential Equations.

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I. INTRODUCTION

Visual information in the scene is captured by CCD or CMOS cameras for machine vision applications. Due to limited Depth of Field (DOF) in machine vision cameras, it is possible to capture the clear image of the objects which are in focus only and other objects in the scene will be blurred [1]. In this situation, Multi focus image fusion is used to combines images of the same scene with different focus to form the composite image in which all objects are in clear focus. Many methods of multi focus image fusion are reported in literature. Among them, multi scale decomposition methods produce good results. But, these methods introduce artifacts in the fused image. To avoid these artifacts, fusion methods based on optimization were proposed. Optimization methods take multiple iterations to generate composite image and remove edge details. To preserve edge details in the final fused image, edge preserving fusion methods were introduced. Popular filters used in these methods are guided filter, bilateral filter, cross bilateral filter, anisotropic diffusion filter. These methods decompose each source image into approximation image and detail image. Fused images are formed by combining manipulated approximation image and detail image. Bilateral filter and cross bilateral filter fusion methods produces gradient reversal artifacts in the fused image whereas guided image fusion method produces halo effects in the fused image [2]. The use of second order Partial Differential Equations (PDE) in image denoising produces excellent results interns of edge preservation, but introduces staircase effect. To remove this stair case effect, non linear fourth order PDE are used. This paper compares and presents the performance of second order and fourth order PDE in multi focused image fusion. The following section overviews second order and fourth order PDEs proposed by Perona & Malik [3] and You & Kaveh [4] respectively. Section 3 presents the multi focused fusion methodology and Section 4 discuss the performance of second order and fourth order PDE. Finally, summary of this paper with conclusion is presented.

II. OVERVIEW OF PARTIAL DIFFERENTIAL EQUATIONS

The second order PDE smoothes a given image at coarser regions while preserving the edges. It uses intra-region smoothing to generate coarser images. At each coarser resolution, edges are sharp and meaningful. The second order PDE use the following flux function to control the diffusion of an image I as

$$I_{i,j}^t = c(x,y,t)\Delta I + \nabla_c \cdot \nabla I \quad \dots\dots (1)$$

where $c(x,y,t)$ = Flux function, Δ = Laplacian operator, ∇ = Gradient operator, t = Time or iteration [3]. The solution for this PDE is

$$I_{i,j}^{t+1} = I_{i,j}^t + \lambda [c_N \cdot \bar{\nabla}_N I_{i,j}^t + c_S \cdot \bar{\nabla}_S I_{i,j}^t + c_E \cdot \bar{\nabla}_E I_{i,j}^t + c_W \cdot \bar{\nabla}_W I_{i,j}^t] \quad \dots\dots (2)$$

In the above equation, $I_{i,j}^{t+1}$ is the coarser resolution image at $t + 1$ scale which depends on the previous coarser image $I_{i,j}^t$. λ is a stability constant which lies in the range $0 \leq \lambda \leq 1/4$. $\bar{\nabla}_N, \bar{\nabla}_S, \bar{\nabla}_E$ and $\bar{\nabla}_W$ & c_N, c_S, c_E and c_S are the nearest- neighbour differences & in flux functions north, south, east and west directions respectively. The model of fourth order PDE is given by

$$\frac{\partial I}{\partial x} = -\nabla^2 [c(|\nabla^2 I|)\nabla^2 I] \quad \dots\dots (3)$$

where is the $\nabla^2 I$ Laplacian of the image I [4]. Since the Laplacian of an image at a pixel is zero if the image is planar in its neighbourhood, the fourth order PDE attempt to remove noise and preserve edges. The diffusion functions $c(\cdot)$ are taken from Perona–Malik diffusivity functions. They are given by, $c(s) = 1 / [1 + (s/k)^2]$ and $c(s) = \exp[-(s/k)^2]$ and offer trade-off between the smoothing and edge preservation. First function is useful if the image consists of wide regions over the smaller regions. Second function is useful if the image consists of high-contrast edges over the low-contrast edges. Both functions consist of a free parameter k . This constant k is used to decide the validity of a region boundary based on its edge strength. To study the performance of second and fourth order PDE in removing the noise and preserving the edges, both filters were applied to the Gaussian distributed noisy image of zero mean and standard deviation of 30

Multi focused Image Fusion using Fast Adaptive Bilateral Filter

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ABSTRACT

This paper presents Fast Adaptive Bilateral Filter (FABF) for fusion of Multi Focuses images. Multi Focused image fusion is used to combine one or more input image into single composite image, focusing all objects in the given scene. FABF filter sharpens the image without producing under and over shoot by increasing the edge slope. This paper uses this property to decompose the input image into high and low frequency images so that different fusion rules can be used for high and low frequency images to produce good quality composite image. The performance this FABF filter in Multi focused image fusion is compared with Adaptive Bilateral Filter (ABF) using Root Mean Square Error (RMSE), Spatial Frequency (SF) and Mutual Information (MI).

Keywords - Adaptive Bilateral Filter, Fast Adaptive Bilateral Filter, Multi Focused image fusion, Root Mean Square Error, Spatial Frequency and Mutual Information.

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I. INTRODUCTION

Machine Vision application uses CCD and CMOS cameras in industries to capture the images of object of interest. Due to the limited depth of field in these cameras, it is possible to capture the clear image of the objects which are in focus only. The remaining objects in the scene which are not in focus will appear as blur. In this situation, Multi focus image fusion is used to combine two or more input images of the same scene with different focus to produce composite image in which all the objects in the scene are in focus. This composite image is called as Multi focused image. This image provides more comprehensive information about the scene which is useful for human perception & machine vision applications and reduces the storage capacity. A good multi focused image fusion method is expected to preserve useful & relevant information from multiple input images in Multi focused image. It should avoid artifacts and noises. It should be robust to shifting, scaling and misregistration. Digital Image processing research community reported many literatures related to Multi focus image fusion methods. Even though, there is a requirement of novel image fusion methods for feature extraction and target recognition. Among the literatures, multi scale decomposition methods are very successful and showing good results. They use different data representation and different image fusion rules to produce Multi focused image [19]. But, in these methods introduces artifacts. To avoid these artifacts, optimization based fusion methods were proposed. Optimization methods took multiple iterations to generate Multi focused image which in turn removes the edge details. To preserve edge details in the Multi focused image, edge preserving fusion methods were introduced. These methods use two scale decomposition edge preserving filter for the purpose of fusion [10-14]. Popular two scale decomposition edge preserving filter are anisotropic diffusion filter [20]. This method decomposes each input

image into low and high frequency image. Multi focused images are formed by combining manipulated low and high frequency image. Even though edge details are preserved, it reflects the staircase effect. To avoid this staircase effect, fusion using Standard Bilateral filter (SBF) was proposed [17, 18, 21-23]. Unlike convolutional filters, BF uses two Gaussian kernel, one for range and another one for spatial. Even though, BF preserves edges, this filter is non-linear and computation intensive. An adaptive variant of BF, called Adaptive Bilateral Filter (ABF) was introduced for image sharpness enhancement along with noise removal [1], where the center and width of the Gaussian range kernel is allowed to change from pixel to pixel. While several fast algorithms have been proposed in the literature for ABF [2-5], most of them work only with a fixed range kernel. Fast algorithm for adaptive bilateral filtering whose complexity does not scale with the spatial filter width was proposed by Raturaj G. Gavaskar and Kunal N. Chaudhury and this filter is called as Fast Adaptive Bilateral Filter (FABF) [7]. This paper compares and presents the performance of ABF and FABF in fusing multi focused images in terms of Root Mean Square Error (RMSE), Spatial Frequency (SF) and Mutual Information (MI). The following section overviews ABF and FABF proposed by Buyue Zhang & Jan P. Allebach and Raturaj G. Gavaskar & Kunal N. Chaudhury respectively. Section 3 presents the multi focused fusion methodology and Section 4 discuss the performance of ABF and FABF. Finally, summary of this paper with conclusion is presented.

II. ADAPTIVE AND FAST ADAPTIVE FILTER

The bilateral filter proposed by Tomasi and Maduchi is widely used in image processing for removing the noise while preserving the edges. Unlike linear convolutional filters, the bilateral filter uses two kernels namely range kernel and spatial kernel, where both are Gaussian kernels. An adaptive variant of the bilateral filter was introduced

RESEARCH ARTICLE

Effect of nucleating agents on the non-isothermal crystallization and degradation kinetics of poly(ethylene terephthalate)

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Poly(ethylene terephthalate) (PET) was synthesized by two steps, namely (a) transesterification and (b) polycondensation. Various analytical instruments were used for the characterization of neat PET. The sodium salt of nucleating agents added with PET was synthesized by the in-situ method under the same experimental conditions. The influence of $-\text{CO}_2\text{Na}$, $-\text{ONa}$, $-\text{SO}_3\text{Na}$, $-\text{PO}_3\text{Na}$ on the crystallization properties of PET was tested. The aromatic $-\text{SO}_3\text{Na}$ nucleated PET exhibited the highest crystallization temperature (T_c) value of 211.4°C with the degradation temperature (T_d) value of 446.9°C. The energy of activation (E_a) for the degradation and crystallization of PET was determined using various kinetic models. The modified Avrami equation showed the 3D crystal growth of PET, which was further evidenced by polarized optical microscopy (POM). The second stage of degradation consumed a higher amount of thermal energy. The experimental results were compared with the literature values.

KEYWORDS

degradation, kinetics, nucleation, PET, sodium salts

1 | INTRODUCTION

Nowadays a lot of plastic materials are domestically used,¹ among them PET is a very important one because PET is a synthetic semi-crystalline thermoplastic polymer with wide industrial applications due to its excellent physicochemical properties. Due to its slow crystallization rate, its applications in the fabrication of injection molded products are restricted. To enhance the crystallization rate of PET, low molecular weight organic auxiliary materials, high molecular weight polymers and inorganic additives are added. Moreover, the various techniques are adopted to improve the rate of crystallization of the PET. In 2020, Zhang et al² studied the nucleating activity of PET by the addition of fluorescent $\text{SiO}_2@\text{Tb}^{3+}$ hybrid. Non-isothermal crystallization process of PET with BaSO_4 was studied by Gong et al.³ Zn/TiO_2 composite nucleated PET was reported in the literature.⁴ Various metal hydroxides were used as a nucleating agent for PET.⁵ In

2017, the effect of BaSO_4 on the crystallization properties of PET was studied elaborately.⁶

Apart from these inorganic fillers, high or low molecular weight organic auxiliary materials are used to improve the rate of crystallization of PET. For example the fast crystallization rate of PET in the presence of Surlyn was studied and discussed in the literature.⁷ The addition of low molecular weight sodium salt of aliphatic or aromatic acid-based auxiliary materials is a convenient and cost-effective method. This work intends to increase the crystallization rate by the addition of sodium salt of both aliphatic and aromatic materials. The sodium salt of bicyclo heptane dicarboxylic acid was added to the PET to enhance the crystallization rate and mechanical properties of PET.⁸ The influence of sodium benzoate on the crystallization of PET was investigated with the help of differential scanning calorimetry (DSC) and polarized optical microscopy (POM).⁹ The SWCNT nucleated crystallization behavior of various aromatic polyesters was analyzed



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Fluorophosphate bio-glass for bone tissue engineering: in vitro and in vivo study

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The objective of the work is to investigate the influence of fluoride in the bioactivity of phosphate bio-glass to utilise in bone tissue engineering. The fluorophosphate bio-glass system was formulated by varying fluoride content in phosphate-based glass $45\text{P}_2\text{O}_5\text{-(30-X)-CaO-25Na}_2\text{O-XCaF}_2$ ($X = 0, 1.25, 2.5, 3.75, \text{ and } 5.0$) using melt quenching technique. The elemental composition and fluoride retention in the prepared material was investigated by X-ray photoelectron spectroscopy. The bioactivity test in simulated body-fluid (SBF) exhibited apatite layer and its bone bonding ability which was characterized by X-ray diffraction patterns and Fourier Transform Infrared Spectrophotometer spectra. The viability of human gastric adenocarcinoma (AGS) and MG-63 cells of the bio-glass confirmed the nontoxic nature. In vivo studies demonstrated the conversion of the fluorophosphate glass to bone in the femoral condyle of the rabbit. After ten weeks, scanning electron microscope with energy dispersive X-ray spectrograph (SEM_EDAX) and confocal laser scanning microscopy examinations revealed the resorption rate and bone-glass interface qualitatively and quantitatively. Consequently, the biocompatible and bioresorbable nature of the fluorophosphate bioglass can be exploited as a potential bone graft substitute in the near future.

Keywords: biocompatible/nano biomaterial/tissue engineering

Notation

R	radius of implant
$r = R - X$	radius of residual glass
X	radius of conversion

1. Introduction

Bone defects are a common problem in orthopaedics, which may be due to trauma, malignancy, infection or congenital disease. These defects can be healed through potential osteoinductive and osteoconductive bone graft filler materials.¹ Bio-ceramics is a synthetic inorganic biomaterial that serves in defect filling, fixes bone grafts and replaces damaged tissue or diseased parts. A wide range of commercially available material can repair small bone defects whereas these materials struggle to repair critically sized bone defects with load-bearing application.² However, a better understanding of the microstructure, physico-chemical and mechanical properties of bioactive glasses extend its application in load-bearing capacity. The best alternative to auto-, allo- and xenografts is to use first-generation ceramics such as hydroxyapatite (HAp) and tri-calcium phosphate (TCP) to meet the quality of cancellous bone graft as an osteoconductive material. Other bone growth stimulants or osteo-inductive materials like bone morphogenic protein (BMP) are only inductive but not osteo-conductive.^{3,4} To date, one of the promising commercialized bone graft substitutes is 45S5 bioglass which promotes osteogenesis and activates its gene expression with some drawbacks.⁵ The

limitations of these materials paved the way for novel synthetic bone graft substitutes. The characteristics of an ideal bone graft substitute should be: bioactive, biocompatible, non-toxic (either the material or its by-products), promotes cell adhesion, osteo-conductive, osteo-inductive, bioresorbable and have elastic-mechanical property near to that of the human bone.⁶

Phosphate-based glasses are third-generation biomaterials and the properties of these glasses can be tuned via their composition, according to the desired end application.⁷ The bioactivity of the phosphate-based glass/ceramics is enhanced by incorporating fluorine in the form of calcium fluoride and producing fluorophosphates glass. Fluorides are also known for stimulating osteoblast cells when applied at moderate concentrations on cell cultures of osteoblasts ($25\text{--}500\ \mu\text{g ml}^{-1}$) whereas higher concentrations ($<500\ \mu\text{g ml}^{-1}$) suppress osteoblastic activity.^{8,9}

The present invention encompasses the preparation of fluorophosphate bio-glass ($45\text{P}_2\text{O}_5\text{-(30-X)-CaO-25Na}_2\text{O-XCaF}_2$) and the study of their physical and biological characteristics. The structure and the key component fluoride ion presence in the prepared material were analysed by X-ray photoelectron spectroscope (XPS) and Fourier transform infrared spectrophotometer (FTIR). An in vitro evaluation reveals the ionic dissolution and characteristic apatite crystal formation of the prepared material which was

Low-temperature processable glass fiber reinforced aromatic diamine chain extended bismaleimide composites with improved mechanical properties

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Abstract

The synthesis of 4,4'-bismaleimido diphenylmethane (BMIM) and modified BMIM by its chain extension using commercially available aromatic diamines like 4,4'-diamino diphenyl methane (DDM), 4,4'-diaminodiphenyl sulphone (DDS), and 4,4'-diamine diphenyl ether (DDE) was done. The synthesized materials have been characterized for structural aspects using Fourier transform infrared spectroscopy (FTIR), differential scanning calorimeter (DSC) and thermogravimetric analysis (TGA). The structure of BMIM was confirmed due to the presence of specific bands at ~ 1400 and 1705 cm^{-1} responsible for C=C and —OC—N—CO— groups, respectively. The reduction in the heat of fusion and enthalpy of curing for chain extended bismaleimides/modified BMIM shows the influence of the swivel group in diamine during curing. The curing window has broadened for BMIM_M and BMIM_E by $\sim 40^\circ\text{C}$ and narrowed for BMIM_S by $\sim 100^\circ\text{C}$. The mechanical properties and the chemical resistance were studied for the composites made from the BMIM and modified BMIM based composites. Fiber-enhanced modified bismaleimide resin has improved mechanical properties.

KEYWORDS

composites, high-performance polymers, mechanical properties, synthesis, thermal properties

1 | INTRODUCTION

The need for advanced materials with ease of processing and enhanced properties is becoming more and more noticeable. Bismaleimides (BMI) is a high-performance thermosetting resin system with a wide range of features such as good thermal and mechanical stability, chemical resistance, water resistance, corrosion resistance, and relatively low cost. Because of its superior epoxy properties, BMI is used in a variety of applications that consist primarily of aircraft and missiles.^[1–3] BMI has also been

used in non-linear optic (NLO) materials.^[4–6] As a result, research related to BMI continues to increase.^[7] To overcome the brittleness due to higher crosslinking density in polybismaleimides, structural modification of the bismaleimide is necessary.^[8] Various researchers' work on BMI resins is done to improve the toughness of the material. The properties can be improved by the addition of various thermoplastic modifiers,^[9] thermosets,^[10,11] elastomers,^[12] nanomaterials,^[13] and fibers.^[14–16] Chandran et al.^[17] studied the influence of the addition of aromatic diamine to bismaleimide resin on the crystallinity,