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Development of a novel agitated vessel for gas-induction to improve the gas-liquid mass transfer

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A novel agitated vessel was developed for improving the gas-liquid mass transfer by a self-inducing mechanism. The effects of aeration time, orifice submergence depth (0.10 - 0.30 m), total gas-free liquid level (0.20 - 0.40 m) and impeller speed on the dissolved oxygen content of water and the volumetric mass transfer coefficient were investigated. The results indicated that the dissolved oxygen content of water increased with increase in aeration time and reached an equilibrium value. It was also noticed that the time required for attaining the equilibrium value of dissolved oxygen content increased with increase in orifice submergence depth and hence with increase in total gas-free liquid level. The volumetric mass transfer coefficient was found to increase with increase in rotational speed of the impeller but decreased with increase in liquid level to tank diameter ratio (*H/T*) at all the impeller speeds chosen for the present work.

Keywords*:* air-inducing reactor, critical speed, gas holdup, dissolved oxygen, mass transfer coefficient.

Nomenclature: C – Dissolved oxygen concentration in water at time t, mg/L; C_0 – Initial dissolved oxygen concentration in water, mg/L; C^* – Equilibrium dissolved oxygen concentration in water, mg/L; D – Diameter of the impeller, m; h – Orifice submergence depth, m; H – Total gas-free liquid height, m; ID – Inner diameter, m; k_La – Volumetric mass transfer coefficient, min^{-1}; N – Rotational speed of the impeller, rpm (revolutions per minute); OD – Outer diameter, m; P – Shaft power, kW; P/V – Power consumption per unit volume of the gas-free liquid, W/m^3; t – Time, min; T – Tank diameter, m; V – Volume of the gas-free liquid, m^3; ε_G – Fractional gas holdup.

INTRODUCTION

Hydrogenation of a variety of substances, ozonolysis, oxidation, alkylation, hydrochlorination and hydrobromination, halogenation, ammonolysis, etc. are industrially important unit processes, which necessitate the complete utilization of the solute gas to a practically possible extent. In a conventional agitated vessel used for gas-liquid operation, the gas is sparged at the bottom of the tank in the form of bubbles and the gas-liquid system is well agitated in order to improve the effective utilization of the gas. But in most of the gas-liquid operations/processes carried out in a conventional agitated vessel, the utilization of gas in a single pass is considerably low due to the low residence time of the gas in the liquid. The utilization of the gas phase in such systems could be improved by external recycling of the unused/unreacted gas, which requires additional energy. Surface aeration is one of the options for internal recycling of the gas in an agitated vessel; but involves some limitations such as high maintenance requirement, inefficient aeration, limited mixing performance, inefficiency at higher liquid depths, etc. Self-inducing type of agitated vessels could provide better contact between gas and liquid at relatively lower power consumption when compared with surface aerators [1–8]. Moreover, by using self-inducing reactors, the solid particles could be kept in suspension at relatively lower impeller speeds than that required by a surface aerator [9, 10].

The gas-inducing reactors found in the literature have a hollow shaft and a hollow impeller. The acceleration of the fluid caused by the rotation of the impeller leads to a reduction in the static pressure. When the area of the low pressure is connected to the gas space, and the reduction in pressure is higher enough to overcome the resistances in the path of the gas, induction of the gas takes place [9–11]. Apart from the hollow-impeller and hollow-shaft combination for gas-induction, stator-rotor (draft-tube) type of gas-induction is also found in the literature [12, 13]. There have been continuous modifications in the design and fabrication of air-inducing reactors over the past three decades [14]. However, all the air-inducing reactors reported so far in the literature could be classified into any one of the three types, namely, stator-rotor type, hollow-impeller and hollow-shaft type and surface aerator type, respectively. Of the three types of air-inducing reactors, the hollow-impeller and hollow-shaft types were investigated by the majority of the researchers. There are many complications in the design and fabrication of hollow-impeller and hollow-shaft type

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Microbial Fuel Cell (MFC)-A review of Design components, Selection of Substrate and Microbes, Parameters affecting the Design and Applications

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Abstract

Recently, Microbial Fuel Cells (MFCs) have achieved colossal attention among the researchers due to the thoughtful operating conditions, using a mixture of organic substrates and industrial effluents as fuel. MFC promises Eco-friendly production and wastewater regimen and proves to be better than the present technologies for the generation of electricity from non-conventional sources. This fuel cell can convert substrate into electricity at all surrounded warmth. In MFC, bio-energy generation depends on the type of microorganism, electrolyte, characteristics of the effluent, suitable electrode materials, proton exchange membrane, design and parameter optimization. However, a few drawbacks and practical barriers are present like high internal resistance, current instability, low electricity production and usage of expensive materials.. In this article, various designs and types of MFC, various components of MFC and its effect in current generation were reviewed. Also, this review has suggested few possible alterations in MFC design which can help in detailed study of MFC. Various advantages and applications of MFC are also laid down in this review.

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ORIGINAL ARTICLE

Comparative studies on ultrasound assisted treatment of tannery effluent using multiple oxy-catalysts using response surface methodology

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KEYWORDS

Tannery wastewater;
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Abstract Advanced oxidation of wastewater is a promising technique for tannery wastewater treatment, as it consumes less chemical addition and energy and it doesn't liberate any secondary effluents. However, advanced oxidation can be improved by conjoining it with energy sources like ultraviolet radiation, ultrasound, etc. Catalysts capable of oxidation like titanium dioxide and iron oxide have been utilized for advanced oxidation of tannery effluent. The present work studies the synergic effect of ultrasound assisted advanced oxidation using two oxy-catalysts, namely zinc oxide and silicon dioxide. The effect of variables like time of treatment, catalyst loading, and power of ultrasound on the reduction of BOD, COD, and TDS were estimated and the results indicated a proficient reduction of contaminants. Upon treatment with silicon dioxide under ultrasound, the COD, BOD, and TDS reduction were found to be 88%, 89%, and 88% respectively, while zinc oxide catalyst indicated 89%, 85%, and 88% reduction. Response Surface Methodology has been utilized for derivation of a mathematical model for COD, BOD and TDS reduction. The spent catalysts were analyzed using Scanning Electron Microscopy and X-ray Diffraction to understand the changes in the characteristics of the spent catalyst. The deposition of contaminants on the catalysts and slight changes in the surface morphology were evident. Hence silicon dioxide and zinc oxide are promising catalysts for the treatment of tannery effluent combined with ultrasound.

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1. Introduction:

Leather is one of the fast moving commodities, which is utilized in products like footwear, bags, wallets, etc. The leather processing sector which involves tanning of leather plays a crucial role in determining international economy, contributing a

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An Extended Approach on Power Conversion Efficiency Enhancement Through Deposition of ZnS-Al_2S_3 Blends on Silicon Solar Cells

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Transparent zinc sulfide (ZnS)-aluminium sulfide (Al_2S_3) composite thin-films are deposited on silicon solar cells through radio frequency (RF) sputtering method at room temperature to investigate the structural, optical, electrical, and thermal characteristics. X-ray diffraction analysis reveals the presence of the powder sample (ZnS-Al_2S_3) and its average crystallite size is 15.83 nm. The minimum electrical resistivity (ρ), maximum hall mobility (μ), and carrier concentration (N) of ZnS-Al_2S_3 nano-layer coated solar cells are measured to be 2.98×10^{-3} Ω cm, 14.89 $cm^2\ V^{-1}\ s^{-1}$ and 24.88×10^{20} cm^{-3} respectively. For a time period of 25 min, ZnS-Al_2S_3 nano-layer sputter coating produces the maximum power conversion efficiencies (PCE) of 19.38% and 21%, obtained at open and controlled atmospheric conditions, respectively. The influence of operating temperature at both these open and controlled atmospheric conditions for ZnS-Al_2S_3 nano-layer coated silicon solar cells is observed. The ZnS-Al_2S_3 composite demonstrates the properties of a desirable anti-reflection coating material for enhancing the PCE of solar cells.

Key words: Renewable energy, silicon solar cell, optical loss, anti-reflection coating, zinc sulfide-aluminium sulfide, power conversion efficiency

INTRODUCTION

Renewable energy is a significant contributor to the achievement of basic energy policy.[1] Photovoltaic energy is the most promising substitute for fossil fuels, owing to its clean energy production, among all the different sustainable renewable energy resources.[2,3] A solar cell is an electrical device that converts light energy into electrical energy through the photovoltaic effect. The elementary material used for the fabrication of solar cells is silicon.[4] High-performance polycrystalline silicon solar cells enhance the light transmittance characteristics with lower optical loss. The power conversion efficiency (PCE) of a silicon solar cell depends on its surface reflections. Anti-reflection coating (ARC) plays a key role in enhancing the PCE of solar cells by reducing the reflection losses in the solar cell.[5,6] Aluminium-doped zinc oxide (AZO) based ARC coating on the silicon solar cell provides

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Influence of dynamic position, fluid intake, hydration, and energy expenditure on sustainable mobility transport

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ABSTRACT

Energy is fundamental for any industrial development and globalization. Due to the demand of energy finding the cheap and environmental friendly commuting is vital. This study deals about how a saddle position affects the performance of the commuter. In regular and sprint cycling, the interaction between the bike and the rider is crucial. The performance of the cyclist depends on the bike setup and rider position. Besides, muscle force and aerodynamics also affect the biomechanical outputs. A series of tests were conducted on both hybrid and road bikes with a different test specimen. In the first session, the saddle height is kept at three different heights −10 mm, optimum and +10 mm and the performances value is noted. In the second session, the saddle was placed at three different angles (−8°, optimum and +8°) and the muscle force during pedalling is measured. Further, the position of saddle setback was done for three different configurations and the parameters such as force effectiveness and work effectiveness index were obtained. The real-time tests are done throughout the month with negligible traffic. The saddle height and saddle setback showed a significant difference in the performance of the bike. Further, the configuration of bike and its handlebar position also influences in the cyclist performance. Selecting the optimum saddle height using bike fitting technique can reduce the lower limb injury risk. Nevertheless, setting saddle at forward position and shifting little backward reduces the 10% of cumulative effort of the cyclist.

1. Introduction

Increased industrialization and globalization created huge demand of energy. The non renewable resource such as coal, natural gas and oil contributes to the global energy demand up to 80% [1]. Besides, due to the depletion of resources and the emission of hazardous gases it is mandatory to search for clean energy. In the same regard, biodiesel, hydrogen and solar are considered to be the promising alternatives [2,3]. Although the implementation of biodiesel is successful, yet still they are not environmental friendly. Thus switching the modes of transport is mandatory. Cycles are the sustainable mode of transport, which characterises the relationship between the cyclist and the machine. In recent days the bicycles gained biblical attention among several classes of people irrespective of their economic level. Bicycles are the machines which emit zero pollution. Further, it is very cheap to maintain compared to energy-driven vehicles [4]. In olden days, bicycles were used by a low-income group of people who can't afford to buy a motorized vehicle. Besides, in recent days the bicycle is growing popular among youngsters owing to the incorporation of flagship models in cycles especially in hybrid, MTB and road bikes [5]. Nowadays bikes are used as a fitness and pleasure by many. Modern bikes are made of ultra-light carbon frame and flexible gear combination which makes the bicycle to reach 40 km/h easily in flat roads [6]. Further, climbing the hill is also made feasible with these modern bikes. Despite these techies, cycles are not very popular as a commuting device in hot and thickly populated countries like India [7]. Although there are several non-profit organiza-

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Hydro-treating and Hydro-isomerisation of Sunflower Oil using Pt/SAPO-11: Influence of Templates in Ultrasonic Assisted with Hydrothermal Synthesis

Shanmugam Palanisamy (https://scholar.google.com/scholar?q=Shanmugam+Palanisamy) [1] (javascript:openRTWindow('https://ejournal2.undip.ac.id/index.php/bcrec/rt/emailAuthor/9889/0');) (https://orcid.org/0000-0002-1603-1683) (http://www.scopus.com/authid/detail.uri?authorId=56225788900), *Durona Palanisamy* (https://scholar.google.com/scholar?q=Durona+Palanisamy) [1], *Mugaishudeen Gul* (https://scholar.google.com/scholar?q=Mugaishudeen+Gul) [1], *Kannan Kandasamy* (https://scholar.google.com/scholar?q=Kannan+Kandasamy) [1], *Borje Sten Gevert* (https://scholar.google.com/scholar?q=Borje+Sten+Gevert) [2]

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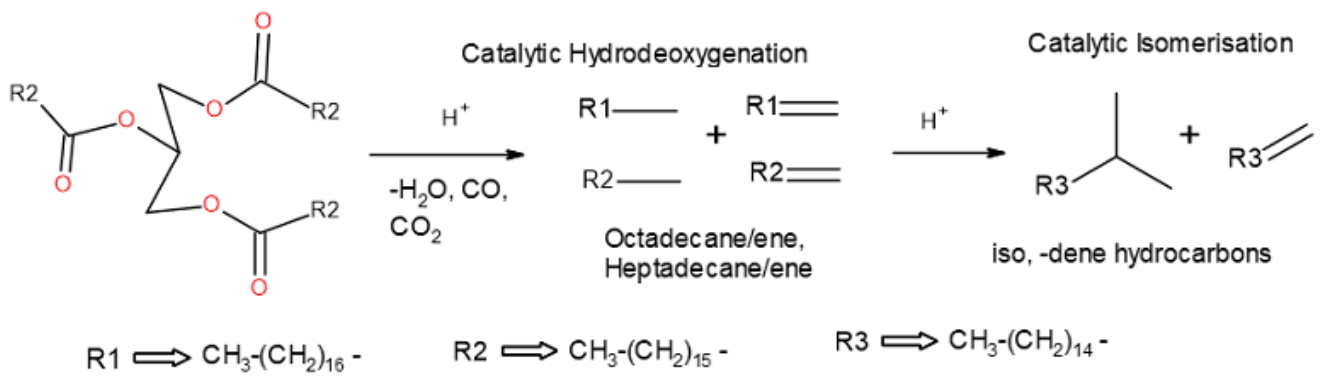

Abstract

Pt/SAPO-11 mesopores type materials has successfully synthesized using different templates, such as: diethylamine (DEA), dimethylamine (DMA), and n-propylamine (n-PA), under ultrasonication coupled with hydrothermal treatment or independently with hydrothermal treatment. The influences of structure directing agent (SDA) and synthesis method are investigated by different characterization techniques and the role of the material as catalyst in hydrotreating of sunflower oil has examined. The synthesized materials have been characterized by X-ray Diffraction (XRD), Scanning Electron Microscope (SEM), and Fourier Transform Infra Red (FT-IR) techniques. It is found that SAPO-11 material which has synthesized with n-PA as a template has the characteristics of high

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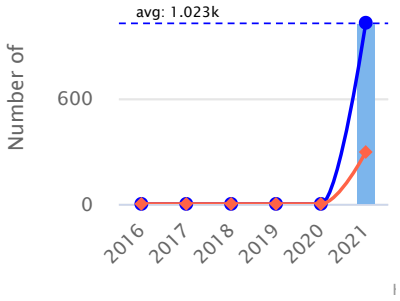

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Review Article

Review on Agro-Based Nanotechnology through Plant-Derived Green Nanoparticles: Synthesis, Application and Challenges

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Abstract

Technologies developed in the field of nanoparticles have replaced the use of chemical to eco-friendly green nanoparticle. The nanoparticle sysnthesis can be attained by top-down and bottom-up methods. The source of nano-paerticle synthesis can be acheived by green plant wastes and microorganisms. This becomes a major solution for the defects of conventional nanoparticles developed by chemical synthesis and it can be substuituted for agriculture field for different application like fertilzer, pesticides, etc. It is important to mention that nanoparticles have considerably increased the production in agriculture. The physiological and biological improvements in plants by the application of nanoparticles based on metals or carbon can be enhanced by advanced techniques of testing and implementation. Metal, metal oxide, composite and polymeric nanoparticles are applied to plants through various modes to increase the crop yield and protect from pathogenic attack for not to risk the crop life-span. Recently usage of nano zeolite in the field of agriculture potentially improves its yield. This review gives a brief introduction about the nanoparticles and its various synthesis methods applied in various fields of agriculture to increase production capacities. Also, it elaborate the application and challenges that carried in application in agricultural field.

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Optimization Studies on Subcritical Water Extraction of Fuels and Fine Chemicals from *Prosopis juliflora*: An Invasive Weed Tree

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Abstract

Waste lignocellulosic biomass obtained from the dry plant matter is the most abundantly available resource for the production of biofuels, and biochar. The invasive weed tree of *Prosopis juliflora* was employed as feedstock for the extraction process, which converts biomass into biogas, bio-oil, and biochar in the presence of subcritical water at high temperatures (250 °C to 374 °C) and pressures (4-22 MPa). The extraction process was performed inside a 50 ml stainless steel hydrothermal reactor with 3.5 g of feedstock and varying process parameters such as temperatures (250–325 °C) and reaction time (30–120 min) and biomass to water loading (10–30 % w/v). The response surface methodology was employed to optimize the parameters for maximizing the bio-oil yield under subcritical condition using Design Expert 8.0.7.1 software. The % yield of bio-oil and biochar during this process were taken as responses. The biomass and bio-oil were characterized using proximate and ultimate elemental analysis, thermogravimetric analysis, and gas-chromatography mass spectroscopy. The results showed that the maximal yield of bio-oil 3.65 % was obtained at a temperature of 277.62 °C, reaction time 59.98 min and biomass to water loading 20.13 % w/v. The resulted bio-oil was found to contain long-chain alkanes, ketones, carboxylic acids, amines, and phenols.

Keywords

Prosopis juliflora, subcritical water extraction, bio-oil, biochar

1 Introduction

Prosopis juliflora is a shrub or small tree in the family Fabaceae. It is native to Mexico, South America and the Caribbean [1]. It grows to a height of up to 12 m; trunk diameter of up to 1.2 m and deciduous, bi-pinnate, light green, compounded leaves with 12 to 20 leaflets shown in Fig. 1 (a). The flowers are in 5–10 cm long clusters of green-yellow cylindrical spikes at the ends of branches. Pods are 20 to 30 cm long and contain between 10–30 seeds per pod as shown in Fig. 1 (b) [2]. *Prosopis juliflora* wood contains 66.20 % holocellulose (47.50 % α-cellulose and 18.70 % pentosans), 29.10 % Klason lignin, and 2.02 % ash [3]. *Prosopis juliflora* has a hard exterior shown in Fig. 2 (a) that can adapt to any drought conditions and has proven to be one of the best firewood with very low moisture content of 7.3 % providing 4.952 kcal energy for cooking in most households in Kenya, where over 80 % of the rural and urban population use firewood for cooking and heating [4]. The ultrastructure of *Prosopis juliflora* collected in Petrolina, State of Pernambuco, Brazil (Figs. 2. (b)–(d)) shows that 18 % of the total volume is occupied by vessels present in few radial multiples of 3-4 and in clusters, with scant diffuse apotracheal parenchyma cells upto 16 %, homogeneous rays 18 %, and the rest is constituted by libriform, non-separate, often gelatinous fibrous tissue that extremely short to short (620–1009–1228 µm); narrow, 10–13–18 µm in diameter; walls very thick (1.5–2.5–4.5 µm) make it a best-evolved species for arid conditions [5].

Prosopis juliflora once touted as a savior for firewood of the drought-prone areas in the southern districts of Tamil Nadu has now become a threat to the environmental system [6]. It is considered a noxious invader in several

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Paradisiaca/Solanum Tuberosum Biowaste Composited with Graphene Oxide for Flexible Supercapacitor

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ABSTRACT

This work focuses on the development of a novel type of chemically activated carbon networks composited with the graphene oxide. Here, the carbon networks were derived from green biomass wastes such as orange peels, banana peels and potato starch. All the obtained carbon materials were being activated using different activating agents based on the higher specific capacitance such as phosphoric acid activated orange peel derived carbon, sulphuric acid activated banana peel derived carbon and hydrochloric acid activated potato starch. Further they were individually composited with graphene oxide for enhanced performance. Different chemical activation is employed for the sake of obtaining higher specific capacitance, energy and power density. Phosphoric acid activation on orange peel derived carbon network was selected due to the improvement in the micropores and further increased the surface area with the controlling capability of structures of activated carbon. To improve the conductivity of the samples, graphene oxide was added. The electrochemical performance of orange peel, banana peel and potato starch derived nano porous activated carbon materials composited with graphene oxide for supercapacitor applications is evaluated using aqueous H_2SO_4 electrolytes at a scan rate of 10 mV s^{-1}. The samples that are prepared are structurally characterized using fourier transform infrared spectroscopy, x-ray diffraction and electrochemically characterized using cyclic voltammetry, galvanostatic charge and discharge measurements, and electrochemical impedance spectroscopy. From the electrochemical measurements, suitability of material as electrode for supercapacitors can be understood. The superior electrochemical performance is attributed in orange peel derived nano porous carbon/ graphene oxide due to porous structure.

Keywords: *Biowaste composite, Citrus Sinensis Flavedos, Graphene Oxide, Flexible Supercapacitor, Musa Paradisiaca, Solanum Tuberosum*

Received: October-25-2020, Accepted: January-13-2021, https://doi.org/10.14447/jnmes.v24i1.a04

NOMENCLATURE

mV s^{-1}	millivolt/sec
FTIR	fourier transform infrared spectroscopy
XRD	x-ray diffraction
CV	cyclic voltammetry
GCD	galvanostatic charge and discharge
EIS	electrochemical impedance spectroscopy
DC	direct current
ESR	equivalent series resistance
m^2g^{-1}	meter square per gram
Ag^{-1}	ampere per gram

1. INTRODUCTION

The fast utilization of fossil fuel with the worsening environment makes the necessity to develop a clean and novel energy storage system [1]. Among the devices, supercapacitor, fills the space between electrolytic capacitors and rechargeable batteries, and fascinated towards new consideration ascribed to its high power density and extended cycle life [2]. It can store huge amount of energy than the capacitors. Similarly, charging and discharging was happened in a pace manner than batteries, and they support without any degradation high charges and deep discharge cycles than rechargeable batteries. Supercapacitors are used for regenerative braking, short-term energy storage, etc. Supercapacitors are classified into electric double-layer capacitor (EDLC) and pseudocapacitor. A double layer is a structure that appears at the interface between the surface of an electrode and electrolyte.

Activated carbon (AC) derived from bountiful biomass is an ecological. As AC is broadly considered for supercapacitors, precursor optimization is crucial. When AC is developed from the banana peel without using the activating agents, it exhibited the specific surface area of 1084 $m^2 g^{-1}$ [3]. From [4], it was confirmed that the pore size of 40 to 50 nm, is more constructive for ion transportation. Carbonization is an ecological pyrolytic reaction, and also exothermic. Carbonization takes place in drying phase, thermal decomposition, and cooling. By means of scalding heat, the biomaterial can be quickly carbonized, further turned into solid carbon. Some of the factors are affecting the charcoal yield such as heating rate, peak temperature, feedstock, gas environment, and pressure. Similarly, specific capacitances of carbonaceous materials are limited due to its structure.

Surface engineering of zinc sulphide film for augmenting the performance of polycrystalline silicon solar cells

V. K. Gobinath[a], R. Rajasekar[b,*], C. Moganapriya[b], A. Manju Sri[c], G. Raja[d], P. Sathish Kumar[e], S. K. Jaganathan[f,g,h]

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[e]*Mining Engineering, Indian Institute of Technology Kharagpur, Kharagpur, India - 721302*

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[g]*Faculty of Applied Sciences, Ton Duc Thang University, Ho Chi Minh City, Vietnam;*

[h]*Department of Engineering, Faculty of Science and Engineering, University of Hull, HU6 7RX, United Kingdom*

The current work focused on enhancing solar cell's Power Conversion Efficiency (PCE) while using zinc sulphide (ZnS) material as Anti-Reflective Coating (ARC). The ZnS layers were deposited over the solar cell surface by RF sputtering technique. The coating was performed in argon gas atmosphere with sputtering time such as 10, 20, 30 & 40 min represented as S-I, S-II, S-III and S-IV respectively. The power conversion efficiency of ZnS coating on polycrystalline silicon solar cells was studied by evaluating optical properties, electrical characteristics, structure morphology and temperature study. It is observed that the S-III coating exhibits optimum hall mobility (μ),improved carrier concentration (N) and electrical resistivity (ρ) and the measured values are 12.88 $cm^2V^{-1}s^{-1}$, 3.98×10^{-3} Ω-cm and 21.88×10^{20} cm^{-3} respectively. The maximum PCE of 17.39% and 19.12% are obtained for S-III coating at open source condition and controlled source condition respectively. The effect of operating temperature on ZnS coated solar cells at both open source and controlled source condition is also investigated. The results revealed that the ZnS can be reliable ARC for improving the power conversion efficiency of solar cells.

(Received March 27, 2021; Accepted July 2, 2021)

Keywords: Sustainable energy, Polycrystalline silicon solar cells, Reflection loss, Zinc sulphide, Power conversion efficiency

1. Introduction

The depletion of fossil fuels and their environmental concerns such as increase in global warming, rise in sea level, air and water pollution made the researchers to focus on the alternative sources of energy. The sustainable energy sources could be modified to address the disadvantages of traditional non-renewable energy sources. Solar energy is identified as the most promising feature to generate electricity which is clean, renewable and eco-friendly. As per the survey, solar energy is capable of supplying energy twice than that of non-renewable energy consumed in a year. In the production of clean electrical power, photovoltaic cells play a significant role [1]. For

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Waste and Biomass Valorization (2021) 12:6795–6809
https://doi.org/10.1007/s12649-021-01472-4

ORIGINAL PAPER

Bioconversion of Feather Composts using Proteolytic *Bacillus mycoides* for their Possible Application as Biofertilizer in Agriculture

Goldy Primo Beryl[1] · Basheer Thazeem[2] · Mridul Umesh[3] · Kandasamy Senthilkumar[4] · Manickam Naveen Kumar[4] · Kathirvel Preethi[1]

Received: 24 December 2020 / Accepted: 12 May 2021 / Published online: 18 May 2021

Abstract

Proteolytic *Bacillus* strains were screened for highest protease production amongst which *Bacillus mycoides* (G2) was chosen as an assuring protease producer. Enzyme activity was maximum at 37 °C, pH-7, when the medium was supplemented with 0.5 and 0.75% of sucrose and beef extract respectively. Tapioca flour and soybean meal were capable of replacing commercial carbon and nitrogen sources respectively. Feather degradation studies revealed 62% of degradation with Quail feather (QF), followed by Chicken feather (CF) (58%), Guinea fowl feather (51%) and Pigeon feather (43%). Biodegradation of feather samples in soil evidenced degradation of Quail feather and Chicken feather at the following pattern—QF Treatment 1 (5%) > CF Treatment 1 (5%) > QF Treatment 2 (10%) > CF Treatment 2 (10%). Maximum degradation of QF and sufficient release of free amino acids into the feather compost was obvious with Field Emission Scanning Electron Microscopic (FE-SEM) and High Performance Thin Layer Chromatographic (HPTLC) analyses respectively. In vitro plant growth studies of tomato and chilly plants were accomplished with feather composts. Maximum growth of 26.44 cm (shoot length) was achieved when feather compost prepared with degraded QF (5%) was utilized as plant growth substrate, than other treatment pots ($P < 0.05$). Plant growth was exemplary in the case of tomato when compared to that of chilly. Sound degradation of QF, followed by CF using *Bacillus mycoides* could strengthen the efficacy of microbial fermentation processes. This significant attempt could support poultry farms as well as organic agricultural sectors ecologically.

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Fuel

Available online 8 December 2021, 122679

In Press, Corrected Proof

Full Length Article

A review on hydrothermal liquefaction of algal biomass on process parameters, purification and applications

Sathish Raam Ravichandran [a], Chitra Devi Venkatachalam [b] ✉, Mothil Sengottian [a], Sarath Sekar [b], Sabariswaran Kandasamy [c, d] ✉, Kesav Prasath Ramasamy Subramanian [a], Kirubakaran Purushothaman [a], Aravindan Lavanya Chandrasekaran [a], Mathiyazhagan Narayanan [e]

https://doi.org/10.1016/j.fuel.2021.122679

Highlights

- Conversion of algae biomass into bio-oil, biochar and biogas using hydrothermal liquefaction.
- Algae is considered as a potential source due to its rapid growth and high flexibility.
- The pathway of HTL involves de-polymerization, de-composition and recombination.
- Carbohydrates, lipids and proteins which are the primary constituents of an algal biomass.

Abstract

Algae, a potential biomass feedstock with a faster growth rate and capability of greenhouse gas absorption, mitigates the limitations of the first- and second-generation feedstock in bio-oil production. hydrothermal liquefaction (HTL) is known to be an active method capable of producing substantial energy resources. In HTL, biomass undergoes thermal depolymerization in the presence of water, at around 280 °C–350 °C following subcritical and near supercritical conditions to produce chemical compounds such as alkanes, nitrogenates, esters, phenolics, etc. The primary product, “Biocrude/Bio-oil” obtained from the reaction, is identified as the essential fuel source after processing and also as a distinct value-added chemical source, along with biochar and biogas as co-products. This review outlines a range of routes available for thermochemical conversion of the algal biomass. It also provides a better understanding of the reaction mechanism like depolymerization, decomposition, and re-polymerization, operating conditions like temperature, pressure, the quantity of catalyst required, and the solvent used in the process. The review also highlights the yield achieved by altering the aforementioned parameters, comparing and presenting them as a collective result.

Keywords

Algae feedstock; Biofuel; Catalyst; Hydrothermal liquefaction; Valorization

J Mater Sci: Mater Electron (2021) 32:25175–25187

Synthesis of activated carbon from black liquor for the application of supercapacitor

Shanmugam Palanisamy[1,*], Senthil Kumar Kandasamy[2], Sathesh Thangmuthu[1], Dhinesh Kumar Selvarasu[1], Marimuthu Panchanathan[3], Prasanna Venkatesh Ramanai[4], and Borje Sten Gevert[5]

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Received: 1 February 2021
Accepted: 4 September 2021
Published online: 9 September 2021

ABSTRACT

In the present study, black liquor carbonization has been investigated by hydrothermal process. The activated carbon from the carbonization of black liquor (AC-BL) and biomass-based activated carbon from citrus sinensis flavedos (AC-OP) has been investigated for suitability in supercapacitor application. The study has analyzed the electrochemical measurement of both AC-BL and AC-OP in electrochemical stations. The role of stable hydroxyl molecules on the surface of carbon material has been observed and its effective conductivity is studied. The superior performance of AC-OP-derived nanoporous carbon has fast ionic and electronic diffusion of the electrolyte in and out of the pores during charging and discharging due to high surface area. AC-BL exhibited with an EDLC mechanism, but AC-OP shows the pseudocapacitance property. The porous structure and oxygen doping characteristics in AC-BL can influence the potential electrode material for applications in the field of supercapacitors. With the help of this movement, the electronic conductivity of the AC-BL has been increased. In general, the electrochemical stability of the EDLC is far better than the pseudocapacitor. From the GCD analysis, it is observed that the specific capacitance of 17.4 and 148.2 F g^{-1} is obtained from GCD spectra for AC-BL and AC-OP, respectively. From the EIS analysis, the ESR value is very small for AC-BL (60 Ω), when compared to AC-OP (155 Ω). To conclude that the EIS results of low conductivity by AC-BL have the potential to be future supercapacitors with enhanced treatment in carbonization techniques.

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https://doi.org/10.1007/s10854-021-06974-4

Chemosphere
Volume 287, Part 1, January 2022, 132090

Bio-energy generation and treatment of tannery effluent using microbial fuel cell

M. Naveenkumar [a], K. Senthilkumar [a], V. Sampathkumar [b], S. Anandakumar [b], B. Thazeem [c]

https://doi.org/10.1016/j.chemosphere.2021.132090

Highlights

- Bio-energy generation from tannery effluent was examined in MFC.
- Distance between the electrodes might be affect the power production in MFC was investigated.
- The increasing pH from 5 to 9 will increase the power density in MFC.
- MFC power production performance was increased by increasing anolyte conductivity and COD effluent concentration.

Abstract

In this study, Graphite Particle (GP) and Carbon Cloth (CC) are employed as anode electrodes to study both bio-energy generation, and decrease of Chemical Oxygen Demand (COD) simultaneously using tannery effluent. The influence of electrodes distance (10 cm and 20 cm) on electricity production was evaluated. COD removal level of GP (75%) and CC (60%), maximum power outputs for 10 cm distance (600 ± 5 mW m^{-2}) & (500 ± 10 mW m^{-2}) and for 20 cm distance (520 ± 5 mW m^{-2}) and also (430 ± 20 mW m^{-2}) GP and CC were noted correspondingly. The outcomes of different parameters of MFC namely pH, conductivity, COD concentration, membrane thickness and size of bio-energy generation from tannery effluent in the MFC were investigated. The experimental results reveal that electrode provides highest power output with 10 cm distance between anode and cathode chamber. As a result, GP electrode is gradually viable, biocompatible, effective and adaptable for field application in MFC. The GP electrode has high potential for more power output, when compared to the CC electrode. The MFC system performance was improved with increasing effluent COD concentration (2340–4720 ppm), anolyte conductivity (1.6–8.1 mS cm^{-1}) and membrane area (9–20 cm^2). The system working with conductivity of 8.1 mS cm^{-1} and its effluent COD concentration of 4720 ppm generated the maximum peak power density of 44.69 mW m^{-2} with respective current density of 109 mA m^{-2}. The findings thus show that considerable power production and effluent treatment can be achieved by MFC.

Keywords

Electrodes; Bio-energy; Microbial fuel cell; Membrane; COD removal; Wastewater

- Review
- Published: 23 October 2021

Methods for chemical conversion of plastic wastes into fuels and chemicals. A review

- Fetcia Jackulin Christopher[1],
- Ponnusamy Senthil Kumar ORCID: orcid.org/0000-0001-9389-5541[2],
- Dai-Viet Nguyen Vo[3],
- …
- Femina Carolin Christopher[4] &
- Lakshmipriya Jayaraman[5]

Show authors

Environmental Chemistry Letters (2021)Cite this article

- 144 Accesses
- Metrics details

Abstract

Plastics are utilized in various materials that are useful in everyday life. As the usage of plastics increases, the disposal of plastic materials has become a major issue, calling for recycling methods. Here, we review the different methods to recycle plastics, with focus on catalytic cracking. We present catalysts, cracking mechanisms, and we compare the various treatment methodologies. Several attempts were made by researchers to increase the efficiency of the cracking process using different catalysts and reactors. Many studies reveal high quality products are obtained by catalytic cracking, which consumes low energy and produces lesser residues when compared to other treatment technologies.

Fig. 1

Fig. 2

NANDHA COLLEGE OF TECHNOLOGY

Approved by AICTE, New Delhi - F No : 06/05/Tn/E&T/2008/33
Affiliated to Anna University, Chennai.

Date: 18.09.2020

Letter of Appreciation

*****

Greetings from Department of Management Studies, Nandha College of Technology, Erode

With all our due respect, we would like to thank **Dr.K.Senthilkumar, Associate Professor, Department of Chemical Engineering, Kongu Engineering College, Erode** for his presence and being a Chairperson for the Technical Session – 2 in **AICTE sponsored International e- Conference on Innovation in Rural Empowerment, Social Dynamics & Welfare in India** organized by Department of Management Studies, Nandha College of Technology, Erode on **15th September, 2020.**

We really appreciate you taking out time for us from your busy schedule. It's always been our pleasure to have you with us and we look forward to see you again for the upcoming events.

Thanking you,

18/09/2020

PRINCIPAL

PRINCIPAL
NANDHA COLLEGE OF TECHNOLOGY
ERODE-52.

Nandha College of Technology * Erode-638 052 *

To

Dr.K.Senthilkumar,

Associate Professor,

Department of Chemical Engineering,

Kongu Engineering College,

Erode.

Vaikkalmedu, Erode Perundurai Road, Pitchandampalayam, (P.O), ERODE - 638 052
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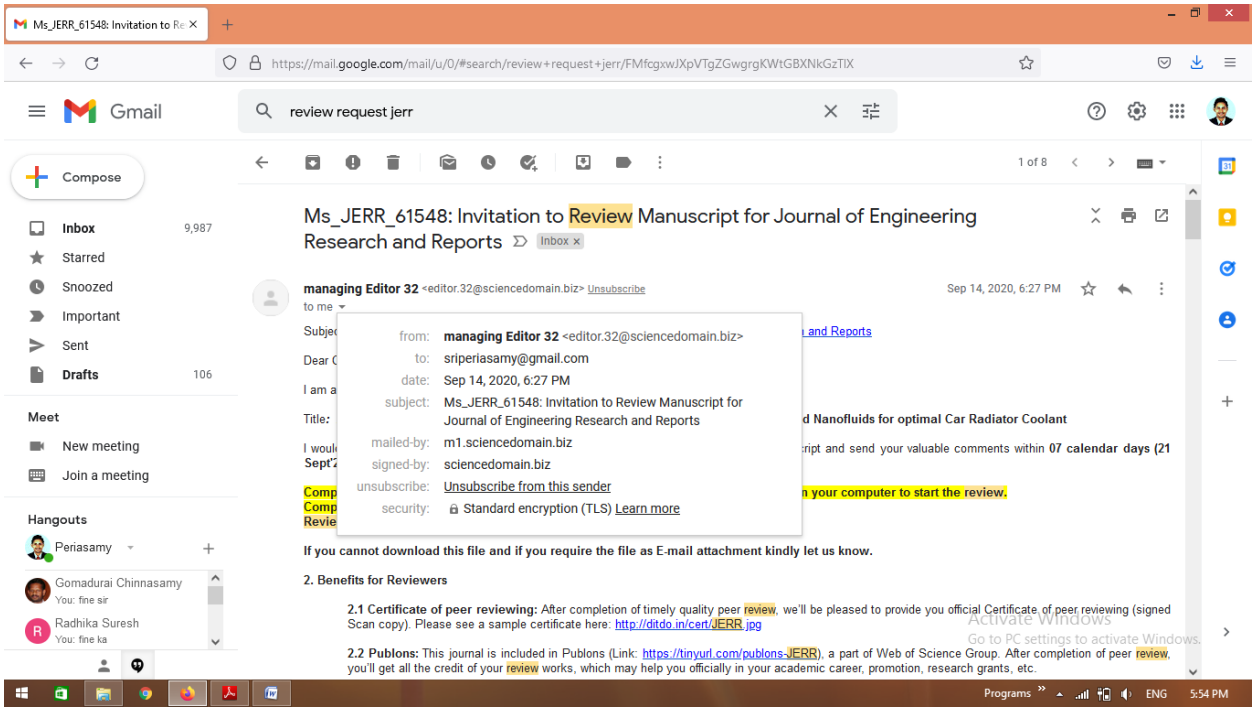
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Rasipuram - 637 408, Namakkal Dist., Tamil Nadu

Dr. N. Saravanan ,
Chairman BOS

17-11-2020

To

Dr. C. Gomadurai,
Associate Professor,
Department of Chemical Engineering,
Kongu Engineering College,
Perundurai.

Dear Madam,

Sub: Board of Studies Meeting for 2020 – 2021 – Reg.

I am glad to inform you that the Board of Studies Meeting in Chemical Engineering of our Institution is scheduled on **19th November, 2020 through Google Meet at 02.30PM.** Kindly make it possible to attend the meeting and give us the benefit of your valuable views and suggestions to improve our curriculum.

Thanking you,

Yours Sincerely

Dr. N. Saravanan.
Chairman, Board of Studies
(Mobile : 94869 31081)

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Email: info@kgfabriks.com

23.01.2021,
Perundurai.

TO WHOM IT MAY CONCERN

This is to certify that **Dr. K. Kannan**, Professor and Head, Department of Chemical Engineering, Kongu Engineering College, Perundurai, Erode has delivered a lecture and provided training on **"Environmental Health and Safety"** for our employees at our Industry on 23.01.2021. Over all feedback about the training is **"Good"**.

For Sri Kannapiran Mills Limited
(Unit : KG Fabriks)

UNIT OF SRI KANNAPIRAN MILLS LTD ★ KG FABRIKS
PERUNDURAI
638052

R. Arjunan
(Manufacturing Manager)

SRI KANNAPIRAN MILLS LIMITED.,
UNIT : KG FABRIKS

Factory: Plot No. FF - 1,SIPCOT IGC, Perundurai – 638 052, Erode (Dt).
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Email: info@kgfabriks.com

23.01.2021,
Perundurai.

TO WHOM IT MAY CONCERN

This is to certify that **Dr. K.Senthilkumar,** Associate Professor, Department of Chemical Engineering, Kongu Engineering College, Perundurai, Erode has delivered a lecture and provided training on **"Environmental Health and Safety"** for our employees at our Industry on 23.01.2021. Over all feedback about the training is **"Good"**.

For Sri Kannapiran Mills Limited
(Unit : KG Fabriks)

KG FABRIKS UNIT OF SRI KANNAPIRAN MILLS LTD. PERUNDURAI 638052

R. Arjunan
(Manufacturing Manager)

Arasu Engineering College

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Chennai Main Road, Kumbakonam – 612 501, Tamil Nadu.
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E-Mail: arasuengg@aec.org.in, arasuengg@gmail.com website: www.aec.org.in

Dr.T.Balamurugan,M.E.,Ph.D.
Principal

24.03.2021

Letter of Appreciation

It is to certify that **Dr. K. Senthil Kumar**, Associate Professor, Department of Chemical Engineering, Kongu Engineering College, Erode has given a key note address in the National Conference on "**Multidisciplinary Research in Science and Humanities (NCMRSH-2021)**" organized by the Department of Science and Humanities on 24.03.2021 at Arasu Engineering College, Kumbakonam.

The content and the way in which he delivered the content were highly appreciated by the participants.

On behalf of the Management, Research Committee and the department of Science and Humanities of Arasu Engineering College, Kumbakonam, I sincerely acknowledge and express our gratitude to **Dr. K. Senthil Kumar**, for his contribution in the Conference.

ARASU ENGINEERING COLLEGE * KUMBAKONAM - 612 501. *

PRINCIPAL
PRINCIPAL
ARASU ENGINEERING COLLEGE
Kumbakonam - 612 501

To

Dr. K. Senthil Kumar,
Associate Professor,
Department of Chemical Engineering,
Kongu Engineering College,
Erode.

ERODE SENGUNTHAR ENGINEERING COLLEGE
(An Autonomous Institution)
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PERUNDURAI, ERODE-638 057
DEPARTMENT OF CHEMICAL ENGINEERING

29.03.2021

To

Dr. K. Kannan,
Professor and Head,
Department of Chemical Engineering,
Kongu Engineering College,
Perundurai.

Dear Sir,

I am very much thankful to you for the lectures delivered in the AICTE Sponsored Short Term Training Programme (Online) on **"ARTIFICIAL NEURAL NETWORKS FOR RAPID PROGRESS IN CHEMICAL AND ALLIED INDUSTRIES"**

S. No.	Topic of the Presentation	Date and Session
1	ANN for Modelling of CSTR and Waste Water Treatment Process.	18.03.2021. 02.00 - 04.00 pm.
2	Modelling of Multiphase Reactor.	20.03.2021. 02.00 - 04.00 pm.

Faculty members of various colleges and Research Scholars attended the above sessions, well appreciated and gave feedback that the above sessions were an eye opener to conduct research in the emerging field.

Thanking you

Yours Sincerely

Dr. P. Akilamudhan.

Dr.P.Akilamudhan,M.Tech.,Ph.D
Professor and Head
Department of Chemical Engineering
Erode Sengunthar Engineering College
Thudupathi,Erode-638 057

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Certificate of Appreciation

This is to certify that Dr.K. Senthil Kumar, Associate Professor

from Kongu Engineering College

was acted as a Resource Person and delivered lecture for the AICTE Sponsored Short Term Training Programme (STTP) under AQIS Scheme entitled "An Awareness Programme —Green Engineering Concepts and Treatment Methods for Farmers in Rural Area" Series - III held on 28/11/2020 organised by the Department of Chemical Engineering, Paavai Engineering College, Pachal, Namakkal - 637 018

Dr. G. SRINIVASAN
Convener

Dr. M. PREMKUMAR
Principal

ARUNAI

Engineering College

TIRUVANNAMALAI

5th International Conference on

Bioenergy Environment and Sustainable Technologies (BEST2021)

&

International E-Conference on **Bioprospecting (ICONBIO)**

29-30 January 2021

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CERTIFICATE OF APPRECIATION

We express our sincere gratitude to

Dr.K.Senthilkumar

Associate Professor, Department of Chemical Engineering, Kongu Engineering College, Perundurai, Erode- 638060

for chairing a session in the 5th International Conference on Bioenergy, Environment and Sustainable Technologies (BEST2021) & International E-Conference on Bioprospecting held during 29-30 January 2021 at Arunai Engineering College, Tiruvannamalai, Tamilnadu, India.

Dr.R.Ravichandran
Principal

Prof. R. Praveen Kumar
Organizing Chairman

NANDHA POLYTECHNIC COLLEGE

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Erode - 638 052, Tamil Nadu
Phone : 04294 - 223727, Mobile : 97504 20222, Fax : 04294 - 224787

M. RABI AHAMED, M.E., Ph.D
Principal

KONGU ENGINEERING COLLEGE
24/2/21
26 FEB 2021
THOPPUPALAYAM

NPC/PCE/20-21/05

23.02.2021

To

The principal

Kongu Engineering College

Erode -638060

Head Chemical
Engineering

Respected sir

Sub: Requesting to depute a faculty of Chemical Engineering for guest lecture on 25.2.2021-Reg

As a part of our association activities, we have to planned to conduct a **Guest Lecture** in our department on 25.02.2021 through Google meet. In this regard I would like to invite Mr. G. Mugaishudeen (Sr.Gr), Assistant Professor of Chemical Engineering Department of your institution to deliver a guest lecture under the topic "ROLE OF CHEMICAL ENGINEERS TOWARDS SUSTAINABILITY" for our students. We would be very happy if you can depute the faculty for the above said programme. Kindly do the needful.

Thanking you

Yours sincerely

NANDHA POLYTECHNIC COLLEGE
ERODE-52

M. Rabi
Principal. 23.2.21
Nandha Polytechnic College
Erode-638 052

Arasu Engineering College

Approved by AICTE & Affiliated to Anna University
[Accredited by NBA | Accredited by NAAC | Recognized by UGC under 2(f) and 12(B)]
Chennai Main Road, Kumbakonam - 612 501, Tamil Nadu.
Phone : (0435) 2777 777 - 82
E-mail : arasuengg@aec.org.in arasuengg@gmail.com website: www.aec.org.in

Dr. T. Bala Murugan, M.E., Ph.D.,
Principal

18.12.2021

Letter of Appreciation

It is to certify that **Dr. K. Senthilkumar,** Associate Professor, Department of Chemical Engineering, Kongu Engineering College, Erode has acted as a resource person for the CSIR Sponsored National Conference on **"Chemical, Environment, Energy and Engineering Research (NCCEEER – 2021)"** organized by the Department of Chemistry, Arasu Engineering College, Kumbakonam on 17.12..2021.

He delivered the content on the topic **"Opportunities for a Greener Textile industry using green technology for sustainable future".** The content and the way in which he delivered the content were highly appreciated by the participants.

On behalf of the Management and the Chemistry Department of Arasu Engineering College, Kumbakonam, I sincerely acknowledge and express our gratitude to **Dr. K. Senthilkumar** for his contribution in the conference.

PRINCIPAL
PRINCIPAL
ARASU ENGINEERING COLLEGE
Kumbakonam - 612 501.

To

Dr. K. Senthilkumar,
Associate Professor,
Department of Chemical Engineering,
Kongu Engineering College,
Perundurai,
Erode – 638 060.

Tamilnadu Petroproducts Limited

15th April 2021

CERTIFICATE

This is to certify that Mr. K.Rishikesh, Final Year B.Tech Chemical Engineering Student from Kongu Engineering College, Erode, Tamilnadu 638060 underwent in-plant training in our Production department of HCD Plant from 15.03.2021 to 25.03.2021 and 08.04.2021 to 15.04.2021.

During this period his conduct was GOOD.

For TAMILNADU PETROPRODUCTS LIMITED

K.VASANTHAKUMAR
DEPUTY GENERAL MANAGER (HR)

Regd. Office & Factory :
Post Box No. 9, Manali Express Highway, Manali, Chennai - 600 068. India.
Tel. : (0091) - 44 - 25945500 to 09 Telefax : 044-25945588
Website : www.tnpetro.com CIN : L23200TN1984PLC010931
TPL GSTIN : 33AAACT1295M1ZB

Internship Certificate

1

Dear JEEVITH K,

Congratulations on the successful completion of Internship Program with us!

We are glad to inform you that you have completed all the milestones of the Internship Program.

Please find below the score summary for behavioral skills. The behavioral pre assessment and post assessment score will help you to u scores prior and post the training.

Behavioral Score

		Pre Assessment									
Associate ID	**Associate Name**	**Grammar**	**Listening**	**Reading**	**Speaking**	**Total**	**Level**	**CEFR Level**	**Level**	**British Co**	
929073	JEEVITH K	267	300	227	282	1076	8	B2	Intermediate	83	Upper Intermed

As part of your communication training you underwent Industry standard language pre-assessment at the beginning of your training. the post - assessment at the end of the training.

The desired English Language competency is for you to be at the Intermediate category

Please refer to the table below to understand on the different levels of assessment scores and its mapping to the desired Language c desired category that you would need to move to before you complete your Year 1 with Cognizant (which would be 12 months from

It is important for you to put in efforts and move a minimum of one level from your current state before you join us back. To help you with a list of self-learning courses through which you can continue with the skill building and utilize the time in hand between your in

Request you to go through the courses to ensure the minimum language readiness that is expected from you at the time of joining C

We also encourage you to take up any other additional self-paced learning and explore other external learning platforms to build you practice, the higher is your preparedness to the job role and project/customer interactions you would be shortly experiencing

Happy Learning!
Gen C Team

NURAY CHEMICALS PVT. LTD.
Plot No.111, SIDCO Industrial Estate, Kakkalur, Thiruvallur District - 602 003.
Tel : 044 - 66616700 / 703 Fax : 044 - 2766 1020
info@nuraychemicals.com www.nuraychemicals.com
GST No:33AAECN0289P1Z2

NURAY
CHEMICALS PVT. LTD.

13th April 2021

TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Mr.S.Ajith** student of **B.Tech (Chemical Engineering)** from **Kongu Engineering College, Perundurai, Erode** has successfully completed his internship in our organization for the period from **15th March 2021** to **13th April 2021.**

During the above period we found him sincere & hard working and his performance found satisfactorily.

"WE WISH HIM ALL THE BEST FOR HIS FUTURE CAREER"

For Nuray Chemicals Private Limited

B Vijayakumar
Head – HR & Admin

NURAY CHEMICALS PVT. LTD.
Plot No.111, SIDCO Industrial Estate, Kakkalur, Thiruvallur District - 602 003
Tel : 044 - 66616700 / 703 Fax : 044 - 2766 1020
info@nuraychemicals.com www.nuraychemicals.com
GST No:33AAECN0289P1Z2

NURAY
CHEMICALS PVT. LTD.

13th April 2021

TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Mr.K.Muralidharan** student of **B.Tech (Chemical Engineering)** from **Kongu Engineering College, Perundurai, Erode** has successfully completed his internship in our organization for the period from **15th March 2021** to **13th April 2021.**

During the above period we found him sincere & hard working and his performance found satisfactorily.

"WE WISH HIM ALL THE BEST FOR HIS FUTURE CAREER"

For Nuray Chemicals Private Limited

B Vijayakumar
Head – HR & Admin

Ministry of Education
Ministry of Information and Broadcasting
Ministry of MSME

सत्यमेव जयते

Ministry of Women and Child Development
Ministry of Commerce & Industry
Ministry of Textiles

Ministry of Education's INNOVATION CELL (GOVERNMENT OF INDIA)

Toycathon 2021

CERTIFICATE

Primary Evaluator

This Certificate is awarded to

MOTHIL S

for exceptional contribution as a Primary Evaluator in

'Toycathon, 2021'.

Prof. Anil Sahasrabudhe	Dr. Abhay Jere	Dr. Mohit Gambhir
Chairman AICTE	Chief Innovation Officer Ministry of Education Innovation Cell	Innovation Director Ministry of Education Innovation Cell

Journal of Pharmaceutical Research International

2021

Certificate No: SDI/HQ/PR/Cert/78505/SMO

Certificate of Excellence in Reviewing

awarded to

S.Mothil

Kongu Engineering College, Perundurai, India

in recognition of an outstanding contribution to the quality of the journal.

Date: 1-Dec-2021

Dr. M Basumondal
Chief Managing Editor

Reg. Offices:

India: Guest House Road, Street no - 1/6, Hooghly, West Bengal, India, Tele: +91 8617752708, UK: Third Floor, 207 Regent Street, London, W1B 3HH, UK, Fax: +44 20-3031-1429

OSTP-2021

(Online Start-up Training Program: An Internship)

Terra-Green
SOLUTION FOR ENVIRONMENT, ENERGY, FIRE & SAFTY

Projects & Environment

Organized by: Terra-Green Technologies Pvt. Ltd., in association with Projects & Environment

20/09/2021 to 08/11/2021

ISO 9001 2015 CERTIFIED

UDYAM REGISTRATION MSME MICRO, SMALL & MEDIUM ENTERPRISES

INDIA 500 STARTUP AWARDS

CERTIFICATE

of Completion

BALASWETHA A P

from

KONGU ENGINEERING COLLEGE

Successfully completed Online Industrial Internship Program on the subject of

MATLAB AND CHEMCAD: AN ENGINEERING DESIGN EXPERTS

with **A** grade.

WINNER 2020 INDIA 500 STARTUP AWARDS IMAGITRUE TECHNOLOGIES PVT LTD

A=90% and above
B=80-89
C=70-79%
D=60-69%

Certificate ID: TG/2021/13427

Issuing Date: 08/11/2021

Director
Terra-Green Technologies Pvt. Ltd

Terra-Green
SOLUTION FOR ENVIRONMENT, ENERGY, FIRE & SAFTY

OSTP-2021

(Online Start-up Training Program: An Internship)

Projects & Environment

Organized by: Terra-Green Technologies Pvt. Ltd., in association with Projects & Environment

20/09/2021 to 08/11/2021

ISO 9001 2015 CERTIFIED

UDYAM REGISTRATION MSME MICRO, SMALL & MEDIUM ENTERPRISES

INDIA 500 STARTUP AWARDS

CERTIFICATE

of Completion

BALASUBRAMANIAN V

from

KONGU ENGINEERING COLLEGE

Successfully completed Online Industrial Internship Program on the subject of

MATLAB AND CHEMCAD: AN ENGINEERING DESIGN EXPERTS

with **A** grade.

WINNER 2020 INDIA 500 STARTUP AWARDS IMAGITRUE TECHNOLOGIES PVT LTD

A=90% and above
B=80-89
C=70-79%
D=60-69%

Certificate ID: TG/2021/13426

Issuing Date: 08/11/2021

Director
Terra-Green Technologies Pvt. Ltd

OSTP-2021

(Online Start-up Training Program: An Internship)

Terra-Green
SOLUTION FOR ENVIRONMENT, ENERGY, FIRE & SAFTY

Projects & Environment

Organized by: Terra-Green Technologies Pvt. Ltd., in association with Projects & Environment

20/09/2021 to 08/11/2021

ISO 9001 2015 CERTIFIED

UDYAM REGISTRATION MSME MICRO, SMALL & MEDIUM ENTERPRISES

INDIA 500 STARTUP AWARDS

CERTIFICATE

of Completion

DHINAKAR.C

from

KONGU ENGINEERING COLLEGE

Successfully completed Online Industrial Internship Program on the subject of

APPLICATIONS OF MATLAB & CHEMCAD

with **A** grade.

WINNER 2020 INDIA 500 STARTUP AWARDS IMAGITRUE TECHNOLOGIES PVT LTD

A=90% and above
B=80-89
C=70-79%
D=60-69%

Certificate ID: TG/2021/13164

Issuing Date: 08/11/2021

Director
Terra-Green Technologies Pvt. Ltd

NATIONAL DESIGN AND RESEARCH FORUM

The Institution of Engineers (India)
#3, Dr. B. R. Ambedkar Veedhi, Bengaluru - 560001
ndrf85@gmail.com I ndrf@ieindia.org
www.ndrf.res.in

Ref. No.: NDRF/2021/07/INT/046

Certificate of Participation

NDRF Online Internship Program - 2021

This is to certify that Mr/Ms Jeeva Prasanth T

Sem: VI Semester Branch Chemical Engineering

from Kongu Engineering College

had participated in the part time online Internship program from 10th July to 23rd July 2021.

Dr. M. Annadurai
(Chairman, NDRF)

Dr. V. Dillibabu
(Director, NDRF)

OSTP-2021

(Online Start-up Training Program: An Internship)

Terra-Green
SOLUTION FOR ENVIRONMENT, ENERGY, FIRE & SAFTY

Projects & Environment

Organized by: Terra-Green Technologies Pvt. Ltd., in association with Projects & Environment

20/09/2021 to 08/11/2021

ISO 9001 2015 CERTIFIED

UDYAM REGISTRATION MSME MICRO, SMALL & MEDIUM ENTERPRISES

INDIA 500 STARTUP AWARDS

CERTIFICATE

of Completion

HAMRISH S

from

KONGU ENGINEERING COLLEGE

Successfully completed Online Industrial Internship Program on the subject of

APPLICATIONS OF MATLAB & CHEMCAD

with **A** grade.

WINNER 2020 INDIA 500 STARTUP AWARDS IMAGITRUE TECHNOLOGIES PVT LTD

A=90% and above
B=80-89
C=70-79%
D=60-69%

Certificate ID: TG/2021/13172

Issuing Date: 08/11/2021

Director
Terra-Green Technologies Pvt. Ltd

AZeotropy 2021

Certificate

OF ORGANIZATION

This is to certify that Mr./Ms. Balaswetha A P

has contributed to AZeotropy by being a distinct part of it as a Campus Ambassador.

PROF. MADHU VINJAMUR
Head of Department,
Chemical Engineering, IIT Bombay

NATIONAL DESIGN AND RESEARCH FORUM

The Institution of Engineers (India)
#3, Dr. B. R. Ambedkar Veedhi, Bengaluru - 560001
ndrf85@gmail.com I ndrf@ieindia.org
www.ndrf.res.in

Ref. No.: NDRF/2021/07/INT/046

Certificate of Participation

NDRF Online Internship Program - 2021

This is to certify that Mr/Ms Jeeva Prasanth T

Sem: VI Semester Branch Chemical Engineering

from Kongu Engineering College

had participated in the part time online Internship program from 10th July to 23rd July 2021.

Dr. M. Annadurai
(Chairman, NDRF)

Dr. V. Dillibabu
(Director, NDRF)

INTERNSHIPSTUDIO

CERTIFICATE

OF INTERNSHIP

THIS IS TO CERTIFY

MONISH M

for completing 5 weeks of internship in Excel Automation with the title of “Multi Region Sales Analysis” at Internship Studio from 5th July to 9th August 2021. We wish you all the best for your future endeavours.

Date:-
18/08/2021

Ashok Sindkar
Instructor & Mentor

Aniket Maheshwari
Founder & CEO

Certificate ID:
ISEAI5102

Certificate ID: IICHE/ID-3313

Date of Issue: Aug 30, 2021

Online Internship Program (OIP-2021)

15TH JULY - 30TH AUGUST, 2021

Indian Institute of Chemical Engineers

Dr. H. L. Roy Building, Jadavpur University Campus, Kolkata- 700 032

CERTIFICATE OF COMPLETION

This certificate is hereby awarded to

MONISH M

KONGU ENGINEERING COLLEGE

from .....

who has successfully completed the INTERNSHIP PROGRAMME *on the subject* **PETROLEUM REFINERY ENGINEERING (PRE)** *following all necessary criteria of the Institute with "* **A+** *" Grade.*

Grading System :

A+: 90-100%
A: 75-89%
B+: 65-74%
B: 55-64%

Prof M.K. Jha
President, IIChE

Dr. Gaurav Rattan
Honorary Registrar, IIChE

Dr. Avijit Ghosh
Honorary Secretary, IIChE
Convener, OIP 2021

THE RAMCO CEMENTS LIMITED

Corporate Office:
Auras Corporate Centre, V Floor,
98-A, Dr. Radhakrishnan Salai, Mylapore,
Chennai - 600 004, India.
Tel: +91 44 2847 8666 Fax: +91 44 2847 8676
Website: www.ramcocements.in
Corporate Identity Number: L26941TN1957PLC003566

22.09.2021

To Whomsoever It May Concern

This is to certify that **Mr. Monish M (Reg no. 19CHR046)** studying **IIIrd year Bachelor of Technology in Chemical Engineering** at **Kongu Engineering College, Erode** has completed his internship program at **The Ramco Cements Limited, Govindapuram Works, Ariyalur District, Tamilnadu** during the period 07.09.2021 to 21.09.2021.

For **The Ramco Cements Limited,**

A Johnson Antony Leo
GM – HR

INDIAN INSTITUTE OF TECHNOLOGY INDORE

(An autonomous institute under the Ministry of Education, Government of India)

e-CERTIFICATE

This is to certify that Mr./~~Ms~~. M. MONISH has successfully completed the "Online Internship for the Undergraduate Students" with IIT Indore Faculty Mentor Dr. Rupesh S. Devan, Department of Metallurgy Engineering and Materials Science, from July 1, 2021to July 31, 2021. He has worked on the area entitled "NANO STRUCTURES AND THIN FILM TECHNOLOGY".

Rupesh

Dr. Rupesh S. Devan
IIT Indore Faculty Mentor

Professor Anand Parey
Dean, Resources Generation


Onnes
Cryogenics
INTERNSHIP
CERTIFICATE
THIS IS TO CERTIFY THAT
Dhivesh Jain
has successfully completed internship program in Ansys Solutions
from 05th Sep, 2021 to 05th Nov, 2021. During the internship, the student
was found to be dedicated, hardworking and diligent.
Dr. A Gopichand
istop
Keep Growing
Director Signature

Outfitto®
WEARABLE BRILLIANCE

INTERNSHIP

CERTIFICATE

This is to certify that

DHIVESH JAIN

persuing Final Year Chemical Engineering @
Kongu Engineering College, Erode, Tamil Nadu, India.

has completed his tenure as an intern with us betweenJune 15, 2021 and July 30, 2021 in our Sales Team. We would like to appreciate his commitment and dedication through out his period of intership with. Team 'OUTFITTO' is wishing him all success, further more.

12th September, 2021.

DATE

JFD BadhriKrishna S
Managing Director,
Outfitto, Salem.

IIT KANPUR

THIS CERTIFICATE IS PROUDLY PRESENTED TO

Dhivesh Jain

participated in "Artificial Intelligence"
from 10th Jun, 2021 to 10th Aug, 2021
and successfully completed the program.

14-Sep-2021

DATE

PAUL MATHEW. I
OVERALL COORDINATOR

Onnes Cryogenics

INTERNSHIP
CERTIFICATE

THIS IS TO CERTIFY THAT

Kishore S

has successfully completed internship program in **Ansys Solutions** from 05th Sep, 2021 to 05th Nov, 2021. During the internship, the student was found to be dedicated, hardworking and diligent.

Dr. A Gopichand

istop
Keep Growing

Director Signature

OSTP-2021

(Online Start-up Training Program: An Internship)

Terra-Green
SOLUTION FOR ENVIRONMENT, ENERGY, FIRE & SAFTY

Projects & Environment

Organized by: Terra-Green Technologies Pvt. Ltd., in association with Projects & Environment

15/09/2021 to 30/10/2021

ISO 9001 2015 CERTIFIED

UDYAM REGISTRATION MSME MICRO, SMALL & MEDIUM ENTERPRISES

INDIA 500 STARTUP AWARDS

CERTIFICATE

of Completion

ARAVIND D

from

KONGU ENGINEERING COLLEGE

Successfully completed Online Industrial Internship Program on the subject of

INDUSTRIAL ENVIRONMENTAL POLLUTION MANAGEMENT

with **B** grade.

WINNER 2020 INDIA 500 STARTUP AWARDS IMAGITRUE TECHNOLOGIES PVT LTD

A=90% and above
B=80-89
C=70-79%
D=60-69%

Certificate ID: TG/2021/12939

Issuing Date: 30/10/2021

Director
Terra-Green Technologies Pvt. Ltd

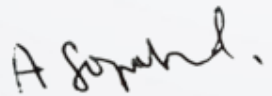
Onnes Cryogenics

INTERNSHIP
CERTIFICATE

THIS IS TO CERTIFY THAT

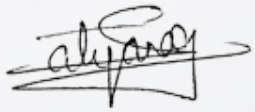
Hariharan R

has successfully completed internship program in **Ansys Solutions** from 05th Sep, 2021 to 05th Nov, 2021. During the internship, the student was found to be dedicated, hardworking and diligent.



Dr. A Gopichand

istop
Keep Growing



Director Signature

ElectroChem Technologies India Private Limited
4 D/1-A, 8th Cross Street, 3rd Main Road, Ambattur Industrial Estate,
Chennai 600058, Tamil Nadu, India.
+91 44 2652 0024, Fax +91 44 26520064
Website: www.electrochemtechnologies.com

DR. HESSE

Date: 04.09.2021

CERTIFICATE OF INTERNSHIP

To Whomsoever it may concern

This is to certify that Mr.R.HARIHARAN from KONGU ENGINEERING COLLEGE, Perundurai – 638060 with Reg. Number: 19CHR024, has successfully completed internship in the field of Electroplating and Metal surface treatment from 02.08.2021 to 03.09.2021 under the guidance of Mr.K.Vishnukanth and Mr.P.Lakshmanan.

During this period of the internship programme he has undergone complete training on Manufacture Analysis and Hull Cell of Electroplating solutions of Zinc, Zinc alloys, Copper, Nickel solutions, Zinc and Zinc Alloys passivation and Topcoats. The candidate has taken overall knowledge of analytical as well as overall knowledge on different electroplating process.

We have observed that the candidate is having hard working nature and sincere during the training period and wish him all the best in his future endeavours.

For ElectroChem Technologies India Pvt. Ltd.

(G.Nitin)
Manager-Laboratory

ElectroChem Technologies India Pvt. Ltd. Chennai 600 058

Mr.Vishnukanth
Technical Guide 1

Mr.Lakshmanan
Technical Guide 2

mail:info@electrochemtechnologies.com

INFINITE ELECTROTECH PVT LTD
Manufactures of Earthing and Lightning Protection Systems
ISO 9001 : 2015 CERTIFIED
CIN : U31908TN206PTC 104427
GST NO : 33AAEC 10646R1ZA

16.09.2021

TO WHOM IT MAY CONCERN

This is to certify that **Mr. R. Hariharan** from **KONGU ENGINEERING COLLEGE**, Perundurai, Erode with **Reg. No: 19CHR024** has successfully completed internship in the field of Electroplating from 19.08.2021 to 30.08.2021.

During this period of internship programme, he has undergone complete training on electroplating process of nickel and copper. We have observed that the candidate is hard working and sincere during the training period and we wish him all the best in his future endeavours.

INFINITE ELECTROTECH PVT LTD Chennai 602 105.

For Infinite Electrotech Pvt Ltd

9551047711, 9884155545
admin@infiniteelectrotech.in
www.infiniteelectrotech.in
C-37, Thiru-vi-Ka Industrial Estate, Guindy,
Chennai - 600 032.

TALAKUNCHI
DIGI - INFO - SECURITY

INTERNSHIP
CERTIFICATE

THIS IS TO CERTIFY THAT

V.Harish Ragavendher

has successfully completed internship program in **Cyber Security and Ethical Hacking** from 20th Sep, 2021 to 20th Nov, 2021. During the internship, the student was found to be dedicated, hardworking and diligent.

Poojitha V

Academic Head

1stop
Keep Growing

Director Signature

INFINITE ELECTROTECH PVT LTD
Manufactures of Earthing and Lightning Protection Systems
ISO 9001 : 2015 CERTIFIED
CIN : U31908TN206PTC104427
GST NO : 33AAEC10646R1ZA

16.09.2021

TO WHOM IT MAY CONCERN

This is to certify that **Mr. S. Aswin** from **KONGU ENGINEERING COLLEGE**, Perundurai, Erode with **Reg. No: 19CHR007** has successfully completed internship in the field of Electroplating from 19.08.2021 to 30.08.2021.

During this period of internship programme, he has undergone complete training on electroplating process of nickel and copper. We have observed that the candidate is hard working and sincere during the training period and we wish him all the best in his future endeavours.

INFINITE ELECTROTECH PVT LTD Chennai 602 105.

For Infinite Electrotech Pvt Ltd

9551047711, 9884155545
admin@infiniteelectrotech.in
www.infiniteelectrotech.in
C-37, Thiru-vi-Ka Industrial Estate, Guindy,
Chennai - 600 032.

ElectroChem Technologies India Private Limited

4 D/1-A, 8th Cross Street, 3rd Main Road, Ambattur Industrial Estate,
Chennai 600058, Tamil Nadu, India.
+91 44 2652 0024, Fax +91 44 26520064

Website: www.electrochemtechnologies.com

DR. HESSE
the products create the future

Date: 04.09.2021

CERTIFICATE OF INTERNSHIP

To Whomsoever it may concern

This is to certify that Mr.S.ASSWIN from KONGU ENGINEERING COLLEGE, Perundurai – 638060 with Reg. Number: 19CHR007, has successfully completed internship in the field of Electroplating and Metal surface treatment from 02.08.2021 to 03.09.2021 under the guidance of Mr.K.Vishnukanth and Mr.P.Lakshmanan.

During this period of the internship programme he has undergone complete training on Manufacture Analysis and Hull Cell of Electroplating solutions of Zinc, Zinc alloys, Copper, Nickel solutions, Zinc and Zinc Alloys passivation and Topcoats. The candidate has taken overall knowledge of analytical as well as overall knowledge on different electroplating process.

We have observed that the candidate is having hard working nature and sincere during the training period and wish him all the best in his future endeavours.

For ElectroChem Technologies India Pvt. Ltd.

(G.Nitin)
Manager-Laboratory

ElectroChem Technologies India Pvt. Ltd. Chennai 600 058

Mr.Vishnukanth
Technical Guide 1

Mr.Lakshmanan
Technical Guide 2

Onnes Cryogenics

INTERNSHIP
CERTIFICATE

THIS IS TO CERTIFY THAT

Asswin S

has successfully completed internship program in **Ansys Solutions** from 05th Sep, 2021 to 05th Nov, 2021. During the internship, the student was found to be dedicated, hardworking and diligent.

Dr. A Gopichand

istop
Keep Growing

Director Signature

Certificate ID: IICHE/ID-3414

Date of Issue: Aug 30, 2021

Online Internship Program (OIP-2021)

15TH JULY - 30TH AUGUST, 2021

Indian Institute of Chemical Engineers

Dr. H. L. Roy Building, Jadavpur University Campus, Kolkata- 700 032

CERTIFICATE OF COMPLETION

This certificate is hereby awarded to

HARRISH J

KONGU ENGINEERING COLLEGE

from .....

who has successfully completed the INTERNSHIP PROGRAMME *on the subject* **PETROLEUM REFINERY ENGINEERING (PRE)** *following all necessary criteria of the Institute with "* **A** *" Grade.*

Grading System :

A+: 90-100%
A: 75-89%
B+: 65-74%
B: 55-64%

Prof M.K. Jha
President, IIChE

Dr. Gaurav Rattan
Honorary Registrar, IIChE

Dr. Avijit Ghosh
Honorary Secretary, IIChE
Convener, OIP 2021

RAISE DIGITAL

INTERNSHIP
CERTIFICATE

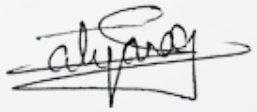
THIS IS TO CERTIFY THAT

Habeeb Raja.R

has successfully completed internship program in **Web Development** from 05th Sep, 2021 to 05th Nov, 2021. During the internship, the student was found to be dedicated, hardworking and diligent.

Megha Singh

istop
Keep Growing



Director Signature

CERTIFICATE
OF PROJECT COMPLETION

RAISE DIGITAL

THIS CERTIFICATE IS PROUDLY PRESENTED TO

Habeeb Raja.R

has successfully undergone Industrial Program on Web Development
from Raise Digital from 10th Jun, 2021 to 10th Aug, 2021 and
successfully completed the projects on

- Advance E-Commerce Website
- E-Commerce Website(Single Page)

Under the guidance of the mentor and company representative

14-Sep-2021

DATE

RDI-2109000163

istop Keep Growing

PROJECT HEAD-MEGHA SINGH

IIT KANPUR

istop
Keep Growing

CERTIFICATE
OF PARTICIPATION

THIS CERTIFICATE IS PROUDLY PRESENTED TO

Habeeb Raja.R

participated in "Web Development"
from 10th Jun, 2021 to 10th Aug, 2021
and successfully completed the program.

15-Sep-2021

DATE

PAUL MATHEW. I
OVERALL COORDINATOR

TIITK-2109004221

ERODE ARTS AND SCIENCE COLLEGE
(AUTONOMOUS)

RANGAMPALAYAM, ERODE - 638 009. TAMILNADU.

(An Institute of The Mudaliar Educational Trust)

(Affiliated to Bharathiar University, Coimbatore - Approved by AICTE New Delhi)

Re-Accredited with "B+" Grade by NAAC

Since 1972

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Dr. R. SANKARASUBRAMANIAN M.Sc., P.B.D.C.S.A., M.Phil., Ph.D.,
Principal

Ref. No. :

Date :

23.11.2021

ATTENDANCE CERTIFICATE

This is to certify that **Dr. Kannan Kandasamy,** Professor & Head Department of Chemical Engineering, Kongu Engineering college, Perundurai has acted as Chief Guest in One-day Life Skill Programme on "How to Impress Others" an organized by the Department of Commerce-Banking & Finance (Self-Finance) , held on 23.11.2021 at Erode Arts and Science College (Autonomous), Near Ring-Road Junction, Chennimalai Road, Erode – 638 009.

Principal

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