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JEEVAKSHARA NEWSLETTER

NEWS LETTER-DEPARTMENT OF BIOTECHNOLOGY &BIOCHEMICAL ENGINEERING

NEWS FROM DEPARTMENT OF BIOTECHNOLOGY & BIOCHEMICAL ENGINEERING, SBCE, PATTOOR

The Department of Biotechnology & Biochemical Engineering is a diverse and powerful faculty encompassing unique expertise in biochemical and molecular life sciences. The Department is recognized nationally as well as internationally for its research quality and output and for training students to be industry-ready professionals. The course broadly encompasses the study of the molecular processes of living systems and organisms. Started in 2002, the Department of Biotechnology & Biochemical Engineering, has in a short span of time, established a unparalleled reputation in teaching and research. Having collaborations with DBT, AYUSH, Oushadhi, University Sains Malaysia and various other reputed institutions, the department actively nurtures manpower development by offering 4-year B.Tech (Biotechnology & Biochemical Engineering) and 2-year M.Tech (Biotechnology& Biochemical Engineering) courses. The highly competent and experienced faculties, with4 PhDs and 7 M.Techs/MSc-M.Phil, have inspired excellence, innovation and strong entrepreneurial skills.

Vision

To nurture research oriented Biotechnology and Biochemical Engineers to address social needs

Mission

- Provide quality education in Biotechnology and Biochemical Engineering
- Inculcate research culture with social commitment
- Instil passion for lifelong learning and sustainable development

Program Educational Objectives (PEOs)

(UG in Biotechnology and Biochemical Engineering)

The graduates will:

- Be able to design, develop and provide solutions for products and processes in Biotechnology and Biochemical Engineering and allied fields through quality education
- Be able to address challenges in industrial and research areas with socio-ethical responsibilities
- Have strong foundation in Biotechnology and Biochemical Engineering to pursue higher education and research

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SCIENCE INDIA

STRENGTHS

Highly educated , skilled ,young, capable & dynamic human resources
English speaking Scholars
Strategic position at various platforms
Democracy, Big market & free media
Biodiversity & Traditional knowledge base
Diversity vs. Ideas-Innovation-Integration
Powerful spiritual strength
yoga-Ayurvada therapy
Geographical location
IT & Software superpower

WEAKNESS

Lack of trained & skill work force
Small supply of specialized professional
Lack of spirits of entrepreneurship and leadership skill
Lack of effective & execution framework
Lack of Indian management models
Lack of transparency-Trust-Responsibility
Lack of learning habits & Team work spirit
Blindly respect anything taught by elders
Cultural Differences
Poor globalsation skill

OPPORTUNITIES

Creation of global brands
BPO & Call center offerings
Resource Based Sectors
Chinese domestic & export market
Leverage relationship in Middle East markets
Indian Domestic Market Growth

THREATS

Internal competition for resources
Over promise / Under delivery
Regional Geo-political uncertainty
Competition from other countries
Corruption & Piracy
Political interferences
Over Population

SHAMNAMOL G K
Sree Buddha College of Engineering, Alappuzha

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SKIN MICROBIOME TO IDENTIFY THE HUMAN HOST

Ms.Parvathi M A, PG scholar, Department of BT&BCE

A microbiome is a community of microorganisms that inhabit a particular environment or a living organism. The recent growth in interest in microbial contributions to human health and disease has led the researchers to examine the microbiome for various applications. It plays an important role in health, metabolism, and immune response and can be influenced by numerous factors; including genetics, geography, diet, and hygiene. It helps in both the health of the skin and cutaneous disorders, including acne, psoriasis and atopic dermatitis. The analysis of microbiome to help in the identification of its host has brought its importance in forensics. Different people host different microbiota which highlights the forensic perspectives in understanding what leads to this variation and what regulates it. In forensic department, smudged fingerprints would be difficult to trace the host, but if the microbiome left by the person can lead to something, it will be effective.

With the help of NGS the sequencing of these microbial DNA became easier, faster and less costly. The new methodologies like Propionibacterium acnes pangenome presence/absence features and nucleotide diversities of stable clade-specific markers can be used to classify the skin microbiomes to their donors. This bacterial microbiome has different application in identifying their host in different fields. As this field is in a developing stage, researches are going on to get a better result from this method. In future if this method succeeds in giving efficient results, then it will open a new door to research field.

When a person touches a surface, he leaves a part of his skin microbiome on the surface for a prolonged period of time and this microbiome is highly resistant to environmental stresses, including moisture, temperature, and UV radiation. The skin associated bacterial communities are radically diverse with high degree of inter-individual variability. So each person has personally unique skin microbiome, which is temporally stable. To understand the complete scope of human genetic and metabolic diversity, it is essential to characterize the factors that influence the diversity and distribution of the human microbiota. Because any change in the metabolic rate and human genetic constitution may affect the skin microbiome community.

The bacterial DNA recovered from touched surfaces gives adequate characterization and comparison of bacterial communities left behind. Researchers have found that the skin bacterial communities persist on surfaces for days to weeks and the degree of similarity between the bacterial communities on the object and the skin of the individual who touched the object can be analyzed.

Metagenomics has changed our views about the skin microbiome and its interactions with the host epithelial and immune systems. The work with microbiome is actually a developing field. Though much similarity was found between the skin microbiome and the deposited ones, this method cannot be completely relied on. Their accuracy is not as good as the result got from fingerprint or host DNA analysis. So much research has to be conducted in order to find the best method to isolate the microbial DNA, which part of DNA has to be analyzed, which bacterial has to be given more importance etc. The factors which affect the composition should also be studied much. With that the diagnosis or treatment of different diseases are even possible. Even in forensics the lead to a person can be obtained with the help of all these factors. If this method becomes a success, then it will be a breakthrough in the microbial scientific field and will bring more opportunities to microbiologists.

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NANOTECHNOLOGY FOR WASTEWATER TREATMENT

Ms. Lekshmi R Babu, Asst.Professor, Department of BT&BCE

Materials which have size smaller than 100 nm in at least one dimension are termed as Nanomaterials. At this scale, materials usually have new size-dependent properties changing from bigger counterparts, many applications have been explored in field of water and wastewater treatment. Many of these similar applications utilize the of nanomaterials which are very smooth and it is scalable in its size-dependent properties. It is usually related to the high specific surface area, . It also depends on fast dissolution, high reactivity, and strong sorption. Various discontinuous properties, such as super paramagnetism, and quantum confinement effect. have been observed in the area of nanotechnology. Adsorption For removing various organic and inorganic contaminants in the field of water and wastewater treatment a polishing step is employed termed as adsorption. Normally in the conventional adsorbents surface area kinetics related to adsorption and selectivity is limited and efficiency plays a major role in it. To meet these limitations a new variety of nano-adsorbents which provide extremely high specific surface area shows significant improvement in their sorption sites, intraparticle diffusion distance is made short , size also becomes tunable. Carbon based nano-adsorbents Organic removal. The efficiency rate is higher for CNTs when compared with activated carbon. It strongly had association on adsorption of various organic chemicals. For the adsorption capacity to be in high mode it mainly depends on large specific surface area and the diverse contaminante which have interactions with carbon nano tubes. Usually adsorption is effected on individual CNTs mainly on their external surfaces, on surface area . When Carbon nano tubes are immersed in the aqueous phase it can form loose bundles/aggregates . The reason behind it is due to the hydrophobicity of their graphitic surface which in-turn reducing the effective surface area. The studies shows that the aggregates of carbon nano tubes may contain interstitial spaces and grooves. It will result in high adsorption energy sites which are required for organic molecules. When CNT bundles are used , it contains a significant number of micropores inaccessible to bulky organic molecules such as many antibiotics and pharmaceuticals. Thus The adsorption capacity of CNTs will be much for some bulky organic molecules . The reason behind is they have more pore size in their bundles and sorption sites are always more accessible . The drawback which wis observed is adsoprttion capacity is very low. It is mainly due to their molecular weights in polar compounds.. CNTs have a tendency adsorb to usually observed polar organic compounds. It is due to the diverse contaminante CNT interactions including effects of hydrophobicity, hydrogen bonding, covalent bonding, and electrostatic interactions. Many of the functional groups always tries to form hydrogen bond with the graphitic CNT surface. It helps to donates electrons. The organic chemicals are positively charged and it maintains adsorption usually in some of the antibiotics at suitable pH and it is facilitated by electrostatic attraction . Different types of Membranes and membrane processes In any water treatment process ultimate goal is to make the treatment of water which is to remove undesired or polluted constituents from

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water. The basic technology adopted is membranes. They always act as a barrier of these type of contaminants. It is designed in such a manner that size is the factor which allows the particles to pass through the membrane. Even though in conventional mode membranes are used highest level of automations, less use of toxic chemicals and design flexibility should be ensured. Selectivity and Permeability plays another role in these transport of materials through the membrane . But it is widely seen it as a major challenge of technology based on membrane. The next barrier observed in membrane driven process is use of high energy consumption in wide industrial applications. The major disadvantage of any membrane is fouling which adds the consumption of energy and thereby operations and design becomes more complicated. In some situations the lifetime of membranes and membrane modules can be reduced. Inorder to overcome the hurdles of membranes a new technology has been adopted which incorporates the functional nanomaterials into the membrane. It improves the permeability and resistance occurred due to fowling is overcome, stability due to mechanical and thermal effects are enhanced. It also renders new functions and abilities for enhancing the contaminant degradation and self-leaning. Nanocomposite membranes Many studies shows that technique of membrane nanotechnology always creates a synergism and it results in the dys-functioning. The reason behind it is nanomaterials are incorporated into polymeric or inorganic membranes. Nanomaterials used for such applications include hydrophilic metal oxide nanoparticles (e.g., Al2O3, TiO2, and zeolite), antimicrobial nanoparticles (e.g., nano-Ag and CNTs), and (photo) catalytic nanomaterial. The fouling needs to reduced by adding hydrophilic metal oxide nanoparticles into membranes The addition of metal oxide nanoparticles and it is considered to be greatest goal. including alumin, silica, zeolite and TiO2 to polymeric ultrafiltration membranes has been shown to increase membrane surface hydrophilicity, water permeability, or fouling resistance. Some of the inorganic nanoparticles shows a significant effects on stability of polymeric membranes in mechanical and thermal aspects. It also reduces the negative impacts created on compaction in the permeability of membranes. Membrane biofouling can be reduced to an extent by adding Antimicrobial nanomaterials which includes nano-Ag and CNTs etc Nano-Ag has been doped or surface grafted on polymeric membranes to inhibit bacterial attachment and biofilm formation.on the membrane surface as well as inactivate viruses. But studies shows that long term efficacy is not observed . In practical aspects appropriate replenishment of nano-Ag needs to be addressed as a good technological initiative. CNTs inactivate bacteria upon direct contact. High bacterial inactivation (>90%) has been achieved using polyvinyl-N-carbazole-SWNT nanocomposite at 3 wt% of SWNT. CNTs are usually observed to be insoluble in nature and no need for replenishment is needed. There is a direct contact needed for inactivation . The experiments of long term filtration shows the fouling impacts on antimicrobial activity of CNTs. The oxidized MWNT which has only 1.5 % by weight

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helps to enhance the permeability and hydrophilicity of polysulfone membranes. In membranes Photocatalytic nanoparticle will be incorporated and it also combine their physical separation function and toward contaminant degradation is exhibited by reactivity of a catalyst. Much effort has been devoted to develop photocatalytic inorganic membranes consisting of nano-photocatalysts (normally nano-TiO2 or modified nano-TiO2). Metallic/bi-metallic catalyst nanoparticles such as nano zero-valent iron (nZVI) and noble metals supported on nZVI have been incorporated into polymeric membranes for reductive degradation of contaminants, particularly chlorinated compounds nZVI serves as the electron donor and the noble metals catalyze the reaction. Biologically inspired membranes The membranes which adopt biological procedures are seen to be very high selective and also it permeates the entry of materials. The observed aquaporins which act as a channel for protein always regulate water flux across cell membranes. The membrane performance is improved mainly due to water permeability nature and high selectivity approach. This methods is widely seen as attractive approach for the improvement in performance of membrane . Aquaporin-Z from Escherichia coli can be incorporated into vesicles made of amphiphilic triblock-polymer, It also exhibit less water permeability and an order of magnitude over the original vesicles is observed to be very less. It also shows the full length rejection to glucose, glycerol, salt, and urea. The design which is potentially observed is to coat aquaporin and finally incorporated into lipid bilayers on the membranes made of nanofiltration commercially. On this approach success was achieved in a limited manner, One of CNTs named aligned CNTs exhibit experimentally and theoretically permeation capability of water and it is proved based on the Hagen Poiseuille equation, It predicts, the nano-sized channel have atomic smoothness and also there is an ordering of water molecules in one dimensional singlefile when it is passing through the nanotubes. The predicted result of membranes are it contains only 0.03% surface area of aligned CNTs and flux will be exceeding the conventional RO membranes. In aligned CNTs sub nanometer diameter is lacking and due to this lacking there is a high of small molecules. Functional group which are present in the nanotube opening is now been proposed to enhance the selectivity of aligned CNT membranes.

NATIONAL TECHNOLOGY DAY, 14 MAY, 2019

Department of Biotechnology and Biochemical Engineering, Sree Buddha College of Engineering, conducted a one day seminar titled "TECNIKA 2K19" as a part of National Technology Day Celebrations which was duly supported by Kerala State Council for Science, Technology and Environment. The seminar was intended to enlighten engineering students about the educational interventions to build business ecosystem on campus and to engage students as partners, to grow start-up culture. Inaugural session was presided by Dr S Suresh Babu, Principal, Sree Buddha College of Engineering and inaugurated by Dr Anoop Raj J.R, HoD, Department of Biotechnology & Biochemical

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Engineering. Shri K.K Sivadasan, Treasurer, Sree Buddha Educational Society delivered the felicitation. Resource Persons and Ms Anju Raj, Programme Coordinator were also present. The Chief guests of the event were Mr. Rahul P.B, CEO, Inker Robotics Academy and Research Centre talked on the topic "Innovation and technological entrepreneurship"and Mr. Anu Karthik, Vice President, Operations and Strategy, Inker Robotics Solutions Pvt ltd. discussed about Startup frame work and opportunities in India. He also gave a brief demonstration of Robotics at their own company 'Inker Robotics'.

Photo: Mr. Anu Karthik addressing the gathering

RESEARCH STORY: NATURE'S SOLUTION FOR CORROSION INHIBITION

Shamnamol G K, Asst.Professor, Department of BT&BCE

Hello folks!! I am Mr. Iron and I stand proud as a strong metal that is inevitable in day to day life. Human beings have smartly combined me along with carbon to create steel and steel in its various forms are widely used in industries and other sectors. Well lately, I am disturbed and gloomy because my pride and strength have been affected by the presence of harsh chemicals around me. These harsh chemicals surrounding me form a corrosive environment and my surface gets degraded. This sad degradation of mine is scientifically termed corrosion. It is not I alone who is affected, but materials like plastic, rubber, ionic and covalent solids, concrete, wood etc. degrade or

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undergo a reduction in usefulness because of similar corrosive environment. Now, about the villain; a typical corrosive environment can comprise of water, air, carbon dioxide, organic liquids, molten salts, gaseous sulfur, etc.

"But why me??– I ask myself and alas, I realize that I am corroded easily when compared to other metals because I have a higher tendency to lose electrons and become an ion. Therefore I can react quickly with oxygen and water- result; I end up getting corroded. I and my alloys are widely used building materials in various industrial sectors owing to high mechanical strength and low cost. However, I am very susceptible to rapid irreversible spontaneous chemical and electrochemical reactions with the components of the environment, leading to a loss of my metal component. "But does somebody bother about me and my degradation?"-'Yes!!- the government is so very concerned about corrosion and the loss it brings to the country's economy, that it supports researchers called corrosion scientists to explore environmental friendly approaches for the effective protection of the metals and their combinations called alloys.

Taking you quickly to the exact technical scenario- Chemical and petro-chemical industries are more affected by mild steel acidic corrosion that leads to massive material wastes and economic losses. In most cases, corrosion is controlled by various techniques such as the application of cathodic protection, coatings, and corrosion inhibitors. However, the problem of corrosion is so big that a very huge amount of inhibitors is required to handle it at a satisfactory level. Further, some of these corrosion inhibitors are toxic to the environment and this has prompted the search for finding eco-friendly corrosion inhibitors for metals in acid solution. Several attempts have been made previously to mitigate these unwanted reactions particularly during some industrial developments like acid cleaning, acid pickling, etc. among which use of corrosion inhibitors is one of the best methods. Acid-based solutions are also commonly used for removing the scales, oxides, and any other contaminations from the steel surface in numerous industrial applications. Most of the acidic solutions, i.e., HCl, are strongly aggressive, resulting in the undesired dissolution of metal. Further, the acid-based treatments impose a heavy environmental burden on the aquatic systems from the acid wash out and other discharges during the treatment procedures. In this context, scientists have indicated the prospects of employing corrosion inhibitors; to note: green corrosion inhibitors as effective interventions to address this industrial problem.

In the last few decades, the use of plant extracts as metallic corrosion inhibitors has attracted significant research attention. Different extracts of plant material such as leaf, root, stem, bark, pulp, fruit, etc. have been effectively employed as sustainable inhibitors for the control of corrosion of different metals and alloys. These plant materials are rich in phytochemicals like alkaloids, terpenoids, flavanoids etc. The heteroatoms present in phytochemicals will adsorb onto the metallic surface form a protective

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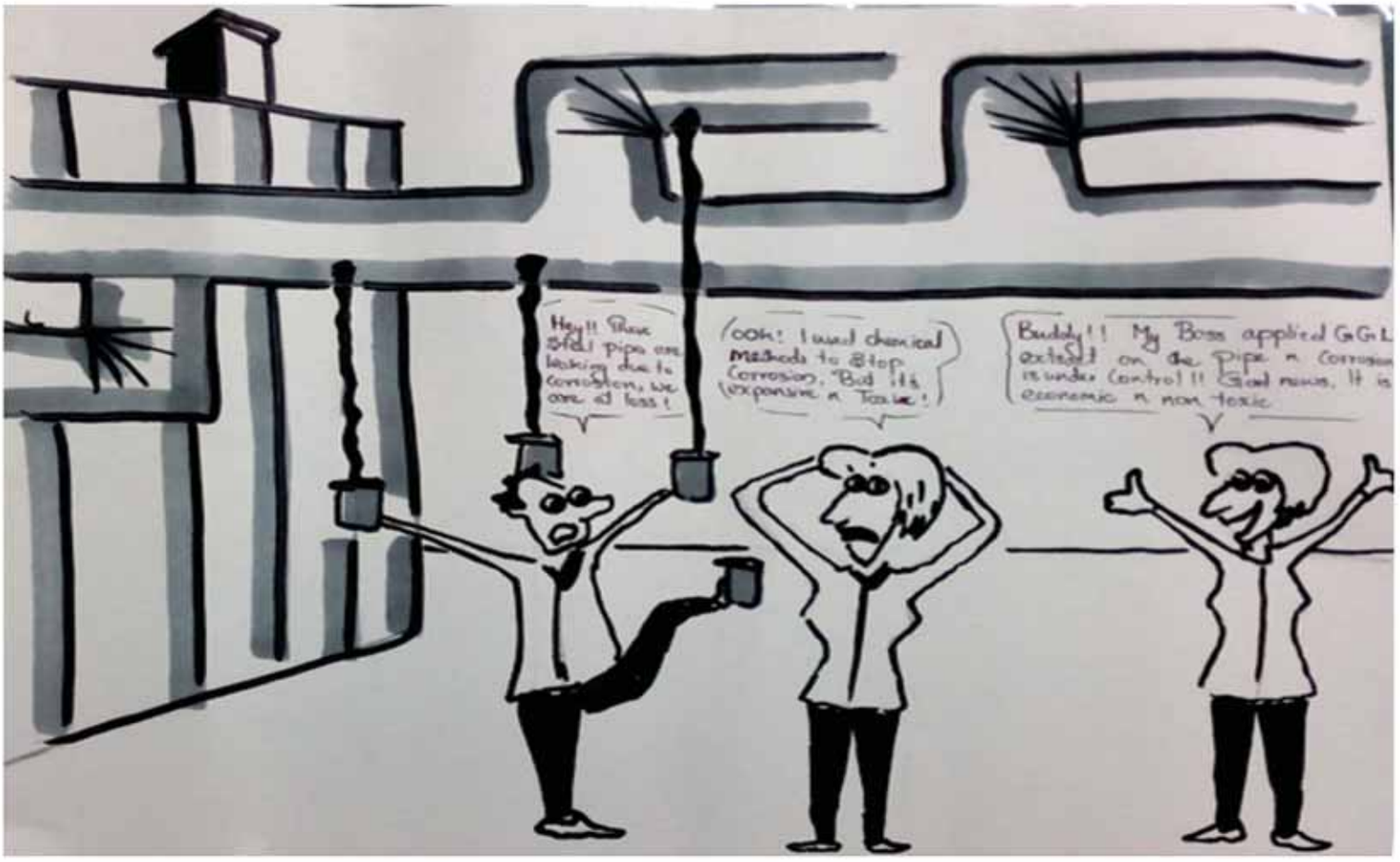
layer which prevents further corrosion. In this regard, two noteworthy points are that, the importance of mitigation of corrosion is not just about saving money. It is equally important in readiness. In India, the estimated amount for corrosion loss is around half of the budget of defense and double the budget for education.

In ancient times, people used tamarind for cleaning copper; brass vessels from tarnishing. From this thought, a novel study that explores Malabar tamarind as a green corrosion inhibitor against metal in acidic conditions was initiated. My new savior, malabar tamarind plant, is affectionately named GGL. "Aww I feel all giggly, nice and special"- I exclaimed when a new corrosion scientist applied GGL on my surface. After some time, I was surprised that corrosion rate decreased significantly because of her presence. My boss did a lot of things for finding the corrosion inhibition effectiveness of GGL on my surface. She varied the quantity of GGL and found out that corrosion rate decreases by increasing the amount of GGL. Unfortunately at higher temperature, GGL will detach from my surface because of desorption. At room temperature GGL will protect me from corrosion. My boss tried different spectroscopic techniques like Scanning Electron Microscopy and Atomic Force Microscopy for identifying her affinity toward me. The study showed that the presence of GGL will protect me from the degradation to a great extent



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So, my future looks promising if I have GGL extract applied onto me!! Before concluding my story, I have some grievances to ask you. Why can't you try different plant extracts like GGL on my surface to mitigate the degradation since our earth is rich in different plant species? Could you also not see if a combination of plant and less toxic chemical based approaches could ideally protect me in a long run? The range of research outcomes on corrosion control using green inhibitors advocates the prospects of these bio-inspired agents as excellent corrosion inhibitors. However, the fact is that the diverse potential of the field is yet to be explored and that the validation of existing results is necessary to realize this option as a scalable industrial solution. Another important dimension that could be explored is the possibility of hybrid coatings preloaded with green inhibitors along with rare metal nanoparticles etc. The metallurgical behavior prediction and adaption of computer-aided tools for optimizing the experimental data on green inhibitor action could also be integrated to warrant this sustainable technology as an industrially adaptable choice.

To conclude my story, mild steel acid corrosion has been identified as a major industrial concern that results in the economic turnover of the country and also affects process efficiency. Although numerous traditional approaches for handling this industrial problem have been addressed, the existing methods are found to have disadvantages from the environmental and economical points of view. Plant extracts have paid high research attention in the last few decades. Toxic traditional synthetic corrosion inhibitors are replaced by plant materials to ease the environmental risk, lower cost, wide spread availability and high corrosion inhibition effectiveness. A preliminary study provides a brief overview of the efficacy of Malabar tamarind as a green corrosion inhibitor against metal and alloys. Results indicate that green corrosion inhibitors hold immense potential as eco-friendly alternatives for the present-day techniques and further studies in this regard are the need of the hour to scale-up the option to an industrial scenario.

ONE DAY SEMINAR ON "CHALLENGES IN BIOPOLYMER PRODUCTION"

So, Department of Biotechnology and Biochemical Engineering organized one day seminar on "**Challenges in Biopolymer Production**" on 28th October 2019. Dr J R Anoop Raj, HoD, department of BT&BCE welcomed the gathering. Mr K KSivadasn, Treasurer, SBES presided the conference and wished all the success of the program.

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Dr Sindhu R, Scientist, NIIST-CSIR inaugurated the BUDS activity in the academic year 2019-20. Dr S Suresh Babu, Principal, SBCE facilitated the function and showed the concern in waste management strategies in Kerala. Finally Ms Shamnamol G K, BUDS staff coordinator proposed the vote of thanks. After the inaugural function, Dr Sindhu R discussed about the research in the field of biopolymer production and its challenges. She also presented the various research works going in the National Institute for Interdisciplinary Science and Technology. It was an enlightening session for the budding engineers. Through the seminar program, the curriculum gaps related to biopolymer production were covered

PROJECT EXHIBITION, 14 NOVEMBER, 2019

Department of Biotechnology and Biochemical Engineering, Sree Buddha College of Engineering, conducted exhibition project models designed by S5 students which was duly supported by BUDS association. 29 students with 11 projects from the department have participated in this fair with all enthusiasm. The exhibition was intended to build confidence of the students. They would be proud of their work getting appreciated by others and their communication skill can also be enhanced. The students will be able to improve their project by suggestions from other faculty members and students. Inaugural session was presided by Dr S Suresh Babu, Principal, Sree Buddha College of Engineering and inaugurated by Dr Anoop Raj J R, HoD, Department of Biotechnology & Biochemical Engineering. Faculty members and students of all branches had visited the project. Dr. Malu Ravi, programme coordinator proposed the vote of thanks.

AN AWARENESS PROGRAM ON "NATIONAL POLLUTION PREVENTION DAY" 2ND DECEMBER 2019

Department of Biotechnology and Biochemical Engineering organized an awareness program on" National Pollution Prevention Day" in the Skill Development Centre, Homi J Bhabha block on 2nd December 2019. Dr J R Anoop Raj, HoD, Department of BT&BCE welcomed the gathering. Dr S Suresh Babu, Principal, SBCE presided the conference and he pointed the current situation of Ganga river. He also added that according to the latest data with the CPCB, most of the Ganga river water in the Uttar Pradesh-West Bengal stretch is unfit for drinking and bathing.Dr R Gopakumar, Professor, Department of Civil Engineering was the chief guest. He came to the topic by an introductory remark that National Pollution Control Day is observed in the memory of those who have lost their lives in the Bhopal Gas tragedy on 2nd December, 1984. The Indian government has launched various acts and rules for controlling and preventing pollution in India after the Bhopal tragedy. It was an eye-opening session and he discussed the importance of the control of pollution. He also recommended that it was not the duty of Government alone, but we also should participate and make the environment clean and live disease-free. Finally Ms Shamnamol G K, BUDS staff coordinator proposed the vote of thanks.

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Paper Publication

1. Sony K Cherian, Malu Ravi and Shamnamol G.K. (2019). "*Aegle marmelos* Fruit Shell as a Precursor for Activated Carbon Production and its Application in Fluoride Removal", *Journal of Advanced Research in Dynamical and Control Systems*. 15-Special Issue, 2018, ISSN 1943-023X, Pg. No. 95-102.

Achievements

1. Shamnamol G.K received Best paper award for the paper titled "Microwave assisted biodiesel production from fish oil: two step process"; 4th International Conference on Bioenergy, Environment and Sustainable Technologies (BEST2019) held at Arunai Engineering College, Tiruvannamalai, Tamilnadu, India during January 28-30, 2019.
2. Shamnamol G.K received Best paper award for the paper titled "Preparation and characterization of activated carbon from *Aegle marmelos* fruit Shell for fluoride removal"; 4th Kerala Technological Congress-KETCON OF KTU TECHFEST 2019 jointly organized by KTU &KSCSTE at Govt. Engineering College,Trichur during 15-17 February 2019.

Conferences / Seminars publications

1. Sujana S Nair, Archana Geeth, Jency John, Jyothish Viswanath, Malu Ravi. Eco-friendly green inhibition of mild steel corrosion in acidic environment by *Tamarindus indica* leaf extract, Kerala Science Congress, Fatima Mata National College, Kollam, 2-3 February 2019.
2. Sujana S Nair, Archana Geeth, Jency John, Jyothish Viswanath and S. Lichindath, Malu Ravi. Eco-friendly green inhibition of mild steel corrosion in acidic environment by *Tamarindus indica* leaf extract. International Conference of Bio-energy, Environment & Sustainable Technologies, Arunai Engineering College, Tiruvannamalai, 28-30 January 2019.
3. Rincy Susan Raju. Relative Quantitation and Sequence Analysis of aquaporin gene in two varieties of *Oryza sativa*, 4th International Conference on Bioenergy, Environment & Sustainable Technologies 28-30 January 2019, BEST 2019
4. Shamnamol G K, Anoop Raj J R, Jaya Mary Jacob. "Mechanistic Insights into the Inhibition of Mild Steel Acidic Corrosion using Leaf Extracts- A Review. 4th Kerala Technological Congress-KETCON OF KTU TECHFEST 2019 jointly organized by KTU &KSCSTE at Govt. Engineering College, Trichur during 15-17 February 2019.
5. Sony K Cherian and Shamnamol G K. "Preparation and characterization of activated carbon from *Aegle marmelos* fruit Shell for fluoride removal". 4th Kerala Technological Congress-KETCON OF KTU TECHFEST 2019 jointly organized by KTU &KSCSTE at Govt. Engineering College, Trichur during 15-17 February 2019.

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6. Reju Rajan, Malavika Aji, Gayathri G Kurup, Arivazhagan Pugazhendhi and Jaya Mary Jacob. Bio-inspired ZnS Quantum Dots as efficient photo catalysts for the degradation of methylene blue in aqueous phase. Kerala Science Congress, Fatima Mata National College, Kollam, 2-3 February 2019.
7. Shamnamol G K. Microwave Assisted Biodiesel production : two step process, 4th International Conference on Bioenergy, Environment & Sustainable Technologies 28-30 January 2019, BEST 2019
8. Athulya Rajeev and Lekshmi R Babu. Generation of Nanofluidic system using Nanosilver for Sustainable Development. 4th International Conference on Bioenergy, Environment & Sustainable Technologies 28-30 January 2019, BEST 2019
9. Shamnamol G K participated in one day seminar on "Awareness of IPR and its relevance in research" jointly organized by Patent information centre-KSCSTE &SBCE on 29th January 2019.
10. Shamnamol G K successfully completed Five day Faculty Development program on "Advanced Materials Processing Technologies", sponsored by APJ Abdul Kalam Technological University, Kerala during 08-12 July 2019.