Book of Abstracts

1st International Conference on
Advances in Material Science and Environmental Engineering

25th to 26th June 2021

Karachi, Pakistan

Edited by:
Prof. Dr. Asif Ahmed Shaikh, Dr. Ali Dad Chandio and Dr. Atif Mustafa

Preface

On behalf of the Conference Committees of 1st International Conference on Advances in Material Science and Environmental Engineering – ICAMSEE 2021, we are privileged to welcome you to Karachi, Pakistan for this conference. But with the onset of COVID-19 pandemic we understand that it is difficult for many to travel and attend this conference physically. Therefore, this conference is being organized at NED University's main campus in a hybrid mode in which there will be limited physical participation along with online participation.

This conference provides a platform for material and environmental scientists and engineers, industrial professionals, policy makers, entrepreneurs and university students to share and exchange knowledge, discuss findings and challenges in their respective fields of knowledge. The focus is on materials and sustainable environment. The conference will provide an opportunity for participation both physically and online. We received a total of 80 papers from which 53 papers and 20 posters are accepted for presentation after review. Material science papers cover various branches including Organic and Functional Materials, Surface Engineering, Advanced Ceramics, Advance Trends in Materials and Nanomaterials. While the Environmental Engineering papers cover various tracks including Water and Wastewater Treatment, Biofuels and Bioenergy and Sustainability.

We would like to acknowledge financial support of Sindh Higher Education Commission for organizing this conference. Contribution of a number of diligent and enthusiastic persons has made this conference possible to be organized. We would like to acknowledge the conference organizing committee, international scientific committee and technical review committee for their time and support. We would like to thank all authors who have submitted their papers to make this conference possible. Our sincere thanks go to members of conference committees along with the students for their untiring efforts and continuous support.

Prof. Dr. Asif Ahmed Shaikh
Dr. Ali Dad Chandio
Dr. Atif Mustafa

June 25, 2021

Programme Outline

Day 1: Friday, 25 June 2021

Syed Mehmood Alam Auditorium		
14:05	Opening Ceremony	
15:15	Tea Break	
16:00	Keynote Session	
	16:00	**KN-01: Prof. M. Reza Aboutalebi (Iran)** ***Recent development and future perspective of biodegradable metals and biomedical applications***
	16:20	**KN-02: Prof. Miklas Scholz (Sweden)** ***Research based assessment of integrated approaches to nature-based solutions***
	16:40	**KN-03: Dr. Waseem Haider (USA)** ***Additive manufacturing & biodegradable batteries***
	17:00	**KN-04: Dr. Jurij Koruza (Germany)** ***Microstructural design of functional properties in piezoelectrics***
	17:20	**KN-05: Dr. Muhammad Saleem (KSA)** ***Electrokinetic decontamination of metal contaminated soil***
	17:40	**KN-06: Prof. Dr. Girolamo Costanza (Italy)** ***Metal foams: production method, properties and applications***
	18:00	**KN-07: Prof. Dr. Mahadzir Ishak (Malaysia)** ***Lasers in advance welding and joining applications***
18:20	Research Showcase and Poster Exhibition	
19:30	Dinner	

Day 2: Saturday, 25 June 2021

Time	Place and Track *Lecture Hall, Computer & Information Systems*	*Video Conferencing Hall, Petroleum Engineering*	*Video Conferencing Hall, Civil Engineering*
09:00 – 09:30	Keynote	Keynote	Keynote
09:30 – 10:00			
10:00 – 10:20	Organic Materials	Functional Materials	Water and Wastewater
10:20 – 10:40			
10:40 – 11:00			
11:00 – 11:30	Tea Break		
11:30 – 12:00	Surface Engineering	Advanced Ceramics	Biofuels and Bioenergy
12:00 – 12:20			
12:20 – 12:40			
12:40 – 13:00			
13:00 – 14:00	Lunch/Prayer Break		

	Lecture Hall Computer Engineering	*Video Conferencing Hall, Petroleum Engineering*	*Computer Center, Metallurgical Engineering*	*Video Conferencing Hall, Civil Engineering*
14:00 – 14:30	Advanced Trends in Materials	Engineering Materials	Nanomaterials	Sustainability
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14:50 – 15:10				
15:10 – 15:30				
15:30 – 15:50				
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KEYNOTE SPEAKERS

Recent developments and future perspective of biodegradable metals for biomedical applications

Prof. Dr. M. Reza Aboutalebi

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ABSTRACT

Over the last 4 decades, innovations in biomaterials and biotechnology have attracted to improve human life, by replacing and repairing soft and hard tissues. During this time, metals have become widely used as orthopedic implants, cardiovascular devices, and hard tissues, due to their high strength and toughness compared with polymers and ceramic materials. Recently, degradable metallic materials have attracted research attention compared to the permanent ones because they can perform their required mechanical function over a specific period of time while being dissolved by corrosion. As a matter of fact, the significant advantages of using biodegradable materials is to eliminate the need of removal surgery. By considering two major aspects of biodegradability and biocompatibility as sufficient and necessary conditions, some metallic materials have been nominated and utilized as appropriate biodegradable metals. These are mainly categorized into three main classes as Mg, Fe, and Zn based biodegradable metals.

Since 2001, a huge number of papers have been published on the development of biodegradable materials, Mg-based alloys among them, have attracted most attention. Several Mg alloys have been investigated, including the AE21(2 wt.% Al and 1 wt.% rare earth elements (RE)), AM60 (6 wt.% Al and 0.3 wt.% Mn) and WE43 (4 wt.% Y and 3 wt.% RE). A German company (Biotronik) launched a magnesium alloy called WE43 as the first proven biodegradable metal implant. However, they suffer from their excessive corrosion and therefore further improvements are still needed. On the other hand, the corrosion rates of Fe-based alloys are generally below clinical needs, so similar problems as found with permanent implants can be encountered. Recently research has shifted towards bio-absorbable zinc (Zn) alloys due to its promising biocompatibility and biodegradability (standard electrode potential of -0.8V is between that of Mg (−2.37 V) and Fe (−0.44 V). The moderate degradability of Zinc results in a favorable corrosion rate for an implant material. However, the poor mechanical properties of Zinc (low yield stress (20MPa) and ductility (12%) has propelled researchers to search for Zn alloys with improved mechanical properties via elemental composition and/or processing manipulation. The aim of this review is to address and compare the advantages and drawbacks of the above metals for biodegradable orthopedic applications. The opportunities as well as the challenges of biodegradable metal-based alloys are also summarized.

Keywords: Biodegradable; Metals; Corrosion; Zinc alloy

Research-based assessment of integrated approaches to nature-based solutions (rain solutions): addressing water, wastewater and storm water management challenges in cities

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ABSTRACT

There is a need to close the demand and supply gap in terms of quantity and quality of water resources. Therefore, the project "Research-based Assessment of Integrated approaches to Nature-based SOLUTIONS" (RAINSOLUTIONS) aims to develop an integrated framework of methodologies to manage nature-based solutions (NBS) for the restoration and rehabilitation of urban water resources systems. The key objectives are (a) to simulate the impact of climate variability on NBS; (b) to develop an indicator system for the evaluation of key NBS; (c) to map ecosystem services delivered by NBS for an evaluation of the best technology to implement in different urban contexts; and (e) to create a NBS planning and design framework to generate recommendations addressing challenges associated with climate resilience and well-being. The most promising NBS for each case study were screened and performance indicators were identified. A strength, weaknesses, opportunities and threats analysis for each case study city was undertaken to identify missing pieces in creating a truly holistic approach to improving water and climate change resilience as well as enhancing ecosystem service. Guidelines for cost-effective urban water system restoration and ecological rehabilitation measures were developed. RAINSOLUTIONS created a decision-support framework linked to a NBS catalogue describing technologies.

Keywords: City; Rain solutions; Storm water; Wastewater; Water

Recent trends in additive manufacturing

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ABSTRACT

Additive manufacturing or 3D printing of metals is emerging and rapidly growing manufacturing technique from prototyping to large production runs. This process involves the fusion of metal powder bed by selectively melting above the melting temperature and building layers on top of each other. The imminent advantages of producing complex geometries, unprecedented manufacturing flexibility, product customization and at the same time economically viable process makes it a potentially disruptive technology for different industrial applications. The huge interest of industries for adapting this technology also brought the attention of research community to work in this area with full potential. The changed melting and solidification dynamics during additive manufacturing, results into striking differences in the microstructural evolution in comparison to the one obtained through conventional casting process. This research will elucidate the microstructure, electrochemical response and the nature of passive oxide film formed on the wrought and additively manufactured metallic materials.

Keywords: 3D printing; Additive manufacturing; Conventional casting

Microstructural design of functional properties in piezo electrics

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ABSTRACT

Piezoelectric materials are widely used in sensors, actuators, and transducers, enabling a range of modern technologies in industrial automation, consumer electronics, smart vehicles, micro robotics, and medicine. The highest piezoelectric properties are achieved in ferroelectric materials, where the electromechanical conversion originates predominantly from the crystal lattice and ferroelectric domains. However, it is often neglected that the functional properties of these materials are also strongly influenced by different microstructural elements such as grain boundaries, pores, secondary phases, dislocations, and others.

In this contribution, we will show how various microstructural elements can be utilized to favorably tune the dielectric, ferroelectric, and piezoelectric properties. *Pores* were used to adjust the local electric fields and obtain Pb (Zr, Ti) O_3 piezoceramics with a relative density as low as 66 %, but with comparable piezoelectric coefficients to their dense counterparts. *Secondary phases* placed at grain boundaries enabled to increase the depolarization temperature of the relaxor ferroelectric ($Na_{1/2}Bi_{1/2}$) TiO_3-$BaTiO_3$ and at the same time reduce the losses, resulting in hard piezoceramics for high-power applications. In another example, a novel precipitation process introduced *secondary phases* into the grains of ferroelectric (Ba,Ca)TiO_3, which refined the domain structure and impeded the movement of the domain walls, rendering a large increase in the mechanical quality factor. The final example entails a mechanical imprint of *dislocation* structures into ferroelectrics. This resulted in pinned domain structures at low electric fields and depinning at intermediate fields. The rigid dislocation structure imposed a macroscopic restoring force on the domains, which made the domain wall displacement reversible and thus greatly increased the dielectric and piezoelectric response.

Keywords: Piezoelectric materials; Ferroelectric materials; Piezoceramics

Electrokinetic decontamination of metal contaminated soil: evaluation of operating parameters

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ABSTRACT

Growing need of low permeable soils decontamination motivated the researchers to utilize the electro-kinetic process. This study presents the results of a systematic bench-scale study on improved extraction of copper and cadmium from contaminated soil. Influence of operating parameters such as electrode material, soil pH, current density, soil temperature, inter-electrode spacing and initial soil moisture content on the decontamination performance investigated. Study revealed that removal of copper, and cadmium reached 88.3% and 64.7% respectively while using titanium electrodes. Removal efficiency improved with the increase in current density, soil temperature and initial soil moisture content. About 68% of copper removal was achieved within 18 hours at soil temperature of 28°C when current density was kept 4.2 mA/cm^2. During this study soil pH decreased from 6.7 to 2.4 near anode and reached up to 12.3 near cathode resulting in augmented metal removal. An improvement of 32% in removal efficiency observed when moisture content increased from 34.6% to 48.9%. Rate of metal removal increased as the inter-electrode spacing decreased to 10 cm, which demonstrated the highest copper removal. The maximum energy consumption found to be 5.2 kWh/m^3 of soil volume demonstrated the economy of process, which can be scale up at cleanup sites

Keywords: Electro-kinetic process; Soil decontamination; Heavy metal; Operating parameters; Removal efficiency

Lasers in advance welding and joining applications

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ABSTRACT

Advanced high strength steel (AHSS) has proven to continually adapt to the requirements of automotive applications wherein high strength, vehicle safety, and weight reduction are the primary objectives. Amongst one of the fabricated products is a tailor welded blank that comprises different grades of steel with varying thickness and is used to produce A-pillar, B-pillar, roof reinforcement, and other parts. These material and dimensional variations give rise to the concept of dissimilar materials welding. Photon-based manufacturing including Laser welding is a robust and rapid technology that could be used to obtain such dissimilar welds. In the current study, a 2000W continuous wave mode laser with an inbuilt camera system was employed to join Al-Si coated 22MnB5 boron steel with a thickness of 1.7 mm with G3135 cold rolled low carbon steel having a thickness of 1.2 mm in butt joint configuration. Bead on plate welding on Al-Si coated was carried out. Furthermore, the effect of laser power on penetration depth was observed. The relation of weld geometry characteristics such as penetration depth, bead width, the aspect ratio was evaluated with laser scanning speed and focal distance. Thereafter the range of welding modes and their transition was identified. Lastly, various defects generated during the dissimilar welding process were also identified.

Keywords: Dissimilar materials; Laser welding; AHSS; Aspect Ratio; Welding modes;

Zero liquid discharge in textile industries: great challenge for industry and academia

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ABSTRACT

In Pakistan, the textile sector usually goes neglected when it comes to managing its water consumption and wastewater treatment. However, considering the acute water shortage for industries and immense pressure from regulatory authorities and international customers, the textile-related stakeholders have started to focus on maximizing water-use efficiency and development of wastewater treatment and reuse. Targeting the sustainable development goals for improved water quality and improved water-use efficiency in textile processing, this study was initiated as an industry-academia collaboration between the U.S.- Pakistan Center for Advanced Studies in Water (USPCAS-W), Mehran University of Engineering and Technology (MUET), Jamshoro with Textile Industries Ltd. for water-related improvement in textile processing and development of wastewater treatment and reuse. In this study, it was planned to analyse the process related variation of produced wastewater for developing the operating conditions of wastewater/effluent treatment plants (ETP) and reverse osmosis (RO) membranes operations, and to explore a viable and indigenous option for the treatment of RO reject water and maximize water recovery. In executing the project, various observations and recommendations were made relating to progress in water-use efficiency in textile processing. For long-term improvement, a processing water management system (PWMS) was developed that provides a comprehensive framework to optimize and control water use as per process and textile goods quality requirements, to adopt and manage on-site water and wastewater recovery and reuse, and to make water-related process modification. Finally, an indigenous and viable treatment method was explored and some options of RO reject water treatment were proposed, which includes the adsorption assisted distillation, recycling of valuable from it, and use of RO etc. Through these methods, the rejected water with high TDS could be separated from a concentrated load of minerals, elements, and dissolved solids via evaporation and adsorption on an adsorbent bed, while the recovered distillate could be used as freshwater in textile processing. With such advancement, the separated concentrate could be easily handled via adsorbent bed backwashing and further concentrate solidification.

Keywords: Wastewater Treatment; Denim Textile Industry; Industry and Academia

Investigation of pH effect on photocatalytic performance for decontamination of methylene blue dye with Cl doped ZnO nanostructures

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ABSTRACT

Water pollution in the worldwide is a grave concern for the human as well as aquatic life. The growing textile processing industries have made conventional water treatments processes ineffective. The search for new methods and new nanomaterials with improved the physical as well as chemical properties for water treatments has become an urgent dire need. Photocatalytic degradation for the water contaminants by nanostructures made with doped metal oxides has attracted the world attention. This process not only involves water treatments but also effectively degrades toxic pollutants in the environment. The Cl doped ZnO nanostructures were synthesized by hydrothermal method. Their photocatalytic performance under the different pH value for water treatments was examined. Experiments show that pH value could improve the photocatalytic properties by varying the acid base properties of the contaminants in the water. The effect of pH and relationship between doping concentrations into ZnO on the photocatalytic performance for the degradation of MB dye is shown.

Keywords: Nanomaterials; Water pollution; Photocatalytic degradation

Non-ohmic conduction in sodium bismuth titanate

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ABSTRACT

A nominal Bi-excess starting composition of sodium bismuth titanate, $Na_{0.5}Bi_{0.51}TiO_{3.015}$ ($NB_{0.51}T$) produces dielectric ceramics that exhibit mixed n-type and oxide-ion conductivity with an ionic transport number of 0.1 at 600 °C. The bulk electrical conductivity, σ_b, of $NB_{0.51}T$ ceramics under a dc bias field of 100 V cm^{-1} has been investigated by impedance spectroscopy. Over the temperature range 550 to 750 °C, σ_b increases by up to one order of magnitude under the dc bias and returns to its initial value on removal of the bias. The enhancement of conductivity is dependent on temperature, atmosphere, dc bias field and the electrode materials. A maximum conductivity enhancement of 2000% is achieved at 600 °C in nitrogen using Pt electrodes. This is in contrast to that observed for other n-type perovskite titanates and oxygen-deficient rutile where σ_b is suppressed under a dc bias. This 'unusual' non-ohmic behavior is attributed mainly to the influence of highly mobile oxygen vacancies in $NB_{0.51}T$. The field-enhanced σ_b is best described to be a consequence of increased pumping of oxygen from the cathode to the anode, in which the electrode reactions play an important role. In addition, dissociation of defect clusters may also contribute to the enhanced σ_b under a dc bias. The high, fast and reversible response to the dc bias voltage may expand the potential application of NBT-based materials to memory devices.

Keywords: Dielectric ceramics; Conductivity; NBT-based material; Memory device

Lead-free ceramics for high energy density capacitors to support sustainable development

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ABSTRACT

The global popularity of portable electronics and electric vehicles has spurred the development of energy storage devices toward higher power densities and energy densities. Dielectric capacitor, as a kind of important energy storage devices, has attracted tremendous attentions based on the advantages of high-power density and fast charge-discharge rate, thus has a critical role to play in decarbonizing the 21st century economy. Finding less toxic, lead-free materials has been a major scientific and technological challenge. Relaxor ferroelectric and antiferroelectric lead-free ceramics are promising candidates due to their relatively small remanent polarizations and high dielectric breakdown strengths. Novel tailored dopant strategies in $BiFeO_3$-$SrTiO_3$ (BF-ST) relaxor ferroelectrics have been proposed in our work: i) Nb-doping to increase resistivity by eliminating hole conduction and promoting electrical homogeneity and ii) alloying with a third perovskite endmember, $BiMg_{2/3}Nb_{1/3}O_3$ (BMN), to reduce polar coupling without decreasing the average ionic polarizability. Using these strategies, ultrahigh energy density of 15.8 J cm^{-3} for BF-ST has been attained in multilayer ceramics. In addition, we combined theoretical calculations, in-situ synchrotron X-Ray diffraction and transmission electron microscopy data to give evidence to the underlying mechanisms that underpin optimization of energy storage density (6.5 J cm^{-3}) in $AgNbO_3$-based antiferroelectric ceramics from micro to macro scales. It is the first observation of a field induced ferrielectric phase and the first time to propose 4 principles for the design of high energy density in antiferroelectric ceramics. These two works both define clear engineering guidelines to design lead-free ceramics for high energy density capacitors to support sustainable development.

Keywords: Lead free ceramics; Capacitors; Portable electronic

ORAL PRESENTATIONS

Organic Materials

Evaluation of a nanostructured MWCNT based RAM coating applied to a glass fiber composite

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ABSTRACT
Stealth enabled RAM coated aircrafts are the dire need of modern warfare. In this study experimental investigation of Radiation Absorbent Material (Based on Carbon Nanotubes) coated on epoxy/glass fiber substrate and enhanced with Multi Walled Carbon Nanotubes (MWCNTs) is presented. Suspension of MWCNTs in Thermoplastic Polyurethane was prepared using magnetic stirring and sonication technique. Epoxy/Glass Fiber substrates (Epoxy/GF) were manufactured using hand layup technique. Carbon nanotubes were added in the concentrations of 5% wt. 7.5% wt. 10% wt. (of MWCNTs) in Thermoplastic Polyurethane. The attenuation of Electromagnetic radiations (8 to 12 GHz) incident on this material was evaluated using the free space method (Agilent e8362b PNA Series Network Analyzer) to determine whether this material can be used as an absorbing structural material. The morphological characteristics of the samples were examined by using scanning electron microscope (SEM, Tescan Vega3). The results show that material can absorb the Electromagnetic radiations (up to 96%) and it increases with increase in concentration of MWCNT's indicating that material can act as an effective RAM material.

Keywords: RAM; TPU; MWCNTs; Radar cross-section; Network analyzer; X-band; RAS

Laser cleaning process for the removal of surface corrosion and paint on stainless steel SS304L

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ABSTRACT

Stainless steel SS304 is one of the most widely employed steel alloys used in a wide variety of industries. However, under certain atmospheric and environmental conditions, it is likely to corrode. High humidity can cause damage to the native chromium oxide layer causing rust formation. Once, the corrosion develops, it becomes difficult to remove the rust layer locally and must be chemically treated or dry blasted. But recently, a novel application of laser surface irradiation can be employed to remove the corrosion products formed on the surface rapidly and robustly. The laser corrosion and paint removal process are a non-mechanical technique that has the benefit of removing rust from difficult to reach areas with high efficiency. However, the rust removal depends on the laser de-rusting process parameters. In this work, the effect of laser cleaning parameters such as power, frequency and number of loops are studied with the aid of an optical microscope to observe surface features. Results indicate that the number of loops is a significant parameter that enhances the corrosion and paint removal significantly. Additionally, the selection of correct frequency, power, and scanning speed along with hatching distance also play a significant part in corrosion removal efficiency.

Keywords: Laser corrosion removal; Laser cleaning; Paint removal; Stainless steel; SS304ICAMSEE-M-02

Functional Materials

Lead-free electro ceramics and capacitors for energy storage

Dawei Wang (Invited Speaker)

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ABSTRACT

Materials with high energy/power density are currently needed to meet the growing demand of portable electronics, electric vehicles and large-scale energy storage devices. High energy densities are commonly achieved for fuel cells, batteries and supercapacitors, but conventional dielectric capacitors are receiving increased attention for pulsed power applications due to their high-power density and fast charge-discharge speed. Due to the environmental and health concerns, lead-free electro ceramics and capacitors with both high recoverable energy density (W_{rec}) and energy storage efficiency (η) are urgently desired, which are now research hot topics world widely. In this talk, our recent works on several novel lead-free dielectrics and capacitors are introduced, including bismuth ferrite (BF), silver niobite (AN), sodium bismuth titanate (NBT)-based systems, with a focus on energy storage characteristics. Due to the enhanced electric breakdown strength (BDS) and large maximum polarization (P_{max}), high W_{rec} (2.5~8.2 J/cm^3) was achieved across a range of compositions. Multilayer capacitors of optimum compositions possessed ultrahigh W_{rec} of 10~18 J/cm^3 and η of 75~93% with large BDS of 700~1000 kV/cm, which were also temperature/frequency stable and fatigue resistance were therefore considered promising candidates for lead-free energy storage applications.

Keywords: Electro ceramic; Portable electronic; Lead-free energy

Fabrication and characterization of bioactive bone cement

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ABSTRACT

Bone cement is a major source to achieve the bone fixation through cemented anchorage. For over 60 years, PMMA-based bone cement is playing significant role in surgical fixation of artificial joints. PMMA-based bone cements have been used due to their cost effectiveness, biocompatibility, good mechanical strength and easy processing. However, these materials lack in suitable biodegradation rate, bioactivity and connectivity with host bone tissues. These limitations can be tailored by inclusion of different components (such as: bio-glass, hydroxyapatite or nanofillers). In this research work, we proposed to solve these limitations by incorporation of bioglass with variations in its composition. For this purpose, we prepared different samples of PMMA-based bone cement with varying composition of bioglass and will characterize to study the effects on mechanical, physical and thermal properties.

As every day several individuals fall victim to accidents leading to severe bone injuries and trauma mainly caused by bicycles/motor vehicle accidents and they may lose fragments of bone which obligate immediate bone implantation. The unavailability of donors and cadaveric tissues suffice for synthetic bone cement. Therefore, need of synthetic bone cement is increasing day by day. So, present study will facilitate the health care sectors as we intend to resolve this need by our research work. This research will provide synthetic bioactive bone cement which can address such problems by its excellent biocompatibility, strength, rapid bone formation and its antibacterial as well as bioactive nature.

Keywords*:* Bioactive bone cement; PMMA based bone cement; 45S5 Bioglass; Silicate based bioglass; Bioglass-PMMA polymer composite

Non-oxide and oxide-based thermoelectric functional materials: comparative life cycle assessment and environmental profile evaluation

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ABSTRACT

Waste heat from factories, automobiles, nuclear and thermal power plants and similar sources offers a high-quality energy source of roughly 70% of the total primary energy, but it is difficult to reclaim given the small and widely dispersed nature of the sources. Thermoelectric (TE) materials offer the only viable method of overcoming these challenges given their ability to generate electrical voltage directly from a temperature gradient and therefore, have attracted much attention as a means to harvest electrical energy from waste heat. To date, the leading materials are metallic alloys such as Bi_2Te_3 which suffer from a number of limitations including high toxicity, chemical and thermal instabilities, low availability and high cost of processing. There is evidence to suggest that oxide-based TE materials could be game changing for thermoelectric applications because of their stability even at high temperatures in air, compared to their non-oxide counterparts. However, a comparative lifecycle assessment (LCA) of non-oxide versus oxide-based TE materials has not been conducted. Using LCA, it was established that contrary to popular narratives, which emphasise toxicity, energy consumption during fabrication constitutes the largest environmental impact for both material types, even under electrical decarbonisation scenarios. Although oxide-based TEs offer better environmental profile, there are concerns over the cost of constituents, their availability and technical performance. For upscaling, strategies for lowering energy consumption such as the use of sintering aids and low temperature processing routes are required.

Keywords*:* Bioactive bone cement; PMMA based bone cement; 45S5 Bioglass; Silicate based bioglass; Bioglass-PMMA polymer composite

Advanced Ceramics

Octahedral tilting at perovskite interface

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ABSTRACT
The interface characteristics of perovskite materials have important influences on their properties. As far as the ideal cubic prototype structure is concerned, most perovskites usually have some structural deformation, and the most common structural deformation originates from the oxygen octahedral tilting. Therefore, it is of great significance to study how the oxygen octahedral tilt evolves at the perovskite interface. Based on the ideal rigid oxygen octahedron model and considering only the deformation caused by the oxygen octahedron tilting, a simple geometric method is proposed to predict the oxygen octahedron tilting behavior at perovskite interface. Firstly, on the basis of Glazer's model, the hexagonal symbol system is established to describe the tilting behavior of oxygen octahedron. Then, based on the minimum requirement of interface energy, the transition mode of oxygen octahedron at the perovskite interface is established by calculation and analysis, which includes abrupt change and gradual change. In addition, abrupt change and gradual change can coexist at the interface. Finally, the above method is applied to a practical example, and it is found that the above results are in good agreement with the experimental results reported in the literature. This simple method can be used to predict the evolution of oxygen octahedron at the interface of perovskite and provide reference and help for the design of interface engineering strategy of perovskite materials.

Keywords: Perovskite material; Glazer's method; Oxygen octahedron tilting

Machine learning for 3D printing Medicines

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BioMaterials

ABSTRACT
3D printing is a transformative fabrication technique that is expected to produce personalised medicine for patients. However, as with every other novel technology, time is needed to realise its full potential. This is due to the inefficient manner trial-and-error experiments are conducted. Fortunately, one adjacent technology that can accelerate development is machine learning (ML), a subset of artificial intelligence. In this talk, the results of ML applied to 3D printing of medicines is presented.

Keywords: 3D printing, Artificial intelligence, Machine learning

Use of sustainable materials for engineering applications

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ABSTRACT

Textile industry is an important sector for economic growth all over the globe. Its main component/raw material is fiber which is acquired either by naturals sources or man-made processes. Conversion of fiber into a useful product consists of variety of complex processes and throughout the processing there is a huge consumption of water, chemicals, energy and generation of wastewater which are detrimental to the environment. This situation urges the use of eco-friendly textiles production which leads to sustainable development and minimization of the carbon footprint in each phase of a textile product's life cycle. And for this, there is a need to innovate new materials which consume less water, energy and chemicals and can be reused to aim for zero wastage. Organic cotton, bio-based fibers blends, Green dyes and finishes, Engineered Water Nanostructures (EWNSs), textile waste fiber reinforced composites, Ozone finishing, Non-woven from textile waste are new materials and processes which mostly add multifunctional characteristics to the conventional textile materials make them green and sustainable with less amount of water, energy and chemical consumption. Use of these materials and processes could play positive role in climate change. Buildings are the prime energy consumers and greenhouse gas emitters, mutually in the developed and developing countries. As a result, it is a calamitous need in the current status quo to change to sustainable buildings. It is essential to comment that sustainability has currently become compulsory in order to undertake many environmental problems. Therefore, the usage of sustainable materials in construction is at the edge of being an obligatory requirement in construction. For that reason, this research provides a firm basis to use sustainable materials in construction industry in the perception of construction contractors. Moreover, circular economy is a part of sustainable development and for that to be in effect, it is a must to employ sustainable materials for different engineering applications which also lead to zero waste and minimize their harmful environmental impact. This paper will discuss the use of sustainable materials in industries who process different materials to convert them into value added products. This discussion will be facilitated by overviewing the published papers related to sustainable material selection for different engineering fields.

Keywords: Sustainable materials; Recycle; Engineering materials; Zero waste; Environmental impact

Advanced Trends in Materials

Titanium alloys and shape memory effect

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ABSTRACT
Titanium is an attractive light weight biocompatible transition metal. Density of Titanium (4.5g/cm3) is about half than Iron (7.9 g/cm3) and little higher than Aluminum (2.7. Extraction of Titanium from its ores is difficult due to high reactivity of Titanium with oxygen. In this conference, author will present different types e.g. α, β and (α+β) titanium alloys. Phase constitution and its effect on the mechanical properties of Titanium alloys will also be presented. Sensitive nature of titanium alloys towards ageing will also be presented. Author's contribution for Titanium based shape memory alloys will also be presented. Some of author's research work results related to nitinol (NiTi), Ti-Cr, Ti-Au and Ti-Pt will also be presented. Research challenges related to the development of titanium-based shape memory alloys in general and especially in Pakistan will also be presented. Author has published the book in 2018 on 'Titanium and Titanium Alloys' under HEC book writing scheme. Contents of this book will also be presented in this talk.

Keywords: Titanium Alloys; Phases; Shape memory Effect; Martensite

A post-doping attempt of Si-NCs with aluminum

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ABSTRACT
An attempt has been made to dope the layers of Si-NCs having size range of approximately 20nm with aluminium. Melting point along with other properties varies as the size of silicon varies from mega to nanoscale. Reduction in melting point (727C at 20nm) at nanometer size range becomes feasible for doping at low temperature as per Si-Al binary phase diagram. Cross sectional analysis of Si-NCs layers using optical microscopy as well as Raman spectroscopy also confirms this doping effect.

Keywords: Doping; Si-NCs; Raman Spectroscopy

Design of experiments for green tyre tread compound development by reducing carbon with eco- friendly filler

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ABSTRACT

This article deals with the design of experiments for the development of green tires by reducing carbon black with ecofriendly filler. Carbon black is traditionally used in tires as filler, but it possesses a major challenge of CO_2 emission during manufacturing stage. In the past few decades, the focus has been shifting on silica fillers to develop low rolling resistance tires resulting in low CO_2 emissions contributing thus establishment of healthy eco system. In the present study Silica is used as a filler to reduce the amount of Carbon. Systematic approach of design of experiments (DOE) is used which suggests that along with silica more other factors (variables) are observed in order to obtain an ecofriendly tire having best possible tire properties as well. Key steps of DOE are followed, from screening, batching (blocking) up to statistical calculation (model equations), results and conclusions. Testing's from various sources succor to verify the statistical results of designed variable's quantities obtained by observing various test responses like, wet traction, dry traction, rolling resistance.

Keywords: Design of experiment; Green tire; Rolling resistance; Wet traction; Dry traction; silica; filler; eco-friendly; Carbon black

Color laser marking of titanium alloy Ti6Al4V

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ABSTRACT
Color laser marking is a relatively modern non-contact technique to bring out colors on the surface of metals that could be used for producing logos, barcodes, craft metalwork, and jewelry. In this research, color laser marking was carried out on Ti6Al4V (TC4) biomedical alloy to investigate the surface characteristics of various colors. Subsequently, this study focuses on the effect of change in the laser frequency and defocus distance on the variation of colors formation. Surface characteristics was evaluated by 3D optical microscopy to obtain roughness and texture features. Hardness measurements were carried out to identify any changes in the mechanical properties while ImageJ software was employed to obtain color information. Results indicate that with the variation of defocus distance and frequency the color varied from that of silver for the base metal to that of blue, gold, orange, shiny silver, and violet along with shades of grey. The surface texture and roughness parameters value of each color varied significantly while the surface hardness remained the same for all colors except for grey. The hardness value increased from that of 392 H_v for base metal to that of 601 H_v for grey color only.

Keywords: Ti6Al4V; Color laser marking; 3D optical microscopy; Surface characteristics

Engineering Materials

The potential use of natural rice husk for carbon capture process in Indonesia: a review

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ABSTRACT

Carbon capture technology is useful in reducing CO_2 emissions, Indonesia is a large agricultural country with aaverage rice husk and rice husk ash availability in last 5 years was 14.1 and 2.5 million. Rice husk has a high calorific value, around 14-16 MJ/Kg. It can also be used as alternative adsorbent in carbon capture technology due to its abundant resources, low cost, and easy maintenance. The husk ash shows higher carbonation conversion and supports CO_2 diffusion to its inner part, better than pure SiO_2 and diatomite sorbent. Rice husks mixed with CaO were able to change the carbonation at intervals of 0.45 - 0.69 for cycles of up to 20. The use of sorbents doped with attapulgite in hydration increased the ability to capture CO_2, with an interval of 0.52 - 0.8 carbonation conversion values. Rice husks have a prospective solution for carbon capture adsorbents in Indonesia.

Keywords*:* Ash; Carbon capture; Indonesia; Rice husk

Facile MnO_2/Co_3O_4 nanocomposite electro-catalyst for water oxidation reaction

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ABSTRACT

Designing a low-cost and simple earth-abundant electrocatalysts is perilous for extensive energy applications. Here, the doping strategy of MnO_2 into Co_3O_4 was applied in various concentration to develop MnO_2/Co_3O_4 nanocomposite (CM) by aqueous chemical method. The electrocatalyst containing higher concentration of MnO_2 exhibits superior OER performance in an aqueous solution of 1 M KOH. The analytical methods such as powder X-ray diffraction (XRD) techniques and scanning electron microscopy (SEM) was performed to confirm the crystalline structure, composition, and morphology of the electrocatalyst respectively. The electrocatalyst reveals lower overpotential of 310mV vs RHE at current density of $20mA/cm^2$ and Tafel slope of 72 mV/dec. The low charge transfer resistance about 74 Ω of CM-0.4 nanocomposite electrocatalyst, it also validates the greater catalytical activity. The electrocatalyst showed $18\mu F/cm^2$ and $450cm^2$ double layer capacitance and electrochemical active surface area respectively, demonstrate that addition of impurities of MnO_2 in Co_3O_4 increases the active surface sites of catalyst. These outcomes donate to a well understanding of such catalysts, which will aid in the improvement of new electrocatalysts for future promising energy production and conversion technologies.

Keywords: Cobalt Oxide; Manganese Oxide; Oxygen Evolution Reaction; Alkaline Media

Photopolymerization based solid-state electrolytes for lithium metallic batteries

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ABSTRACT

UV-curing allows to obtain of a highly cross-linked solid-state polymer electrolyte membrane that was designed for the use of lithium metallic batteries (LMBs). The vital composite electrolyte membrane was successfully fabricated by PEO and (LATP) in the presence of UV photo-polymerization. The cross-linked solid-state Electrolytes can accommodate a liquid electrolyte inside the membrane via strong interaction with lithium-ion and solvents. Solid-state Electrolytes membrane shows much higher mechanical properties than pure PEO based electrolyte. The conductivity of CGPE reached about $3\ 10^{-3}$ S cm^{-1}, lithium transference number were observed 0.7 and presented a wider electrochemical stability window (ESW) at room temperature. Most importantly, the fundamental function of LATP is to support in building a stable solid-electrolyte-interphase (SEI) and limits the growth of dendrites. The solid electrolyte interphase (SEI) formed between lithium metal and liquid electrolytes plays a critical role in all of these processes. The prepared ceramic-based electrolytes effectively render to inhibit lithium dendrite growth in asymmetrical cell Li/SPE/Li test during charge/discharge at a current density of 2 $mAcm^{-2}$. In addition, the battery assembled of $LiFePO_4$/SPE/Li exhibits superior charge/discharge cycling. This provides a fundamental strategy that the ceramic-based electrolytes design a prime solution for high-performance lithium-metal batteries.

Keywords: Lithium-metallic Batteries; Lithium dendrite; Solid state polymer Electrolyte; UV

Structural, surface, dielectric, impedance and modulus spectroscopic studies of lanthanum doped Mn0.5Ni0.5LAXFe2-XO4 nanoparticles

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ABSTRACT

A series of lanthanum La doped nickel ferrites $Mn_{0.5}Ni_{0.5}La_xFe_{2-x}O_4$ with doping concentrations (x = 0.0, 0.04, 0.08, 0.12, 0.16, 0.20) is synthesized via a sol-gel auto-combustion method. Structural properties are determined with the help of X-ray diffraction. The effect of La doping on dielectric properties of nickel (Ni) ferrites is discussed. X-ray diffraction analysis confirms the existence of pure FCC spinel phase, and no impurity phase was detected. The lattice constant decreases initially due to strain produced by La^{3+} ions replacement. At higher doping concentrations, the lattice constant increases due to the large ionic radius of La^{3+} ion as compared to Fe^{3+} ion. Tangent loss (tanδ), dielectric constant and dielectric loss values are determined in the 1 MHz to 3 GHz frequency range, and explained by the Maxwell-Wagner model. A persistent behavior of dielectric loss and dielectric constant was found in the mid region of microwave frequency. The most stable behavior of the dielectric constant and dielectric loss in the high frequency region is found in doping concentration. AC conductivity is also discussed in the 1 MHz - 3 GHz region, and attributed to grain and grain boundary resistive behaviour at low and high frequencies. Cole-Cole plots of different samples, corresponding to different doping concentrations, are used to describe the conduction phenomena. The stable response of dielectric constant (ε') and dielectric loss in mid region of microwave frequency make $Mn_{0.5}Ni_{0.5}La_xFe_{2-x}O_4$ nanoparticles a potential candidate for microwave devices. The magnetic properties of prepared samples are characterized through vibrating sample magnetometer. Magnetic properties such as coercively, saturation, remanence, magnetic squareness, magneto crystalline anisotropy constant (K) and Bohr magnetron were measured from the recorded M–H loops. Furthermore, Lanthanum doped Mn-Ni nanocrystalline ferrites may be suitable for many industrial and domestic applications.

Keywords: Nanocrystalline; Magnetic properties; X-ray diffraction

Nanomaterials

Photo enhanced degradation of cationic dye (methylene blue) using biogenic titania from malus domestic extract

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ABSTRACT

Herein synthesis of TiO_2 nanoparticles is reported via green synthesis route by using Malus Domestics (Apple) for degradation of methylene blue that belongs to the family of cationic dyes. Malus domestica extract was selected as stabilizing and bio-reducing agent due to the presence of phytochemicals like quercetin and chlorogenic acid, surface topography studied through SEM exhibits dense, spherical and scattered particles of TiO_2. XRD patterns confirmed the formation of anatase phase with 13 nm crystalline size. FTIR spectroscopy confirmed the Ti-O-Ti bond formation. Optical visible range was evaluated to be 390 nm using UV-vis Spectroscopy. TiO_2 synthesized through green route degraded 98% of MB in irradiation time of 120 mints

Keywords: Synthesis of TiO_2; XRD; SEM; Spectroscopy

A facile approach in fabrication of silica (SiO_2) nanoparticles derived by sol-gel method for durable super hydrophobic surface coating applications

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ABSTRACT
Super hydrophobic surfaces are being extensively studied, fabricated, and utilized for various application since past decade due to their extra-ordinary self-cleaning attributes and anti-wetting property. Herein we report the synthesis of SiO_2 nanoparticles by adapting hydrothermal and sol-gel techniques using solution of sodium silicate as precursor. surface modification of synthesized SiO_2 nanoparticles done by treating it with TMCS at ambient temperature. Modified nanoparticles were spray coated on both metal and glass substrate after sonication with acetone for 30 minutes. A notable contact angle was achieved between substrates and water droplet that averaged about 154º for metal and 151º for glass substrate.

Keywords: Superhydrophobic; Thin-film; Silica nanoparticles; Sol-gel; Surface Modification.

Highly efficient CdO / Co_3O NuC_4 electrocatalyst for oxygen evolution reaction

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ABSTRACT

To solve energy problem and reduce environmental pollution, the water oxidation is only promising solution. Due to high cost and low availability of precious metal, so it is challenging task to reduce the overpotential and fast kinetics of the reaction to find the non-noble transition metal oxide. Literature demonstrated that Co_3O_4 in pristine form, it is highly corrosive in alkaline media and has low electronic conductivity, so by alteration of structure or adding others metal or metal oxide, sulphides or phosphides in Co_3O_4 has shown significant OER activity. Here in present work cadmium oxide /cobalt oxide composite is produced to improve the conductivity and charge transport properties, which directly or indirectly enhance the OER performance. Effective OER performance was optimized to 0.04 gm of Cd in Co_3O_4, that showed potential of 1.54V vs RHE at 10 mA/cm^2 current density and 62 mV/dec Tafel slope. The Cd-0.04 / Co_3O_4 has low impedance in terms of low charge transfer resistance, high capacitance value and large electrochemically active surface area. Morphological analysis also verifies the alteration of Co_3O_4 structure by doping Cadmium oxide. In this viewpoint, present cobalt-oxide-based composite electrocatalyst can be considered as one of the best OER electrocatalyst.

Keywords: Oxygen evolution reaction; Electrocatalyst; Cobalt oxide; Cadmium oxide

Surface Engineering

Antifungal and mechanical properties of heat cured acrylic resin impregnated with dimethyl amino ethyl hexadecyl dimethacrylate alone or in combination with nystatin: an in vitro study

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ABSTRACT
Treatment of edentulism with implant retained prosthesis is the ideal solution but being expansive its use is limited. Poly methyl methacrylate is alternatively the material of choice and is widely used in regions with lower socioeconomic status to restore edentulism. Despite the many advantages of PMMA resin as a dental polymer, it is not considered as ideal denture base material because of viscoelastic behavior, inferior mechanical strength and more susceptibility to microbial adhesion (C. albicans) due to its weak surface properties, especially excessive surface roughness. Stomatitis is the main problem associated with PMMA resin dentures.
Several investigations have been performed to endow PMMA denture base resin with antimicrobial properties. Two classes of released and contact active antimicrobial agents have been added. The mechanical properties were decreased in the resin impregnated with releasing antimicrobial agents and the antimicrobial property is unsustainable in resin impregnated with contact active antimicrobial agents.
The aim of this study was to investigate the impregnation of heat cure PMMA resin with different concentrations of DMAHDM (5%, 10 %, 20 %) alone or in combination with and Nystatin (500000 units) to test its antimicrobial activities and mechanical properties.

Keywords: Poly (methyl methacrylate); DMAHDM; Antifungal; Dental polymer; Mechanical properties

Synthesis of novel Mg doped cobalt oxide for active oxygen evolution reaction performance

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ABSTRACT

Improvement of electrocatalysts get incredible consideration for capacity and energy change systems. Diverse electrocatalysts for oxygen evolution reaction (OER) have been created and examined. It is worldwide demand to achieve a productive, lower cost and earth-abundant electrocatalyst for OER. Among them cobalt oxide (Co_3O_4) has revealed its activity in OER. Herein, Mg doped Co_3O_4 composite have been synthesized by co-precipitation method and found active electrochemical performance for OER as well. Two composites were formed by varying the Magnesium salt; 0.02 mg and 0.04 mg for sample 1 and sample 2. X-ray Diffraction (XRD) affirms its composition and phases of composites. Scanning electron microscopy (SEM) uncovers the morphology of as-arranged composites. Besides, electrochemical tests reveal that composite with 0.04 mg of Mg reaches at current density of 20 mA/cm^2 at an over potential of 320 mV with the Tafel slope of 65 mV/dec, which demonstrates quick OER action. Electrochemical impedance spectroscopy (EIS) showed lower charge transfer resistance of 85 Ohms for Sample 2. Cyclic voltammetry (CV) represents double layer capacitance value of 15.1 mF/cm^2. OER activity of the synthesized electrocatalyst with more modest Tafel slope and lower over potential uncover impact toward promising electrocatalyst for water splitting framework.

Keywords: Mg doped Co_3O_4; Electro catalyst; Co-precipitation; Oxygen evolution reaction

Water and Wastewater

Floating treatment wetlands: a natured based solution for wastewater treatment and reuse in Pakistan

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ABSTRACT

In Pakistan, water pollution due to the discharge of untreated wastewater in the environment is mainly due to the lack of an indigenous, low cost, and sustainable wastewater treatment technology. An innovative indigenous floating treatment wetlands (FTWs) technology has been developed using locally designed and developed floating mat and available indigenous plants. FTWs are a low cost, sustainable, and environment friendly technology for wastewater treatment and reuse. The use of FTWs is an innovative approach in Pakistan for the remediation of wastewater polluted with organic and inorganic pollutants. The plants associated microorganisms colonizing on/in the roots, degrade the organic contaminants, whereas inorganic pollutants like nutrients and potential toxic metals are taken up by the plants. The augmentation of specific bacteria in FTWs enhanced its pollution removal efficiency. Our developed FTWs technology has been successfully applied in the field and industries for the remediation of domestic and industrial wastewaters. Up to 90% removal of both organic and inorganic pollutants from the wastewater has been achieved.

Keywords: Floating treatment wetlands; Phytoremediation; Wastewater; Plant-bacteria partnership; Natured-based solution

Pyrolysis coupled anaerobic digestion for sewage sludge and associated food waste residues treatment

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ABSTRACT

The requirements for enhanced technologies, such as pyrolysis and anaerobic digestion, are important to improve food waste and sewage sludge. The pyrolysis process was applied to two waste streams, namely hardly biodegradable residues and sewage sludge, at 500 °C with a heating rate of 25 °C min^{-1} to obtain hardly biodegradable residues biochar (DBR-Char) and sewage sludge biochar (SS-Char). The performance of the different biochar as additives with food waste treatment in the AD was investigated to enhance biogas production and reactor robustness to achieve average methane contents in biogas up to 75% compared with the control. Biochar addition also improved process stability, with the Methanosaeta/Methanothrix 99.55% in the CK1 (reactor with inoculum, food waste, and DBR-Char) and 98.13% in the CK2 (reactor with inoculum, food waste, and SS-Char) as the dominant genera among the anaerobic consortia. Overall, the biochar had a positive effect on the digester stability, averted the hardly biodegradable residues and sewage sludge disposal challenges, and further promoted high bio-methanation.

Keywords: Pyrolysis; Anaerobic digestion; Food waste; Biochar; Bio-methanation

Removal of tannic acid stabilizes CuO nanoparticles from aqueous media by PAFC: effect of process conditions and water chemistry

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ABSTRACT

The increased utilization of CuO nanoparticles (CuONPs) in various fields raises concerns about their discharge into water containing a wide range of organic ligands. Moreover, the adsorption of these ligands can stabilize the CuO-NPs in drinking water treatment plants. Thus, their removal from potable water is important to mitigate the risk to humans. The present study explored the efficacy of coagulation-sedimentation (C/S) process for the removal of tannic acid (TA)-stabilized CuO-NPs using poly-aluminum ferric chloride (PAFC) as a coagulant. Moreover, the influence of process conditions (stirring speed) and water chemistry (i.e., pH and ionic strength (IS)) were also investigated to determine their impact on removal. The results showed that stirring speed in the reaction phase significantly affected the removal due to increased flocculation compared with stirring speed in the mixing phase. In addition, pH and IS affect the colloidal stability and removal efficiency of CuO-NPs. A relatively better removal performance (< 99%) of CuO-NPs was found at lower coagulant dosage in the pH range 6-8. The addition of organic ligands reversed the surface charge potential and enhanced the colloidal stability of CuO-NPs, resulting in the destabilization of TA-CuO NPs, thereby reducing the optimum PAFC dosage for removal. By contrast, the IS above the critical coagulation concentration decreased the removal efficiency due to inhibition of the ionic activity of PAFC hydrolysate in the aqueous environment. Fourier- transform infrared spectroscopy findings of TA-CuO NPs composite flocs suggest that the primary removal mechanism might be mediated via the combined effect of neutralization, complexation as well as adsorption.

Keywords: Organic ligands; Tannic acid; Coagulation; Sedimentation; Nanoparticles; Poly-aluminum ferric chloride

Energy and water conservation in textile continuous bleaching process: a sustainable and cleaner production practice

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ABSTRACT

The present study deals with the experimental and analytical work based on collection and filtration of water from textile fabric post-washing and its recycling or re-use in textiles pre-washing during different bleaching processes. This was performed at two continuous bleaching machines in Yunus Textile Mills Karachi, Pakistan. In this study, textile continuous bleaching processes were carried out with and without water recycling, consumptions of water and energy (in the form of saturated steam) were observed at two bleaching machines, along with this physical and chemical quality measures of water to be re-used were performed. Beside these, bleached textile fabric quality was also measured which include whiteness, absorbency, starch, and pH, in both conditions i.e., with and without water recycling. Approximately 41% of water and 13% of energy can be saved during both bleaching processes. Through achieved results it was observed that a significant amount of water and energy can be conserved without affecting textile fabric quality, which is directly economical and indirectly environmentally beneficial.

Keywords: Water and energy Conservation; Water Recycling; Continuous Bleaching Process; Post and Pre-washing; Textile processing

Biofuels & Bioenergy

Prospects of biomass energy production using non-edible oil seeds as alternative fuels in Pakistan

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ABSTRACT

In recent times, the world has been confronted with energy crises due to depletion of fossil fuel resources. Biodiesel is an emerging solution for the present-day concerns about rising oil prices and depletion of fossil fuel resources throughout the world generally and Pakistan particularly. There is a vast land available with good climatic conditions for huge biomass production from non-edible oil yielding plant species. This project is initiated in Pakistan with concept of mega tree plantation for green fuel for green Pakistan. The overall objective of this project is to reduce carbon in atmosphere using renewable green fuel. To investigate the impact of mega tree plantation on degraded barren and eroded land to overcome the energy crises, environmental pollution and promote biodiversity and ecosystem conservations in Pakistan. This study described in detail an optimized protocol for biodiesel production using nano-heterogeneous catalysts from indigenous non-edible oil seeds. Based on qualitative and quantitative analysis of biodiesel using Fuel properties standards, GC-MS, NMR, Ft-IR and SEM and their byproducts, the bioenergy from such resources can be feasible, cost effective, environment friendly, if mass plantation of such resources may initiate in suitable places. The concept of green fuel from green plants has positive impact on climate stability and biodiversity promotion. The lesson learned from this study will be adopted throughout the country generally and Baluchistan particularly. This study suggests decision makers in government of Pakistan and Baluchistan to take initiative to develop project for commercial production of biodiesel using indigenous plants-based biomass energy.

Keywords: Non-edible oil; Seeds; Biodiesel; Technologies; Pakistan

Parametric optimization of syngas production from algal biomass gasification using central composite design

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ABSTRACT

Gasification has been considered as a reliable and commercially matured thermochemical conversion technology for producing synthesis gas from biomass. The effect of process parameters on product distribution and quality of syngas depends upon the composition and nature of the biomass as a feedstock. Adding to the extensive research towards the algal biomass for biofuel infrastructure development, including its virtual benefits such as high biomass growth rate, suitability of cultivation without arable land and other bioremediation advantages, the present research aims at optimizing the process parameters for algal biomass gasification using horizontal axis quartz furnace (hqf). Four experimental parameters, such as furnace temperature (500 to 900 ºC), algae loading (0.6 to 2.5 g), equivalent ratio (er) (0.1 to 0.35) and heating rate (5 to 25 ºC /min) were optimized under varying conditions using Central Composite Design (ccd) for optimum syngas (H_2 and CO) production. Results showed temperature as the crucial process parameter exerting a major influence on H_2 content, followed by algae loading and heating rate. The maximum H_2 production of 42 mol% was achieved at optimized process parameters such as temperature, algae loading, heating rate and ER as 703ºC , 1.5 g, 22 ºC /min, and 0.29 respectively. Statistical approach revealed that the predicted model is in accordance with the obtained data from experimental work. Consequently, it was inferred that algal biomass as a feedstock for air gasification demonstrates a significant potential to produce syngas at commercial-scale.

Key words: *C. vulgaris*; Air gasification; Parametric Optimization; Syngas

Ameliorating effect of different waste materials for enhancement of algal biomass and lipid production

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ABSTRACT

In response to the energy crisis and abrupt climate changes, microalgae have received a great deal of attention as a biofuel feedstock. Microalgae seems useful feedstock due to their higher growth rate, photosynthesis and lipid accumulation. Environmental and culturing condition variations can alter lipid production as well as chemical compositions of microalgae. During the present research work a number of waste materials derived from media including tap water, distilled water, municipal wastewater, poultry waste, mixture of municipal wastewater and vegetable waste, fruit waste, vegetable waste, rice water, liquid soil media and BG media were tested for microalgal culture and their growth improvements. The fresh weight of *Oedogonium* sp. at day 7 was found highest in rice water 1.245 ± 0.067^{b} g and dry weight of 0.308 ± 0.017^{a} g and biomass productivity was about 42.4%. At day 14 the highest fresh weight was obtained from municipal water 1.187 ± 0.055^{b} g with high dry weight 0.357 ± 0.063^{b} g and biomass productivity 26.4%. Microalgae grown in poultry waste had less fresh (0.621 ± 0.032^{a} g) and dry weight (0.166 ± 0.020^{a} g). the highest lipid content was high extracted by using the chloroform: methanol 2:1 (v/v) as compared to the hexane: methanol 2:1 (v/v) as an extraction solvent. The high amount of lipid was extracted from the culture grown in liquid soil media (46%) by using chloroform and methanol on day 7. Hence, rice water and municipal wastewater can be used as a low-cost media for the culturing *Oedogonium* sp.

Key Words: Algae; Biofuel; Media; Waste material; Sustainability

Sustainability

Cleaner production in the industrial sector of Pakistan and its relationship to sustainable development goals

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ABSTRACT

Cleaner Production is the continuous application of an integrated preventive environmental strategy applied to production processes. Cleaner production implements practices and technologies to prevent damages to increase an overall efficiency and reduce risks to human beings and the environment. Cleaner production practices contribute towards Sustainable Development Goals not only through the efficient management of resources and energy, but also through the development and implementation of new technologies, promoting environmentally friendly practices throughout the supply chains, facilitating in complying with environmental legislation and assisting environmental watchdogs in developing environmental policies for industrial sector. The Sustainable Development Goals covers three dimensions of performance: social, environmental, and financial aspects of an organization to evaluate their performance. An integrated approach may be required to clarify and evidence their effective implementation through Cleaner Production (CP) practices and concepts. "The 2030 Agenda for Sustainable Development" was adopted by United Nations Members in 2015, outlining 17 Sustainable Development Goals (SDGs). Goal 9 of Sustainable Development Goals relates to "building resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation". For industrial sector of Pakistan, Cleaner Production involves the conservation of raw materials and energy, the elimination of toxic raw materials, and the reduction in the quantities and toxicity of wastes and emissions. This paper reviews how some selected industries in Pakistan implemented Cleaner Production at their facilities, achieved environmental efficiencies as well as financial savings and addressed the cleaner production/sustainable development goals.

Keywords: Cleaner production; Industrial sector; Pakistan; Sustainable development goals; Preventive environmental strategy

Environmental impacts of grape production orchards using life cycle assessment in Iran (case study: Karun city)

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ABSTRACT

Studying the product life cycle is a good way to evaluate the environmental impact. The purpose of this study was to evaluate the environmental impacts of grape production in Iran during a production period during 2020-2021. Required information was collected through questionnaires and in-person interviews with gardeners from 43 grape producers. Life Cycle Assessment and Simapro's software were used to assess the environmental impacts. The system boundary was considered from the origin of raw material production to the regional consumption market of the product and the functional unit equivalent to one ton of grape fruit. Global warming, acidity, water depletion, phosphate, fossil and potash constitute the six impact groups under study. The results showed that CO_2 and NH_3 had the most effect on the grape cultivation system in terms of impacts of global warming and acidity. Normalization index or share of effects of global warming, acidity, water depletion, fossil, and phosphate and potash production of one ton of grapes in Iran was determined 0.003, 0.285, 0.25, 0.387, 0.261 and 0.107 respectively. Normalization results showed that the fossil resource depletion effect group had the highest potential damage to the environment among the studied groups. After the fossil resource depletion effect group, the highest potential environmental damage was related to the acidity and depletion effect groups. The Environmental index (Ecox) for grape production system was 0.328 for one ton of grape production in Karun city and 0.743 for Resource Depletion Index (RDI). In order to reduce the environmental impact of grape production in the study area, we can reduce and optimize the use of nitrogen fertilizer inputs and diesel fuel.

Keywords: Environmental impact; Grapes; Life cycle assessment

Recycling of agro-industrial ashes as cementitious material in concrete

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ABSTRACT

This study has considered two agro-industrial wastes to recycle in concrete production. This approach could reduce the environmental problems associated with waste generation. Therefore, this study focused on Sugarcane Bagasse Ash (SCBA) and Rice Husk Ash (RHA) as cementitious resources. The research work included 5%, 10%, and 15% incorporation of SBCA and RHA individually to replace ordinary Portland cement (OPC) then blended ashes were replaced as 10%, 20%, and 30% to produce blended concrete. It was experimentally declared that the compressive strength of concrete was reduced with the incorporation of SCBA and RHA separately and combined as cementitious material at 7 and 28 days, respectively. Based on experimental findings, it was concluded that the use of 5% of SCBA and 5% of RHA as cementitious material in concrete could provide appropriate results for structural applications of concrete.

Keywords: Sugarcane bagasse ash; Rice husk ash; Cement; Compressive strength

Exploring role of local government councilor managed collection and recycling of solid waste

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ABSTRACT
Solid waste pollution is both visible and is a cause for other problems such as clogging of drains and sewers. Variety of solid wastes such as industrial and medical waste poses health hazards. Solid waste has money value, and as such a good number of solid wastes are recycled including commercial and domestic waste. In large urban areas like Karachi, the sheer scale of solid waste generation and controlling its impact on urban life and services requires specialized management tools and institutions. Although the Metropolitan Corporation or the Municipality is generally responsible for collection, transfer and final disposal of solid waste; but it is not been effectively managed so far. The reasons for inability to manage solid waste disposal in Karachi range from political and governance issues to that of technical capacity and resource constraints. This paper focuses on management issues and explores the opportunities for Local Government Councilor managed neighborhood level waste collection and recycling. A local Government Councilor acts as an intermediate agency between the households and Government, capable of managing the neighborhood level centers. Councilors are elected by the people in their respective areas to represent them in the Metropolitan Government. They are at the lower level of Government hierarchy but are resourceful and good at mobilizing Government budget and citizen contributions. Strengthening their role may not lead to a complete solution but at least will make domestic waste collection and recycling possible. In the absence of active citizenship, powerful private sector and weak Local Government; an entrepreneurial and creative Local Government Councilor can efficiently and sustainably manage solid waste problem at union council or ward level. This paper looks at international best practices in 3Rs - reducing, recycling and reusing solid waste; and identifies opportunities and risks for adapting them to Karachi's situation. The paper, through a case study of two neighborhood areas in Karachi's Civil Lines and Orangi union council assesses Local Government Councilors' role and recommends strategies for strengthening their role in solid waste management as a measure for pollution control. Best practices of neighborhood level recycling centers are particularly discussed because of its scale of operation and contribution to cost saving and improving operational efficiency at city level.

Keywords: Sustainability; Solid waste; Government; Pollution control; 3Rs

Integration of newly developed quality, environment, health and safety management system in operation and maintenance of onshore wind energy industry of Pakistan

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ABSTRACT

Wind energy industry is growing swiftly in the renewable sector. In Pakistan, 24 onshore wind farms became operational during 2013 to 2018 accumulating 1236 MW in the national grid. O&M phase is the longest among 4 phases of a wind turbine. Workers involved in O&M activities are at higher risk than the workers in the construction industry. QEHS-MS is the only pathway for secure and environment friendly activities. QEHS-MS developed on ISO 9001:2015, ISO 14001:2015 and ISO 45001:2018 is also called integrated management system (IMS). In this research, an integrated QEHS management system is designed, complying National and International standards. A controlled documentation system is the part of the QEHS-MS developed. Four levels of documentation are designed for a single framed management system. EHS culture is the key attribute to evaluate organizational performance. In present research study, EHS culture of onshore wind farms of Pakistan was calculated in percentage using a feasible evaluation tool, categorizing in 5 levels. Using this research any onshore wind farm can develop and integrate the QEHS-MS in O&M and precede for IMS certifications. EHS culture of onshore wind farms can also be evaluated and analyzed to identify grey areas for enhancing EHS in business and may lead in the market.

Keywords: QEHS management system; EHS culture; Onshore wind farms; Integrated management system; Wind energy

POSTERS

Photocatalytic removal of bisphenol a using 3d structured bismuth oxide clay media

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ABSTRACT

A 3D structured clay media was integrated by using a 3D printed mold. Dip-coating method was used to obtain Bismuth oxide thin films on clay media surface. The bare and coated media were analyzed for phase and crystalline structure that confirms the films as tetragonal β-Bi2O3 in the case of coated media. UV-Vis spectroscopy of the bare and coated media was also analyzed, the absorbance spectra were observed in the visible range in the case of coated clay media. The energy band gap was estimated using tauc plot i.e., ~ 2.4ev. At first, the media was investigated for its photocatalytic activity, then the emergent compound Bisphenol A was investigated at varying concentrations using the bare clay, Bi_2O_3 coated clay and control solution. Kinetics was found similar as the concentration was increased; this could be due to the transparent solution of BPA that does not resist light to pass on the material. Maximum removal of BPA achieved was 80% using Bi_2O_3 coated clay media under solar light irradiation.

Keywords: 3D structured bismuth oxide; Photocatalysis; Bisphenol A; Clay media

Optimization of fixed dome biogas plant for underprivileged communities living at lower Indus region of Pakistan

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ABSTRACT

The increased pollution due to fossil fuel combustion and increase in conventional energy cost, the utilization of the renewable energy has become an attractive source of energy in many countries including Pakistan. In this study, a fixed dome biogas plant was constructed in accordance with weather and geological parameters to optimize the basic parameters such as pH, TS (Total Solids), volatile solids (VS), TA (Total Alkalinity), temperature (T) and VFA (Volatile Fatty Acid) of the biogas plant for obtaining optimal efficiency. The biogas production was measured by using Ritter drum type (wet test) gas flow meter with maximum flow rate of 500 liters/hr. The average alkalinity was 2954 mg CaCO3/L whereas VFA, TS, and VS were 475 mg CaCO3/L, 5.1%, and 68% respectively. The average biogas production was obtained 0.43 m^3/Kg *VS* with the temperature of digester slurry at 20 ºC whereas maximum biogas production was measured when the digester slurry temperature was 35 ºC. Hence, the efficiency of the biogas plant was calculated through degree of degradation in digester to 65%. Conclusively, the results of this study reveal that the VFA/TA ratio was 0.1 which indicates the process of anaerobic digestion is stable.

Keyword: Fixed dome biogas plant; Gas production; Temperature; Efficiency; VFA/TA ratio

Microalgae-bacterial consortium for effective textile wastewater treatment: a sustainable solution

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ABSTRACT
The unchecked disposal of textile wastewater containing high concentration of nitrogen (N), phosphorus (P) and Chemical oxygen demand (COD) is responsible for causing Eutrophication resulting in the loss of precious aquatic life and water pollution. Worldwide eutrophication issues highlighted the need for a cost effective and eco-friendly method for removal of nutrients from textile wastewater. Bioremediation is such a technique used in 21th century in this regard. Therefore, a batch scale experimental study was conducted with three different experiments Vis, single stage, two stage and consortium to remove nutrients with maximum biomass production. The results indicated that consortium of microalgae-bacteria provide maximum removal efficiency as 58.57 % nitrate, 86.42 % phosphate, 91.5% COD, respectively. The native *Chlorella sp*. of microalgae with *Staphylococcus sp. of bacteria* was used in experiments were observed under fluorescence microscopy. Hence, results indicated that this method not only treats textile wastewater cost-effectively but also produces chlorophyll as biomass which could be utilized to produce biofuels to overcome energy deficit and grow crops with organic fertilizer production.

Keywords: Consortium; Nutrient's removal; Eutrophication; Biomass; COD

Financial gains for strengthening desalination technologies

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ABSTRACT
Many reasons have virtually drifted water stress into a crisis with severe economic and social repercussions. As a result, initiatives are directed to retrieve usable water from the largest marine resource such as ocean. The erection of thermal and mechanical desalination projects remain the only avenue to address this water crisis. Water desalination investments have expanded all over the world and specially in the region of the Middle East. The Mechanical & Thermal desalination share evaluating the cost associated with different technologies in the world production, its market, capital investment, capacities and supplies, the big potential user (countries) of this plant along with their capital investment have been analyzed. The recent contracts and forecasting the future requirement of desalinated water and market share for Middle East countries have been examined. It is duly feared that water stress may prevent infrastructural development from maturation in the coastal belt of Pakistan, where ample developmental activities are concentrated. It argues that a little fore-thought for attaining and mastering the technology and training manpower for the desalination industry can become an opportunity for earning foreign exchanges. It also provides recommendations for establishing and strengthening the desalination industry.

Keywords*:* Desalination; Market share & investment; Economic; Coastal area

Efficient photo-esterification capability of bismuth vanadate photocatalyst for biodiesel production

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ABSTRACT

In current investigation, the first mutant castor variety of Pakistan (NIAB Gold) was used for biodiesel production which has 57 % oil content. The study was carried in two steps. Because of the presence of high free fatty acids (FFAs), castor oil was first esterified using different homogenous and heterogeneous catalysts. It was observed that among different catalysts used, Bismuth vanadate ($BiVO_4$) depicted maximum potential for esterification of FFAs under visible light irradiation. All-important parameters were optimized during photo-esterification process and about 97.49 % of FFAs were esterified by using 1:1 methanol to oil ratio and 3 % $BiVO_4$ catalyst in 90 minutes. In the second step, the esterified castor oil was used for biodiesel production. Different catalysts were used for trans-esterification process and the highest fatty acid methyl ester (FAME) yield (90 %) was obtained by using CaO catalyst within 4 h of reaction time at 65 ºC. A comprehensive physicochemical analysis of synthesized biodiesel was carried out and it was observed that castor oil biodiesel meets all the ASTM standards. Results indicated that $BiVO_4$ is an efficient catalyst for biodiesel production from non-edible oils which need to be treated in order to esterify FFAs before biodiesel production process.

Keywords: Castor oil; Free fatty acids (FFAs); $BiVO_4$ photo catalyst; Biodiesel

Development of biodegradable and edible packaging materials

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ABSTRACT
An edible film made of different compounds like papaya paste, gelatine and soy protein(SP), the thin layer will be created from papaya paste, gelatin and soy protein. This study point is related to create a packaging material that can be eaten after the utilization. The created edible film will be analyzed by implies of color, mechanical properties and effect of gelatin on over all barrier characteristics. Expansion of soy protein in papaya may have effect on transition and melting temperature. The prepared film will moreover be analyzed through FTIR to check the compatibility of soy protein with papaya paste. At last, the prepared packaging will be utilized to viable applications to check the relevance of the film's to packaging nourishment.

Keywords: Edible film; Papaya puree; Defatted soy protein; Gelatin; Film properties

Development of encapsulating materials for packaging opto-electronics

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ABSTRACT
Organic electronics have used in various applications such as in photovoltaics (OPV), organic light emitting diodes (OLEDs), organic field effect transistors (OFETs) and organic photodetectors (OPDs) due to their flexible and adaptable nature. Presence of moisture and oxygen content increase degradation rate of organic electronic devices, especially under illumination and material becomes unstable. Even produce hazardous effects on encapsulating material of organic electronics. Encapsulation materials not only fulfil requirement of WVTR & OTR but also having properties such as light weight, cost effective, flexible and the most important optically transparent. Manufacturers are very concerned to use economical deposition technique to improve life of opto-electronics. In this work, solution method is used via doctor blade to produce packaging film. Polymer such as PVA and PVB are used as a matrix to develop a composite for thin film. Glass flakes as a filler is used because it decreases thermal expansion while increase stiffness. As the filler content increase, transmission decreases. Various characterization techniques have applied to monitor barrier properties, surface morphology, thermal & mechanical stability, solubility and optical transparency.

Keywords: Encapsulation; Thin film; Solution processing; Nano composite

Consumption of several industrial wastes in concrete as a cement replacement material and its impact on strength

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ABSTRACT
Approximately 50% of marble production becomes wastage during quarrying process, and in Pakistan this figure reaches to 73%. According to projected statistics, 37.26 million m3 fuel-wood is being consumed in 2015 only in Pakistan. Industrial by-products are commonly used in concrete production as cement replacement materials (CRMs) to enhance both fresh and hardened properties of concrete as well as to save the environment from the negative effects caused by their disposal. A little investigative effort is made to utilize the wood ash (WA) and marble dust (MD) as CRM in concrete; and to evaluate their effects on strength of concrete. It has been done by preparing the WA and MD samples by some physical means. After the formation of proper usable material, it is partially replaced with cement (5%, 10%, 20% and 40%) in concrete specimens to analyze the impact on its compressive strength. From the experimental work it has been found that by incorporating 10% wood ash (WA) the strength of concrete cube increases up to 4 to 5%, by incorporating 10% marble dust (MD), the strength of concrete increases 16 to 17%. Higher concentration of WA or MD leads to the decrement in strength. The porosity of concrete specimen also decreased at 10% inclusion of wood ash.

Keywords: Cement replacement; Compressive strength; Concrete; Marble dust; Wood ash

Enhancing the moisture barrier properties of PVA by incorporation of graphene oxide

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ABSTRACT
Graphene is stiffest, thinnest and strongest material known which can be found synthetically from graphene oxide (GO) as GO consists of layers of graphene and Polymer/graphene nanocomposites possess unique properties but, Graphene oxide (GO) has proved to be the best alternative form of atomic thick carbon scaffold as fillers for improved physical properties. For fabrication of GO different methods have been introduced. But, in this study; GO was prepared by using Tour's method and used later to prepare a nanocomposite with poly (vinyl alcohol) (PVA), for its application as packaging film using a very simple and environment friendly method. Later on to enhance moisture barrier properties heat treatment of the prepared film were also done.

Keywords: Thin film; Graphene Oxide; Poly (vinyl alcohol); Barrier properties

Perhydropolysilazanes layers as decent gas barrier films

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ABSTRACT
Currently, wide usage of Polysilazanes as an alternative route to produce dense, homogeneous, and defect free silica films is observed. We can produce a dense and homogenous SiO^2 films from PHPS liquid precursors and can be utilized as a potential barrier against diffusion of gases. For this reason, PHPS are widely being used for various applications, more specifically in Organic light emitting diodes (OLED) displays, semiconductor industry, and for packaging purposes. One of the important reasons using PHPS coating is their volume expansion, that is due to their rise of molecular weight during the conversion of PHPS to silica, owing to its reaction with air and moisture, thus exhibiting very low susceptibility to crack formation and shrinkage. In this paper, we have demonstrated the process optimization of the curing times of the PHPS in terms of curing methods, curing environment as well as deep UV irradiation along with simultaneous heating of the substrate. The quickest curing was achieved when the layers were irradiated with deep UV at smaller distances along with heating at 100ºC. The cured layers were further characterized in term of WVTR against different film thickness, the lowest WVTR was exhibited by the films having thickness of 400 nm. The WVTR was further decreased by creating multilayers of PHPS and lowest WVTR of 10^{-3} g/m^2.day was achieved with three consecutive PHPS layers. This result clearly puts PHPS as a suited candidate for encapsulation of organic solar cells.

Keywords: Polysilazanes; Moisture permeability; Thin films; Solar cell encapsulation; Transparency

Experimental investigation of various supplementary cementitious materials by partial replacement of cement

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ABSTRACT
In Pakistan, tons of solid waste generated from household, industries and factories mainly comprises plastic bottles, clothes, wrappers, cans, ash, bricks and dirt, glass, textile, cardboard, food wastes, leather, paper, plastic, rubber, metal, wood and yard wastes on daily basis**.** At present, there is no proper utilization of these generated wastes rather than dumping in the landfill sites. It is an undeniable fact; major proportions of these wastes require a longer time span to decompose and are main contributors of environmental degradation. The development in concrete technology can decrease usage of natural energy reserves and reduce environmental contamination. Cement is the major cause of environmental pollution even though knowing the fact the construction industry still significantly depends upon cement for the construction of substructures and superstructures. In this era of science and technology, engineers and contractors are more inclined towards incorporation of different waste materials which are inexpensive, durable and provide more strength to the concrete structures. In this way, the cost of cement will be reduced and achievement of more strength will be possible. In this era of coronavirus pandemic, where enhancing environmental health through better air quality, water and sanitation, waste management, along with efforts to safeguard biodiversity, will reduce the vulnerability of communities to pandemics and thus improve overall societal well-being and resilience. Recently many researchers established that utilization of waste materials in combination with cement can significantly contribute positive influence towards the concrete workability, durability, strength and most importantly enhances environmental sustainability. In this research work variety of supplementary cementitious materials have been tested through experimental investigation as partial replacement of cement to formulate their compatibility as a construction material. The cementitious materials are used as alternatives of traditional concrete including fly ash, rice husk ash and marble dust powder. Concrete mixtures were prepared, experimented and conducted comparative analysis among compressive strength of conventional concrete and concrete having partial replacement of cement with supplementary cementitious materials. This research study examined that incorporation of 20% Fly Ash provides 12.37% increment while 10% Marble Powder and 10% Rice Husk Ash (RHA) provide only 4.16% increment in compressive strength of concrete cylinders in comparison with conventional concrete

Keywords: Environmental contamination; Concrete technology; Cementitious materials; Rice husk ash

Phytochemical, antimicrobial, and antioxidant activities of euphorbia mile extracts

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ABSTRACT

Plants have been extensively used for medicinal purposes in the past. Euphorbia species are also studied due to their nutritive and therapeutic potential. Herein, we investigated the quantitative and qualitative screening of phytochemicals to evaluate the biochemical, antimicrobial, and antioxidant activities of Euphorbia milli extracts in different solvents. Plants were collected from the agriculture university Peshawar nursery and the plant was identified by a taxonomist. Moreover, spectrophotometric methods were employed to quantify the phytochemical and pharmacological activities which include alkaloids, glycosides, flavonoids, saponins, steroids, tannins, and terpenoids. Total proteins, sugar, and reduced sugar of all three extracts of leaves, shoots, and flowers were also quantified. Antioxidant activity of leaves, shoot and flower for all three extracts was determined using standard DPPH free radical scavenging assay. Bacillus subtilis was employed to determine the antimicrobial activity of all three extracts. We found a variation of positivity and negativity in extracts of leaves, shoot, and flowers in different extracts. Flower extracted with acetone was found with the lowest total protein and leaves extracted with water were found with the highest protein level. Leaves extracted with methanol and acetone was found with the lowest total sugar, and vice versa in shoot extracted with the methanol. Reducing sugar was maximum in leaves extracted with methanol and lowest in shoots extracted with methanol. Leaves extracted with acetone was found with lowest antioxidant activity and comparatively higher in flower extracted with water w.r.t to other extracts. The study concluded a wide variety of euphorbia milli secondary metabolites and their medicinal value as antioxidant and antimicrobial activity of water, methanol, and acetone extracts of the shoot, flower, and leaves and their potential as drug agents.

Keywords: DPPH; Antioxidant; Antimicrobial; Pharmacology; Spectrophotometry**.**

Effects of cerium oxide nanoparticles on biodiesel blend

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ABSTRACT
Generating power from renewable energy sources has got interested all over the world and Pakistan also. In today's world, it is normal to fear that fossil fuels will be used soon. Energy prices are continually rising to their highest. Renewable energy supplies such as biodiesel have to be developed in Pakistan so that a sustainable energy mix can be made available to safeguard the interest of energy. In this respect, Jatropha biofuel becomes a good choice. It is extracted from Jatropha Curcas which has high oil-containing seeds and can grow quickly and can resist harsh environments also. This biofuel is used as a source of fuel mixed with diesel to get energy. The burning of fossil fuels also emits harmful emissions, by the utilization of biodiesel, these discharges can be lessened and so by the use of nanoparticles not only these emissions can be more reduced, but we can also improve the brake-thermal efficiency and decrease the specific-fuel consumption. So, for the implementation of this, a method has been studied in which nanoparticles of cerium oxide is mixed in a specific amount with jatropha biodiesel by the aid of ultrasonicator at 24.0 kHz, it was done for around twenty-five minutes to make a homogenous mixture of biodiesel, then the biodiesel blend was tested to get its chemical composition and properties. The fuel properties were then fed into the software to get different results. The whole performance showed a rise in the brake-thermal efficiency, reduce the specific-fuel consumption and the gases at the exhaust such as harmful particulates and NOx were reduced.

Keywords: Biodiesel; Renewable energy; Power