4th Conference on

Sustainability in Process Industry

SPI-2018

24th-25th October, 2018

Book of Abstracts

SPI-2018

Sustainability in Process Industry

From Nano to Macro Technology

University of Engineering & Technology, Peshawar

Conference on

SUSTAINABILITY IN PROCESS INDUSTRY (SPI-2018)

October 24 -25, 2018

Organized By:

DEPARTMENT OF CHEMICAL ENGINEERING
UET, PESHAWAR

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PREFACE

Sustainability means "to maintain or endure." According to the work of the UN Brundtland Commission, sustainability in the context of development is to "meet the needs of the present without compromising the ability of future generations to meet their own needs". Sustainable development encompasses social, cultural, environmental and economic aspects.

Pakistan is facing various problems and energy is one of the main issues today. There are many reasons behind energy crises in Pakistan, inefficient processes are one of the major factors amongst them. It is high time to address sustainability, link it to the process industries, and to contribute to sustainable development of Pakistan.

The Chemical Engineering Department of University of Engineering and Technology, Peshawar plays a vital role in research areas of national interest. Our faculty is actively involved in applied research at both national and international level.

The 1st conference on **"Sustainability in Process Industries (SPI-2012)**, held at UET, Peshawar on March 28, 2012, attracted prominent researchers from all over Pakistan which created a linkage and presented approaches for the application of sustainability in the process industry.

The Department of Chemical Engineering had again taken initiative to hold a 2nd conference on **"Sustainability in Process Industry (SPI-2014)**", on May 22, 2014 in collaboration with PASTIC and NAYS. The 3rd conference in this series, i.e. **"Sustainability in Process Industry (SPI 2016)"** was held on October 19-20, 2016, organized with the support of Higher Education Commission (HEC) in collaboration with PASTIC.

Continuing this tradition the 4th conference in this series, i.e. **"Sustainability in Process Industry (SPI 2018)"** is organized on October 24-25, 2018 with the support of Higher Education Commission (HEC), Frontier Works Organization (FWO), in collaboration with PASTIC.

The mission of this conference is to identify new directions for research and development on **"Sustainability in Process**

Industry" and share success stories regarding applied research and industrial case studies on R&D.
We hope that you will find this 4th conference on **"Sustainability in Process Industry (SPI 2018)"** intellectually stimulating and that the conference will provide you with a valuable opportunity to share ideas with other researchers and industrial practitioners.

Prof. Dr. Mohammad Younas
Chair

ACKNOWLEDGEMENT

It is our great pleasure to welcome you to the SPI-2018 4th conference of this series, i.e. "Sustainability in Process Industry (SPI-2018)". Putting together SPI-2018 was a team effort. We first thank the authors for providing the content of the program in the form of oral and poster presentations and all other participants. We are also grateful to the keynote speakers from academia and various industries. These valuable talks can and will guide us to a better understanding of "Sustainability in Process Industry".

We also thank the host organization, UET, Peshawar, and our generous sponsors HEC, PASTIC, FWO, Technology Links (Pvt) Ltd, Rizvi and Co. (Pvt) Ltd, and Meditron (Pvt) Ltd, without their support it would not be possible to hold this conference.

We are grateful to all organizers, who worked hard in order to make this conference successful.

ABOUT PASTIC

Established in 1957 as Pakistan National Scientific & Technical Documentation Centre, (PANSDOC) by UNESCO under PCSIR, later on project was formulated and it was converted to Pakistan Scientific & Technological Information Centre (PASTIC) and transferred under the administrative control of Pakistan Science Foundation in 1973.

PASTIC is committed to serve Scientific and Technological Information needs of R&D and Industrial Community through Anticipatory and Responsive Information Services. PASTIC collects information from within the country as well as from abroad, processes and organizes the same and disseminate to its users. PASTIC is the premier organization for dissemination of Scientific and Technological Information to the citizens of Pakistan through a network of its Centers located at Islamabad, Karachi, Lahore, Peshawar, Quetta, Faisalabad and Muzaffarabad. PASTIC clients include Scientists, Researchers, Engineers, Entrepreneurs and Industry people.

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- **Scientific Periodicals of Pakistan:** A handy guide of scientific periodicals published in Pakistan
- **Technology Round Up:** A bimonthly ebulletin provides latest national & international innovative S&T news/products and Industrial technology related forthcoming events.
- **R&D & Industry Information:** Universities/institutes of Pakistan; industrial challenges/problems & solutions; Pakistani commercial products/indigenous innovations; Chambers of Commerce in Pakistan; HEC established ORIC offices in universities; industries of Pakistan: Liaison between national and international industries; overseas investors of industry and commerce in Pakistan; Industrial Associations in Pakistan; Pakistan Industrial Academia Linkages.

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- **Reprographic Services PASTIC:** Reprographic Section has facilities for composing, designing, plate making, offset printing, binding etc. for Printing of books, Pamphlets, Brochures, Journals, Newsletters, Cards, Folders etc. These facilities are not only used for printing of PASTIC publications but are also extended to all other S&T and R&D Organizations.
- **Human Resource Development (Capacity Building)** through Seminars/Workshops /Trainings/ Exhibitions for knowledge based technological & industrial development in Pakistan for:
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PASTIC is striving hard to become a leading national organization of Scientific and Technological information resources for promoting & supporting Research & Development for sustainable socio-economic development.

ABOUT FWO

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To be a Premier Civil Engineering Construction Company

Values

- Unwavering resolve to complete projects no matter how difficult the situation or terrain is.
- Committed to Quality and adherence to timelines
- Complete focus on client satisfaction to proactively find solutions that best achieve the goals
- Follow international engineering practices

National Frontier Works Organisation (FWO), today's most versatile and vibrant construction firm, was established on 31 October 1966 to wrought a miracle and carve out a modern highway, the Karakoram Highway, across crags and crevices of the highest mountain ranges of the world. It was towards the completion stage of KKH that the Government analyzed the tremendous potential of FWO in carrying out civil engineering projects in difficult and inhospitable areas and decided not only to keep FWO in existence, but also to expand its tentacles throughout the country.

FWO History

For the last 51 years FWO has left its imprints, bringing prosperity to utterly backward and forgotten areas from the sun burnt plateaus of Baluchistan to lush green dales of Swat and Chitral and from the deserts of Sindh to snow capped Siachin. Over these years FWO has worked in diversified fields to include development of communication infrastructure like construction of roads, railway lines and airfields; irrigation like construction of dams, canals and barrages; power projects like thermal and hydal; tunneling and mining; telecommunication; construction of residential and industrial infrastructure and proved its unmatched qualitative and quantitative capabilities.

In 1991, FWO was called upon to participate in the reconstruction phase of Kuwait, after the Gulf war, and given to clear 3000 square

kilometers of highly mined area, littered with large quantity of ammunition left behind by the withdrawing Iraqi Army. FWO cleared the area in a record time of just 16 months, ahead of others construction forms of USA, UK, France, Egypt and Bangladesh. Similarly, in 2006, FWO constructed a road from Torkham to Jalalabad in the most hostile and difficulty security environment.

With professionally qualified and competent staff, efficient work force, flexible organisation and a large pool of modern construction equipment and machinery FWO is capable of undertaking any construction assignment at short notice anywhere in Pakistan or abroad. FWO, motto 'Striving for Excellence' amply speaks of the continued efforts to deliver the best.

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CONFERENCE PROGRAM

Venue: Centre for Advanced Studies in Energy, University of Engineering & Technology, Peshawar Sector B/3, Plot D, Hayatabad، Phase 5

Time	**1st Day, 24th October, 2018 George E. Davis Hall**
08:00-09:00	**Registration**
Inauguration Ceremony	
09:00-09:05	Recitation from the Holy Quran
09:05-09:15	Welcome address by Prof. Dr. Mohammad Younas (Conference Chairman)
09:15-09:30	Address by Dr. M. Akram Shaikh (DG, PASTIC)
09:30-09:40	Opening Remarks by Prof. Dr. Muhammad Abdul Aziz Irfan (Dean, Faculty of Mechanical, Chemical and Industrial Engineering)
09:40-09:50	Address by Prof. Dr. Iftikhar Hussain (VC, University of Engineering and Technology, Peshawar)
09:50-10:00	Address by Chief Guest
10:00-10:40 **Plenary Lecture-01 (George E. Davis Hall)** **by** **Prof. S. M. Javaid Zaidi** **(QAFAC Chair Professor** **Center for Advanced Materials** **Qatar University, Qatar)** **Comparative Study of Electrochemical Methods for Determination of Methanol Permeation Through Proton-Exchange Membranes**	
10:40-11:30 Tea Break and Poster Session 1(Carl Bosch Hall)	
Technical Session 1A (George E. Davis Hall) **ENERGY ENGINEERING-1**	
Session Chair: **Prof. Dr. Abdul Waheed Bhutto** Session Co-Chair: **Dr S. Naveed ul Hassan**	

11.40-12.00	KN-01	Prof. Dr. Abdul Waheed Bhutto *(DUET Karachi)*	Food-Energy-Water nexus: opportunities for advancement on nature based solutions
12.00-12.15	EE-01	Dr. Muazzam Arshad *(UET Peshawar)*	Energy Recovery in Steel Industry
12.15-12.30	EE-02	Dr. Nasir Khan *(China University of Petroleum, East China)*	Viscosity reduction of crude oil by using ultrasonic waves: A Review

12.30-12.45	EE-03	Muhammad Shehreyar Khan *(OGDC L Karak)*	Optimization & Economic analysis of crude stabilization unit
12.45-13.00	EE-04	Sana Ullah *(GIKI, Topi)*	Application of modified activated charcoal by bentonite clay for the isolation of dibenzothiophene from model oil
13.00-13.15	EE-05	Muhammad Alam Zaib Khan (*UET, Peshawar)*	Preparation, characterization and effect of binding materials on bio mass Pellets properties
Technical Session 1B (John Coulson Hall) SEPARATION SCIENCE AND TECHNOLOGY-1			
Session Chair: **Dr. AsimLaeeq Khan** Session Co-Chair: **Dr. Asmat Ullah**			
11.40-12.00	KN-02	Dr. Asim Laeeq Khan *(COMSATS Lahore)*	Matrix Membranes comprising of fluorinated and sulfonated PEEK and functionalized mesoporous COK-12 for CO_2 separation
12.00-12.15	SP-01	Dr. Zaib Jahan *(NUST, Islamabad)*	Cellulose Nanocrystals/PVA nanocomposite membranes for CO_2/CH_4 separation at higher pressure
12.15-12.30	SP-02	M. Zia ur Rehman *(UET, Lahore)*	Competitive adsorption of organic dyes from multicomponent solution using amine functionalized carbon
12.30-12.45	SP-03	Zufishan Shamair *(COMSATS, Islamabad, Lahore)*	Ionic Liquid Fused Mixed Matrix Membrane for CO_2 Separation
12.45-13.00	SP-04	Tanzila Anjum *(LSE, Lahore)*	A comprehensive study on the performance and antifouling enhancement of PSf Mixed Matrix Membranes by embedding different nanofillers: Zeolite 4A, UiO-66 and Zeolite 4A@UiO-66

13.00-13.15	SP-05	Zabia Sajjad *(COMSATS Islamabad, Lahore)*	Ionic Liquid based membranes for butanol-water separation using pervaporation
Technical Session 1C (Robert H. Perry Hall) **HEALTH, SAFETY & ENVIRONMENT**			
Session Chair: **Dr. Amanullah** Session Co-Chair: **Dr. Hayat Khan**			
11.40-12.00	KN-03	Dr. Amanullah *(UOA, Peshawar)*	Climate smart agricultural practices on degraded soils: symbiosis for sustainable crop production and food security
12.00-12.15	HSE-01	Dr. Waqas Ahmad *(UOP, Peshawar)*	Desulphurization of heavy distillate fuels using air assisted performic acid oxidation system.
12.15-12.30	HSE-02	Nida Zafar (*NUST Islamabad)*	Encapsulation of Slow-Release Urea Fertilizer in Fluidized Bed Coater Using Different Plasticizers
12.30-12.45	HSE-03	Nouman Ahmad *(NUST, Islamabad)*	To study the effect of PVA/Starch blends on dissolution rate of slow release urea fertilizer
12.45-13.00	HSE-04	Sudeeha Ishaq *(LSE, Lahore)*	Mixed Matrix Membranes comprising of BioMOF-1 in Polysulfone matrix for CO_2 Separation
13.00-13.15	HSE-05	Bilal Beig *(NUST, Islamabad)*	Slow Release Urea
13.15-14.15 **Lunch/Prayer Break – Poster Session 2 (Carl Bosch Hall)**			
Session 2A (George E. Davis Hall) **RENEWABLE ENERGY**			
Session Chair: **Prof. Dr. Naveed Ramzan** Session Co-Chair: **Dr. Nehar Ullah**			
14:15-14:35	Keynote-04	Prof. Dr. Naveed Ramzan *(UET Lahore)*	Effect of demineralization on the physiochemical structure and thermal degradation of biomass
14:35-14:50	RE-01	Dr. Khalid Mahmood Khan *(UET Lahore, FSD Campus)*	Highly Efficient Perosvkite Solar Cells based on Low-temperature Solution-

			Processed Electron Transporting Layers
14:50-15:05	RE-02	Dr. M. Alam Zaib Khan *(UET Peshawar)*	Performance analysis of diesel engine using biodiesel from waste vegetable oil
15:05-15:20	RE-03	Haris Mahmood Khan *(UET Lahore)*	Characterization of hydroxyapatite extracted from quail bones
15:20-15:35	RE-04	Rumaisa Tariq *(NUST Islamabad)*	Study of Sewage Sludge Pyrolysis Mechanism and Kinetics with model-free & model-fitting Approach
15:35-15:50	RE-05	Uzma Nawaz (*UET Peshawar)*	Home Pump-Storage Hydroelectric System as Alternative to Battery Bank in UPS System
15:50-16:05	RE-06	M. Sheheryar Iqbal *(NUST, Islamabad)*	A comparative study for an off grid model village on its electrification options
16:05-16:20	RE-07	Asif Ali *(USPCAS-E UET Peshawar)*	Bio methane from biogas, renewable energy resource for Pakistan
16:20-16:35	RE-08	M. Khawar (*UET Lahore)*	To Study the Effect of Particle Size of Indigenous Coconut Shell on Torrefaction
16:35-16:50	RE-09	Muneeb Hussain *(USPCASE NUST, Islamabad)*	A Technical Discussion on Mini/Micro Hydro Plants (MHPs). A Case Study of Gilgit Baltistan (GB).
Session 2B (John Coulson Hall) MODELING AND SIMULATION			
Session Chair: **Dr. Atta Ullah** Session Co-Chair: **Dr. Muazzam Arshad**			
14:15-14:35	KN-05	Dr. Atta Ullah *(PIEAS)*	Case Studies on Eulerian CFD Simulation of Chemical Process Systems
14:35-14:50	MS-01	Dr. Umer Afzal *(UET, Lahore)*	Experimental validation of a CFD simulation model to determine the distribution of gaseous emissions in the industrial indoor environment
14:50-15:05	MS-02	M. Ali Jamal *(GCU, Faisalabad)*	Experimental and Multiphase CFD studies of flow patterns

			and intensified micromixing performance of a multichannel micro-impinging stream reactor
15:05-15:20	MS-03	Ahsan Ayub (*SCME, NUST Islamabad)*	Sensitivity Analysis of Urea synthesis Process using Artificial Neural Networks
15:20-15:35	MS-04	Zanib Nawaz (*UET, Lahore)*	Impact of coal blends and co-firing with biomass on emission and efficiency of pulverized coal-fired power plant
15:35-15:50	MS-05	Aeman Qayyum (*UET Lahore)*	Furnace Oil Syngas Cleaning via Physical and Chemical Absorption
15:50-16:05	MS-06	M. Shoaib Khan *(UET Peshawar)*	BIM Based Energy Simulation for Assessment of Buildings Energy Wastage for Pakistan
16:05-16:20	MS-07	M. Aaqib *(UET Peshawar)*	Eye Gazed Controlled Wheelchair
16:20-16:35	MS-08	Muhammad Umer (*SCME, NUST Islamabad)*	Data-based Prediction and Sensitivity Analysis of Syngas Composition of a Moving Bed Coal Gasifier
16:35-16:50	MS-09	Zia-ur-Rahman (*SCME, NUST Islamabad)*	Exergy Analysis of Cumene Production Process through Interfacing of MATLAB and Aspen PLUS Environments
Session 2C (Robert H. Perry Hall) **MATERIALS ENGINEERING AND MINERAL PROCESSING**			
Session Chair: **Dr. Muhammad Najam Khan** Session Co-Chair: **Dr. Irshad Ali**			
14:15-14:35	KN-06	M. Najam Khan *(BUITEMS), Quetta)*	Annealing studies of Zinc Tin Oxide nanoparticles hydrothermally synthesized at lower temperature
14:35-14:50	MPE-01	Ms: Rabia Sharif *(UET, Lahore, FSD Campus)*	Comparative Analysis of Various Repelling Finishes on the Hydrophobic/ Oleo phobic Properties of Conventional Cotton Fabric
14:50-15:05	MPE-02	Ms. Ishrat Rahim *(UOP, Peshawar)*	Morphological, optical and sensing properties of

			graphene decorated by silver nanoparticles and PMMA thin film based sensors
15:05-15:20	MPE-03	M. Sulaiman *(UET, Lahore)*	Study of thermal and nano mechanical characteristics of chemically pretreated rice straw fiber.
15:20-15:35	MPE-04	Ishtiaq Ahmed *(UET Peshawar)*	Geopolymeric composite material for the application of thermal energy storage
15:35-15:50	MPE-05	Anem Saeed *(UET Lahore)*	Synthesis and Electrochemical Characterization of Novel Heterogeneous Ion Exchange Membranes based on Thermoplastic Polyurethane for Desalination of Brackish Water using Electrodiaylsis
15:50-16:05	MPE-06	Saeed Ullah *(Gomal Univ., D. I. Khan)*	Carbon nanotubes-based nanocomposites for the electromagnetic interference shielding
16:05-16:20	MPE-07	Pakeeza Mustafa *(NUST, Islamabad)*	Preparation and characterization of active and intelligent PVA/STARCH films for food packaging applications.
16:20-16:35	MP-E08	Afnan Ahmad *(UET Peshawar)*	Efficient Use of Waste Cardboard in Construction material
16:35-16:50	MPE-09	Sarfaraz Khan *(UET Peshawar)*	Development of Cobalt/Chromium Mixed Metal Oxide Coatings as a Good Corrosion Resistant Material
16:50-17:10 Tea (Carl Bosch Hall)			
19.00-22.00 Networking Dinner			
2nd Day, 25th October 2018			
09:00-09:40 **Plenary lecture-2 (George E. Davis Hall)** **By** **Prof. Dr. Asad Ullah Khan** **(Department of Chemical Engineering, COMSATS University Islamabad, Lahore Campus, Lahore, Pakistan 54000)**			

Stabilizing Aqueous Suspensions of Alumina and Zirconia by Controlling Interparticle Interactions through the Use of Commercial Polyvalent Organic Electrolytes			
Technical Session 3A (George E. Davis Hall) **Water Resource Management and Waste Water Treatment**			
Session Chair: **Prof. Dr Khadija Qureshi** Session Co-Chair: **Dr. Muhammad Daud**			
09.40-10:00	KN-07	Prof. Khadija Qureshi *(MUET, Jamshoro)*	Arsenic in Sindh & Health Risk Assessment
10:00-10:15	WWT-01	Khurram Imran Khan *(GIKI, Topi)*	Sustainable Removal of Arsenic from Contaminated Drinking Water by Electrochemical Process using Iron Electrodes
10:15-10:30	WWT-02	Sehrish Shafqat (*Riphah International University*)	Water Scarcity and Quality in Urban Sector: Domestic Recycling Solutions for Water Woes of Pakistan
10:30-10:45	WWT-03	Adnan Akhtar *(UET, Lahore)*	Treatment of dye polluted aqueous phase by electrocoagulation: Optimization Study
10:45-11:00	WWT-04	Amna Bashir *(GIKI, Topi)*	Improvement of Water Flux through Membrane in Forward Osmosis by Comparing and Investigating Multiple Salts Draw Solutions
11:00-11.15	WWT-05	Irrfan *(GIKI, Topi)*	Removal of Chromium from Tannery Waste
Technical Session 3B (John Coulson Hall) **SEPARATION SCIENCE AND TECHNOLOGY-02**			
Session Chair: **Prof. Dr. Arshad Hussain** Session Co-Chair: **Dr. Jamil Ahmad**			
09:40-10:00	KN-08	Prof. Dr. Arshad Hussain *(SCME, NUST, Islamabad)*	Fabrication and Characterization of Cellulose Acetate based Mixed Matrix Membranes for Gas Separations
10:00-10:15	SP-06	Dr. M. Aslam (*COMSATS Lahore)*	Energy-positive Treatment of Domestic Wastewater with a staged Anaerobic Fluidized Bed Ceramic Membrane Bioreactor

10:15-10:30	SP-07	Dr. M. Ahmad (*GCU, Faisalabad*)	Separation of complex feed streams of a product by layer melt crystallization
10:30-10:45	SP-08	Sidratel Muntaha *(UET, Peshawar)*	Feasibility study of Micro-filtration Membrane for Dewaxing of Edible oil.
10:45-11:00	SP-09	M. Raees *(COMSATS Islamabad, Lahore)*	Fabrication and Characterization of Novel Thin Film Nano-composite Membranes by Interfacial Polymerization for Solvent Resistant Nanofiltration
11:00-11:15	SP-10	Zaman Tahir *(COMSATS Islamabad, Lahore Campus)*	Mixed Matrix Membranes for gas separation based on Functionalized UiO-66 MOF
Technical Session 3C (Robert H. Perry Hall) Biochemical, Catalysis and Reaction Engineering			
Session Chair: **Dr. Sajjad Hussain** Session Co-Chair: **Dr. Naseer Ahmad Khan**			
09:40-10:00	KN-09	Dr. Sajjad Hussain (*GIKI, Topi*)	Electrochemical and Photo-assisted electrochemical technologies: an alternative to treat emerging contaminants
10:00-10:15	CRE-01	Abdul Sattar Jatoi (DUET, *Karachi, Sindh)*	Study to investigate parametric effect on biodesulfurization of coal
10:15-10:30	CRE-02	M. Sagir (*University of Gujarat*)	Catalyst for FFA reduction for bio-diesel production
10:30-10:45	CRE-03	Abid Ullah *(UET Peshawar)*	MnO2 based carbon nanotubes (CNTs) catalysts with enhanced Oxygen Reduction Reaction (ORR) activity in Polymer Electrolyte Membrane Fuel cells (PEMFCs)
10:45-11:00	CRE-04	Saad Ullah Khan *(GIK, TIO)*	Electrochemical degradation of Reactive yellow 145 synthetic dye through anodic oxidation of Ti/Ti0.7Ru0.3O2
11:00-11:15	CRE-05	Dr. Shaukat Ali *(University of Peshawar)*	Manganese-Catalyzed Sustainable C-H Bond functionalization

11.15-11.40 Tea Break (Carl Bosch Hall)			
Technical Session 4A (George E. Davis Hall) **GREEN SAFE AND SUSTAINABLE DEVELOPMENT**			
Session Chair: **Prof. Dr. M. Suleman Tahir** Session Co-Chair: **Dr. Hayat Khan**			
11:40-12:00	KN-10	Prof. Dr. M. Suleman Tahir (*University of Gujrat)*	Effective utilization of Pakistani Reserves for Sustainable Energy Production
12:00-12:15	GSD-01	Mian Waqar Ul Mulk *(OGDCL)*	Control system to self-regulate adsorption & desorption processes for solid desiccant dehydration unit
12:15-12:30	GSD-02	Waheed-Ur-Rehman *(UET Peshawar)*	Concentration of Pomegranate Juice through Non-Thermal Osmotic Distillation Technique using PVDF and PTFE Membranes
12:30-12:45	GSD-03	Ali Ahmed Durrani (*UET Peshawar)*	Multivariable regression analysis for Super-hydrophobic PVDF flat sheet membranes in DCMD
12:45-13.00	GSD-04	Salma Amir *(University of Peshawar)*	Determination of dinitroaniline herbicides in water and onion samples by SUPRA microextraction: Green chemistry approach

Technical Session 4B (John Coulson Hall) **ENERGY ENGINEERING-2**			
Session Chair: **Prof. Dr. Abdul Waheed Bhutto** Session Co-Chair: **Prof. Dr. Farid Khan**			
11:40-12:00	KN-11	Prof. Dr. Mahmood Saleem (*ICET, University of Punjab)*	Entropy Generation and Work Lost Analysis of Rice Husk Fired Thermal Power Plant; A Case Study
12:00-12:15	EE-06	Zeeshan Hameed *(NUST Islamabad)*	Synergetic Effect and Kinetic Evaluation of Biomass and Sewage Sludge blends in Co-Pyrolysis Environment
12:15-12:30	EE-07	Inzamam Ul Haq (*UET Peshawar)*	Basin Design Optimization of Gravitational Water Vortex Power Plant

12:30-12:45	EE-08	Shahi Mulk *(USPCAS-E UET Peshawar)*	Development and Testing of Electromechanical Over-Speed Controller For Vertical Axis Wind Turbine System
12:45-13.00	EE-09	Qurat Ul Ain *(USPCASE, UET Peshawar)*	Lightning Protection Analysis of Shiekh Muhammadi Grid Station by Effective Placement of Surge Arresters
Technical Session 4C (Robert H. Perry Hall) **PRODUCT AND PROCESS DEVELOPMENT** Session Chair: **Engr. Younas Khan** Session Co-Chair: **Dr. Nehar Ullah Khan**			
11:40-12:00	KN-12	M. Yasir Khan (*University of Karachi)*	Synthesis of Metal Oxide Nanostructures by Low Cost Solution Process for Optoelectronics Applications
12:00-12:15	PPD-01	Ramesha Tariq *(UET, Lahore)*	Small Scale Production of H_2 via Autothermal Reforming in an Adiabatic Packed Bed Reactor
12:15-12:30	PPD-02	M. Bilal Israr (*UET Peshawar)*	Impact of Horizontal Urban Sprawl on the Road Construction and Financing – A Case Study for Peshawar Based Terrain Exchangers
12:30-12:45	PPD-03	M. Ahmad *(OGDCL Lahore)*	Characterization and rheological behavior of various Pakistani crude oils
12:45-13:00	PPD-04	Faizan Halim *(UET Peshawar)*	Masonary Retrofitting for out of Plane bending using Fiber Reinforced Plastic bands
13:00-13:15	PPD-05	Shehbaz Ahmad *(UET Peshawar)*	Optimization of Heat Exchanger using Quasi-Newton Method

13:15-14:15 Lunch and Prayer Break, Poster Session 4 (Carl Bosch Hall)	
14:15-14:45 **Plenary Lecture-3 (George E. Davis Hall)** **By** **Engr. Younas Khan** **(Askari Cement Wah)** **Industrial Psychology & Engineering Management**	
Closing Ceremony (George E. Davis Hall)	
15:00-15:05	Recitation from Holy Quran
15:05-15:15	Wrap-up by Prof. Dr. M. Younas (Conference Chair)
15:15-15:30	Award distribution announcement by Prof. Dr. Saeed Gul (Conference Co-Chair)
15:30-15:40	Vote of thanks, Prof. Dr. M. A. Irfan Mufti (Dean, Faculty of Mechanical, Chemical & Industrial Engineering)
15:40:15:50	Closing remarks, Prof. Dr. Iftikhar Hussain (VC, UET Peshawar)
15:50-16:00	Address by Chief Guest
16:00- 16:20 High Tea (Carl Bosch Hall)	

POSTER PRESENTATIONS

S.N	Author Names	Affiliation	Abstract Title
1	Farrukh Altaf	*NUST, Islamabad*	Preparation and Characterization of Antibacterial PVA/Starch based Hydrogel membrane for wound Dressing using Essential Oils
2	Ali Akbar	*UET, Lahore*	Effects of different binder types and their mixing ratios on the quality of biomass pellets
3	Ihtesham Ahmad	*NUST, Islamabad*	Size Optimization of Lead-Acid Batteries in Residential UPS sector, under Various Operating Conditions
4	Laraib Shoukat	*USPCAS-E UET Peshawar*	Comparison of Technical and Environmental Parameters in Different Energy Models.
5	M. Hamza	*UET Peshawar*	Estimation of Errors induced in domestic gas meters with age

6	Saeed ur Rahman	*UET Peshawar*	Removal of iron contents by flotation technique from Koga Nepheline syenite Buner, Khyber Pakhtunkhwa, Pakistan.
7	Abdur Rehman	*UET Peshawar*	Denoising of Texture Images Based on L0 Norm Smoothing
8	M. Sajid Khan	*UET, Lahore*	Sensitive analysis of post combustion carbon capture technology with MEA/glycerol mixture as a solvent
9	Tariq Mahmood	*UET, Lahore*	Effect of absorber intercooling and rich solvent recycle for post-combustion CO_2 capture system
10	Azqa Khalid	*COMSATS, Islamabad, Lahore Campus*	Economic Comparison of Various Pervaporation Based Ethanol Recovery Schemes for Syngas Bio-Refinery
11	Qaisar Khan	*UET Peshawar*	Design and Analysis of a Miniaturized Dual-band Conformal Implantable Antenna for Capsule System Applications
12	Abdul Basit	*UET Peshawar*	Seismic Fragility of Reinforced Concrete Moment Resisting Frame Structures in Pakistan
13	Inzamam Ul Haq	*USPCAS-E UET Peshawar*	Mathematical modelling of Power Transformer based on State Space vectors in MATLAB Simulink
14	M. Imran Ahmad	*UET Peshawar*	Deep learning through project-based learning in Chemical Engineering courses
15	Kashif Ali	*USPCAS-E UET Peshawar*	Phase Change Materials for Personal Cooling
16	M. Saad Rehan	*UET Peshawar*	Characterization of Dera Ismail Khan KPK Region Shale Rock using X-Ray Diffraction
17	M. Ayaz	*UET Peshawar, Abbottabad Campus*	Iot Based Fully Automated Lawn Mower with Cutting Level Adjustments
18	Afnan Haider Khan	*CECOS University, Peshawar*	Parametric Analysis of Bus-Bar in Silicon Cell of the Photovoltaic Module Under the Static Wind Load
19	Micaiah Das	*UET, Peshawar*	Technical Design for a Bio-Ethanol fermentation pilot plant from potato peels waste

20	M. Raheel khan	*USPASE, UET, Peshawar*	Comparative Analysis of Conventional and Concentrated photovoltaic technologies for power generation in Pakistan
21	Zanib Khatoon	*UET, Peshawar*	Development of membrane for CO_2 capture
22	M. Nouman	*UET Peshawar*	Effect of Aspect Ratio on Seismic Behavior of Unreinforced Brick Masonry
23	Khurram Shahzad Baig	*University of Wah*	Mechanism for Adsorption onto Wheat straw
24	M. Ayaz	*UET Peshawar, Abbottabad Campus*	A Comprehensive study of Inductive Power Transfer Technology Based on High frequency H-Bridge Topology and Parallel Transmitting Coils Configuration
25	Munazza	*USPCAS-E UET, Peshawar*	Comparison of Socio-Economic Parameters in National Energy Models across the world
26	M. Altaf	*UET, Peshawar*	Recycling of waste LCDs
27	Syed Ali Shah	*UET, Peshawar*	Optimization of shell and tube heat exchanger by Genetic algorithm (GA) METHOD
28	M. Junaid Ammar	*UET, Peshawar*	Design of Integrated Forward Osmosis- Reverse Osmosis (FO-RO) Wastewater Treatment System for the Production of 100 m^3/day Potable Water

ABSTRACTS
(Plenary, Keynote, and Invited Talks)

Progress in Fuel Cell Technology Development as Clean and Sustainable Power Source

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ABSTRACT

Fuel cells has attracted worldwide attention as a promising alternative clean energy source due to growing environmental problems. Significant technological advancements have been made to develop fuel cells and make it a viable clean energy option. For transportation and domestic power applications fuel cells operating at low temperature, such as the proton exchange membrane fuel cells (PEMFCs) and direct methanol fuel cell (DMFC) are being developed. For fuel cells to be a feasible and economically viable, innovations in fuel cell components developments are required. In order to realize the success of fuel cell technology, exploration of new materials development for performance improvement and cost reduction remains a major challenge. Many efforts have been made in various research laboratories and automobile companies to develop high-performance fuel cells. In this presentation, advancement made for components development for PEM fuel cell in our lab will be described**.**

Low Temperature Methane Combustion Over Palladium Loaded on HBETA and Ti-Containing Zeolites – The Role of Support Properties in Enhancing the Hydrothermal Stability

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ABSTRACT

Nano-sized palladium particles were impregnated on HBETA and titanium-containing-zeolite and assessed for combustion of lean methane mixtures. A notable increase in hydrothermal stability was observed during time-on-stream experiments, where an almost constant, steady state activity obtaining 90 % methane conversion was achieved below 400 °C. The understanding on the stability of the catalysts were explored by characterizing the catalyst using H2-chemisorption, TPD, XPS analyses as well as N2-adsorption-desorption, XRD,

SEM, TEM. The results suggest that surface oxygen mobility and coverage plays a major role in the activity and stability of the lean methane combustion in the presence of large excess of water vapour. It was identified that water adsorption and in turn the hydrophobicity of the catalyst support as the major factor influencing the long term stability of combustion catalysts. The hydrophobicity and competitive adsorption of water with oxygen is suggested to influence oxygen surface coverage.

Stabilising Aqueous Suspensions of Alumina and Zirconia by Controlling Interparticle Interactions through the Use of Commercial Polyvalent Organic Electrolytes

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ABSTRACT

This talk will describe the optimisation of processes for certain alumina and zirconia ceramic aqueous suspensions by using three commercial and widely used dispersants. These studies have been carried out in order to investigate and characterise the stability of these suspensions. Three different commercially available dispersants `Darvan C' an ammonium poly(methacrylate), (R. T. Vanderbilt Company, Inc., USA), `Alumi-non' (aurintricarboxylic acid ammonium salt, Fluka Chemicals, UK) and `Tiron' (4-5-dihydroxy-1, 3-benzenedisulfonic acid disodium salt, Fluka Chemi-cals, UK) have been employed as aqueous ceramic stabilising agents for a commercial alumina and zircon powders. The results obtained reveal that there is a critical concentration for each dispersant, which gives the lowest viscosity and other rheological parameters such as, the complex, storage and loss moduli for the materials used. This critical concentration, which provides the lowest viscosity (called here the optimum concentration), was found as 1, 0.25 and 0.10 wt% for `Darvan C', `Aluminon' and `Tiron', respectively for alumina. For zirconia the optimum concentrations were 0.25 and 0.10 wt% of `Aluminon' and `Tiron', respectively. The adsorption isotherm, Electrophoresis, Sedimentation studies are also carried out to support the rheological experiments. Atomic Force Microscopy which probes the stabilisation mechanisms at a nanoscale has been also employed and its findings are correlated with the rheological studies which measure the bulk mechanical properties of the suspensions**.**

Arsenic in Sindh & Health Risk Assessment

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ABSTRACT

One of the concerns of the world today is the contamination of water bodies by arsenic. (As) is a very toxic element, which can be harmful to human health. World Health Organization (WHO) has set the per-missible limit of 10 ppb. The presence of Arsenic in groundwater of Sindh, Pakistan, was analyzed by Arsenic Kit and atomic absorption spectrometer. Water samples of Twenty-Four (24) districts on both left and right bank of RI (River Indus) were analyzed for Arsenic presence and from the results that highest As concentration was results as 200 ppb (parts per billion) i.e. above the WHO (World Health Organization) limit (10 ppb). Highest levels of As were observed in Sakrand, district Shaheed Benazirabad followed by Hala, Matairi, TMK (Tando Mohammad Khan) and Nasarpur regions. It was observed that ground water of areas on the left bank of RI was more contaminated than the right bank. Coordinate systems and Origin Pro was used for creation of Contour map to highlight the elevated arsenic in the studied regions. HRA (Health Risk Assessment) of these areas was carried out to calculate EDI (Estimated Daily Intake), TQH (Target Hazard Quotient) and CR (Cancer Risk). The estimated daily intake of arsenic was found from 0.305-5.667 µg/kg. 45% of the ground water samples tests investigated were above the permissible limits of As in water and generally located on the left bank of RI. The local wells in Sindh have never been tested for metal concentration former to use. These results provide baselines for researchers, NGO's (Non-Governmental Organizations) and government to apply arsenic treatment technologies in those areas.

Production of Furfural from Biomass Wastes in Fixed Bed Reactor

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ABSTRACT

Furfural, an important chemical, is produced in laboratory from various feed stocks. Four different types of biomass wastes (rice husk, bagasse, sawdust (*Dalbergia sisso* Roxb.), and sawdust (*Populus caspica* Bornm.) were prepared and investigated over 300-500°C temperature range in a fixed bed reactor. Effect of catalyst, temperature, and type of biomass wastes on the yield of furfural was

investigated. GC-FID (gas chromatography-flame ionization detector) was used for analysis of the product. It was observed that the furfural yield changed inversely with pyrolysis temperature. The highest yield of furfural was 43.77% achieved at 300°C from sawdust *(Dalbergia sisso* Roxb.) in the presence of sulfuric acid. The yield of furfural from rice husk, bagasse, and sawdust (*Populus caspica* Bornm.) at 300°C was 15.37%, 23.95%, and 14.18% respectively**.**

Food-Energy-Water Nexus: Opportunities for Advancement on Nature Based Solutions

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ABSTRACT

The conventional delivery of food, energy and water (FEW) services, which are essential for human existence and development, has been resource-negligent, posing significant challenges for sustainable development. Traditionally, global challenges, though interconnected, have been addressed singly, at times reducing one problem while exacerbating others. Failure to evaluate policy responses with an integrated approach leaves interdependencies hidden and gain for one side entails a corresponding loss for the other side which limits the policy planning entranced in trade-offs. The attempts for sustainable transformation of FEW services often overlook the interlinkages between the three systems. Nexus approaches simultaneously examine interactions and trade-offs and assess accomplishments. Interlinkages provide significant opportunities for advancement on nature based solutions (NBS) and concepts of green economy, simultaneous progress on multiple Sustainable Development Goals. This study provide an overview of FEW nexus. Study also review FEW nexus approach in the context of the progress on multiple Sustainable Development Goals. Study also examine benefit of the FEW nexus approaches while developing policies by countries and international donor agencies. Study also identifies the knowledge gaps which impedes adoption of nexus approach.

Keywords: Nature based solutions; Sustainable Development Goals; Green economy

Visible Light Photocatalysis of Mixed Phase Zinc Stannate/Zinc Oxide Nanostructures Precipitated at Room Temperature in Aqueous Media

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ABSTRACT

Aqueous synthesis was used to obtain zinc stannate (ZTO) nanoparticles by precipitation at room temperature. Pourbaix diagrams were employed to formulate the precipitation reactions and synthesis process. Solution pH was controlled during the synthesis process as a major variable. The synthesized ZTO particles showed good photocatalytic activity under UV light irradiation. In order to improve visible light photocatalytic activity of ZTO nanoparticles, mixed phase zinc stannate/zinc oxide (ZnO) composites were prepared by co-precipitation at room temperature. Effects of precursor concentrations on the size and morphology of the obtained particles are reported. The composite ZTO/ZnO showed better photodegradation under visible light irradiation compared to ZTO and ZnO nanoparticles with methylene blue (MB) as a test chemical contaminant. Experiments were designed to elaborate on the active species for photocatalytic degradation of the dye and are reported here. Benzoquinone (BQ) was found to be the most effective scavenger, reducing the photodegradation considerably, indicating that O2−• plays a major role in MB degradation since 50% reduction in photocatalytic activity was observed.

Keywords: Chemical precipitation, ZTO/ZnO composite, Visible light photocatalysis, Surface defects

Effect of Annealing Atmosphere on the Optical and Electrical Properties of Al-Doped ZnO Films and ZnO Nanorods Grown by Solution Process

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ABSTRACT

We demonstrated the synthesis of highly transparent conductive Al-doped zinc oxide (AZO) films through sequential nucleation and growth using a hydrothermal process. Vertically-aligned zinc oxide nanorods (ZnO NRs) were grown on the as-synthesized AZO films and the seed layer formed on glass/AZO by a low-temperature solution process. The ZnO NRs were randomly grown on the as-deposited AZO films. However, a high density of ZnO NRs grew vertically on the seeded AZO films. The influence of annealing atmosphere on

the optical and electrical properties of as-deposited AZO films and after growing ZnO NRs on AZO films were performed by annealing in air, hydrogen, oxygen, nitrogen and argon ambient. The results indicated that the resistivity and mobility were lowest for argon-annealed samples, whereas the carrier density was highest. The normalized PL peak intensity of argon-annealed sample in visible region was highest due to increase in surface defects.

Future Directions of Membrane based Gas Separation Technology

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ABSTRACT

Among the CO_2-mitigation technologies, the membranes based separation technology has attracted considerable interest due to its economic advantages as well as technically and eco-friendly process. CO_2 separation by membranes has proved to be associated with low energy consumption, low capital investment, low maintenance requirements, ease and simplicity in installation operation, low space and weight requirement, higher process flexibility, and low ecological footprint. Polymeric membranes are well poised to replace the conventional gas separation processes such as pressure swing adsorption, cryogenic distillation and absorption. However, according to well-known Robeson's upper-bound, the current polymeric materials have reached a permeability-selectivity tradeoff limit. Consequently, considerable efforts have been devoted to discover materials and procedures for the synthesis of new membranes with improved performance.

This talk will review the current status of the development of novel membranes for gas separations. Lessons learnt from the development of the current applications will be reviewed and used to suggest better membrane process development strategies.

Keywords: Gas Separation, Novel Membranes, Industrial Separations.

Case Studies on Eulerian CFD Simulation of Chemical Process Systems

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ABSTRACT

Computational fluid dynamics (CFD) has evolved as a powerful tool to simulate chemical process systems involving hydrodynamics, heat and mass transfer. Due to the maturity of technique, Eulerian method for simulation of multiphase systems has been widely used in the finite volume framework. We have used this methodology for hydrodynamic simulation of three different multiphase systems namely: assembly of heated rods, fluidized bed and turbulent contact absorber. First system was simulated as a single phase flow system involving heated rod assembly. In second system, CFD simulation of fluidized bed operating at high velocities was performed. In third case, a turbulent contact absorber involving three phases was simulated. In all the three cases, the simulated results were validated against available experimental data. It was found that in all the cases the results obtained matched the experimental data well. Minor quantitative differences were observed, which could be attributed to different models and model closure parameters.

Technology Development for Protein Enrichment from Rice Waste through Chemical Process

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ABSTRACT

Pakistan is a major producer of rice and above 80% of rice production is in Gujranwala, Pakistan region. Rice mills are producing waste broken rice which is used for the production of Glucose and waste cake in the roasting process. In normal practice, the fine rice is sent for slurry preparation where water is being added in combination with the α-Amylase enzyme. The retention time for enzymes to reduce rice into glucose, protein, and starch is 19 min at 104°C in stirred tank reactor at 50 RPM. Currently, α- amylase (α-AI) inhibitor is used and facing some limitations that the reaction conversion is not up to the mark and unconverted rice, starch, and α- Amylase is being received in the final product. The need of the hour is to use some other enzyme i.e. E1, E2, E3, E4 and E5 in order to achieve food grade protein production with minimum unconverted material and increased glucose production. The liquefaction section is followed by filter press in which crude protein and glucose are extracted and

collected after filtering through cheesecloth filter press. The liquid produced is the medical grade blood glucose send for packing while the cake obtained is a feed grade crude protein. The feed grade crude protein cake is composed of 50 % protein, 6 % glucose, moisture, starch, unconverted α- -amylase inhibitor and fibrous material. The need of the hour is to increase the percentage of protein in the cake by reducing unconverted and unwanted impurities to convert feed grade protein product to food grade. In this research this Crude protein extract was pre-incubated in different temperature (30-95°C) and for thermal stability and achieving required heat, the raw protein extraction is treated in pre –incubator at about 37 °C for time (30-240 min). For pH stability, the pre-incubated citrate phosphate buffer (pH 3-9) of the sample was assayed for inhibitory activity after adjusted pH to 6.9. Presently there is no technology available in the region and technology used in advanced courtiers is not addressing the regional problem. This project has potential to produce the value-added product like edible human grade protein which has high value in developed countries.

Theme 1: Biochemical, Catalysis and Reaction Engineering

Preparation and Characterization of Antibacterial PVA/Starch based Hydrogel Membrane for Wound Dressing using Essential Oils

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ABSTRACT

Health related issues are main fright of today's era. Nowadays researchers are focused on two main problems related to wound i.e Anticipation of infection and rate of healing of wounds. Numerous cellular and biotic atmospheres are entangled in the process of wound restoration. In current research, the hydrogel membranes were prepared by esterification of poly vinyl alcohol (PVA) with starch and glutaraldehyde. Three types of organic oils (clove oil, Oregano oil and tea tree oil with three different concentrations of 0.1ml, 0.2ml and 0.3ml for each oil) was used separately as antibacterial agent. Antibacterial Activity, Membrane properties and Physical Properties of all formulated hydrogels were performed. The maximum anti-bacterial activity for formulated hydrogel was achieved by adding 0.1ml clove oil in PVA/Starch Hydrogel. The physical and mechanical characterization of membranes with and without these antibacterial agent solutions of different concentration by Fourier Transform Infrared (FTIR) spectroscopy, x-ray diffraction (XRD), and differential scanning calorimetry. The FTIR results indicated the presence of -OH- group in hydrogel membrane which exposed strong hydrogen bonding due to addition of antibacterial agent. The SEM results specified about dense nature of membranes with or without antibacterial agent. Mechanical investigation of hydrogel membranes showed appropriate strength. Furthermore Hydrogel expressed good water preventing capacity and swelling properties. The experimental outcome designated that formulated Hydrogel expressed good Antibacterial, Mechanical and Physical properties that could be used as wound dressing applications.

Manganese-Catalyzed Sustainable C-H Bond functionalization

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ABSTRACT
A manganese(I)-catalyzed sustainable and direct C-H allylic allylation of aryl ketones is developed using weakly coordinating ketone moiety as directing group. The C-H functionalization method proceeds smoothly in a regioselective monoallylation manner to provide access to various substituted o-allylated (het)arenes in high yields. With challenging allylic electrophiles bearing substituents at α, β and γ-positions excellent regioselectivity(S_N2') was achieved under mild conditions (RT - 35 ^oC). Mechanistic studies revealed a rate determining C-H bond cleavage giving manganacycle and subsequent reaction with allylic electrophiles to give aryl-allyl coupled product.

Keywords: Cross-Coupling, Catalysis, C-H bond Cleavage, Regioselectivity, Manganacycle.

Study to Investigate Parametric Effect on Biodesulfurization of Coal

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ABSTRACT
Coal combustion emits many harmful gases, causing huge problems to the environment. Among these gases, sulfur dioxide, nitrogen oxides and carbon dioxide maintain stability in alleviating environmental problems. The pollution caused by coal combustion is the biggest problem in the current use of coal, and it is also the biggest constraint to the increase in the use of coal. Sulfur emissions from coal combustion are considered to be the main cause of acid rain. There is no cost-effective technology for desulphurization of coal, but biotechnology may provide solutions. Sulfur emissions harmful to the environment and human health after coal combustion. It is necessary to explore economic and environmental technologies, namely biotechnology. Current work focus on degradation of dibenzothiophene couple with parametric effect**.** *Rhodococcusspeci*was ultilized as bio-catalyst for conversion

DBT(dibenzothiophene) into 2-HBP (hydroxybiphenyl) followed by 4S-Pathway.The isolate could degrade 0.26 mM DBT through the 4S pathway within 6 days. Preliminary studies for sulphur removal using isolate indicated Pakistani coal to be more amenable (61% sulphur removal) followed by Lignite (9.2%). Different operational parameters include pH, Temperature, Rpm, pulp density and different carbon source. The maximum degradation of DBT compound into 2-HBP by utilizing 30 ^{o}C, 160 rpm, 15pulp density and glucose as carbon source. This could suggest that isolate *Rhodococcusspeci*had ability to degrade DBT compound from coal.
Keywords: Bio-degradation, dibenzothiophene, Pakistani low rank coal, native microorganism

Development of Cobalt/Chromium Mixed Metal Oxide Coatings as a Good Corrosion Resistant Material

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ABSTRACT

Metals oxides (MO) are one of the best protective coatings against corrosion prevention in process industry. Optimizing preparation methods can enhance the electrochemical properties of the MOs towards corrosion resistance. Current research was carried to develop cobalt/chromium bi-metallic coatings of various compositions and to investigate their properties for possible application as a corrosion resistant material. Thermally prepared Crx-Co1-x oxide coatings of different compositions were formed on a carbon steel substrate (CS). Electrochemical properties of the developed coatings were investigated through Tafel and cyclic voltammetry. Weight loss experiments and Scanning Electron Microscopy (SEM) were done to check stability of the coatings. Comparative analysis of the results obtained for bare metal CS (substrate) and Crx-Co1-x showed that coatings are very good in resistant to corrosion as compared to bare CS. Various coatings compositions of Crx-Co1-x were tested for the same application under same experimental conditions using corrosion rates and current densities, which concluded that Cr 0.7-Co 0.3 is best composition of metal oxides for corrosion control up to great extent and improved the stability of carbon steel substrate against corrosion. In addition, it was also concluded that resistance towards corrosion is strongly depends upon the nature of the components of which metal oxide is composed and their compositions as well.
Key Words: MMO, Scanning Electron Microscopy (SEM), Tafel curves, Cyclic Voltammetry, Thermal Decomposition.

MnO_2 Based Carbon Nanotubes (CNTs) Catalysts With Enhanced Oxygen Reduction Reaction (ORR) Activity In Polymer Electrolyte Membrane Fuel Cells (PEMFCs)

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ABSTRACT

Polymer Electrolyte Membrane Fuel Cell (PEMFC) is an electrochemical power generating technology which is deemed to play a vital role in future global energy solution. It uses a precious metal Platinum (Pt) catalyst for Oxygen Reduction Reaction (ORR), which is a major hinderer in the commercialization of PEM fuel cell. By using a non-precious group metal (NPGM) instead of Pt will reduces the cost of PEMFC. Herein MnO_2 carbon nanotubes (CNTs) were synthesized by impregnating the transition metal in a high surface carbonaceous material CNTs by hydrothermal synthesis techniques. To enhance the catalytic reaction and increase the volumetric current density, the species were pyrolyzed at 800^0C temperature under nitrogen atmosphere. During pyrolysis, the nitrogen was also doped in the frame work of carbonaceous material. The species were treated with acid, removing the unwanted metals and adding oxygen functional group to the CNT frame work due to which the activity of the catalyst is amplified. Linear Sweep Voltammetry (LSV) depicts a current density of 3.7 mA/cm^2 vs Standard Calomel Electrode (SCE) in 0.1M KOH electrolyte. Rotating Disk Electrode (RDE) was conducted at 400, 800, 1200, and 1600 rpm. The extraordinary results of NPGM are expected to prove a landmark in fuel cell commercialization.

Keywords: Carbon nanotubes, Oxygen Reduction Reaction, Proton Exchange Membrane Fuel Cell

Catalyst for FFA Reduction FFR Bio-Diesel Production

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ABSTRACT

A hybrid catalyst for free fatty acids (FFA) in Jatropha oil reduction developed along with biodiesel production is reported. In current project catalysts namely silica sulfuric acid, silica supported boron trifluoride and the mixture of the two were examined. It was observed that independently, the silica sulfuric acid and silica supported BF3 were not very effective. However, a strong synergistic effect was observed when used the mixture of these two catalysts. Which reduced the FFA to a very low value of less than 1% with a conversion efficiency of 98% and the reusability of catalyst was also found excellent. Activation energy was calculated to be 45.42 $KJ.mol^{-1}$ for hybrid catalyst. The products were analyzed by FT-IR and NMR spectroscopic techniques and results are reported. Further biodiesel production was also investigated found the conversion efficiency was maximum at 1:6 mole ratio.

Determination of Dinitroaniline Herbicides in Water and Onion Samples by SUPRA Microextraction: Green Chemistry Approach

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ABSTRACT

An efficient solvent microextraction method was developed for analysis of dinitroaniline herbicides (pendimethalin and trifluralin) in water and onion samples.. The proposed method involved vortex-shaking microextraction of supramolecular solvent (SUPRA) (250 mg 1-undecanol; 10% THF) with herbicides sample for 0.5 min. This solvent mixture provides an appropriate balance of hydrogen bonding, dipole–dipole and π-cation interactions to efficiently extract dinitroaniline herbicides .Factors affecting the extraction efficiency of herbicides like pH, amount of 1-undecanol, percentage of tetrahydrofuran (THF), composition and volume of SUPRA and vortex time were studied in linear range of 0.03-100 mgL^{-1}. The proposed method has been applied to the spiked water and onion samples and recoveries upto 99.0 % was obtained with low LOD of pendimethalin and trifluralin (3 - 5 $ngmL^{-1}$) for water samples and somewhat higher (7-11 $ngmL^{-1}$) for onion samples. Calculated

analytical eco-scale value (> 75) of the proposed method fulfilling principles of green analytical chemistry.
Keywords: dinitroaniline herbicides; supramolecular solvent; microextraction; 1-undecanol.

Theme 2: Energy Engineering

Comparison of Socio-Economic Parameters in National Energy Models across the World

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ABSTRACT

Pakistan is facing an unprecedented energy crisis for a couple of decades. The major reason of shortfall of energy is due to lack of proper and successful energy modelling in Pakistan. In order to address the energy crises, along with national energy model, every province of Pakistan needs to formulate a definite energy model for the future. To build a successful energy model a thorough study of energy models of different developing and developed countries is required. In energy modelling four main topologies are considered i.e. social, economic, environmental and technical. In this research, a comparison of socio-economic parameters is done to analyze the important aspects for future energy model of KP. In this paper parameters regarding socio-economic topology is first defined, then these parameters are extracted from the existing energy models of different countries. These parameters are then compared in an excel sheet which shows the reason behind the energy success of developed countries. This data will be guidance for policy makers towards the future energy models for KP as well as for Pakistan

A Technical Discussion on Mini/Micro Hydro Plants (MHPs). A Case Study of Gilgit Baltistan (GB)

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ABSTRACT

Energy is the lifeblood of all economic activities; scarcity of electricity and other forms of modern energy is a major barrier in the social and economic development. About 1.6 billion people in the world living in the rural areas have no access to electricity because of remote location and other technical and economic reasons. Pakistan is blessed with bountiful natural resources in the form of water that can be utilized to create electricity. The better and efficient use of clean renewable energy resources helps in getting rid of power shortages.

More than 12000MW mini/micro hydro potential is estimated to be available in the country. Out of this potential less than 5 percent has been tapped so far. Although the region of Gilgit Baltistan (GB) have tremendous potential for hydropower generation, most of the hydro plants in the region have been constructed without a thorough analysis. In Gilgit Baltistan (GB) micro/mini hydel plants (MHPs) having capacity between 100kW to 500kW have an estimated potential of 300MW exists respectively, but still the present system of energy generation is unable to meet region's rapidly increasing energy demands. The aim of this research is to study the role of mini/micro hydel plants for generating electricity for rural communities and to assess the cost effectiveness and environmental sustainability of these plants. It will also identify the issues and problems associated these mini/micro hydel plants, also study their performance and socio-economic impacts on the region. It is hoped that the suggestion and recommendation present at the end will be helpful for stakeholder to come up with well-designed policy in the future.
Keywords: Energy, Electricity, Renewable, Economic, Environmental impact.

Viscosity reduction of crude oil by using ultrasonic waves: A Review

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ABSTRACT

Recent energy demand persuades researchers to economically exploit and transport heavy and extra-heavy crude oils. Crude oil is usually transported via pipelines from production point to storage facility or ports. However, high viscosity is the principal challenge for petroleum industries in the pipeline transportation of heavy and extra-heavy crude oils. Various conventional techniques, such as blending of kerosene oil, gas plasticization, and thermal cracking, were employed to decrease high viscosity of these kind of crude oil. But some associating problems in conventional used methods are additional capital investment, high operational cost and increasing susceptibility of pipelines to corrosion. On the contrary, ultrasonic waves stimulation is an efficient, reliable, convenient, and environment-friendly technique for the viscosity reduction of different kinds of heavy and extra-heavy crude oils. The current study attempts to review all research works undertaken for the viscosity

reduction of crude oil samples acquired from various oil fields by either independent use of ultrasonic waves or the combination of ultrasonic waves technique and conventional methods. Ultrasonic waves generate thermal energy via three different means and violent implosion of formed bubbles in cavitation phenomenon during acoustic waves stimulation. These severe implosions help to reduce viscosity of heavy crude oil due to degradation of partial intramolecular bond and subsequent separation from asphaltene particles. However, crude oil exposure for extended time further breakdown asphaltenes particles into minute particles. Consequently, asphaltenes solubility increases and causes more suspension in a given crude oil samples. More interestingly, the synergetic effect of ultrasonic waves stimulation and the conventional method found to be significant in crude oil viscosity reduction. This study reviewed the contributions of previous researchers on this topic in recent 2.7 decades time. The heavy oil viscosity reduction for long pipeline transportation and Enhanced Oil Recovery (EOR) by either independent use of ultrasonic waves or ultrasonic waves stimulation/conventional method combination were also identified. The challenges and some prospective research areas regarding ultrasonic waves technology application in petroleum industries were also anticipated.
Keywords: Heavy crude oil, Viscosity reduction, Ultrasonic waves, Long distance transportation pipeline, Enhanced oil recovery

Characterization and Rheological Behavior of Various Pakistani Crude Oils

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ABSTRACT

Six Pakistani crude oils are characterized and their rheological behavior is studied in a standard rotational rheometer. TBP distillation data and density of whole crude oil are used to perform the basic characterization and to obtain the product distribution of the crudes. All the crude oils studied exhibit non-Newtonian behavior under the conditions of experimentation. Various non-Newtonian models such as the power law model, Bingham plastic model, and Herschel-Bulkley model are used to fit the experimental rheological data. The power law model exhibiting pseudoplastic behavior is found extremely satisfactory for the majority of the crude oils.
Keywords: Pakistani crude oil; characterization; rheology; power law; Bingham plastic; Herschel-Bulkley.

Energy Recovery in Steel Industry

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ABSTRACT

This work covers the energy audit of a local steel mill and cover different areas that need keen attention regarding energy conservation. This work also includes the methods of deploying waste heat and opportunities to save cost annually. The key equipment in steel industry contains furnace, conveyors, coolers, fans and motors that activate the entire process. This work will focus on process design of waste heat recovery systems & equipment and perform process simulations to compare the performance of the designed systems. This will help us to finally choose the optimum energy recovery process. Energy optimization and simulation will be performed using Aspen Plus® simulation tool. Our aim is energy conservation which will reduce energy consumption. Furnaces and boilers that are not sealed-combustion units draw heated air into the unit for combustion and then send that air up the chimney, wasting the energy that was used to heat the air. Also the fuel gases coming out of furnace can be used in order to pre heat the air entering the furnace as they exit at a very high temperature so this is one of the way to conserve energy. We will do energy audit which quantifies energy usage according to its discrete functions. It is an effective tool in defining and pursuing comprehensive management of the energy usage in various processes of the steel plant.

Keywords: Waste heat recovery, Energy optimization, Modeling & Simulation.

Estimation of Errors Induced in Domestic Gas Meters with Age

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ABSTRACT

In gas distribution networks accurate metering is necessary because a great number of diaphragm gas meters are installed and most of the meters are old. The purpose of this work is to study the effect of operational age on the performance of gas meters. In this work a statistical model is introduced to notice the measurement error of diaphragm gas meters while considering the effects of age on ($0.20Q_{max}$) and ($0.80Q_{max}$) of the maximum flow rate. In this study, G4 diaphragm gas meter were used because of its prevalence in Pakistan. Using regression analysis, this study analyzed the experimental results to determine the performance of diaphragm gas meters as a function of age. The statistical model proposed was able to evaluate the amount of error at $.20Q_{max}$

and $0.80Q_{max}$. The results showed a correlation between age and error and strong impact of age on the measuring error. The results can be used as a correction factor on diaphragm meters' operation on different age groups
Keywords: Diaphragm meters, Measurement error and Statistical Modeling.

Effects of different binder types and their mixing ratios on the quality of biomass pellets

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ABSTRACT

The need for use of renewable energy in order to curb the energy crises, both at industrial and domestic sector, has paved a way for more research into green technologies. Among renewable energy sources, biomass entails significant socio-economic and environmental benefits through utilization of residues. Among biomass sources, bagasse offers the highest potential as fuel for cogeneration plants at the existing sugar due to its high volatile content. In Pakistan, ~12 million tons of bagasse is produced annually. However, utilization of bagasse in its raw form is non-viable due to low bulk density, low HHV and low durability. Therefore, it is necessary to densify the bagasse in the form of pellets. Based on the preliminary results, the pellets produced by using raw bagasse were less durable. Therefore, in this study cow dung and molasses were used in different proportions as binders to increase the durability and heating values of biomass pellets. Production of biomass pellets using a commercial scale palletization mill and analyzed them to study their physical and chemical characteristics was the objective of this research work. Based on experimental results, 25-30% increase in percentage durability was observed with cow dung addition, but it decreased the higher heating values. Similarly, 10-15% increase in durability values were observed by adding molasses. But molasses addition has detrimental effect too, i.e. it increased 20-25% ash contents as well.
Keywords: Bagasse, cow dung, durability, higher heating value, pelletization.

Size Optimization of Lead-Acid Batteries in Residential UPS sector, under Various Operating Conditions

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ABSTRACT

Battery plays an important role in sector of energy. It functions as a storage device in renewable energy applications like solar/wind energy, and in UPS (Uninterruptible Power Supply) systems. Battery is one of the costly components, it constitutes up to 60% of total cost in Solar energy Systems and up to 80% in UPS system. System's reliability and performance depends upon battery. To increase systems' efficiency, battery performance needs to be optimized. Battery size is an important factor while choosing a suitable battery for an application. It should be able to provide requisite power and energy demand. Mostly, only criterion for selecting battery size is the required load. In this research, battery performance is studied under different charge/discharge cycle and operating temperature. It has been found that the load shedding effects the total power a battery can provide. Batteries of 80Ah, 100Ah, 150Ah, 200Ah, 220Ah and 250Ah were used for simulations in MATLAB. To cases of power outages scenarios have been defined for simulations. The results show that along with the required load, power outages should also be considered when selecting an optimum size of battery for UPS sector.
Keywords: Battery, Simscape/MATLAB, SoC, Duty Cycle, Ah Capacity.

Optimization & Economic analysis of crude stabilization unit

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ABSTRACT

Nashpa Oil & Gas field is located 42km away from city of Kohat, on main Indus highway operated by Oil & Gas Development Company Limited (OGDCL). Currently LPG plant & crude stabilization units have been installed & are in operation.

The primary objective of crude stabilization process, which is one of the most common operations in the gas processing world, is to primarily reduce the vapor pressure of the condensate liquids so that a vapor phase is not produced upon flashing the liquid to atmospheric storage tanks. This is done by stabilizing the crude oil by stripping off the associated gases so that the Reid Vapor Pressure (RVP) of crude is within desired range for safer transportation. The current crude stabilization is a refluxed operation along with a side reboiler to provide heat of separation, and a pump around stream for a heat recovery. The process stabilizes the crude oil condensate and the gas stream is dehydrated before feeding to the cryogenic system for extracting NGL. The purpose of this paper is to discuss the case scenario of the existing column and to show how sound design review and optimization will considerably improve the process and recovery while improving the economics of the LPG plant, utilizing in-house idle equipment to minimize capital cost. The case study is done on licensed

version of Honeywell's benchmark software Unisim Design, Aspen Process Economic Analyzer & in-house developed excel sheets.
Keywords: Modeling and simulation, Unisim Design, RVP, crude stabilization.

Application of modified activated charcoal by bentonite clay for the isolation of dibenzothiophene from model oil

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ABSTRACT

Conventional hydrodesulphurization being conducted at extreme conditions (3-7 MPa, 300-400 C) and stringent environmental controls have constrained industries to search for alternatives to mitigate refractory sulfur compounds in transportation fuels. Among numerous other desulfurization methods adsorption desulfurization has pulled in more consideration due to several advantages such as operation at mild conditions, low operation cost and availability of inexpensive adsorbents. In the present work several composites of activated charcoal/bentonite clay were prepared and utilized as an adsorbent for the removal of dibenzothiophene (DBT) from model oil. Batch experiments were conducted to observe the effect of different parameters such as contact time, adsorbent dosage and temperature. Later these parameters were also optimized. Activated charcoal has better surface acidity but their sole micropores distribution limits the removal of large sulfur compounds such as DBT whereas bentonite clay has poor surface acidity but it's mesoporous structure enhances removal efficiency. An attempt was made to overcome these limitations and analysis revealed that AC_{50} adsorbent showed better adsorption performance among other adsorbents. Adsorbents other than AC_{50} have greater fraction of bentonite clay or activated charcoal which in turn poses the problem of less surface acidity or insufficient mesopores. Kinetic studies for DBT adsorption followed pseudo second order reaction while the determined kinetics were well described by Freundlich isotherm. AC_{50} characterization revealed enhanced surface properties as compared to other adsorbents.
Keywords: Dibenzothiophene, Activated charcoal, Adsorption, Bentonite clay.

Energy Harvester for Vehicle's Suspension Vibrations Application

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ABSTRACT
In this paper, the fabrication and experimentation of a novel vibration-based, electromagnetic energy harvester is described. The harvester is appropriate for harvesting energy from vehicle's suspension system. The developed harvester consists of movable magnets and a wound coil. The harvester can easily be attached to the damper of the suspension system and will convert the damper vibration from road and other sources into electrical energy by virtue of the relative movement of magnets and coil. The developed energy harvester is tested under sinusoidal vibration of different acceleration levels from 0.3 to 3g. The harvester successfully produced a maximum open circuit voltage of 13.43 V at base acceleration of 3 g and at a resonant frequency of 16 Hz. Moreover, at matching impedance of 256 Ω, it delivered an optimum load power 151 mW at a resonant frequency of 16 Hz and at 3 g base acceleration**.**
Keywords: Damper, Electromagnetic, Energy generation, Harvester, Suspension system, Vibration-based, Vehicle motion.

Comparison of Technical and Environmental Parameters in Energy Modelling

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ABSTRACT
Energy demand is increasing globally due to population growth, improved living standards, access and availability of energy resources to the poor especially in developing countries. Policy decisions made today have ripple effect in energy system and can significantly shows its implications in long run. Pakistan is with rich with primary resources but the resources and opportunity can only be utilized if strong energy policies and future vision is in place. What is really missing in Pakistan energy sector is the combination of vision, strategy and commitment on the part of policymakers. In this paper, different energy models of developed and developing countries are analysed and important parameters for each topology (social, technical, environmental, economic) are extracted. Predominantly, technical and environmental parameters are compared and analysed in National energy models of different countries. Results will show us which important parameters need to be more focused for designing the strategy and devising future energy policy for Pakistan and will help in finding the existing capabilities of energy models to address different policy questions.

Theme 3: Environmental Science and Engineering

Climate Smart Agricultural Practices on Degraded Soils: Symbiosis for Sustainable Crop Production and Food Security

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ABSTRACT

Climate change refers to major changes in temperature, precipitation, or wind patterns, among others, that occur over several decades or longer. Food security is the key challenge under climate change that is highly vulnerable to continuously changing climatic patterns. Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. Climate change has negative impact of both water (low & high water stresses) and soil (low soil fertility, loss of organic matter, soil pollution etc.) resources. The loss of water and soil resources results in low yield per unit area which is the main cause of food security globally. Climate Smart Agriculture (CSA) is defines as the sustainable increase in productivity, enhances resilience (adaptation), reduces/removes GHGs (mitigation) where possible, and enhances achievement of national food security and development goals (FAO). There are three main pillars of CSA: (1) productivity (food security), (2) adaptation, and (3) mitigation necessary for achieving the sustainable development goal. The decline in crop productivity and problem of food security can be reduced with adaptation and mitigation strategies: 1-Diversification of production system (crop diversification, multi-species plantation forestry, regeneration of native species; 2-Integration of production systems (crop/livestock, agroforestry, promotion of legumes in crop rotations, adoption of short-rotation commercial species; 3-management practices and technologies (soil, nutrient and water conservation practices, high quality seeds, avoiding burning of crop residues), and 4-Ecosystem conservation and restoration (forest conservation, protected area management, afforestation and reforestation & control of wildfires etc.). Climate Smart Agriculture practices include sustainable soil management/crop management/water management; sustainable livestock/poultry/fisheries management; sustainable energy, forestry and natural resources management. The best management practices (BMPs) which are individual or combinations of management practices that researchers, have identified as the most effective and economical way of reducing damage to the environment. The BMPs reduce pollution from nutrients are: (a) nutrient management, (b) irrigation water management, (c) agricultural waste management systems, and (d) composting. Integrated crop management (ICM) practices combines the best of modern technology with some basic principles of good farming practices for sustainable development. The ICM includes: the use

of proper cropping pattern and rotations, tillage systems/conservation tillage, appropriate cultivation techniques & intercropping, green and brown manuring, careful choice of seed varieties, cultivars, hybrids & genotypes, minimum reliance on artificial inputs such as chemical fertilizers & pesticides, maintenance of the landscape, the enhancement of wildlife habitats, improvement in water quality, increase in soil biodiversity, improvement soil health. Changing SOM (SOC) affects the capacity of soils to buffer against environmental change, and changes the provision of ecosystem services required for crop production. The SOM, therefore, closely regulates the resilience of the agricultural system to climate change. Our long-term field experiments on field crops e.g. cereals crops (rice, wheat & maize), oilseed crops (canola, sunflower & soybean) and grain legumes/pulses (chickpea, mung bean & mash bean) confirmed a significant increase in yield per unit area with integrated nutrients management under semiarid climate. The combined application of plant nutrients especially major nutrients (nitrogen, phosphorus and potash) along with bio-fertilizers (beneficial microbes) and organic carbon sources (farmyard manure; animal manures: poultry manure, cattle manure, sheep manure, goat manure etc.; plant residues: onion residues, garlic residues, wheat residues, rice residues, chickpea residues, faba bean residues, canola residues etc.) into the soil had significantly improved crop growth and increased productivity and profitability. Investments in education will help long term changes in behavior and mind-sets and incorporate the concept of environmental sustainability in daily life to facilitate change in the grower's culture. Sustainable agriculture practices are rapidly increases in farming community aiming at producing food and energy in a sustainable way to improve health of all.

Keywords: best management practices, nutrients management, water management, organic farming, climate change

Electrochemical and Photo-Assisted Electrochemical Technologies: An Alternative to Treat Emerging Contaminants

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ABSTRACT

The occurrence of pharmaceuticals and personal care products in the environment has raised concerns about their impact upon environmental and public health. This study investigated the effectiveness of electrochemical, photo assisted electrochemical, to antibiotic degradation in aqueous solution. The electrochemical and photo-assisted electrochemical degradations were performed in a filter press type flow cell using a dimensionally stable anode

with nominal composition of $Ti/Ru_{0.3}Ti_{0.7}O_2$. During both these processes the effects of different parameters were analyzed, such as, nature of the electrolyte concentration of the supporting electrolyte (NaCl) and the applied current density. The variation of antibiotic concentration was determined by high performance liquid chromatography (HPLC) and the amount of organic matter was monitored by analysis of total organic carbon (TOC). The results indicated that SMX was completely degraded, but TOC was partially removed in all processes studied, during experimental period the increase of the current density and NaCl concentration enhanced the degradation and TOC removal in the electrochemical processes. The degradations followed by HPLC coupled with mass spectrometry, in which several intermediates were identified and proposed a reaction sequence for the degradation of SMX. The hydroxyl radical and active chlorine attack benzene and isoxazólico rings, and has been demonstrated that the initial compounds formed were hydrolyzed and chlorinated compounds. Inorganic ions such NO_3^-, NH_4^+ and SO_4^{2-} were also identified during degradation processes.

Keywords: Electrochemical oxidation, Emerging contaminants, Degradation

Encapsulation of Slow-Release Urea Fertilizer in Fluidized Bed Coater Using Different Plasticizers

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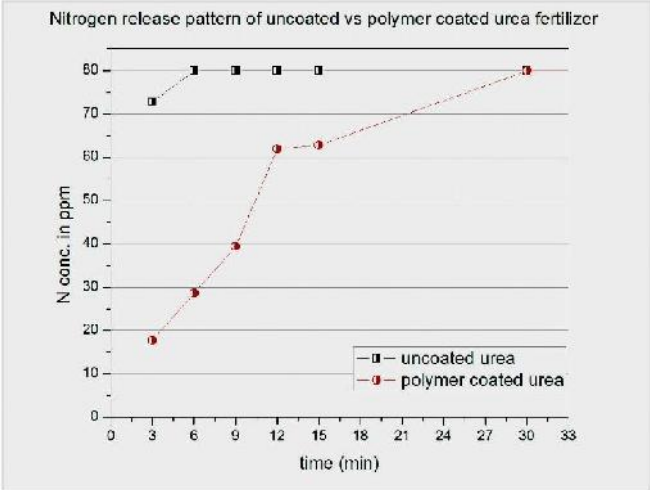
ABSTRACT

Urea encapsulated with polymer is one of the finest applied technique to make slow release urea fertilizer. Starch is naturally occurring abundant biopolymer but with low tensile strength. Poly-vinyl Alcohol (PVA) is synthetic biodegradable polymer and makes Starch/PVA blend with comparatively high strength. In current study, slow release Nitrogen formulations were synthesized based on Starch/PVA and Plasticizers (Acrylic Acid, Citric Acid and Malic Acid). The slow release profile of urea is examined in water using UV-VIS Spectroscopy technique. The effect of coating and decrease in nitrogen loss was also confirmed through field test. To get the best results different ratios of coating materials were used and compared. To encapsulate the urea prills Fluidized Bed Granulator was used. Slow release urea fertilizer is considered to enhance production while alleviating negative environmental effects caused by hazardous chemicals like Ammonium (NH_4^+) and Nitrate (NO_3^-). from different results it is scrutinized that SRF can reduce the ratios of these harmful chemicals in the soil. The aim of this research is to boost crop yield by producing biodegradable and economically practicable slow release urea fertilizer.

In a nutshell, Starch/PVA/Citric acid blend shows high potential as coating material. For Industrial application insight into improving efficiency of the

coating is required.



Keywords: Starch, Poly-vinyl Alcohol (PVA), biodegradability, slow release urea.

To Study the Effect of PVA/Starch Blends on Dissolution Rate of Slow Release Urea Fertilizer

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ABSTRACT

The aspiration behind this scientific research was to enhance the efficiency of granular urea fertilizer using PVA/Starch polymeric blends along with Sulfur, Molasses and Plaster of Paris as binding agent for producing slow release urea fertilizer. Slow release urea fertilizer was synthesized using dip coating technique. Characterization of coated urea includes Conductivity analysis, Scanning Electron Microscopy (SEM), Fourier Transform Infra-Red (FTIR), X-ray diffraction (XRD) and crushing strength testing. The nutrient release rates were determined in ultra-pure distilled water using conductivity meter. Scanning electron microscopy (SEM) was used to examine the morphology of slow release urea in terms of its thickness, smoothness and uniformity. The ultraviolet (UV) spectroscopy study additionally validated the release behavior of coated urea in terms of nitrogen concentration in water. The FTIR analysis revealed that starch and PVA chemically bounded with each other by cross linking reaction in presence of molasses and sulfur enhances the films formation ability. The XRD analysis shows that the crystal structure of PVA was changed after

being cross-linked with starch. The application of thick coating layer on urea granules also increased the impact resistance during storage and handling of urea fertilizer.

Laboratory Investigation of Waste Marble Dust on Subgrade Soil in Slushy Portion of Flexible Road Pavements

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ABSTRACT

Road network is the key element of any nation. These structures should be build sustainably for a prolong time so that it can perform generously in order to fulfill the requirements of the to-date traffic. These structures consist of multiple layers and each layer has its own significance and value. Its foundation is almost considered as the natural ground which is firstly trodden down at certain ratio termed as "Natural Ground Compaction" or the Subgrade.

During construction/rehabilitation/widening phase; the engineers often dealt with "Slushy Portion". This portion if not removed/replaced; lead to serious failure of road pavement structure because of its high moisture content ratio. But removal or replacement is not a appropriate solution for so as it is pricey and leads to high finance up to considerable amount in mega projects. So this portion is treated with Waste Marble Dust (WMD) for accurate results up to certain amount of replaced material and this A-6 or A-4 (High L.L and P.I) soil is stabilized after performing certain laboratory tests like CBR Test, Modified Proctor Test, Swell Value and Atterberg's Limit with fruitful results.

Keywords: Road Infrastructure, Natural Ground Compaction, California Bearing Ratio, Moisture Content, AASHTO.

Assessment of Biomedical Waste Management in KP Public Hospitals: An Ignored and Emergent Public Health Problem in Pakistan

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ABSTRACT
Public sector hospitals in KPK breed substantial quantity of Bio-Medical Waste (BMW) per day (0.5 to 2.5 kg/bed/day). These wastes includes Risk Waste (75%) and Non-Risk Waste (25%) which influence directly and indirectly the health of serving doctors, patients and hospital administration with a very sturdy pessimistic impact on our green environment and aquatic life. Hence this generated medical waste should be treated properly before it affects human and our green environment. This study aims to investigate the Common Bio-medical Waste Treatment Facility (CBWTF) of some hospitals with deep study of the biomedical waste generation, collection, storage and disposal situation of the hospital. Appraisal in this regard was done via detail questionnaires, interviews, meetings, discussions, site visits and participant pragmatic approach. These studies divulge that biomedical waste were collected manually in all hospitals without proper training and without any precautionary measures and were then burned, dumped, entombing or mixed with municipal wastes. The incinerators of the most hospitals were found ill-functioning. from the mentioned study it can be concluded that proper and friendly strategy should be implied for the secure removal of biomedical waste.
Keywords: Hazardous Waste, Sustainable Environment, Bio-Medical Waste (BMW), Common Bio-medical Waste Treatment Facility (CBWTF), Hospital Waste Management.

Mixed Matrix Membranes Comprising of BioMOF-1 in Polysulfone Matrix for CO_2 Separation

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ABSTRACT

Among the CO_2-mitigation technologies, the membrane-based separation technology has attracted considerable interest due to its economic advantages as well as technically and eco-friendly process for CO_2 separation from large emission sources. The objective of this work is to develop high performance mixed matrix membranes (MMMs) comprising of bio metal-organic framework (Bio-MOF-1) and polysulfone (PSf) polymer matrix. For the very first time, a Bio-MOF was used as filler in MMMs. Bio-MOF-1 particles were synthesized and MMMs were fabricated by dispersing synthesized Bio-MOF-1into polysulfone matrix followed by the gas separation tests by using a custom-built gas separation setup. Bio-MOF-1 crystals showed well defined rectangular-like shapes (nano-bars) with lengths of ~0.5-4.0 µm and widths of ~0.05-0.20 µm and smooth surfaces. SEM images of membranes demonstrate good dispersion and interaction of the filler in the polymer matrix, even at high loadings. The gas transport properties of MMMs with Bio-MOF-1 loading up to 30 wt% were investigated, and the results showed such MMMs had a CO_2 permeability of 16.57 Barrer and ideal selectivity of 42.6 and 45.6 for CO_2/CH_4 and CO_2/N_2 respectively. This corresponds to an increase in 168% and 58% for CO_2 permeability and ideal selectivity respectively in comparison to pristine polymer membranes. For gas mixtures with a 50:50 (CO_2/CH_4) and (CO_2/N_2) feed composition as well, the synthesized MMMs displayed significantly improved separation of CO_2 from CH_4 and N_2:CO_2 permeability at 30 wt% loading increased by 128% and 129% combined with enhanced selectivity by 46.7% and 34.2%, respectively for CO_2/CH_4 andCO_2/N_2 gas mixtures in comparison to pure PSf. Analysis of solubility-diffusivity in the MMMs revealed the presence of adeninate amino and pyrimidine Lewis basic sites that decorate the pores and have relatively narrow pore dimensions in Bio-MOF-1 can greatly enhance the adsorption of the CO_2 molecules. MMMs were found to have lower activation energies of permeation of CO_2 than unfilled pure PSf membrane. Overall, a decrease of 68% in activation energy was observed in MMM with Bio-MOF-1 (30 wt%) loading as compared to unfilled pure PSf membrane. The CO_2 permeability of the membrane was observed to increase with increased temperature. The selectivity rate of unfilled pure PSf and MMMs for CO_2 was tested at different CO_2 concentrations in the feed showed similar behavior i.e. membranes were found to have higher CO_2 selectivity at lower concentration of 10% and have least CO_2 selectivity rate at higher concentration of 70% due to the CO_2 induced plasticization. Finally, the comparison with relevant literature showed that even without any functionalization of Bio-MOF-1, it showed higher selectivity than amine functionalized MOFs and quite comparable permeability.

Keywords: CO_2 separation, Permeability, Selectivity, Adeninate, Bio metal-organic framework.

Efficient Use of Waste Cardboard in Construction Material

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ABSTRACT

The increasing number of concrete construction industries is a major problem around the globe due to emission of CO_2 which is a serious threat to environment. The rising demand of concrete construction is a major issue in future, for which an alternate way is to find out ecofriendly materials and minimize the use of common materials for concrete production to reduce its cost. On the other hand, production of paper and cardboard stood 407 million metric tons around the world according to 2014 report and a huge amount of cardboard are discarded into landfill or dump site in almost every country without utilizing it by recycling, creating serious environmental problem. Since most of the people in developing countries like Pakistan, India, Bangladesh, and Sri Lanka etc. cannot afford concrete construction, due its high expenses because, approximately 80% of the construction cost of a building is due to expensive material. This study is based on the potential use of waste cardboard as a partial replacement of aggregate, yielding common brick into low cost, lightweight and ecofriendly concrete bricks, pushing the boundaries of research in the field of innovative sustainable construction material. Since there is no specified code for its mix proportioning, therefore experimental investigation was carried out by preparing specimen of three different mix proportions, 1:1:1.5, 1:1:2, and 1:2:4 (cement, cardboard, sand) based on trial and error. To find out the compressive strength of these three mix proportions, a cubic dimension specimen were prepared and after 7, 14 and 28 days curing, compressive strength tests were carried out on air dried samples. On the basis of results, it is concluded that using cardboard as a partial replacement of aggregate, yield low strength bricks due to which it can be used for non-load bearing walls utilizing waste cardboard as a construction material.

Key Words: Cardboard, Compressive strength, Ecofriendly, Lightweight, Mix Proportion

Desulphurization of Heavy Distillate Fuels using Air Assisted Performic Acid Oxidation System

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ABSTRACT

Heavy oils are widely used as low cost fuels in industries, however they contains high sulfur content, which limits their application. The conventional hydrotreatment is not only very expensive process but also inadequate to desulfurize the heavy oils. In the current study, desulfurization of commercial oil samples containing high sulfur contents (1.2 to 5 wt %) was investigated using air assisted performic acid oxidation followed by solvent extraction. In case of different commercial oil samples i.e. untreated naphtha (UN), light gas oil (LGO), coker derived combined heavy gas oil (HGO) and Athabasca bitumen (At. Bit.), the desulfurization yield of 61.7, 63.4, 47.2 and 42.5 % was attained, respectively. Combined extraction by aq. acetonitrile (80 %) followed by aq. methanol (80 %) was found to be efficient extraction system for ODS of commercial oil. The recovery yield of different commercial oil samples, during the process was found to be in the range of 92 to 88 %.

Keywords: Oxidative desulfurization, Performic acid oxidation, extraction, heavy oil, Air oxidation.

Theme 4: Modelling & Simulations

Experimental Validation of a CFD Simulation Model to Determine the Distribution of Gaseous Emissions in the Industrial Indoor Environment

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ABSTRACT

In the chemical process industry, there are various sources of emissions produced by burning fuel for power or heat, through chemical reactions, and from leaks from different processes or equipment. The Computational Fluid Dynamics (CFD) modeling and simulation could be employed to predict the spatial and temporal distribution of the gaseous emissions with the air flow in the industrial indoor environment. CFD could be used as an effective and adequate tool for the loss prevention and risk mitigation in the industry. The objective of this research is to develop an experimental methodology for the purpose of validation of the developed 3D CFD simulation model for the determination of distribution of gaseous emissions in the indoor environment. The experiments were performed on 3D general indoor room environment with the gas concentration measurements taken place at different locations inside the room. The CFD simulation results were compared against the experimental data. It was found out that the simulation results were in good agreement against the experimental results.

Keywords: Pollution, CFD, environment, emissions, validation

Experimental and Multiphase CFD Studies of Flow Patterns and Intensified Micromixing Performance of A Multichannel Micro-Impinging Stream Reactor

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ABSTRACT
In chemical industries, reactors are the most important equipment. The intensification of reactors has attained great attention from scientific community during past few decades. The key factor of intensification of reactor is intensified the mixing at molecular level recognized as micromixing. A multi-channel micro impinging stream reactor (MC-MISR) has been fabricated with visible polyplex glass. The reactor has four inlet channels and a large reaction area. The outlet of the reactor is kept large to ensure a smooth outflow of streams after reacting. Experimental and computational fluid dynamics (CFD) studies have been carried out and micromixing efficiency in MC-MISR has been investigated by Villermaux-Dushman (iodate-iodide) competing parallel reaction scheme. The micromixing efficiency has been measured in terms of segregation index (*Xs*), Reynold number (Re_j), concentration of H^+ on micromixing. The results show that the segregation index (*Xs*) is decreased, when Reynold number (Re_j) is increased. In multiphase CFD study for fluid behavior, k-ε turbulence model, Eularian multiphase model and finite-rate species transport models are used in cooperation with transient state. CFD provides an insight into multiphase flow patterns, velocity vectors, micromixing behavior of flow regimes and micromixing efficiency index. A comparison is built between experimental and numerical results and the accuracy of numerical models being discussed. MC-MISR offers the advantage of handling of large fluid volumes, avoiding blockage of outlet channels, high degree of mass transfer and mixing as compared to other microreactors.
Keywords: Micromixing, Process Intensification, Villermaux–Dushman reaction, Eularian model

Small Scale Production of H_2 via Autothermal - Reforming in an Adiabatic Packed Bed Reactor

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ABSTRACT
To reduce the emission of CO_2, carbon-based fuels can be replaced by environmental friendly fuels such as H_2. For this purpose, fuel processing of CH_4 is a common method for the production of H_2. In the present work, 1-dimensional heterogeneous reactor model for autothermal reforming (ATR) of CH_4 has been developed and implemented on gPROMS model builder 4.1.0® in which the mass and energy equations have been incorporated in both gas and solid phase along the axial direction in an adiabatic packed bed reactor. 18 wt. % NiO/Al_2O_3 is used as a catalyst. The performance of ATR has been investigated by observing the effects of temperature, pressure, steam to carbon ratio (S/C) and gas hour space velocity (GHSV) on CH_4 conversion, selectivity of outlet

gases and H_2 yield (wt. % of CH_4). The sensitivity analysis is performed on both low and high pressure conditions. The predicted results are compared with the thermodynamic data, developed on chemical equilibrium with application (CEA) software. It is concluded that 1 bar, 773 K and S/C of 3 can result in CH_4 conversion and H_2 purity up to 99% and 95% respectively.
Keywords: Modelling, H_2 production, Thermodynamic data, Autothermal reforming.

Sensitive Analysis of Post Combustion Carbon Capture Technology with MEA/Glycerol Mixture as A Solvent

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ABSTRACT

In this work, glycerol was studied as a solvent in an absorption/stripping technology for the post combustion CO_2 capture process. Glycerol being a non-toxic and an environment friendly liquid is investigated for its suitability for the desired process. The process was simulated using a rate based model with two different cases under similar operating conditions. In the 1st case, mono-ethanolamine (MEA) was studied as a solvent to simulate base case model and then an aqueous mixture of MEA/glycerol was studied as a solvent in the 2nd case. ENRTL-RK thermodynamic model was used in both cases. Various operating parameters, such as variation in CO_2 partial pressure in the flue gas, MEA mass fraction and the desorber pressure were evaluated against process characterization parameters like L/G ratio, CO_2 removal rate, lean loading, rich loading and the specific energy requirement of the reboiler. The model results were validated against literature reported data and were found in an excellent agreement. Further, sensitivity analysis was performed to find out the most suitable operating conditions for the prescribed process.
Keywords: Post combustion carbon capture, reactive and physical absorption, rate-based simulation, solvent loading.

Effect of Absorber Intercooling and Rich Solvent Recycle for Post-Combustion CO2 Capture System

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ABSTRACT

It is widely accepted that CO_2 being a greenhouse gas is a major source of global warming and climate change. According to the BP statistical review of world energy in 2017, CO_2 emissions have been increased by 55 % in last 25 years and Asia Pacific is at the top of the list with 48.2 % CO_2 emissions. Approximately, 72 % energy needs are met by fossil fuels around the globe and the combustion of the fossil fuel for electricity production has the major contribution in these emissions. Therefore, the interest in reduction of CO_2 emissions from power plants has been increased over the years to reduce the impact on the global warming and climate change. It is found that the reactive absorption using amine solvents is the most effective and promising technique for combatting CO_2 emissions from the power plants at the tail end. However, the high regeneration energy requirement is one of the major disadvantages and the energy is provided by extracting steam either at low pressure turbine section or through feed water heater sections of solvents. Further, intercooled absorber, rich solvent recycle or combination of both is an important and useful technique which may save energy requirements for an MEA-based post-combustion carbon capture. In the present study, base case model will be developed in Aspen Plus® and effect of loading, temperature, CO_2 concentration, solvent concentration will be analyzed. The specific reboiler duty, overall energy requirements and required packing area will be reduced and rich solvent loading will be enhanced. In conclusion, intercooling, rich solvent recycle and their combination will help in optimization of the above mentioned parameters along with reduction in the overall energy requirements.

Keywords: Post combustion CO_2 capture, intercooled absorber, rich solvent recycle, modeling and simulation

Furnace Oil Syngas Cleaning via Physical and Chemical Absorption

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ABSTRACT

As global energy demand rose by 2.1% in comparison to the last year rate of 1.2 %, syngas is becoming increasingly important in power generation and production of liquid fuels. However, the presence of the contaminants (H_2S, NH_3, COS, CS_2, HCl, Cl, HCN) in syngas generated from petrochemical industries is the cause of several operational and technical issues ranging from equipment corrosion, fouling, catalyst deactivation and environmental pollution. Therefore, it is necessary to remove these contaminants from syngas for its effective use in downstream applications. This research work investigates comparative potential through modelling and simulation using Aspen Plus v.10 of two major technologies to remove above-mentioned contaminants from raw syngas which includes physical and chemical absorption. For chemical absorption system, a rate based model for simultaneous absorptions of acid gases into aqueous alkanolamine solution is developed which governs the coupling of mass transfer and chemical kinetics including specific features of electrolyte species. Further, PC-SAFT is employed as the thermodynamic property model in the physical absorption process simulation. The two methods will be compared in the aspects of the equipment requirement, design criteria including solvent concentration mass flowrates and circulation rates, percentage of acid gas removed, acid gas removal ability, environmental emissions and associated costs. The research work ends with conclusion and a brief discussion about future perspectives to improve optimum design and operation conditions for the furnace oil syngas cleaning using physical and chemical absorption.
Keywords: Acid gas removal, Alkanolamines, Modeling and simulation.

Impact of Coal Blends and Co-Firing with Biomass on Emission and Efficiency of Pulverized Coal-Fired Power Plant

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ABSTRACT

Despite the fact, Pakistan has enormous energy resources, Pakistan is facing a severe energy crisis from the last few years. To overcome the energy crisis, Pakistan is planning to install several pulverized coal-fired power plants under China Pakistan Economic Corridor (CPEC), which will produce about 8.4 GW of electricity. These coal power plants are based on imported coal therefore they will have massive impact on the economy. Further, Pakistan is an agrarian country and is gifted with vast coal resources, therefore Pakistan has abundant biomass and coal resources. If these resources are properly managed, it will lift up drowning economy. This research work includes blending of imported coal with biomass and with indigenous coal. Impacts of blending on the system are taken into account in terms of efficiency, economics and emissions. Aspen Plus®

is used to model and simulate the super-critical pulverized coal-fired power plant. Further, results are also evaluated on Aspen Plus®. Power plant is evaluated at different blending ratios of coal and biomass. Blending of the imported coal with biomass and native coal will make the use of domestic resources and will reduce overall emissions. Furthermore, use of domestic resources increases the availability of fuel and makes system economical. Use of domestic coal and biomass for power generation might be a practical solution to tackle the energy crisis in Pakistan.

Keywords: Energy crisis, Coal-fired power plant, Coal blending, Co-firing, Modeling and simulation.

Design and Analysis of a Miniaturized Dual-band Conformal Implantable Antenna for Capsule System Applications

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ABSTRACT

In this paper, a conformal dual-band implantable antenna over the MedRadio (401-406 MHz) and midfield (1.45- 1.6 GHz) frequency bands is reported for capsule endoscope applications. The total thickness of the proposed antenna is 0.05 mm, which allows its wrapping inside a capsule inner boundary. A significant amount of size reduction was achieved due to the novel shape of the antenna. In the conformal state, the total volume of the antenna measures only 16.88 mm^3 ($\pi \times 10$ mm $\times$ (5.4^2 - 5.35^2) mm^2), while that in the flat form is 26.5 mm^3. This miniaturization is achieved by introducing angled meandered six slots with one end opened on the patch, four long arms and one circular slot in the ground plane. The designing and optimization process of the proposed antenna is carried out in the center of a homogeneous muscle phantom (HMP). The consequences imposed on the performance of the designed antenna due to wrapping and internal elements of the capsule are also examined. HFSS has been used for the antenna designing and its performance evaluation both in the flat and wrap conditions.

Keywords: Dual-band, Conformal, Implantable, Capsule endoscope, Biotelemetry.

Economic Comparison of Various Pervpaoration Based Ethanol Recovery Schemes for Syngas Bio-Refinery

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ABSTRACT
Bioethanol production through syngas fermentation has emerged as a promising technique to extract energy from biomass. However, due to lower enzyme activity the product separation from very dilute fermentation broth is a major bottleneck to be tackled for its successful commercialization. Distillation, the widely used industrial technique for bioethanol separation, is consuming a large part of process energy content. The present study is designed to investigate three pervaporation integrated separation schemes with corresponding distillation based conventional configurations. Comparison on the basis of energy consumption and economics is presented. The processes were evaluated using commercial simulation software Aspen Plus V. 9.0 with an integrated Aspen Custom Modeler's pervaporation model. Pervaporation integration in the two columns distillation configuration was found to be the best alternative overall with least annual operating cost**.**

Seismic Fragility of Reinforced Concrete Moment Resisting Frame Structures in Pakistan

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ABSTRACT
Most of the existing reinforced concrete structures in Pakistan are designed as Ordinary Moment Resisting Frame (OMRF). In case of seismic activity being not designed for seismic control they may be vulnerable to certain level of failure. This research has reported the fragility of such structures in order to get an idea of how much these structures can get damaged or be life threatening. An analytical model of the 5-aZDOzisBCCstory reinforced concrete frame was performed in SAP2000 whose analysis and design results were based on Seismic moment resisting frame (SMRF) reinforced concrete structures. SeismoStruct software was then used to perform Incremental Dynamic Analysis (IDA). Incremental Dynamic analysis (IDA) was performed in software using three different nodal accelerations. An IDA Envelope was obtained from Incremental Dynamic Analysis (IDA) which was used to develop fragility curves. These fragility curves shows that columns are more vulnerable to seismic damage

which is a serious loss of these structures and can result in complete collapse of structure and eventually can be a serious source of life loss.

Keywords: Incremental Dynamic Analysis (IDA), IDA Envelope, OMRF

Lightning Protection Analysis of Shiekh Muhammadi Grid Station by Effective Placement of Surge Arresters

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ABSTRACT

Installation of line arrester is foremost important to improve lightning performance of transmission lines especially dealing with high voltages. This paper depicts a case study regarding a 500 kV transmission line of NTDC (National Transmission And Dispatch Company, Pakistan) and evaluates the most appropriate approach relating surge arrester placement and type. Arresters limit the voltage across equipment thus provide protection in presence of strike .In this research, metal oxide surge arresters are analyzed. Transient modeling of three phase line and substation is done in PSCAD/EMTDC software which supports transient and steady state analysis of power systems. The analysis is carried out to find precise choice and location of lightning arrester to minimize the outages due to lightning surges.

Multivariable Regression Analysis for Super-Hydrophobic PVDF Flat Sheet Membranes in DCMD

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ABSTRACT

Membrane distillation (MD) is a separating technique in which hot vapor transports from saline feed solution to cool permeate side through a porous membrane driven by temperature gradient. Super hydrophobic PVDF flat sheet membranes were prepared by phase inversion method and tested at varies process conditions. The aim of this research is to simulate process conditions with properties of a membrane i.e. pore size using multi variable regression analysis using MATLAB.

Keywords: Multivariable Regression, PVDF membrane, flat-sheet, Phase inversion, DCMD, MATLAB.

BIM Based Energy Simulation for Assessment of Buildings Energy Wastage for Pakistan

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ABSTRACT
The importance of energy analysis in building design has been grown because of the increasing awareness of its role in building life cycle cost and environmental impacts. The Building needs to keep occupants safe, comfortable efficient and also have thermal comfort and visual comfort. But they have lack of above parameters and then using alternative means of heating or cooling a space such as space heaters or window-mounted air conditioners that could be substantially worse than typical Heating, Ventilation and Air Conditioning (HVAC) systems. Pakistan has critical energy break that need to bind. Most of the construction companies uses practiced techniques including Energy Plus and IDA for energy simulation. These usual techniques are costlier, time consuming, difficult to perform and lack of interoperability. Thus a fascinating technique known as Building Information Modelling can be used as a choice. By applying BIM as a resource for energy analysis, the input data will be more efficient and the existing data more reusable. This paper presents a new approach and interoperable software environment for energy analysis. BIM is an approach to build 3D computer model for the design process and its performance is assessed by simulating its energy model. Four Storey Building located near Ring road Peshawar is designed in Revit for energy analysis and exported into Green Building Studio for analysis. The results exhibit implicit benefits of applying BIM based techniques. The clarification of thermal performance can be done in different phases of building process. BIM process is optimizing energy efficient design and give positive results. The Research benefits sustainable building design by applying BIM to this building and it is clear that we are running with Energy wastage for Pakistan. Real Project experience show that all the building owner have benefits to do Energy Retrofitting for their buildings.
Keywords: Energy Retrofitting, Energy Plus, Green Building Studio, BIM, Revit

Sensitivity Analysis of Urea synthesis Process using Artificial Neural Networks

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ABSTRACT
Urea is a nitrogenous fertilizer which is widely used in agriculture industry. Computational methods have been used to realize stable and efficient operation of urea synthesis process; various modeling frameworks have been proposed to analyze the process. However, the models need to be transformed into dynamic mode to capture the true behavior of the process. Due to complex nature of the process, efficient dynamic modeling of the process has been a challenge. In this study, Excel, MATLAB and Aspen PLUS environments were integrated to develop a dynamic model of the urea synthesis process. The model comprised of four major sections, i.e. HP section, MP section, LP section and Vacuum section. The integrated framework was used to generate 4000 data samples of the process at varying process conditions, i.e., temperature, pressure, etc. The data was used to develop an Artificial Neural Networks (ANNs) model for further analysis of the process. ANN model was capable in relating process variables with output, i.e., urea flowrate. Furthermore, the ANN model was used to perform sensitivity analysis of process variables in the context of their effect on the output. Top four sensitive variables of each section were selected and physical reasoning of their sensitivity was discussed.
Keywords: Snam Progetti Urea synthesis, Machine Learning, Parametric Study, Dynamic Modeling, Soft-sensors

Optimization of Heat Exchanger using Quasi- Newton Method

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ABSTRACT
Commonly used heat exchanger operation in the industries is not well-thought-out as cost effective procedure due to a lot of energy waste during the operation. As energy crises are one of the chief cornerstones worldwide, seriously affecting the economy, therefore there is a continuous demand for energy conservation. As a result, increasing attention of the researcher has been directed towards alternative energy production methods, making them highly target specific, cost-effective, environmentally-friendly, and possessing the desirable properties of a chemical reaction. The current study is focused on quasi-newton approach as an optimization technique to effectively reduce the cost of heat exchanger. The dimensional parameters such as tube length, number of tubes and shell diameter were altered conferring different case studies to effectively demonstrate the optimization of heat exchanger. The overall results using MATLAB for computation of values were found encouraging to implement this new approach

to reduce the total cost of the heat exchanger likened to cost obtained by the previously reported methodologies.

Keywords: Optimization, MATLAB, Heat exchangers.

Basin Design Optimization of Gravitational Water Vortex Power Plant

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ABSTRACT

The gravitation water vortex power plant is one of the micro-hydro turbine system that usually comes also in pico-hydro turbines category, which uses the natural flow of water to generate a free surface vortex. Runner is installed in this region to rotate the shaft and in turn produce electricity. It is one of the low head turbines usually used in areas where head is ranging from 0.7m to 3m.

In this paper, various basin geometries (i.e. cylindrical and conical) were designed in SolidWorks and simulated using techniques from computational fluid dynamics (CFD) to study their efficiency and to generate a high velocity profile vortex that can generate electricity in a desired range. Performance analysis of different designs was carried out with respect to changes in parameters such as inlet channel length, height and width, basin angle (only in case of conical design), height and diameter and also in outlet hole diameter and position. The CFD results showed that conical basin having outlet in center can give us best efficiency. It is concluded that optimized basin design and its related parameters can lead us to highly efficient turbine, which can overcome national energy crises in low head areas.

Keywords: Free surface vortex, Cylindrical basin, Conical basin, Computational fluid dynamics.

Deep Learning through Project Based Learning in Chemical Engineering Courses

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ABSTRACT
This paper presents how project based learning helped in increasing achievement and deep learning for students in chemical engineering. Education for Chemical Engineers is undergoing a paradigm shift in Pakistan driven by the outcome based education (OBE) system being implemented in higher education institutions. The emphasis of outcome based education in Engineering is achievement of learning outcomes by students and not just instruction by Teachers through lecturing. In this work instruction mechanisms were modified to become student-centered for encouraging deep learning and increased student achievement. Insight gained through implementation of project based learning model are presented within the context of teaching and assessment for OBE.
Keywords: project based learning; outcome based education; collaboration; deep learning.

Optimization of shell and tube heat exchanger by Genetic algorithm (GA) METHOD

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ABSTRACT
Heat exchangers are widely used in chemical industry for heat recovery. That means a lot of investment on heat exchangers. Among different types of heat exchangers shell and tube is used mostly, so it is needed to optimize the cost of the shell and tube heat exchanger model. To achieve our objective we need to run the model of shell and tube heat exchanger in MATLAB and then to apply an optimization technique on the model. For this goal to achieve we have to take data from literature.
The optimization technique that is applied in this case GENETIC ALGORITHM METHOD (inspired from Darwin theory of evolution). This method will be applied by programing in MATLAB. By applying GENETIC ALGORITHM METHOD, it will give optimum values of shell and tube heat exchanger design variables (tube diameter, baffle spacing, length, number of passes, pitch, baffle cut, and head type) that correspond to optimum cost.
Keywords: MATLAB, GENETIC algorithm, Modeling and simulation.

Eye Gazed Controlled Wheelchair

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ABSTRACT
In this modern era, every individual desire to be self-reliant and want to move and walk independently. Clinicians indicated that 1 out of 5 persons are disabled. The Great scholar like Stephen Hawking and some famous personalities affected from this crippling phenomenon. Our research aim is to mobilize a disabled person through the eyeball, with eyesight being their guide that enables a disabled person to fulfill his aim and goal without any other body stress. Numerous techniques and interfaces have been developed for complex disabilities but these are costly and not in the range of common man. We developed a cost-effective system for disable users. The user required to wear a head mounted camera in front of his eyes for image processing and detection. The OpenCV algorithm can be brought under the realm of utilization in the field of image processing and detection purpose. This algorithm perform its task in two steps. While doing first step, it detects the whole face and in the second step the eyeball is detected. A user webcam takes a continuous capturing which is interfaced through the laptop. Once eyeball is detected then the user can move eyeball up, right and left and as a result the wheelchair move straight, right and left respectively in the desired direction. However, for an emergency condition, we used a stop button. The user input is sent to Arduino board which is serially interfaced and in turn controlled the motors which after then allow the wheelchair to move in the prescribe direction.
Keywords: Eye Gaze; Head Mounted Camera, PWD (Person with disability)**.**

Exergy Analysis of Cumene Production Process through Interfacing of MATLAB and Aspen PLUS Environments

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ABSTRACT
Cumene, a very important intermediate chemical component, is produced through the Friedel–Crafts alkylation of benzene with propylene. For an energy efficient operation of the process, a robust energy analysis mechanism is always desired. In quest for realizing high energy efficiency, exergy analysis has got attention of researcher due to its advantage over the conventional energy analysis method. Exergy analysis is more capable of capturing true thermodynamic potentials of a process by incorporating the second law of thermodynamics. In this work, exergy analysis of cumene process was performed using the interfacing of Aspen PLUS and MATLAB. A MATLAB

based code was used extract process information, i.e., temperature, pressure, etc., from the Aspen based process model and to calculate exergy. The dimensions of exergy evaluated in this work included physical, mixing and thermal. Exergy was calculated for all streams of the process followed by exergy efficiency of all equipment. The streams exergy and equipment exergy were used to derive overall exergy efficiency of the process.
Keywords: Second law of thermodynamics, Friedel–Crafts alkylation, benzene, propylene

Data-based Prediction and Sensitivity Analysis of Syngas Composition of a Moving Bed Coal Gasifier

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ABSTRACT

Gasification is the conversion of carbonaceous substances such as coal, biomass, and agricultural waste into syngas having high heating value. Moving bed coal gasifier is commonly used for coal gasification. Stable operation of coal gasification is always desired to produce high-quality syngas. Soft sensors have been used to monitor the operation as an alternative to a hardware sensor and realize stability in process. Soft sensors are the online estimation of variables that are hard to measure based on few variables that are easy to measure. In this study, soft sensor was developed through the ensemble learning method, i.e., boosting, for prediction of syngas composition. In addition, sensitivity analysis was performed on the one-dimensional thermal equilibrium model of moving bed coal gasifier. The effect of process and design parameters on syngas composition was evaluated over a wide range.
Keywords— Aspen PLUS simulation, moving bed coal gasifier, ensemble learning, sensitivity analysis

Sensitivity Analysis of Urea synthesis Process using Artificial Neural Networks

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ABSTRACT

Urea is a nitrogenous fertilizer which is widely used in agriculture industry. Computational methods have been used to realize stable and efficient operation of urea synthesis process; various modeling frameworks have been proposed to analyze the process. However, the models need to be transformed into dynamic mode to capture the true behavior of the process. Due to complex nature of the process, efficient dynamic modeling of the process has been a challenge. In this study, Excel, MATLAB and Aspen PLUS environments were integrated to develop a dynamic model of the urea synthesis process. The model comprised of four major sections, i.e. HP section, MP section, LP section and Vacuum section. The integrated framework was used to generate 4000 data samples of the process at varying process conditions, i.e., temperature, pressure, etc. The data was used to develop an Artificial Neural Networks (ANNs) model for further analysis of the process. ANN model was capable in relating process variables with output, i.e., urea flowrate. Furthermore, the ANN model was used to perform sensitivity analysis of process variables in the context of their effect on the output. Top four sensitive variables of each section were selected and physical reasoning of their sensitivity was discussed.

Keywords: Snam Progetti Urea synthesis, Machine Learning, Parametric Study, Dynamic Modeling, Soft-sensors

Exergy Analysis of Cumene Production Process through Interfacing of MATLAB and Aspen PLUS Environments

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ABSTRACT

Cumene, a very important intermediate chemical component, is produced through the Friedel–Crafts alkylation of benzene with propylene. For an energy efficient operation of the process, a robust energy analysis mechanism is always desired. In quest for realizing high energy efficiency, exergy analysis has got attention of researcher due to its advantage over the conventional energy

analysis method. Exergy analysis is more capable of capturing true thermodynamic potentials of a process by incorporating the second law of thermodynamics. In this work, exergy analysis of cumene process was performed using the interfacing of Aspen PLUS and MATLAB. A MATLAB based code was used extract process information, i.e., temperature, pressure, etc., from the Aspen based process model and to calculate exergy. The dimensions of exergy evaluated in this work included physical, mixing and thermal. Exergy was calculated for all streams of the process followed by exergy efficiency of all equipment. The streams exergy and equipment exergy were used to derive overall exergy efficiency of the process.
Keywords: Second law of thermodynamics, Friedel–Crafts alkylation, benzene, propylene

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ABSTRACT

Gasification is the conversion of carbonaceous substances such as coal, biomass, and agricultural waste into syngas having high heating value. Moving bed coal gasifier is commonly used for coal gasification. Stable operation of coal gasification is always desired to produce high-quality syngas. Soft sensors have been used to monitor the operation as an alternative to a hardware sensor and realize stability in process. Soft sensors are the online estimation of variables that are hard to measure based on few variables that are easy to measure. In this study, soft sensor was developed through the ensemble learning method, i.e., boosting, for prediction of syngas composition. In addition, sensitivity analysis was performed on the one-dimensional thermal equilibrium model of moving bed coal gasifier. The effect of process and design parameters on syngas composition was evaluated over a wide range.
Keywords— Aspen PLUS simulation, moving bed coal gasifier, ensemble learning, sensitivity analysis

Theme 5: Processing and Material Engineering

Morphological , Optical and Sensing Properties of Graphene Decorated by Silver Nanoparticles and PMMA Thin Film Based Sensors

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ABSTRACT

Humidity sensors are extensively used in industries to detect the moisture in the surrounding for which we require a highly sensitive sensor exhibiting quick response/recovery time. In this paper, we reported the humidity characteristics of graphene/silver nanoparticles composite (Gr-AgNps) and graphene/silver nanoparticles/PMMA composite (Gr-AgNps-PMMA) based efficient humidity sensors. Addition of silver nanoparticles and PMMA to graphene yields sensors with enhanced response time and conductivity respectively. Aqueous solution of Gr-AgNps and Gr-AgNps-PMMA was drop casted over interdigitated copper electrodes with 50 µm gap embedded in the substrates in dust free environment. The surface morphology of the thin film was analysed using scanning electron microscopy (SEM). The value of band gap obtained from the UV-vis spectra for Gr-AgNps and Gr-AgNps-PMMA nanocomposite was 4.7 and 4.1 eV respectively that can be possibly tuned by varying the concentration of the constituents in the composite. Apparent increase in capacitance (100-10,000 nF) with the increase in the humidity percentage (30-95 % RH) at lower frequencies for both the sensors was recorded using LCR meter (GW Instek817). Resistance of the sensors dropped to zero as the humidity level is increased from 30 to 95 % RH in the chamber. The devices were tested for real time stability and for fast response/recovery time. Both the devices showed an excellent stability and response by recording their resistance and capacitance respectively. A lagging of % RH decreasing response from % RH increasing response was observed at 500 Hz frequency for both the sensors depicted from the hysteresis curve. The humidity response of Gr-AgNps was observed comparatively better than that of the Gr-AgNps-PMMA based humidity sensors.

Keywords: Humidity sensors, graphene, thin film, response/recovery, band gap.

Study of Thermal and Nano Mechanical Characteristics of Chemically Pretreated Rice Straw Fiber

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ABSTRACT

This work focused on thermal, chemical composition and nano mechanical properties of rice straw fiber (RSF) after pretreatment with glycerol and water. These properties were examined using Fourier transform infrared (FTIR) spectroscopy, thermogravimetric analysis (TGA) and Nanoindenter. Chemical composition of RSF showed that amount of hemicellulose and acid insoluble lignin decreased, and cellulose content increased in RSF after pretreatment. Nanoscopic mechanical properties of RSF which include hardness and elastic modulus of cell wall layers were investigated and found that these properties enhanced after pretreatment. Thermal stability of RSF increased after pretreatment and reached upto 300 °C which makes it more suitable as a filler material in green composites.

Keywords: Rice straw fiber, Chemical composition, Thermal properties, Mechanical Properties.

Comparative Analysis of Various Repelling Finishes on the Hydrophobic/Oleo phobic Properties of Conventional Cotton Fabric

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ABSTRACT

Effect of selected environmental friendly C6 based fluorocarbons such as Nuva 1811 (Archroma), Nuva 3538(Archroma), Phobol CP-C (Huntsman) and Phobol CP-NH (Huntsman) were studied. Repellency performance characteristics of finished fabrics were evaluated with respect to oil and water repellency. Crease

recovery angle of treated fabric was also measured. Further, mechanical properties of finished fabric were analyzed by measuring Tensile strength retention and tear strength retention tests. Obtained results depicted that each finishing agent has remarkable effect on repellent properties of fabric. Experiments show that all finishes exhibit good oil and water repellency up to 15 washes. Even after 30 washes, Nuva 1811 and Phobol CP-C impart good water repellency, whereas in comparison with oil repellency, detoriation shows up to 15 washes and was partially retained up to 30 washes. Nuva 1811 shows maximum crease recovery angle >160 as compared to untreated cotton fabric having crease recovery angle of 152 . Effect of these finishes on mechanical properties of fabric was not significant.

Keywords: Cotton, Environment friendly finishes, Fluorocarbons, oil repellency, water repellency.

Carbon Nanotubes-Based Nanocomposites for the Electromagnetic Interference Shielding

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ABSTRACT

The advancement and modernization of existing technology became possible due to the utilization of new emergent materials. However, the device operation is still facing a serious problem of electromagnetic interference (EMI) which disrupts, delay or reduces the performance of these devices. For example, receiving calls on a mobile phone near the television lead to the glimmering of sound as well as the picture. The EMI can also affect the machinery installed in the airplanes and filling stations and that is why the passengers are cautioned against the use of mobile phones and other electronic devices during the flight. Besides the electronic components, the EMI can also affect the human health for example; the exposure to these radiations can cause skin cancer, headache as well as many other skin diseases. A number of efforts, using various material structures, have been made to eliminate these problems. In the present work, nanocomposites with different wt.% of multi-walled carbon nanotubes (CNTs), were prepared and tested for the electromagnetic interference shielding effect. In the studied frequency range (2-18 GHz), we noticed that the shielding mechanism was dominated by absorption. Composites with high carbon nanotubes revealed the % absorption of more than 50 dB. Additionally, the tensile strength was found to increase with the incorporation of multi-walled carbon nanotubes. The capability offered by CNT-based composites i.e. the

observed absorption and high tensile strength enables them to shield the electromagnetic interference and thus can be used in the electromagnetic absorber technology.

Keywords: Carbon nanotubes, absorption, composites, shielding.

Preparation and Characterization of Intelligent and Active PVA/Starch Films for Food Packaging Applications

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ABSTRACT

Food packaging industry has a great demand for biodegradable and environmental friendly packaging material due to imposed restrictions by environment protection agencies. Keeping these factors in mind active and intelligent films are prepared using PVA and Starch that are capable of anti-bacterial activity and color changing properties. Propolis Extract (PE) and Anthocyanin (Anth) are added to provide them anti-bacterial and colorimetric properties. Mechanical properties of these films are studied by using two different cross-linkers i.e. Boric acid and Glutraldehyde. These cross-linkers have increased their mechanical strength and water resistant properties. The maximum stress calculated at entire area for measuring mechanical strength of PVA/Starch/PE/Anth films is 15N/mm^2 and 10N/mm^2 using Glutraldehyde and Boric acid respectively. Antibacterial activity test was performed against most common food born bacteria i.e. E coli and Marsa. The maximum antibacterial activity by PVA/Starch/PE/Anth films was shown against E coli and Marsa is 25mm and 12mm respectively. SEM analysis has proved that addition of PE and Anth to films have significantly improved the smoothness of surface, whereas, pH test ranging from 1 to 14 has shown color change in films. Finally, food spoilage test is performed for checking the application of these films in food packaging industry. All results have concluded that PVA/Starch/PE/Anth films have many advantages such as biodegradability, anti-bacterial and colorimetric properties.

Slow Release Urea Synthesis Using Polymeric Blends

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ABSTRACT

To tackle nitrogen related environmental pollution, development of an economical, slow release urea fertilizer is need of the hour. A research study was conducted to retard the release of nitrogen from prilled/granular urea fertilizer. This research will focus on estimating and developing methods that will look into technological improvements which enhance urea efficiency with minimum cost. This can be done by application of sulfur, starch, gelatin, gum arabica polyvinyl alcohol, Plaster of Paris, Molasses and paraffin wax were used as coating material .Fluidized bed coater was used to synthesized slow release urea fertilizer. The ultraviolet (UV) visible spectroscopy analysis was used to study the dissolution rate of coated urea in terms of nitrogen concentration. Combination contains sulfur, starch and PVA as coating material whereas molasses and wax as sealing agent shows best result. Pot test was also carried out to support the release rate results and check the impact of coating on plant growth. Scanning electron microscopy (SEM) was used to study the morphology of coated urea in terms of its thickness, smoothness and uniformity as shown in figure-1 below. Coating materials (sulfur, starch, polyvinyl alcohol, Plaster of Paris and wax) reduced the release rate of nutrient nitrogen from urea fertilizer, significantly. Crushing strength was carried out to assure that the urea prills can survive throughout from the phase of product manufacturing till its sales and marketing. Combination containing both molasses and wax shows highest crushing strength of 22.05N.This is the first ever project in the history of Pakistan that will look into technical development of urea in order to enhance its efficiency, in collaboration with industry. This efficiency enhancement of urea is very helpful and related to national needs, as Pakistan is an agricultural country.

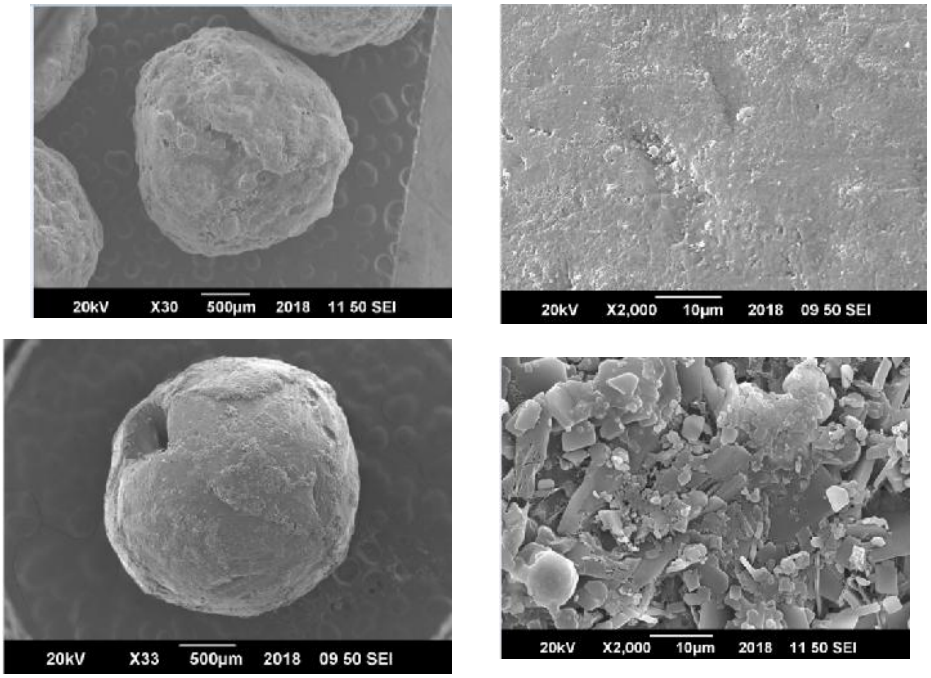

Figure-1 : SEM micrograph of uncoated and coated urea

Geopolymeric Composite Material for the Application of Thermal Energy Storage

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ABSTRACT

To reduce the primary energy consumption from non-renewable energy sources and improvement in the integration of renewable energy sources is the need of hour. This research work is focused on sensible thermal energy storage composite material system using aluminosilicate rich mud and milled glass powder as source material with phase change material using finite element method (FEM). Overall composite material will be integral of concretes with recycled aggregates and a geopolymer concrete. The analysis of composite material will be carried out to find out optimized energy storage system, and other thermal properties. Different characterization techniques i.e: XRD, XRF, SEM and flam test will be conduct for composite material investigation. It was observed that thermal storage zone ranges were 37 to 60 °C, while storage density of composite aggregated was 0.1-0.2 MJ/kg. The incorporation and compatibility of expanded clay/paraffinic-wax with geopolymer matrix is high,

resulting in a storage capacity suitable for thermal storage application in buildings.
Keywords: Geopolymerization, Finite element method, Milled glass powder

Characterization of Dera Ismail Khan KPK Region Shale Rock using X-Ray Diffraction

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ABSTRACT

With the increasing energy requirements and rapid depletion of fossil fuel reserves, the energy sector of Pakistan needs to look forward for alternate resources mainly unconventional oil and gas. Sizeable work has been done in the exploration of conventional oil and gas reservoirs however the exploration of unconventional reservoirs is still in the early stages. Fortunately, the sedimentary area of Pakistan is enriched with thick shale formations. These reservoirs are mostly located in the lower Indus basin region, predominantly in Ranikot and Sembar, mainly in upper Sindh and lower Punjab while a sizeable reserve is also found in Khyber Pakhtunkhwa. Oil and gas reserves are present in the shale rock in the form of small pockets. Because of its low permeability, less amount of gas and oil can flow through the shale rock. In order to achieve the target of maximum production rate from shale formations efficient drilling techniques must be introduced which is only possible if the composition of shale rock is known. X-Ray Diffraction (XRD) is the most common technique used for identifying the mineral content of rocks. The paper presents XRD analysis of shale rock in Dera Ismail Khan region of KPK. Outcrop shale samples were collected from six different locations in Sheikh Badin station. These samples included the rocks of Datta and Chichali formations. The obtained samples were crushed to powder and XRD analysis was performed using Bruker D8 Advance X-Ray Diffractometer. The obtained XRD pattern when compared with the standard database showed that Quartz was the most highly diffracted non-clay mineral found in all the samples. This is because of the fact that quartz has a good crystalline form. On the other hand, the clay minerals showed smaller peaks than quartz.
Keywords: Unconventional oil and gas, Shale formations, Production rate, Drilling techniques, X-Ray Diffraction, Outcrop shale, Crystalline form

Masonry Retrofitting for out of Plane bending using Fiber Reinforced Plastic bands

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ABSTRACT

The unreinforced masonry is a brittle material. Hence if the stress state within the wall exceeds masonry strength, brittle failure occurs, followed by possible collapse of the wall and the building. The major types of masonry failure modes have been identified as: in-plane diagonal cracking, out-of-plane wall collapse, separation of adjacent walls, and cracking due to stress concentrations around openings Different researcher have worked on different techniques like steel mesh, Polypropylene band, Ferro cement overlay, Epoxy, grout injection and many more methods and found best results. In this research paper, an attempt is made to increase the seismic capacity of unreinforced masonry (URM) structures by proposing a new composite material which can improve shear strength and deformation capacity of URM wall systems. Fiber Reinforced plastic bands having high tensile and shear stiffness can significantly increase in-plane and out-of-plane strength of masonry wall.

Effect of Aspect Ratio on Seismic Behavior of Unreinforced Brick Masonry

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ABSTRACT

The lateral in-plane response of unreinforced masonry structures plays an important role in their seismic behavior which is further dependent on their energy dissipation capacities. This article presents a study on experimental investigation of the energy dissipation capacity of unreinforced brick masonry by testing three full scale walls with different aspect ratios, under in-plane quasi static loading. A constant level of vertical stress resulting from a two storey unreinforced masonry building was applied on the wall. The energy dissipation capacity of the wall specimens with aspect ratios are compared at the end.

Keywords: Brick masonry, Aspect ratio, In-plane response, Seismic behavior.

A Comprehensive study of Inductive Power Transfer Technology Based on High Frequency H-Bridge Topology and Parallel Transmitting Coils Configuration

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ABSTRACT

Inductive power transfer technology is a challenging, and interdisciplinary research area. It can make astonishing change in the field of electrical engineering and electronic engineering. It can be used for charging batteries of single electronic smart phone as well as multiple electronic smartphone wirelessly. Based on the concept of high frequency H-bridge inverter topology and parallel transmitting coils, the prototype is developed for charging smart phones. The proposed prototype is implemented by using high frequency 1-5MHz H-Bridge topology to mitigate the transmitting coil size up to 12cm & receiving coil size up to 3cm. It can charge 6 electronic smart phones simultaneously with ameliorate efficiency of 91.5%. Numerical results are matched with simulation results which have been carried out in MATLAB/Simulink environment. This paper entrust out the numerical and simulation results for multiple wireless charging with maximum efficiency

Personalized Cooling System Using Phase Change Material

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ABSTRACT

Over the years there have been improvements in technologies to enhance the thermal comfort and decrease heat stress, heat stroke, and heat-related injuries. People working in severe conditions such as firemen, traffic policemen, soldiers, and labors suffer a lot from the heat stress. The most widely used personal protective system against heat stress is cooling vest that contains phase change material (PCM) for thermal energy storage. PCMs have the property of absorbing/releasing heat when they change their phase at their melting point. In addition to the personalized cooling devises, PCMs are also used in buildings to improve thermal comfort, energy storage in solar cells, textiles, cooling of electronic devices, automobiles, food industries and in many other applications where thermal energy storage is required. The cooling apparel which contains

phase change material as a coolant is a cost effective solution against heat, and can provide cooling for 4-6 hours. If the PCM has greater heat of fusion, more heat is absorbed; furthermore good thermal conductivity assists in efficient removal of heat. For the phase change materials to be employed in vests, their melting temperatures should be in the range of human comfort. In this work different PCMs are explored for use in personalized cooling vest. Hexadecane is finally selected to be used as a phase change material having a melting point of $18^{o}C$, which lies in the human thermal comfort. The heat of fusion of this material is 236kJ/Kg and various methods are explored to improve its thermal conductivity.

Proposed Chemical Plant for the Production of Natural Hydroxyapatite (100 Kg Per Day) Mineral by using Waste Bovine Bones as A Raw Material

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ABSTRACT

Each year thousands of people lose and break bones due to accidents or chronic diseases (such as cancer etc.). For bone healing, surgeons usually prefer to extract bone tissues of same patient, and then the obtained tissues are utilized for the reconstruction of defective bones. Very often, doctors may graft tissues obtained from donors due to limited availability, however, it is not favored because donor samples may be biologically non-compatible or can transmit diseases, such as hepatitis C, HIV, etc. Fortunately, material scientists reached to conclusion that hydroxyapatite ($Ca_{10}(PO_4)_6(OH)_2$) can be easily utilized to reconstruct the broken bones. However, the import cost of artificial bone materials is far expensive (16,000 rupees per kg) for our local community. For this reason, we have prepared a detailed design report to evaluate the cost and profit potential of indigenously prepared bio-compatible hydroxyapatite (HAp) by using waste animal bones as a raw material. Broadly, the proposed chemical plant will consist of dryer, double roll crusher, sieve shaker, ball mill, autoclave, heat exchangers, filter press, and furnace. The process design of each equipment is part of present work. The cost of prepared HAp will be less than Rs 10,000 per kg, whereas, the estimated cost for the whole chemical plant is about 100 million rupees.

Keywords: Hydroxyapatite, process design, and cost estimation.

Removal of Iron Contents by Flotation Technique from Koga Nepheline syenite Buner, Khyber Pakhtunkhwa, Pakistan

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ABSTRACT

In this study, flotation technique was applied to remove impurity like iron oxide which is 3-4%, from Koga Nepheline Syenite. Flotation technique is used to reduce the iron contents, i.e. hematite in Nepheline Syenite, Koga, to its allowable limit for various uses like ceramics, glass making, steel making industries. Previously many separation methods like magnetic separation, acid leaching and flotation were used, but floatation is more efficient method. Flotation of iron is investigated by using batch flotation cell. Different PH values and amounts of suitable chemical reagent were tested, due to which considerable amount of iron contents in this ore are reduced for industrial use. Anionic Collector (oleic acid), Frother like Aero froth 65 and Sulphuric acid (H_2SO_4) as a modifier and particle of -200µm to +63 µm were investigated for efficient results. The results showed that impurities from Nepheline syenite by reverse flotation is reduced to 1.05% at optimum conditions, viz. pH 3, and collector dosage 1.5 mg/500gm. This Nepheline syenite after beneficiation can be utilize for ceramic industries.

Keywords: Nepheline Syenite, Flotation, Anionic collector, Magnetic Separation, Acid leaching.

Recycling of waste LCDs

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ABSTRACT

Environmental sustainability requires that the recycling of materials is guessed to be a key aspect in a developed and under developed economy. PVC have long being used as an essential component in many industries resulting in producing greater tonnage of waste which often is of no commercial use. This plastic waste can be recycled with other non-metallic waste of different waste electronic appliances such as LCDs to make LCDs/PVC composite. Mechanical properties, thermal properties and surface morphology of the PVC and Non-Metallic LCD Waste Fraction (NMF) is investigated in this work. Results showed that adding the NMF up to a certain limit can effectively upgrade mechanical properties

such as, percent strain, tensile and bending strength and modulus. An optimum value of NMF ratio for improved mechanical properties was found to be 20wt% of the total formulation weight of raw materials. Further addition of NMF crossing the optimum value worsened its mechanical properties. The thermal properties such as softening temperature, melting temperature and crystallization temperatures gradually improved with the addition of NMF till last level at 50wt% of NMF. Adding 125micron NMF with identified optimum weight ratio increased the percent strain, tensile strength, tensile modulus, bending strength, bending modulus of composites values of 21%, 41%, 15%, 15.4% and 8%, respectively in comparison to the pure recycled PVC. From this reported work it can be safely concluded that by adding an optimum amount of NMF of LCDs in the recycled PVC can significantly improve its mechanical properties. This research thus suggests a reasonable way of recycling the waste NMF by the use of a green technology which may resolve the environmental pollution problem and can promote the resource recovery and sustainable development.

Keywords: Waste PVC, Waste LCD, NMF, sustainable recycling, Polymeric materials

Theme 6: Renewable Energy

Highly Efficient Perosvkite Solar Cells based on Low-temperature Solution-Processed Electron Transporting Layers

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ABSTRACT

Perovskite solar cells are a breath of fresh air in the emerging photovoltaic technology landscape. They have amazed with an incredibly fast efficiency improvement, going from just 2% in 2006 to over 22.1% in 2017. Owing to their high and rapidly improved efficiencies, as well as low potential material & processing costs it has several advantages compared to other cells in terms of flexibility, semi-transparency and ease of scale-ability. Furthermore, with thin film solution processability, applicability to flexible substrates and being free of liquid electrolyte, this technology combines the benefits of Dye Sensitized Solar Cells (DSSCs), Organic Photovoltaics (OPVs), and thin film solar cells. One of the main advantages of perovskite solar cells is the lower energy and financial costs of their production compared with conventional solar cells. The perovskite and many of the other components can be produced using low-temperature methods.

Keywords: Perovskite solar cells, Electron transporting layer, Power conversion efficiency.

Characterization of Hydroxyapatite Extracted from Quail Bones

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ABSTRACT

Sustainability has become a watchword and leading principle for modern world, and with it a growing appreciation that anthropogenic ‘waste’, in various forms, can offer a worthy source of energy. In this investigation, hydroxyapatite (HA) is extracted from the quail bones. Raw quail bones were calcined at temperature

range (700-1000 °C) after washing with boiled water and organic solvents. The calcined HA was characterized by Thermogravimetric analysis (TGA), Fourier transforms infrared (FTIR)and X-ray diffraction (XRD). It is successfully shown that quail bones are inexpensive source of HA. HA can be used as a potential catalyst for biodiesel production.
Keywords: Hydroxyapatite, quail bones, biodiesel.

Synergetic Effect and Kinetic Evaluation of Biomass and Sewage Sludge blends in Co-Pyrolysis Environment

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ABSTRACT

Co-pyrolysis of lignocellulosic biomass and sewage sludge blends is perceived as a possible substitute for fossil fuels, as they are richly available and because they assist in reducing global warming and environmental betterment. So, the exploration of synergetic effects for sugarcane bagasse/sewage sludge and rice husk/sewage sludge blends of different extents (100%B, 70%B30%S, 50%B50%S, 30%B70%S, 100%S) and (100%R, 70%R30%S, 50%R50%S, 30%R70%S, 100%S) is done through co pyrolysis process. For this resolution, thermogravimetric analysis (TGA) tool is being utilized. Fourier transform infrared spectroscopy FTIR and elemental analysis is done to characterize these biomass and sewage sludge blends. The kinetic and thermodynamic analysis by using Coats and Redfern integral Model is done to describe co-pyrolysis behavior of biomass and sewage sludge blends by using thermogravimetric analysis TGA. Thermogravimetric analysis of these blends is pragmatic at 20°C/min heating rate with nitrogen flow in the temperature range of 25-800°C. Coats and Redfern model contains seventeen reaction models with five major reaction mechanisms to investigate the behavior of co-pyrolysis environment. Active co-pyrolysis zone is divided into two reaction zones, zone I (200-400°C) and zone II (400-600°C). The kinetics analysis indicated the substantial consequence of bagasse amount on the interaction with sewage sludge as compared to rice husk interaction of sewage sludge. In phase I from 200-400°C, the values of enthalpy ΔH and entropy ΔG are usually greater than that of enthalpies obtained from phase II from 400-600°C for all reaction mechanism used in Coats and Redfern method. In second phase, the enthalpy ΔH is usually lower or in negative value. The change in entropy ΔS is negative in both phases.
Keywords: Rice husk, Bagasse, Thermogravimetric analysis, Thermodynamic parameter.

Home Pump-Storage Hydroelectric System as Alternative to Battery Bank in UPS System

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ABSTRACT

The energy crisis in Pakistan has led to load shedding. The use of Un-interrupted Power Supply (UPS) with battery backup as a source is the only option for the general public during load shedding. Battery replacement is costly, which has put financial burden on their use. Portable generator sets produce noise and environmental pollution with high capital and operational cost is high. An alternative scheme is to replace the battery with UPS system by a small pump storage hydroelectric scheme that essentially consists of an upper reservoir (intake) and a lower reservoir (tailrace) with electricity generating and pumping modes. In this research a small home pump-storage plant is proposed that can eliminate costly batteries in UPS system and can be a clean possible long-term solution. The work includes an easy installation of pump-storage scheme and designing of suitable hydro turbine that can be made locally with minimum effort and with components easily available in the local market. The scheme can also help to reduce the electricity bills.

Keywords: Hydroelectric, Impulse Turbine, Inverter.

Study of Sewage Sludge Pyrolysis Mechanism and Kinetics with model-free & model-fitting Approach

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ABSTRACT

Presently, Sewage sludge from waste water treatment plant is getting attention because it has potential to yield energy and biofuels (biooil and biochar). Pyrolysis of sewage sludge is most auspicious practice to attain these products. The core aim of this exploration is to understand the behavior of pyrolysis process by using TG-DTA and thermo-kinetic analysis by using model-free (Friedman, KAS, OFW and Popescu) and model fitting (Coats and Redfern) methods. Elemental composition of sewage Sludge is determined by ultimate and proximate analysis and existed functional group is identified through FTIR analysis. For thermogravimetric analysis, three heating rates (5, 10 and 20°C/min) are used to explore the thermal disintegration of components and TG-DTG curve is divided into two main zones 200-400°C and 400-600°C. The

kinetic limitations (Activation energy Ea, Arrhenius factor A, linear regression R^2) and thermodynamic limitations (change in enthalpy ΔH, change in Gibbs free energy ΔG, change in entropy ΔS) are determined by using model free and model fitting method is done to pronounce pyrolysis behavior of sewage sludge by using TGA-DTA data. Result demonstrates that Phase interfacial reaction model (S1) at 10°C/min is best fitted model based on ideal linear regression equal to 0.99 for both zones. First order reaction model (F1) showed higher Ea for all heating rates. Enthalpy values are calculated using Friedman (10-302kJ/mole), OFW (41-227kJ/mole), KAS (37-228kJ/mole) and Popescu (27-236kJ/mole) respectively. The adverse values of entropy ΔS signified that the disintegration in the activated phase has a more ordered assembly than before the thermal disintegration and that the reactions in the activated state are milder than predicted. Among all models, Diffusion and phase interfacial methods showed greater value of ΔG as compared to other methods in both zones.
Keywords: Sewage sludge, FTIR, TGA-DTA, Thermo-kinetics properties.

To Study the Effect of Particle Size of Indigenous Coconut Shell on Torrefaction

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ABSTRACT
Coconut shell of different sizes (0.5, 1.0 and 4.0 mm) were torrefied at constant temperature (250 ºC) in a torrefaction rig. The effect of particle size was investigated on the properties of the torrefied product, such as HHV, ash contents, IR spectra and thermo-gravimetric weight loss and derivative weight loss. The particle size was the most important variable in the torrefaction process. Increasing the particle size led to more weight loss of coconut shell and increased mass of the torrefied product remaining in the rig. The ash content evolution of the torrefied product showed that its properties approached a steady state within 30 min.
Keywords: Size distribution, Torrefied product, properties.

Parametric Analysis of Bus-Bar in Silicon Cell of the Photovoltaic Module Under the Static Wind Load

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ABSTRACT
Photovoltaic (PV) module is an essential part of the solar energy harvesting system in order to produce electric power directly from the solar radiation. PV module being exposed to the external environment comes across various extreme conditions, among which mechanical laods are one of the contributor towards its degradation. Mechanical loads include uniform and variable static as well as dynamic wind and snow loads. These load induce stresses in various components of the PV module and cause the degradation of PV module with time. Among various other factors, the mechanical reliability of PV module can be linked to its various design parameters such as number of bus-bars, thickness of bus-bar ribbons, type of Si-cell, type of glass and type of adhesive material etc.
In this work, effort has been made to establish the relation of numbers of bus-bar and its ribbon thickness with the mechanical integrity of PV module. Finite element analysis (FEA) of the PV module with a Si-cell having different number (2, 3 and 4) of bus-bars and different thickness (0.1 mm to 0.3 mm with an increment of 0.05 mm) of the bus-bar ribbon was performed for the uniform static wind load of 2400 Pa (IEC-61215). FEA results show that different von-Mises stresses were produced in various components of the PV module as the number of bus-bars and its ribbon thickness in the Si-cell is changed. Minimum stresses were observed in the 3 BB cell having ribbon thickness of 0.1 mm, thus makes it more mechanically reliable.
Keywords: Mechanical integrity, Finite Element Analysis, Wind load, von-Mises stresses and IEC-61215.

Performance Analysis of Diesel Engine Using Biodiesel from Waste Vegetable Oil

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ABSTRACT
This research is based on synthesis of biodiesel from waste vegetable oil through the process of transesterification and to check the performance of diesel engine. Biodiesel can play a modest role in reducing greenhouse gases and other potentially hazardous emission related to fossil fuels. It can be use in engines in the form of blends without any engine modification and can be produced from the domestic oil resources like vegetable oil, animal fats and waste cooking oil by transesterification process at ambient pressure and temperature. In this study, production of biodiesel was carried out in a small batch by transesterification of waste cooking oil with potassium hydroxide catalyst. The washing of biodiesel was carried out by distilled water. Titration of waste cooking oil for finding the free fatty acid contents. Physical and chemical properties of biodiesel were compared with Petro-Diesel. Different performance parameters have been experimented on the different blends of biodiesel. from the result it was found

that biodiesel perform good then diesel in terms of engine brake power, torque and specific fuel consumption. By looking at the specifications of engine fuel consumption, air to fuel ratio and specific fuel consumption we come to know that Blend B15 of Biodiesel is better than B0, B5 and B10. While for engine brake power and torque Blend B5 of biodiesel is better than B0, B10 and B15.
Keywords: Biodiesel, transesterification, Used vegetable oil, Greenhouse Gases.

Basin Design Optimization of Gravitational Water Vortex Power Plant

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ABSTRACT

The gravitation water vortex power plant is one of the micro-hydro turbine system that usually comes also in pico-hydro turbines category, which uses the natural flow of water to generate a free surface vortex. Runner is installed in this region to rotate the shaft and in turn produce electricity. It is one of the low head turbines usually used in areas where head is ranging from 0.7m to 3m.

In this paper, various basin geometries (i.e. cylindrical and conical) were designed in SolidWorks and simulated using techniques from computational fluid dynamics (CFD) to study their efficiency and to generate a high velocity profile vortex that can generate electricity in a desired range. Performance analysis of different designs was carried out with respect to changes in parameters such as inlet channel length, height and width, basin angle (only in case of conical design), height and diameter and also in outlet hole diameter and position. The CFD results showed that conical basin having outlet in center can give us best efficiency. It is concluded that optimized basin design and its related parameters can lead us to highly efficient turbine, which can overcome national energy crises in low head areas.

Keywords: Free surface vortex, Cylindrical basin, Conical basin, Computational fluid dynamics.

Technical Design for a Bio-Ethanol Fermentation Pilot Plant from Potato Peels Waste

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ABSTRACT

Bio-Ethanol, a type of bio-fuel, has great value as a prospect fuel due to its high efficiency and low environmental impact. The process starts with pretreating the peels mainly washing to prevent any dirt and grit to enter the liquefaction and Saccharification process. Liquefaction around 120°C causes starch to come out to the surface making it easily reachable for the microorganisms to complete the conversion to glucose and finally to Bio-Ethanol. This study employs Simultaneous Saccharification and Fermentation for its economic feasibility. Also, use of Talaromyces Cellulolyticus as the source for pectin, alpha amylase and Cellulase proven economically beneficial to the production process, is used to promise higher yields. The distillation and reactor unit, in accordance with the process needs, were designed, while the rest of the units were given a general description including their design procedure. After calculating the Engineering and Chemical Design for the mentioned equipment, a Cost Estimation for the plant was made. An ROI 6.1% and a payback period of 7 years, showed the models capacity as a pilot scale plant in Pakistan.
Keywords: Unit Design, Cost Estimation, Process Design, Simulation.

Development and Testing of Electromechanical Over-Speed Controller for Vertical Axis Wind Turbine System

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ABSTRACT

In the wake of environmental concerns, there is growing focus on renewable sources of electricity production. One of the most promising source is wind power. Around the globe, large scale projects are being undertaken to exploit wind power during the past few decades. At the end of 2016, global annual wind market was more than 54 GW, bringing total global installed capacity to nearly 487 GW. Despite, many successes, this technology needs improvement. Of the many, one such issue is to effectively regulate the wind turbine speed against wind gust. The minimization of over-speed risk is of high importance due to economic implications of over-speed, such as loss of turbine unit and blades structural fatigue. Thus, it is imperative to control wind turbine blades in turbulent wind speed to protect structural damages to the blade, unit cost reduction and protection against burning of the generator. This research pertains to the development and subsequent testing of electromechanical over-speed controller for VAWT system. The testing and analysis of this over-speed controller is practically performed on a prototype controller for parameterization to establish feasibility of this system for its application on commercial VAWT in terms of cost, power drawn from on-board battery, brakes delay and robustness. The prototype braking-system is fabricated using Arduino, 20W motorized

brakes, gear assembly and 24W motor. The Electro-mechanical braking system is automated by Arduino which assess wind gust and commands for applying brakes on turbine shaft. The testing of the brakes was conducted to determine moment of Inertia **I**, total Angular Torque **L** of the shaft when brakes are applied to analyze whether braking system can hold moment of Inertia of the turbine shaft at a threshold of over-speeding. The controller and braking system developed for over-speeding is fully autonomous and robust so that time delay in applying brakes is achieved as minimum as possible to avoid shaft damages. The analysis of the tests revealed that Angular torque of the shaft can be reduced to zero using motorized brakes operated by on-board battery. The brakes were so firm that such a high angular torque was reduced to zero without structural damages to shaft with minimum delay. It is established that Electro-mechanical brakes can be integrated to locally manufactured off-grid wind turbines to protect blades from over-speeding due to wind gust.
Keywords: Darrius turbine, wind gust, Over-speed controller, Angular torque, off-grid, Moment of Inertia.

Preparation, Characterization and Effect of Binding Materials on Bio-Mass Pellets Properties

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ABSTRACT
The fossil fuels are continuously depleting in the world and the world is looking up for Renewable Energy to meet the energy demands. With abundant availability of Bio Waste, the research focus on Solid Bio Fuel (Pellet Fuels) which could be substituted for fossil fuels. At first solid waste of different raw material is converted to a small Pellet size with improve density of fuel as a result of high compression and temperature. The raw materials used for these pellet fuels were waste from wheat, corn, sugar, cane and mustard. Most of the raw material contained natural Binding materials, however different Binding Materials were used in forming these pellet fuels e.g. sucrose and calcium hydroxide. These Pellet fuels were then tested for their Calorific value, Ash content in bomb Calorimeter and for Carbon, Hydrogen, Nitrogen, and Sulphur percentages in XRF. In the research the carbon content is reduced in the fuel to 24% which is much less than ordinary fuel. The Calorific value was found to be 6952 Btu/lb which was very close to Coal having a value of 7500 Btu/lb.
Keywords: Pellet Fuel, Binding Material, Bio Waste, Solid Bio Fuel.

Bio Methane from Biogas, Renewable Energy Resource for Pakistan

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ABSTRACT
Lack of efficient and affordable energy technologies are major constraints in development of emerging and developing economies. Pakistan is no exclusion to other emerging nations, thus is an energy-short country. Renewable energy has a great growth potential to meet our future energy demands. The number of biogas energy generation Systems is increasing steadily, as they are generated with low-cost and can be operate with very small budget. Pakistan's 70% population residing in rural areas, so biogas energy can be a good substitute. A national policy regarding the development of biogas energy technology is needed to enhance the biogas potential. This study focuses on control of agriculture waste by chemical absorption process, in which the biomass is converted into fuel. In this way not only biomass is treated but renewable energy can be generated. The raw material, biomass, was fed to an anaerobic digester that operates at 35 ^{o}C and produces biogas along with sludge biomass. The mixture of biogas and sludge biomass was separated with the help of flash unit and further separation was done by centrifuge to get concentrated biomass and water. The raw biogas was compressed from 1 bar to 5 bar in order to remove ammonia from biogas. The biogas was upgraded to bio methane in an absorption column by treating biogas with potassium hydroxide. The process has the advantage of being able to remove complete hydrogen sulfide. Cost analysis indicated that the chemical absorption is feasible.

Keywords: Biogas, Chemical absorption, Bio methane, Renewable energy, Pakistan.

Comparative Analysis of Conventional and Concentrated Photovoltaic Technologies for Power Generation in Pakistan

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ABSTRACT
Sun is a primary source of energy that could fulfill the need of energy as per demand of the modern world. Pakistan receives solar irradiance by average 5-6 kwh/m^2 per day, which shows a great potential for a green and clean power generation. The Alternative energy development board reported that 28 solar power projects are under development with a capacity of 956.4 MW. Quaid-e-azam solar park adds around 100 MW of electricity to the national grid. However, the currently used solar technologies come with severe real time challenges. For instance, the silicon-based solar cells are limited by efficiency

i.e. around 17%. With the invention of modern photovoltaic, and in a quest to increase efficiencies and reduce costs, engineers in the 1970s demonstrated that concentrating sunlight and focusing the equivalent of hundreds of "suns" onto solar cells increases their efficiency. For example, 20.7% efficient mono-c-Si cells, under AM 1.5G spectral conditions, reach 26.5% efficiencies under 500 suns. In this paper a 20 MW Solar power plants i.e convential photovoltaic and Concentrated photovoltaic are modeled using System Advisor Model (SAM). In order to elevate the performance of the plant through SAM a typical meteorological year (TMY) data, consisting of hourly values of direct normal irradiance (DNI), ambient temperature, wind speed, global horizontal irradiance and atmospheric pressure, are used. Quetta with an annual DNI of 2206 kwh/m^2 is chosen for the technical and economic analysis of the proposed power plants. Comparative analysis of annual energy production, capacity factor, efficiency, levelized cost of electricity and net capital cost is carried out through SAM. from the technical analysis we concluded that concentrated PV generate more electricity than convential PV and have high efficiency and capacity factor as compared to the convential PV, while economic analysis shows that conventional PV have low levelized cost of electricity as well as low net capital cost when compared to the concentrated PV.

Keywords: Annual Energy Production, Capacity factor, Levelized Cost of electricity.

Theme 7: Separation Science and Technology

Cellulose Nanocrystals/PVAnanocomposite Membranes for CO_2/CH_4 Separation at High Pressure

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ABSTRACT

Biogas has potential to be used as an alternative energy source substituting conventional fossil fuels. However, optimization of biogas production as well as upgrading of biogas quality is required. Crystalline nanocellulose (CNC) has excellent mechanical properties as well as high moisture uptake ability. These properties make CNC a promising candidate to be used as an additive in polyvinyl alcohol (PVA) facilitated transport membranes (FTM). The overall objective of this work is to develop CNC/PVA nanocomposite membranes for biogas upgrading through CO_2 capture. The effect of CNC concentration and pH of the casting solution has been investigated to optimize CO_2/CH_4 separation. Membrane characterisation shows that addition of CNC affects the degree of swelling, crystallinity and thickness of resulting membranes. Whereas, the permeation test showed that the permeance and selectivity for CO_2 increased with addition of CNC. Membranes with 1% CNC and pH 10 gives the best results under given set of conditions. The maximum permeance achieved by the formulated nanocomposite membranes was 0.29m^3 (STP)/ (m^2 h bar) whereas selectivity of CO_2 over CH_4 was 43. It was also observed that increasing feed gas pressure caused a decrease in membrane performance.

Keywords: Crystalline nanocellulose (CNC), Polyvinyl alcohol (PVA), Nanocomposite membranes, Facilitated transport membranes (FTM), Biogas upgrading.

Energy-positive Treatment of Domestic Wastewater with a staged Anaerobic Fluidized Bed Ceramic Membrane Bioreactor

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ABSTRACT

Recent concerns over water scarcity, climate change and sustainability of wastewater-energy nexus have regarded the wastewater more as a resource rather than a waste; for water, energy and fertilizing elements it contains. Anaerobic membrane biotechnology is currently recognized as a promising technology for wastewater treatment. However, membrane fouling is an inevitable phenomenon and long-standing challenge as it can reduce membrane lifetime and increases capital/operational costs. Despite important progress in reducing energy consumption for membrane operation, energy decrease remains as one of the important targets in anaerobic membrane biotechnology research and development. This objective may be achieved by different ways looking only on the membrane operation or looking at the whole process. A novel approach to control membrane fouling with much less energy expenditure than one required by conventional ways is anaerobic fluidized membrane bioreactor (AFMBR). However, higher sustainable membrane flux and optimized membrane operation needs a careful consideration in next generation of particle sparged AFMBR for the treatment of wastewater, being objective of energy neutral or energy positive membrane operation. This study will overwhelm a novel staged anaerobic fluidized bed ceramic membrane bioreactor (SAF-CMBR) system developed to treat low-strength wastewater. An alumina dioxide ceramic membrane was applied for the SAF-CMBR system submerged in fluidized bed of granular activated carbon (GAC). GAC as fluidized media was used for biofilm development and to control fouling by mechanical scouring actions created on the membrane surface through recirculation of reactor bulk without biogas sparging. The SAF-CMBR system was operated continuously for 350 days at 25°C with hydraulic retention time (HRT) varying from 2.1 down to 1.32 h depending on the membrane flux applied. The overall COD removal efficiency of more than 90% was obtained. A higher net sustainable membrane flux of 22 L/m^2/h was achieved during continuous operation by combination of maintenance cleaning using sodium hypochlorite solution and scouring effect of GAC particles without any adverse effect on organic removal. The electrical energy required for membrane operation reduced to as 0.024 kWh/m^3, which is only 10% of the electrical energy produced from methane produced in the system; conceding the system as net energy positive/producer.

Keywords: Membrane biofouling; Ceramic membrane; Fluidized media; wastewater, Energy recovery, Microbial community

Competitive Adsorption of Organic Dyes from Multicomponent Solution using Amine Functionalized Carbon

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ABSTRACT

The research study focuses on competitive adsorption of Methyl Orange (MO) and Rhodium 6G (Rh6G) dyes from aqueous solution onto amine functionalized carbon (AFC). Various parameters influencing the removal of dyes were studied. The uptake of dyes increases with rise in temperature which showed the process is endothermic in nature. However, the percent removal of Rh6G (72%) was higher at all temperature ranges(10-40 C) as compared to methyl orange (51%). The concentration of Rh6G positively enhances the removal of methyl orange hence showed a synergistic effect. The solid adsorbent i.e. AFC were also characterized by Fourier Transform Infrared Spectroscopy (FTIR) and Scanning Electron Microscopy (SEM) to analyze the functional groups on the surface and the texture of adsorbent respectively. The characterization results were used to explore the mechanism of adsorption of dyes over the solid sorbent. Standard Gibbs free energy (ΔG°), enthalpy (ΔH°) and entropy (ΔS°) gave the information about thermodynamic aspect of adsorption process. ΔG° showed the feasibility and spontaneity of adsorption process.

Keywords: Binary Adsorption, Methyl Orange, Rhodium 6G, Amine enriched carbon, Dye pollutants.

Mixed Matrix Membranes for Gas Separation based on Modulated UiO-66

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ABSTRACT

Metal-organic frameworks (MOFs) have been broadly investigated and employed for different applications including gas separation storage, media for gases, adsorbents, catalysis, sensing, drug delivery, thin film devices, clean energy, luminescence and magnetism since last decade.

Gas separation performance is significantly enhanced by moderating MOFs with different CO_2 phillic functional groups. Amine, imide, carboxylic and sulfonic group functionalized MOFs have attained massive interest. In present work, sulfonic group is grafted on UiO-66 in the presence of a coupling agent

(MPTMS). Influence of sulfonated functionalization of MOF on gas separation performance of MMMs was investigated in this work. The results revealed that the $–SO_3H$ functionalized UiO-66 exhibited superb selectivity, high CO_2 uptake, improved physicochemical stability and superior heat of adsorption due to strong interactions of grafted groups as compared to pristine UiO-66.
Keywords: Gas separation, Sulfonated-UiO-66, Metal Organic Framework (MOF), MMMs

Ionic Liquid Fused Mixed Matrix Membrane for CO_2 Separation

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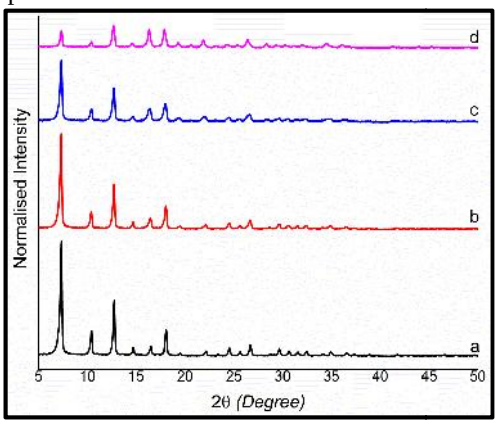
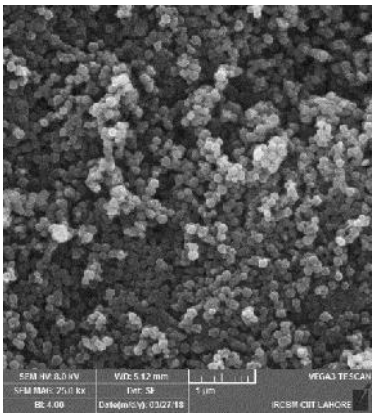
ABSTRACT

Carbon Dioxide (CO_2) capture is one of the major industrial operation nowadays because of its harmful effects on environment. CO_2 is separated from flue gases to reduce the amount of greenhouse gasses in atmosphere and removed from natural gas to provide clean energy with low footprint. Among the available techniques for CO_2 separation, membrane technology has inherent advantages such as low cost, high energy efficiency and potential for easier upscale. This research is conducted to combine cost and energy efficient membrane technology with highly selective Ionic Liquids (ILs) for the selective separation of CO_2 from CH_4 and N_2. In this study plain Mixed Matrix Membranes (MMMs) and three component mixed matrix membranes (MMMs) were fabricated. ILs were combined with Zeolite imidazolate frameworks (ZIFs), a widely studied material, due to their structural resemblance to the inorganic zeolites and having characteristic properties of metal organic frameworks (MOFs) i.e. chemical, thermal and water stability, was used as third component of MMMs. Commercial IL, 1-butyl-3-methylimadzolium tetrafluoroborate, was used to modify ZIF-8 particles. The modified ZIF-8 particles were characterized by XRD, FTIR and SEM. These modified fillers were used in synthesis of three component MMMs. The performance of the membranes were tested for CO_2 separation from CH_4 and N_2. Experiments were conducted at different operating conditions to evaluate the commercial potential of membranes. IL incorporation

in MMMs had profound effect on the gas separation abilities of membranes resulting in increase of 47% in CO_2/CH_4 selectivity at highest loading compared to the pure Polysulfone membrane. These results clearly identify the potential of IL in membrane technology and potential application for effective and efficient CO_2 separation. It is expected that the such membranes will play a vital role as efficient separation materials, for flue gas separation and natural gas purification.





Keywords: Ionic Liquid, Mixed Matrix Membranes, ZIF-8, CO_2 Separation.

Concentration of Pomegranate Juice through Non-Thermal Osmotic Distillation Technique using PVDF and PTFE Membranes

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ABSTRACT

Pomegranate juice was concentrated through Osmotic Distillation (OD) in flat sheet membrane cell. Polyvinylidenefluoride (PVDF) and Polytetrafluoroethylene (PTFE) membranes were compared to concentrate the juice. Membrane hydrophobicity, morphology, roughness and chemical structure were analyzed before processing and after 24 hours of continuous operation. Hydrophobicity was decreased drastically in case of PVDF membrane. It was found that PVDF membrane was more sensitive to membrane wetting and structural degradation as compared to PTFE membrane. Moreover, the juice was concentrated to 41°Brix through PTFE membrane in a total time of 24 hours while a final concentration of 18.5 ^{o}Brix was achieved in case of PVDF membrane. The quality parameters of pomegranate juice were improved in the

concentrate, which shows that the PTFE membrane can safely be used for commercial application.

Key words: Osmotic distillation, Pomegranate juice, Flat sheet membranes, water flux

A Comprehensive Study on the Performance and Antifouling Enhancement of Psf Mixed Matrix Membranes by Embedding Different Nanofillers: Zeolite 4A, UiO-66 and Zeolite 4A@UiO-66

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ABSTRACT

Among polymeric membranes, Polysulfone (PSf) membranes have been used in drinking water production. It has intrinsic hydrophobic nature which makes it prone to organic fouling due to the presence of organic matter present in water. Generally, with the addition of hydrophilic fraction in polymer matrix, water layer form on the membrane surface that don't allow the foulant material to deposit on the membrane surface and result in reduced fouling. Therefore, in this study, antifouling Mixed Matrix Membranes (MMMs) were prepared by incorporating two kinds of porous fillers, UiO-66 and Zeolite 4A and their combination (Zeolite4A@UiO-66) in PSf matrix. The complimentary effects of nanofillers were investigated on membrane morphology and performance. UiO-66 nanofiller synthesized while Zeolite 4A nanofiller was commercially available. All membranes with different nanofiller loadings (0.5%, 1% and 2%) were casted by phase inversion technique. The morphological characteristics of membranes were investigated with Atomic Force Microscopy (AFM), Scanning Electron Microscopy (SEM) and water contact angle. Membrane performance was analyzed by measuring pure water flux, humic acid rejection, static humic acid adsorption and antifouling properties i.e. Relative Flux Reduction (RFR) and Flux Recovery Ratio (FRR). AFM results showed that all MMMs possessed lower roughness as compare to the neat PSf membrane. SEM cross section of membranes confirmed that all MMMs possessed wider macrovoids with nanofiller loadings as compared to neat PSf membrane. According to surface morphology of membranes, all MMMs are prone to agglomeration with high filler loadings and membranes with combined fillers (Zeolite4A@UiO-66) showed more tendency of agglomeration than single filler membranes. With increasing the nanofiller concentration in polymer matrix, hydrophilicity of all MMMs also increased which resulted in low humic acid adsorption but overall, combination membranes (Zeolite4A@UiO-66) showed lower hydrophilicity and more humic acid adsorption as compared to membranes consist of single filler.

Typical tradeoff between permeability and selectivity was witnessed within all MMMs. All MMMs showed higher pure water flux than neat PSf membrane except Zeolite4A@UiO-66 (1%) membrane which showed highest humic acid rejection and best fouling resistance results with low RFR and highest FRR than all MMMs. Such membranes can play an important role in water and wastewater treatment techniques by solving the issues of membrane fouling from an economic as well as technical point of view.
Keywords: fouling resistance, membrane performance, hydrophilicity.

Ionic Liquid Based Membranes for Butanol-Water Separation Using Pervaporation

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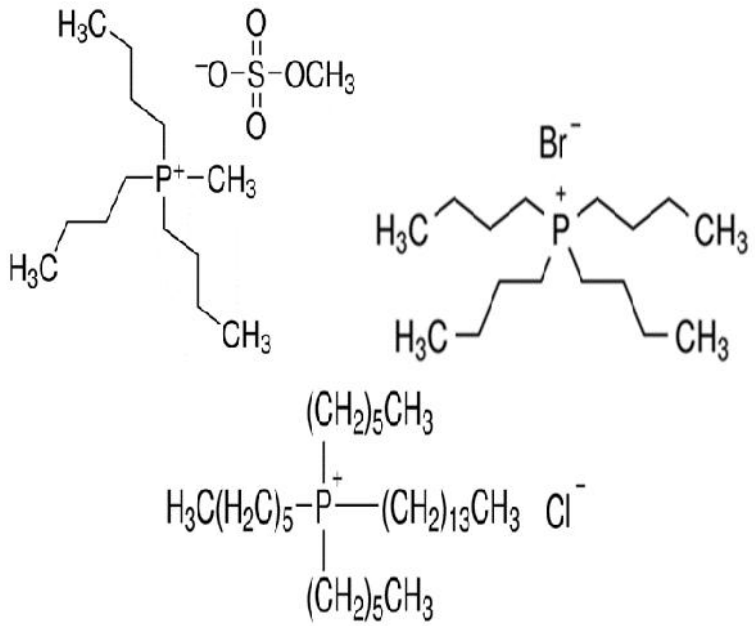
ABSTRACT
The separation of butanol from acetone-butanol-ethanol (ABE) obtained from fermentation broth is getting increased attention due to the renewable nature of feed stock. Depletion of conventional fossil fuels and environmental concerns have encouraged the researchers to focus on renewable and green biofuels. Bio-butanol being a good quality fuel of high octane number is getting importance as a vehicle fuel. Conventional methods of butanol separation are proved to be highly energy intensive or they need to be regenerated, which costs additionally. Moreover, the recovery of desired product also becomes difficult. Pervaporation is employed commercially integrated usually with some other separation techniques such as distillation. Use of ionic liquid membranes in pervaporation system is an emerging technology these days. Ionic liquid in membrane act as a medium that offers high selectivity and stability to the membranes. The objective of our research is to use ionic liquids of different alkyl length based on different anions but same (phosphonium based) cation having hydrophilic properties in membrane technology for the separation of butanol from water. In order to achieve our objective, dense ionic liquid membranes of Polyvinyl alcohol (PVA) based on three ionic liquids were synthesized. Ionic liquids used were Tributylmethylphosphonium methyl sulfate [TBMP]MS, Tetrabutylphosphonium Bromide [TBP]Br, and Trihexyl (tetradecyl) phosphonium Chloride [THTDP]Cl. The membranes were characterized by FTIR, SEM, AFM, and contact angle measurement. High selectivity of ionic liquids make these membranes most promising for butanol-water separation.



[TBMP]MS [TBP]Br [THTDP]Cl

Fabrication and Characterization of Novel Thin Film Nano-composite Membranes by Interfacial Polymerization for Solvent Resistant Nanofiltration

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ABSTRACT

Porosity is an exceptional property for molecular materials but, surprisingly metal organic frameworks are found as materials which exhibit porosity as well as very high surface area. MOF's have been commonly used in gas separation, gas storage and catalysis but, due to high porosity and high surface area, now they are being used widely in microfiltration, ultrafiltration and nanofiltration.

In current work, interfacial polymerized asymmetric membranes were synthesized. MOF-5 (Zn-BDC) was dispersed in the top thin layer of the membranes. As being hydrophobic MOF-5 was added in organic monomer during the fabrication of the top layer. Effect of composition of MOF-5 in synthesized membranes was studied. In this regard, a solution of methanol solvent and congo-red dye was prepared for nanofiltration experiment to evaluate solvent flux and solute rejection.

Results were compared to our previous work, in which MOF-5 based mixed matrix membranes were prepared by phase inversion. It was observed that, interfacial polymerized membranes showed better filtration results than that of mixed matrix membranes. Because later technique is better for the confirmation of the presence of nanoparticles in the polymer matrix.
Keywords: Metal organic framework, interfacial polymerization, nanofiltration

Control System to Self-Regulate Adsorption & Desorption Processes for Solid Desiccant Dehydration Unit

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ABSTRACT

Raw natural gas mostly carries significant amount of water contents due to existence of connate water in cavities of sedimentary reservoir rock. Hence, the natural gas must be treated to meet the gas sales contract and to supply high quality dry and clean natural gas to consumers. Various gas dehydration technologies are employed in industries which include liquid desiccant absorption and solid desiccant adsorption. If cryogenic conditions are envisaged in LPG/LNG units downstream of dehydration where significantly lower water content is required, solid desiccant dehydration units are the first preference. Most solid desiccant dehydrators operate in a preset sequence based on fixed cycle time. As the capacity of the desiccant decreases with the passage of time, hence fixed timer based dehydration units may result in poor dehydration that could be a potential hazard to downstream cryogenic equipments. In this research a self-regulating control system is designed for optimizing the solid desiccant dehydrators by continuously monitoring internal health of the unit. Implementation of the proposed system will yield in efficient removal of water contents from natural gas along with more reliable operation and extended life of the desiccant.
Keywords: Molecular Sieve, Dew Point, Dynamics & Control, Dehydration.

Separation of Complex Feed Streams of Products by Layer Melt Crystallization

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ABSTRACT

The last few decades driven by strict governmental policies toward chemicals disposal and emissions, the chemical industries are looking for new innovative separation technologies to overcome all these problems. Melt crystallization can provide a unique solution in this regard to high purity application as well as environmental and health benefits. Many materials which have close boiling points like different isomers, azeotropic mixtures and heat sensitive materials which are difficult to be purified by conventional technologies like distillation, liquid extraction and absorption etc, can be separated by melt crystallization. The basic principle of this technique is cooling a melt in a controlled way to crystallize a relative pure crystal fraction. Different studies suggest that this technique can serve as an alternative to conventional separation processes because of the following advantages: (1) high selectivity with high purity in a single step; (2) no solvents are required; (3) it operates at low temperatures compared to distillation; (4) and has less phase change energies as compared to liquid-gas phase transition. In this work applicability of layer melt crystallization for separation of complex feed streams is evaluated. This complex product is a mixture of different components, some of which are eutectics with each other while others are not. Layer melt crystallization is known to work often quite well if the mixtures are eutectic and have an advantage of an easy scale up and an easy solid liquid separation. For this purpose first solid liquid equilibria were measured for the complex mixtures by using differential scanning calorimetry (DCS). Then, on the basis of this information different experiments were carried out on a laboratory scale layer melt crystallizer to calculate crystal growth rates as well as purities and yield at different crystallization times and temperatures as a function of layer thickness. The purity of the layer was determined by using HPLC. The result of purity and yield obtained at different steps were also compared with each other to optimize the process. In the end post crystallization steps like sweating and rinsing of the layer with pure melt was carried out and included in the discussion.

Keywords: Complex feed streams, Crystal layer purity, Differential scanning calorimetry (DSC), Layer melt crystallization, Solid liquid equilibrium

Synthesis and Electrochemical Characterization of Novel Heterogeneous Ion Exchange Membranes based on Thermoplastic Polyurethane for Desalination of Brackish Water using Electrodialysis

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ABSTRACT

Ion-Exchange membranes are used in various charge-based electrochemical separation processes such as electrodiaylsis, dialysis, reverse-electrodiaylsis and in fuel cells and battery applications. Both homogenous and heterogeneous ion-exchange membranes have been developed and used in research and on commercial scale, as well. Control of electrochemical and mechanical properties is easier in heterogeneous ion-exchange membranes however they pose efficiency issues during separation. Permeability of ions through membranes is linked with the selectivity of ions in a reverse manner therefore a successful membrane design requires an optimum trade-off between permeability and the selectivity. Intrinsically conductive polymers such polypyrrole, polyaniline, polythiophene, when deposited on the based ion-exchange membranes improve membrane stability and the selectivity, in particular. Polyaniline is a promising electroactive polymer with tuneable conductivity and other electrochemical properties. In this research, novel heterogeneous cation exchange (CE) membranes based on polyester-thermoplastic polyurethane (TPU) have been prepared by solution casting technique for the application in electrodiaylsis (ED) in the treatment of brackish water. The incorporation level of polystyrene-sulfonated divinyl benzene (PSS/DVB) cation exchange resin has been elucidated with water-uptake, ion-exchangeability and membranes transport numbers. The ion-exchangeability increased by increasing resin content along with water-uptake that resulted in membranes swellability. The membrane transport number was measured through membrane potential studies using Gamry Potentiostat and in-house built two-compartment permeation cell. The transport number showing membrane selectivity increased by increasing resin content up to a certain loading level and then started decreasing showing pronounced effects of membrane porosity upon swelling at high resin loading. This porosity resulted in “leakage” permeation thus decreasing selectivity in terms of transport number. The membranes will be characterized using scanning electron microscope for surface morphology, fourier-transform infrared for chemical structure, thermogravimetric analyzer (TGA) for thermal stability. Electrodiaylsis trails are also planned using these novel membranes to assess their suitability in desalination of brackish water. As a future plan, these heterogeneous ion-exchange membranes will be modified using electroactive

polyaniline through various in-situ deposition techniques to improve stability and selectivity.

Keywords: Ion-Exchange Membranes, Thermoplastic Polyurethane, Electrochemical Applications, Electrodiaylsis.

Mechanism for Adsorption onto Wheat Straw

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ABSTRACT

The estimated wheat production in Pakistan was 25.7 million metric tons on 2017 and it was associated with the production of 33 million metric tons of wheat straw. Wheat straw is an agricultural waste material and it is a renewable resource. Researchers are trying to make the best use of waste materials to produce value added products. Its use may include the removal of contamination from water and/ or production of biofuel etc. The basic step in its use for any purpose is the adsorption of particles (contaminants, enzymes etc.) onto it. Therefore, it was found important to study mechanism of adsorption onto wheat straw. Scanning electron microscopic (SEM) was used to exam the surface structure of the wheat straw along with the Energy Dispersive Spectrum (EDS) analysis. It was confirmed that the adsorption occurred on wheat straw. Further, wheat straw was delignified to increase surface area. Pore sizes were measured by using Micromeritics instruments. Presence and absence of bigger particles (enzymes) were measured by using UV- Spectrophotometer. It was observed that at first adsorption occur on the surface of wheat straw. Because of lignin coating, the working capacity is very limited. Delignification gives more access to pores (increased surface area) and the working capacity increase many fold. The adsorbent material (wheat straw) is reusable.

Keywords: Renewable resource, Agricultural waste, Wheat straw, Adsorption, Delignification

Feasibility study of Microfiltration Membrane for Dewaxing of Edible oil

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ABSTRACT

Raw oil extracted from different sources such as seeds, flowers and so forth contain various impurities like free fatty acids, wax, phospholipids, water and

pigments which effects the quality of oil and harmfully effects the human body. Therefore it is necessary to refine the raw oil before using it. Steps involve in refining are degumming, Deacidification/Neutralization, decolorization, dewaxing, deodorization and drying. Conventional dewaxing of oil is carried out through winterization technique. However, membrane dewaxing technique is replacing conventional winterization. The feasibility of microfiltration ceramic membrane technique for dewaxing of Canola oil was studied in this research. The experiments were carried out by using a laboratory scale cross flow membrane. During the process Canola oil was passed through microfiltration membrane. The results obtained from the experiments were acceptable, which concludes that microfiltration membrane is suitable for dewaxing of edible oil.
Keywords: Canola oil, Dewaxing, Porous ceramic membrane.

Development of Membrane for CO2 Capture

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ABSTRACT

One of the major source of CO_2 emission is fossil fuels. Global warming increases day by day due to emission of CO_2. Various kinds of technologies are used to perform separation like cryogenic distillation, absorption but membrane separation technique are favorite due to many advantages like cheap, environment friendly and energy efficient. In addition, it is essential to have good compatibility between polymer and filler. TiO_2 filler has developed nano-sized and are very compatible with commercially available Polyamide Polyethylene Oxide copolymers. In this particular study, a mixed matrix membrane is fabricated consist of Pebax 2533 as base polymer and TiO_2 as filler. The resultant mixed matrix membrane has been used the combined effect of easy processability of Pebax 2533 polymer and high permeation performance of TiO_2 which can give high permeability and selectivity. The morphology and dispersion of nano-partical are observed through scanning electron microscope (SEM), X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), thermal gravimetric analysis (TGA).
Keywords: Gas Separation, mixed matrix membrane.

Theme 8: Water Resource Management and Wastewater Treatment

Treatment of Dye Polluted Aqueous Phase by Electrocoagulation: Optimization Study

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ABSTRACT

The textile industries are one of the most pollutant releasing industries in the world. Surveys show that textile waste constitutes up to 5 percent of all landfill area. Textile wastewater mainly includes two types of dyes namely reactive and dispersive dyes. Reactive dyes, those involves azo dyes, are frequently employed due to their availability and versatility. Due to low biodegradability, dyes impart significant effects on the environment which disturb the whole eco-system. So there is a growing need for the removal of dye wastewater in order to make water feasible for aquatic life. Different chemical and physical processes are used for the treatment of textile discharge but electro-coagulation is one of the efficient and advantageous processes. The research results summarize the removal of azo dye (Congo Red) from aqueous solution by electrocoagulation using Iron (Fe) electrode. In this study, Central Composite Design (CCD) under Response Surface Methodology (RSM) was used to investigate the effect of major operating variables and optimizing the conditions of electrocoagulation for iron electrodes. The key parameters such as pH (3-9), Inter-electrode distance (2-4cm) and initial concentration of dye (500-1000 mg/L) was studied. Results showed that pH was the most influential variable among all other parameters. 90% COD removal efficiency and 97% decolorization efficiency was observed under optimized set of conditions (i.e. pH = 3, Inter-electrode distance = 3cm and initial dye concentration of 1000 mg/L).

Keywords: Wastewater, COD reduction, Decolorization

Electrochemical degradation of Reactive yellow 145 synthetic dye through anodic oxidation of Ti/Ti0.7Ru0.3O2

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ABSTRACT
Textile industry wastewater containing dyes poses a chronic and synergistic effects to environment. This study examines the electrochemical oxidation of the Reactive yellow 145 synthetic organic dye used in the textile industry. All the experiments were performed using electrochemical flow cell while Ti/TiO.7Ru0.3O2 and stainless steel were used as anode and cathode, respectively. The effect of varying operating condition i.e. current density (2- 10 mAcm-2), supporting electrolyte (Sodium chloride, Sodium sulphate and Sodium Nitrate), different molar concentration of supporting electrolyte i.e. sodium chloride and different initial pH of solution were studied. The optimum operating condition achieved; current density =5 mAcm-2, sodium chloride as a supporting electrolyte with its 0.1 molar concentration and independent of initial PH of the solution. Under the optimum conditions, the colour removal efficiency was 97% for 60 minutes of electrolysis. Results obtained in this research clearly demonstrates that the production of the electro generated strong oxidant species like HOCl or OCl-1 (Hypochlorite ion), ClO2-1, ClO3-1, ClO4-1 or active chlorine, on surface of Ti/Ti0.7Ru0.3O2 resulting in the improvement of the decolorization. The electrode used were characterized by the cyclic voltammetry in aqueous medium of sodium chloride and sodium sulphate with and without presence of Reactive Yellow 145. The Reaction Kinetics of the electrochemical process has also been studied. On the basis of the efficient results obtained, a possible degradation process for the anodic oxidation of Reactive yellow 145 has been proposed.
Keywords: Electrochemical flow cell, Dye removal, Reactive yellow 145

Water Scarcity and Quality in Urban Sector: Domestic Recycling Solutions for Water Woes of Pakistan

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ABSTRACT
Water demand is increasing day by day with population growth and causing a serious issue of absolute water scarcity. Pakistan is already lying in scarcity zone since year 2000 and there is no water recycling or saving policy at domestic level on single unit (home) in Pakistan. This research work focuses on water recycling at domestic level by aiming as a road map for the fulfillment of future water demand with grey water and runoff by rain. Gray water is produced

by daily work like washing, laundry, bath etc. it is cloudy appearance water and can easily be reused with a little effort.
This research work will assess the total recyclable water at domestic level. Selection of appropriate technology, from available physical, chemical and biological treatment technology, for domestic sector is identified. Recycling potentials is determined with two variables that are no. of people and available area where available area is the dominant factor.
Keywords: Domestic runoff by rain, grey water, domestic Solution, Recycling Potential.

Sustainable Removal of Arsenic from Contaminated Drinking Water by Electrochemical Process using Iron Electrodes

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ABSTRACT

Arsenic contamination in ground water is one of the major causes of arsenicosis and many other illnesses due to drinking arsenic-rich water. The survey confirms that regions in Northern Sind and Southern Punjab have arsenite [As(III)] and arsenate [As(IV)] that have contaminated underground water much above the specified limits by World Health Organization i.e. <10 ppb (parts per billion). In order to reduce arsenic concentrations in drinking water, an experimental portable unit attached with solar panel is developed to reduce the arsenic concentration through electrocoagulation. The experimental outcomes illustrate that the increase in distance between electrodes causes decrease in current density only. However, if a constant current density is maintained for different distances then there is no observable change in the arsenic removal efficiency. The unit is capable to work throughout the day producing nearly 40-45 cycles of filtered water at the rate of 40 liters drinking water in the prescribed limits.
Keywords: Electrocoagulation, Filtration, Arsenite, Arsenate

Improvement of Water Flux through Membrane in Forward Osmosis by Comparing and Investigating Multiple Salts Draw Solutions

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ABSTRACT

Forward osmosis (FO) is known as the net movement of water across a semi-permeable membrane driven by a difference in chemical potential across the membrane. We have developed a prototype desalination plant for experimentation and acquiring insight into the method of the Forward Osmosis and improving the flux of water diffusivity through the membrane to increase the overall efficiency of the process. The FO process does not require higher pressure as compared to reverse osmosis process, and hence has a significantly lower operating cost, therefore, introducing an energy efficient water purification technology. The FO process was carried out with counter flow orientation and a flow rate of 1.75 l/min, on both ends. Flux rates were measured, considering a negligible change in density, and an effective membrane (CTA) surface area of 49 cm^2. Meta-thesis precipitation was conducted in batches and optimal compositions were determined, of Barium Sulfate, to maximize quality of the effluent obtained. The effects of membrane fouling were examined, on flux rate and ex-situ cleaning methods were employed (0.1 % H_2SO_4, 0.1% NaOCl). After cleaning and experimentation, tests of pH, conductivity, total dissolved solids (TDS) and temperature were conducted to legitimize the authenticity of the collected solution. Draw solutions from assorted salts (NaCl, $MgSO_4$, $CaCl_2$, $MgCl_2$) have been developed and experiments with multiple draw solutions and feed inlet compositions were conducted. Best draw solution with the highest osmotic pressure differential and ease of regenerability was observed to be Calcium Chloride. The real challenge in using forward osmosis lies in improving the flux of water diffusivity through the membrane to increase the overall output of the process and thereby proving our point of the water travel through osmosis. Also separation of water from draw solution by Meta Thesis Precipitation or a double displacement reaction. We addressed both of these challenges and developed a draw solution with a higher osmotic pressure and ease of regenerablilty hence improving the water flux through the membrane.

Keywords: Seawater Desalination, Forward Osmosis, Membrane, Amalgamated Mixture.

Removal of Chromium from Tannery Waste

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ABSTRACT

Tannery effluent is the main source of carcinogen chromium in rivers, lakes and seas. The chromium can be harnessed or deactivated by oxidation in the presence of photo catalyst, the Titanium Dioxide (TiO_2), activated by solar or

artificial light; This photo-catalysis process, can also be used for removal of other heavy metals from the environment or a solution as well**.** We design and construct a portable, efficient and cost-effective equipment using the TiO_2 as a photo catalyst that is not only able to remove chromium up to Pakistan Health and Safety Standards but also be able to recover usable amount of chromium, which is a costly metal. The proposed design can reduce the overall cost of implementing this project in tannery industry. In the present work, we used a mixture of 50-50 Brookite and aesthetic form of Titanium Dioxide as our catalyst. Firstly, we do experiments to confirm the usability of photocatalytic removal of chromium from tannery waste. Then by using solutions of chromium prepared in our lab, we continuously circulate the solution of chromium salt with a pH of 3 over the catalyst while UV light (540 nanometer**)** is continuously shining on the catalyst. The result that obtained for chromium removal has an efficiency of 96%. This is a batch process and it is easier to achieve the correct result with reduced chromium in the solution, it also feasible with tanning process currently used in the industry.

Keywords: Photocatalysis, UV spectrophotometer, and Ultravoilet lamp.