Posters List (Day 1)

Abstract (#NA)

Title: Review of Novel Additives for Sustainable Plastics.

Authors: Rasha Daadoush, Harrigan, Mohamed Elanany, Magdy Mohamed Gad.

Saudi Aramco

New legislation is being introduced worldwide primarily in developed countries that sometimes mandate high percentages of degradable plastics or simply ban single use plastics primarily in food applications and packaging. Some economies consider plastics recycling the only acceptable option given the inevitable contribution of degradation to greenhouse gas emissions. While others consider bio-based polymers, even ones that are not biodegradable such as bio-based PET, polyethylene and polypropylene as more sustainable alternatives to oil and gas derived plastics.

In this paper we will review the potential opportunities for developing additives that promote the biodegradation of polymers with the objective to produce polymers and plastics that are biodegradable, compostable, bio-convertible and more sustainable. The study identifies various new commercial products and conducts a preliminary assessment of commercial additives and explores some potential novel approaches using advanced biosynthesis and genetic manipulation to develop commercially viable additives for biodegradability and bioconversion.

Abstract (#19394)

Title: Isolation and characterization of biopolymer (PHA)-producing bacteria from the environment.

Authors: Aisha S. Alwuhaib, Harrigan, Mohamed Elanany, Magdy Mohamed Gad.

Saudi Aramco

Polyhydroxyalkanoates (PHAs) are biopolymers that are of interest because they can be used to produce bio-plastics. They are produced by many types of bacteria when environmental conditions are rich in carbon but poor in nitrogen. PHAs are biodegradable and are suitable starting units to synthesize plastics that do not accumulate in the environment. The use of such neutral polymers would help counteract the current accumulation of standard non-biodegradable polymers in the global environment.

In this study, we describe the isolation and identification of PHA-producing bacteria from waste water and composts. Environmental samples were collected from a wastewater treatment plant at Petersfield and from garden compost. Bacterial isolates were recovered after growth on a range of media, including M9 minimal medium, minimal salt medium (MSM) and Luria-Bertani (LB). The minimal media contained a low

nitrogen, high carbon ratio. PHA production was initially tested after staining with Nile Blue. From the isolates recovered from the waste water, 40.4% were capable of producing PHAs, whereas 44% of the isolates recovered from compost were able to produce PHAs. Phylogenetic typing of 16S rRNA genes amplified from the isolates and BLAST homology matches identified that the bacteria came from the following genera: Alcaligenes, Aeromonas, Arthrobacter, Bacillus, Pseudomonas, Citrobacter, Acinetobacter, Klebsiella and Raoultella. The presence of a PHA synthase gene (phaC) was confirmed for 23 strains by PCR amplification using primers phaCF1BO and phaCR2BO. However, some strains did not amplify for the phaC gene although they gave a positive staining reaction with Nile Blue. The nature of these strains is being further investigated using a biochip using probes designed as part of this study. Elucidation of the pathways involved in biosynthesis of biopolymers would help in developing analogous biomimicry approach for chemical synthesis of bioplastics using oil-based monomers.

Abstract (#NA)

Title: Removal of Polyaromatic Hydrocarbons (PAHs) from water using Activated Carbon from Date Seed.

Authors: Adeola A Akinpelu.

KFUPM

Preparation of activated carbon (CDSP) from date seed powder (DSP) by chemical activation (using ZnCl2) has been studied. CDSP and DSP were used to remove carcinogenic organic pollutants (polyaromatic hydrocarbon) from contaminated water. Adsorption behavior of CDSP and DSP were compared during the removal of naphthalene and fluorine (PAH model compound) in aqueous solution. FTIR, BET and SEM were used to characterize the microstructure and morphology of DSP and CDSP. The surface area of CDSP (723.8694 m^2/g) is almost 100 times surface area of DSP (8.3012 m^2/g) as a result of chemical activation. Batch equilibrium adsorption data were fitted to the Langmuir, Freundlich and Temkin models, of which the Langmuir model exhibited the best fit. The correlation of Langmuir model for naphthalene adsorption on DSP was observed to be higher (i.e R2 = 0.9125 for DSP and R2 = 0.8311for CDSP) while the correlation for adsorption of flourene is higher for CDSP (i.e R2 = 0.9936 for CDSP and R2 = 0.9871for DSP). The maximum adsorption capacity per gram (qe) is slightly higher but far more stable on CDSP (372.50 ng/g for both naph and fluorene) than on DSP (366.68 ng/g for naph and 252.590 ng/g for fluorene). Similarly, the calculated qe (370.370ng/g for both naph fluorene) were observed to be closer to experimental qe (372.50 ng/g for naph and 367.361 ng/g for fluorine) on CDSP than DSP. The calculated qe (208.333 ng/g for naph and 204.082 ng/g for fluorine) on DSP are far away from experimental qe (366.68 ng/g for naph and 252.590 ng/ g for fluorine). The results of this study indicate the high potential of the activated carbon from date seed (CDSP) as an efficient and successful adsorbent for the removal of carcinogenic PAHs from water body.

Abstract (#19260)

Title: NOx and SOx Reduction Performance of Cordierite Honeycombs Washcoated with Spinel Catalysts.

Authors: Md. Hasan Zahir.

KFUPM

a-Center of Research Excellence in Renewable Energy (CoRERE), Research Institute, King Fahd University of Petroleum & Minerals, (KFUPM), Dhahran 31261, Saudi Arabia.

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Organic and inorganic materials can store ambient heat and release it when necessary by temperature-controlled phase change. This process offers an ideal method of efficient solar energy management and utilization. Phase change materials (PCMs) are important commercially available heat storage materials of high latent heat density with a capacity to maintain a constant temperature during heat release. PCMs can be utilized in many fields, including smart housing, solar energy utilization, temperature-controlled greenhouses, temperature-regulating textiles, and heat management in electronics. In this study, heat energy storage systems were fabricated with the impregnation method by using MgO and Mg(OH)2 as supporting materials and polyethylene glycol (PEG-6000) as the functional phase. MgO and Mg(OH)2 were synthesized from the salt Mg(NO3)·6H2O by performing hydrothermal reactions with various types of precipitating agents. The precipitating agents were NaOH, KOH, NH3, NH3 with pamoic acid (PA), or (NH4)2CO3. Our results show that the selection of the precipitating agent has a significant impact on the crystallite structure, size, and shape of the final products. Of the precipitating agents tested, only NaOH and NH3 with PA produce single-phase Mg(OH)2 as the as-synthesized product. Pore size distribution analyses revealed that the surfaces of the as-synthesized MgO have a slit-like pore structure with a broad type pore size distribution whereas the as-synthesized Mg(OH)2 has a mesoporous structure with a narrow pore size distribution; this structure was found to enhance the latent heat of the PCM as well as to mitigate supercooling. The PEG/Mg(OH)2 PCM also exhibits reproducible behavior over a large number of thermal cycles. The heat storage capability, microstructure, and interactions with the PEG/Mg(OH)2 composite were characterized using DSC, SEM imaging, FTIR, Raman spectroscopy, and TGA. The liquid PEG was found to be stabilized within the porous matrix. The thermal conductivity of composite PCMs was also increased. A viable shape-stabilized composite PCM system for use in thermal energy storage was developed.

Abstract (#19440)

Title: The feasibility of a frequent monitoring of microbiological activities in oil trunkline.

Authors: Abdulaziz AlSubaie, Saud AlSubaie.

Saudi Aramco

Microbiologically Influenced Corrosion (MIC), is one of the most common corrosion caused in the oil industry. Most of the companies around world are spending major investment in overhead operation cost not only to repair the corroded and damage assets but also to prevent the operation facilities from the corrosion. One of the major factors of havening an effective corrosion control system is the frequent mentoring the microbiological activities in the system. There are serval types might occur in the operation facilities such as Sulfate Reducing Bacteria, Acid Producing Bacteria and Nitrate reducing bacteria. Saudi Aramco has become one of the world leaders in the successful and safe operations of sour oil and gas facilities. The company has placed rigorous technical engineering controls and monitoring standards. The laboratories are part of the large chain contributing to the provision of the analysis required for quality insurance and operation efficiency. Southern Area Laboratories Division (SALD) has for many years been providing the analysis required for Southern Area Oil Operation with instant support and reliable data. This study will evaluate the feasibility of determining the microbiological activities in oil trunkline. The study will share five years of routinely data for the analysis conducting for water samples collected from the trunk line and the corrective action required. Moreover, the study will share the limitation of international method measurement for the sour stream and the potential interferences for the lab method and how can you overcount it.

Abstract (#19444)

Title: Comparison study of Measurement methods for Moisture Content in NGL Samples

Authors: Saqr AlOtabi, Abdulaziz AlSubaie.

Saudi Aramco

The moisture is normally occurred in the natural gas. This water considered as main cause of corrosion and scales in the operation facilities. There are several methods used to dehydrate the gas such as pressurizing, chilling and absorption process. In order to meet the quality specification to protect the operation facilities the plant engineer needs to have an effective measurement for the moisture level in the system. This study will present the finding of a comparative study for three method used to determine moisture in Natural Gas
1. Capacitor Sensors (Dew Point Analyzer) ASTM D1142
2. Karle Fischer Titration ASTM D-4377
3. TEG Scrubbing.
Moreover, the study will propose a new method which Analyses of Trace Water in Petroleum Products by GC . The results find as below:
1-There are a variety of analyses methods in use today and the choice ultimately lies with the end user. But all of them are designed for Gas not NGL.

2-All devices have their own advantages and disadvantages. But there is certain thing, if you didn't provide a clean, representative gas sample, you will have difficulty in making an accurate determination of the water vapor content of your NGL stream.
3-The reproducible determination of the water content is tricky.
4-The Repeatability determination of the water content in Karl Fischer is tricky. You need to enhance the sample homogenous in order to enhance the Repeatability.

Abstract (#19605)

Title: Feedstock recycling for sustainable management of single-use plastic packaging waste.

Authors: Aaron Akah, Mohamed Elanany.

Saudi Aramco

Plastics are important and ubiquitous materials in our economy and daily lives. They have multiple functions that help tackle a number of the challenges facing our society. This is the case in packaging, where plastics help ensure food safety and reduce food waste. Global production of plastics has grown 20 fold from 15 million metric tons (Mt) in 1964 to 350 million Mt in 2017. As the use of plastic in modern society has increased, so have the issues related to plastic recycling and disposal.

Traditional recycling techniques such as those used in mechanical recycling, can only recycle about 20% of the total plastic waste generated and therefore, other methods are required to tackle the plastic waste that cannot be recycled mechanically. Feedstock recycling of plastic has emerged as a useful way to address the issues associated with plastic waste that cannot be mechanically recycled due to contamination. It is based on the decomposition of polymers by means of heat, chemical agents, and catalysts to yield a variety of products; ranging from the starting monomers to mixtures of compounds, mainly hydrocarbons, with possible applications as a source of chemicals or fuels.

Abstract (#NA)

Title: Determination of the efficacy of biocides against Microbial contamination of Pseudomonas aeruginosa in biodiesel.

Authors: Mousa Al Enezi, Al Enezi, Mousa S, Khanfar, Husam S., Mohamed Gad, Magdy.

Saudi Aramco

Microbial contamination of fuel is a widespread problem, with huge economic consequences. The resultant biomass produced from microbial contamination of fuel causes blockage of fuel filters, valves and pipelines, the formation of sludge in storage tanks and fouling of fuel injectors, potentially causing engine failure. Biochemical activity of the infecting consortia is responsible for Microbially Influenced Corrosion (MIC) of fuel tanks and pipework, and reduced lifespan of engine parts (due to hydrogen sulphide production) additionally biosurfactant production causes oil/water emulsification Microbial contamination of fuel storage tanks and pipework is a widespread and potentially costly issue,

prevention (or timely intervention) of infection can be achieved by the routine use of fuel biocides. Two fuel biocides Eradicate and Eliminate were tested for their ability to control infections of Pseudomonas aeruginosa ATCC 33988, a model contaminating organism which was originally isolated from a contaminated fuel storage tank.
Eradicate is active against P. aeruginosa at half the recommended dosage (1 in 4000). At high concentrations (1 in 1000) Eradicate eliminates all microorganisms from the test flasks within 24 hours. At lower concentrations (1 in 2000, 1 in 4000) complete eradication of viable P. aeruginosa was not seen until 48 hours later.
Eliminate achieved a complete kill of P. aeruginosa contamination at 1 in 1000 and 1 in 10,000 after 72 hours. The recommended dosage is 1 in 4000. Biocide concentration of 1 in 1000 began to significantly reduce the number of viable organisms within the biodiesel after only 3 hours (2.05E+06 down to 1.99E+05 and 6.25E+05 down to 4.72E+04). After 24 hours, all biocide concentrations tested demonstrated a marked reduction in viable organisms, even at 1 in 50,000 the viable organisms were reduced from 2.71E+06 down to 4.69E+03 in the biodiesel sample containing H2O and from 1.31E+06 down to 5.50E+02 in the 100% biodiesel sample.
The normal pattern of fuel tank colonization begins with a founder species such as P. aeruginosa, an aerobic bacteria, that alters the pH and oxygen levels of the microenvironment to such an extent that the other species – such as anaerobic sulphate reducing bacteria or pH sensitive fungi may flourish. Preceding biocide efficacy testing, an assessment of the background microflora present in the unsterilized diesel sample was conducted. This assessment was done to ascertain the degree of background microflora and whether a sterilization pre-treatment was required to ensure consistent results.
Future work recommended for this project would involve co-contamination of diesel with a consortium of diesel degrading organisms, to ensure that the biocide has the ability to remove established contamination consisting of a multi-species biofilm at low concentrations.

Abstract (#19255)

Title: 3D Localization of Magnetic Induction-Based Internet of Underground Things for Oil and Gas Reservoir.

Authors: Nasir Saeed, Tareq Y. Al-Naffouri and Mohamed-Slim Alouini.

KAUST

According to the report of the international energy agency (IEA), the energy needs of the world is expected to escalate by 40 % in 2030 [1]. This ever-increasing demand for energy constitutes 20 % and 50 % escalation from the oil and gas industries respectively. However, the operating environment of the oil and gas industries is challenging to fulfill this inexorable demand for energy [2]. One of the primary challenges of the underground oil and gas reservoirs is to obtain their real-time information. This challenge can be addressed by using internet of underground things (IoUGT) which can optimize the production of oil and gas, monitor the flow of oil and gas, and can monitor the reservoir. The IoUGT based intelligent oil and gas fields can improve the accuracy, integrity, and timeliness of the production process.

Although IoUGT enable multiple applications for underground oil and gas reservoirs, the challenging underground environment prevents the use of conventional terrestrial wireless communication systems. Therefore, magnetic-induction (MI) has emerged as a promising wireless communication technology to

develop practical underground sensing systems. Magnetic Induction (MI) is an efficient wireless communication method to deploy operational internet of underground things (IoUGT) for oil and gas reservoirs. The IoUGT consists of underground things which are capable of sensing the underground environment and communicating with the surface. The MI-based IoUT enable many applications, such as monitoring of the oil rigs, optimized fracturing, and optimized extraction. Most of these applications are dependent on the location of the underground things and therefore require accurate localization techniques. The existing localization techniques for MI-based underground sensing networks are two-dimensional and do not characterize the achievable accuracy of the developed methods which are both crucial and challenging tasks. Therefore, this work proposes a novel three-dimensional (3D) localization technique based on isometric scaling (Isomap) for the future IoUGT. Moreover, this work will also present the closed form expression of the achievable accuracy of the proposed technique which takes into account the channel parameters of the underground magnetic-induction. The derived expression will provide the suggestions for an MI-based underground localization system by associating the system parameters with the error trend. Numerical results will be provided to demonstrate that the localization accuracy is affected by different channel and networks parameters such as the number of anchors, noise variance, frequency, and the number of underground things. Also, the results will be compared to the traditional techniques.

Abstract (#NA)

Title: Fuel oil blending quality improvement through Machine learning and Mathematical Modeling.

Authors: Ahmed Filali, Schroeder, Timothy C.

Saudi Aramco

Viscosity is considerably a very important physical parameter in the Oil & Gas industry. Fuel oil is one of these major products. Generally refineries ignore fuel oil blending optimization due to various reasons. However, fuel oil optimization can lead to serious margin gains once you look at the production chain of fuel oil beginning from source. The ability to estimation or predicting the viscosity prior the blend actual process is very essential and indispensable as to prepare for the accurate blend recipe. Essentially, most of these formulas are derived from regression analysis of experimental data instead of physical mechanisms. Currently there are about a dozen empirical formulas, semi-empirical formulas and calculating charts evaluating the mixture viscosity that are published or reported. Yet each facility has its own data and crude blend which have major impact on any formula/model used. Moreover, they are not applicable for non-binary systems.

The aim was to reduce the process variation which incur the use of valuable cutter stocks to correct the blend, leading to loss of significant margins in the process. In addition, it takes the process a step closer to automation. Thus process variation is reduced.
To achieve these objectives, machine learning (ML) algorithm was created using k-Nearest Neighbor (kNN), which is used for classification predictions, in addition to multiple regression models were developed, evaluated and tested for its performance to predict the viscosity of black oil, which require blending 7 components to achieve on-spec final product as fuel oil. In addition, improving the blend process itself which aims to reduce the variation of the process as it steps to become automated. Revoking the need to conduct correction blends. It was also noticed that ML algorithm can provide better

performance on some cases compared to regression models Figures 2 & 3. The results of these models were significant as the process variation dropped by 17%. The trend Figure 1 shows clearly the process variation reduction gained after the implementation date (March onward).

In conclusion, machine learning algorithms can provide a better performance when applied to problems. In the Oil & Gas industry the amount of sensors and data points available is humongous, providing a very fertile bases to such application development. The utilization of these technologies is the path forward for making intelligent and optimized systems and processes.

Abstract (#19579)

Title: Machine learning approach to build a Virtual Multiphase Flow Meter.

Authors: Muqbil Alkhalaf.

Saudi Aramco

A crucial part of optimizing well production is accurate multiphase flow metering for both onshore and offshore environments. The industry currently relies on test separators and multiphase meters. These methods have limitations in terms of cost, transportation and safety. In this paper, an alternative method to do multiphase metering based on machine learning will be discussed.
Approach:
An alternative to the traditional multiphase flow meter (MPFM) is a Virtual meter. A Virtual meter is a statistical model that is developed and trained using operating wells historical data and machine learning algorithms. The user will be able to interact with the model using an interface to read current flow conditions and run different scenarios—Pressure, temperature or choke opening—to get live and predictive measurements.
After training the model a forecasted flow measurements is generated by running the test samples dataset—Pressure , temperature, choke opening, permeability… etc.— through the machine learning model. Afterwards, the forecasted measurements is compared to the actual flow meter readings to show the accuracy of the model. In addition, since different neural network (NN) designs is used to build different models, an assessment of each approach in comparison of the other NN in terms of convergence speed and accuracy is discussed.
Conclusion:
Using logging points for different types of measurements such as pressure, temperature and choke opening along with the characteristics of the reservoir, a virtual meter can generate the flow rates of the well within acceptable range of accuracy. Hence, this model can be used for predictive or live measurements of flow.
Novel Additive Information:
In this paper different types of datasets, including pressure and temperature, will be used to further increase the accuracy and dimensions of the model. By running different datasets it shows the type of data that is necessary of building a virtual meter and the data that has no significant impact on the performance, hence, can be neglected. In addition, this paper will cover the assessment of using different types of neural networks for building a virtual meter, based on convergence speed and accuracy.

Abstract (#19226)

Title: Artificial Intelligence Applications in Reservoir Engineering: A State-of-the-Art Review.

Authors: Hana AlMatouq, Abdulaziz Al-Qasim, Ruslan Miftakhov & Sunil Kokal.

Saudi Aramco

Currently, the world is on the brink of a fourth industrial revolution, which introduces new technologies that can connect digital, physical, and biological applications. This revolution is spreading rapidly and is invading different industries around the world including the oil and gas industry. The fourth industrial revolution (4IR) includes a number of disruptive technologies: artificial intelligence (AI), data analytics (DA), machine learning (ML), robotics, internet of thing (IoT), Deep learning (DL), reinforcement learning (RL), and advanced materials, among others. AI is the ability of machines to mimic, in some capacity, intelligence. AI technologies can be used to lower the risk of uncertainty during complex decision-making tasks. They are expected to profoundly change the economics and quality of life in our society.

AI is slowly making inroads into the oil and gas industry. A literature search shows hundreds of papers published in SPE and other databases. However, it is not yet labeled as a standard solution in the industry. It is still emerging and there is considerable progress yet to be made. AI in the petroleum industry, and specifically in reservoir engineering, has a great potential in terms of improving operations, productivity, recovery and optimizing resources. Nonetheless, the measures of success, and the obstacles of adopting AI technologies are still not clear due to the many challenges, and different outlooks.

This paper discusses the motivation and provides a comprehensive review of the ongoing AI applications in reservoir engineering and their effect on improving the landscape. Some of these applications and technical areas include PVT, phase behavior and reservoir fluid properties, routine and special core analyses, reservoir characterization, description and simulation, recovery improvement, failure prediction, and EOR screening. The paper provides an overview of AI in reservoir engineering from a recovery perspective, reservoir monitoring and surveillance, and highlights some applications in unconventional resources.

Many specific cases and examples are discussed where AI has already made a business impact. The review provides a good starting point to understand the potential, and challenges that AI faces, in terms of applications in reservoir engineering. The paper also proposes new potential AI applications in reservoir engineering.

Abstract (#19492)

Title: Quantitative Rietveld Phase Analysis of X-ray Powder Diffraction (XRD) data of Crystalline Materials.

Authors: abdullah aldakheel, HUSIN SITEP, NOKTAN ALYAMI, RASHA AL GHAMDI.

Saudi Aramco

If the sample preparation are appropriately conducted with great care, quantitative Rietveld phase analysis of X-ray powder diffraction (XRD) data of crystalline materials part from the corrosion products at the affected equipment in gas plants and refinery is a well-established technique to determine the identified phases down to 0.05%,. Even though a sample physical nature from which the XRD data are collected is seemingly simple, sample preparation in powder diffraction is generally the most common source of errors with accurate quantitative Rietveld phase analysis [[Sitepu (2002). J. Appl. Cryst. 35, 274–277; Sitepu et al. (2005). J. Appl. Cryst. 38, 158–167; Sitepu (2009). Powder Diff., 24, 315-326]]. This paper emphasizes the basics of sample preparation requirements and quantitative Rietveld phase analysis of XRD data of crystalline materials part (i.e., non-hydrocarbon) from compressor discharge and piston chamber equipment at refinery. The results showed that iron oxide corrosion products in the form of akaganeite [Fe(O,OH)16Cl1.3] is the major phase for both the piston chamber gum/sludge and head solids. Additionally, iron sulfate heptahydrate corrosion products in the form of melanterite [FeSO4(H2O)7] is mainly appeared at the valve head solid. The XRF findings supported the XRD results. The findings will help the field engineers to identify the root causes of the sludge deposits, and develop remedial action plan to avoid reoccurrence.

Abstract (#19284)

Title: Size exclusion chromatography: A key tool for the optimization of demulsifier formulations

Authors: Saroj K Panda, Murtala A. Mohammed and Arnaud Cadix.

Saudi Aramco

The separation of oil and water phase from crude oil emulsion is generally achieved using one of the four different factors, i.e., thermal, mechanical, chemical and electrical. The strongest one is chemical separation with the use of specifically designed surface-active molecules known as demulsifiers. Demulsifier formulations are a mixture of two to four types of intermediates. A formulation is optimized with respect to the oil composition, specific gravity of oil, water cut, salt content in water, and operating temperature. Once the formulation is optimized, the consistency in the quality of the formulation is essential to maintain the optimum separation of water throughout the production period of crude oil from a specific field in order to rule out any negative influence from the selected demulsifier. The appropriate method to optimize formulations is the bottle test method. However, this method remains laborious, time-consuming, imprecise, and requires access to fresh crude oil, which is not convenient from a practical viewpoint. Therefore, other physical and chemical properties are routinely monitored to ensure the consistency of the demulsifier quality. Recently, it was observed that there was a significant influence on the performance of a demulsifier from different batches with very close physical and chemical

properties.
For this purpose, we developed an analytical method using size exclusion chromatography in combination with a UV-diode array detector, a refractive index detector, and a multiangle laser light scattering detector for the optimization of crude oil demulsifier formulations. The developed method revealed the correlation between the content of high molecular weight species in the formulation and the water separation performance in crude oil emulsion. The developed method was found to be superior in terms of time, precision and ease of applicability in comparison to industry accepted bottle test method. Moreover, this method can also be used to control the consistency of the demulsifier intermediate chain length dispersity and to develop new demulsifier formulations.

Abstract (#19301)

Title: Gel permeation chromatography in the quality assessment of drag reduction polymer

Authors: Thunayyan Alqunaysi, Ahmad A Wedhaya and Saroj K Panda.

Saudi Aramco

The use of drag reduction polymer (DRP) to increase the flow rate of crude oils and refined products, such as gasoline and diesel fuel, in pipelines is inevitable to meet the ever increasing demand of energy from petroleum. The selection of a particular DRP is justified considering two factors viz. cost and performance. The performance of the polymer can be precisely estimated by hydrodynamic testing. However, such test is expensive and time consuming and may not be convenient for the performance check on a routine basis. There is, therefore, a strong demand for alternative tests that can correlate with the performance of DRP, once the performance of a DRP is established from the hydrodynamic testing. One of the important criteria for successful performance is the average molar mass. The higher the mass, the more efficient the DRP is. Simultaneously, it is also important to maintain an optimum mass, otherwise very high molar mass may negatively impact the refined product quality such as diesel and gasoline.

In the present work, the molar mass distribution of DRPs of different batches will be determined using gel permeation chromatography in combination with a refractive index detector and a light scattering detector to ensure the consistency of molar masses of DRPs from different batches. The effect of higher mass of DRP on the product quality will also be assessed. Moreover, a simulated experimental set up will be established to study the ability of the DRP to withstand the turbulent flow. The presentation will cover the analytical method development, establishment of simulated experimental condition for turbulent flow and its impact on DRP.

Abstract (#19256)

Title: Applications of liquid chromatography in petroleum industry

Authors: Amal R. Lajami, Saroj K. Panda.

Saudi Aramco

Chromatography is well known for its capabilities in separation, identification, and quantitation. In general, gas chromatography is routinely used for the analysis of volatile parts of complex crude oil mixture such as naphtha and gas oil. However, due to its inherent limitation to volatile and thermally stable compounds, high boiling compounds of crude oil mixture and polymeric additives used in petroleum industry cannot be successfully analyzed. Therefore, another mode of chromatography, such as liquid chromatography (LC) has been used as an important tool for the analysis of compounds that are not accessible with other analytical techniques. LC operates in a variety of modes such as normal phase, reversed phase, hydrophilic interaction, size exclusion, ion exchange and others which are mostly dependent on specific combinations of stationary and mobile phases. The mode of the separation is chosen based on the solubility and polarity of the analytes.
In this work, a number of key liquid chromatography applications used in the petroleum industry will be presented where other techniques are not suitable enough to provide reliable information. For instance, separation and quantitation of polycyclic aromatic hydrocarbons and heavy polycyclic aromatic hydrocarbons which are vital for controlling the quality of drilling additives and successful operation of hydrocracker unit, respectively, will be discussed. Another preferable LC technique mostly used in the petroleum industry is size exclusion chromatography (SEC). In particular, SEC has been used to screen the demulsifier formulations, and determine the molecular weight distribution and quantitation of kinetic hydrate inhibitors and drag reducing agents. This presentation will cover the development of a range of LC methods for specific analytes that have significant impact in the operation of petroleum industry.

Abstract (#19303)

Title: A kinetic study of FCC thermal cracking for crude oil to chemicals

Authors: Qi Xu.

Saudi Aramco

Overall propylene global demand is expected to grow at an annual average rate of ~3% over the next 10 years, according to an IHS report in 2014. This increasing demand has outpaced that for gasoline and fuel products, and prompted refineries and petrochemical companies to align their operations to provide the required supply, through innovation and new technologies. One of the newly developed technologies is the high severity fluid catalytic cracking (HSFCC®) technology, based on FCC process at high temperature conditions, to produce chemicals, mainly olefins, such as propylene, ethylene, and butenes, from feedstocks, such as crude oil and its fractions. Kinetic study is an integral part of the technology development.
In the present work, a kinetic model of five lumps has been built and studied for thermal cracking of three feedstocks, one light fraction, one heavy fraction, and one whole crude oil. The five lumps are heavy cycle oil (HCO), light cycle oil (LCO), gasoline, gas, and coke. A reaction network was built to show the reaction pathways for the five lumps. Then a mathematical model was built using the Runge-Kutta algorithm. After it was built, the mathematical model was used to calculate the kinetic parameters using experimental data. Then the model is used to study the kinetics of FCC process in general. First, the predicted yield from the kinetic model matched well with the yields from the experiment, indicating the accuracy of the kinetic model. It is shown that the gas yield from the feed increases with overall conversion at the same temperature. When compared at the same conversion, it is observed that the gas yield is higher when the temperature is higher for all the three feedstocks. Given the same temperature, it is shown that the gas yield is higher when the feedstock is heavier. Furthermore, it is shown that the activation energies and frequency constants are dependent on the feedstocks, using this current reaction kinetic model. And the lump profiles for the three feedstocks display different characteristics over the time of the experiments. Hence it is recommended that the reaction kinetics and parameters for each specific feedstock should be studied separately.

Abstract (#19473)

Title: The Promotion Effects of Co and Ni on the Hydrodesulphurization by Mo Loaded on Carbon

Authors: Umar C. Abubakar, Tawfik A. Saleh.

KFUPM

Waste tire-derived activated carbon (WDAC) was used as support for Mo based catalysts for application in the hydrodesulphurization of dibenzothiophene (DBT). Co and Ni nickel were added as promoters to obtain Mo/AC, CoMo/AC, and NiMo/AC catalysts. Materials were prepared through excessive wetness impregnation and then calcined at 300oC. Various techniques including BET FT-IR XRD, XPS, TPD and TPR were used for characterization. Catalytic activity tests were carried out in a pressure batch a reactor at a

temperature of 350 degree celsius and hydrogen pressure of 5 MPa hydrogen pressure using a Model fuel containing 1000 ppm sulfur. Results showed that direct desulfurization is most favored route and deep desulfurization was achieved in shorter time with the CoMo/AC compared to NiMo/AC and Mo/AC.

Abstract (#19187)

Title: Assessing and Improving Lab-Scale Distillation Efficiency

Authors: Ali H. Alshareef, Amjed Alshammari.

Saudi Aramco

Lab-Scale distillation is an important competency in refining development and optimization research. One use of the distillation results is to determine the yield or conversion of specific oil fractions before and after thermal treatment. For example, the yield of naphtha from hydrocracking experiments can be easily determined using basic lab-scale distillation. The ability to isolate the naphtha from the product and analyze it separately highlights the advantage of distillation against using simulated distillation results only.
Three distillation setups were tested. One setup utilized a packed column, while the other two used a specialized distillation column, Snyder Column, which has four segments (or trays) separated by floating glass balls. The two setups with the Snyder column either utilized a single column or two columns on top of each other to increase the number of theoretical plates. Fractionation of a hydrocarbon feedstock was performed every 25°C and the simulated distillation was performed on each fraction. The efficiency of the separation was determined using actual cut point range, the overlap degree, and the total mass recovered. The results indicated that specialized columns, such as Snyder column perform much better than packed columns and that increasing the theoretical plates does increase the fractionation efficiency at the expense of greater weight loss.

Abstract (#19363)

Title: Development of Nano-sized Zeolite Y for Crude Direct Conversion

Authors: Hanaa Habboubi, Linhui Ding.

Saudi Aramco

Hydrocracking is one of the most important heavy oil conversion processes in modern refineries and petrochemicals plants. Hydrocracking catalysts play a critical role in determining the product slates and properties, and thus the economics. Zeolite Y is a widely used cracking component of the commercialized hydrocracking catalysts for heavy oil hydroconversion due to its appropriate pore structure, acidity, and

hydrothermal stability. However its interconnected 12-membered ring channels make it difficult for large molecules present in heavy oil fraction to diffuse to the inner surface where most of the reaction sites are located. An effective way to reduce or eliminate the undesired diffusion limitation it to reduce the crystal sizes of the zeolites. When the particle sizes are reduced to nano-size, substantial changes in the physicochemical properties can be obtained. Nano-sized zeolite beta crystals were reported to exhibit higher catalyst activity, a lower rate of catalyst deactivation, and higher product quality than conventional microcrystalline beta materials. The presentation summarizes the studies on the effect of different silica and alumina source and synthesis conditions on the particle sizes, pore structure, crystallinity, and acidity. The appropriate synthesis method of the nano-sized zeolite Y was selected and the synthesis conditions were optimized.

Abstract (#19426)

Title: Hypo chlorination system at Qurayyah Seawater Plant

Authors: mohammed Al-Arab, Osamah Al-Shurafa.

Saudi Aramco

Treated seawater is often injected to maintain reservoir pressure and increase the efficiency of oil production. To assure the integrity of the seawater, several measures is being looking at. One of them is Hypochlorite injection. At Qurayyah seawater plant, hypo chlorination system is established to generate hypochlorite solution from Arabian Gulf seawater.

Laboratory experimental study was done to evaluate the reflection of Hypochlorite in Microbial growth reduction by linking particle count data with hypochlorite concentration.

28 filters was targeted for this study. Samples were collected from inlet & outlet three times a day. Particles count analysis and hypochlorite concentration analysis were performed and recorded. It was noticed that particles results have significantly dropped after implementing the efficient hypo-chlorination injection.

Finally, customer has increase the requirement of hypo. in terms of location & frequency.

Abstract (#19288)

Title: Molecular Structure of Coke Precursors in Pyrolysis Fuel Oil by Tandem Mass Spectrometry

Authors: Hendrik Muller, Nadrah A. Alawani, Qasim Saleem, and Donya A. Alsewdan.

Saudi Aramco

Steam cracking is a key refining process to produce valuable chemicals such as light olefins. Due to the high temperatures involved in the cracking process, even light, clean feed streams such as naphtha produce a significant amount of a heavy residual fraction called pyrolysis fuel oil (PFO). Known to contain extensive polynuclear aromatic hydrocarbon compounds, which deposit and are responsible for downstream fouling and coke formation, PFO is also a challenging mixture for detailed molecular level characterization. To understand its composition at a near molecular level, a PFO sample (a fraction with boiling point above 300 °C) obtained from a commercial steam cracking process was characterized via atmospheric pressure photo ionization (APPI) high-resolution mass spectrometry (MS) using a Fourier transform ion cyclotron resonance mass spectrometer, and tandem MS. The MS data indicated aromatic hydrocarbon species with a high number of aromatic rings. Tandem MS experiments of various precursor species isolated from the sample confirmed the presence of extensively condensed aromatic systems. Together, the MS data give an insight into the aromatic cores present in the PFO sample and also the pattern of alkyl substitution. The identified structural motifs, analogous to continental asphaltene structures, support the possibility of self-assembly into larger aggregates, which might ultimately be linked to coke formation.

Abstract (#19249)

Title: Distinct aromatic species in a heavy oil solution

Authors: Qasim Saleem, Donya A. Alswedan, Nadrah A. Alawani, Hendrik Muller.

Saudi Aramco

Steam cracking is a key refining process to produce valuable chemicals like light olefins. However, depending on the feed, it can lead to the production of a heavy residual fraction, the so-called pyrolysis fuel oil (PFO), at concentrations of ~30 %. The deposition of PFO is implicated in downstream equipment fouling and coke formation. Known to contain mainly polynuclear aromatic compounds, PFO is a challenging mixture for detailed characterization. To understand the composition of its heavy molecules towards addressing process issues, a PFO sample (b.p. > 300 °C) obtained from a commercial steam cracker unit was characterized via liquid-state NMR spectroscopy. The 1H spectra obtained confirmed the presence of large molecular species with alpha-methyl groups, methylene groups (alkyl chains), and aromatic protons. To gain a deeper understanding of the molecular composition of the species, pulsed field gradient 1H NMR spectroscopy was employed. Distinct diffusion behavior was observed for the groups in the sample, suggesting the presence of different structural motifs in solution. It is posited that

these distinct structures, analogous to asphaltenic archipelago and/or continental structures, could potentially play a role in the self-assembly of large aggregates implicated in coke formation.

Abstract (#19406)

Title: Band gab engineering of UiO-66 MOF platform as efficient method for enhancement the CO2 conversion

Authors: Mostafa Zeama, Mahmoud M. Abdelnaby, Mohamed A. Morsy, and Zain H. Yamani.

KFUPM

Zr-based MOFs, specially UiO-66, are well-known for their unique merits reflected in their stability, photoactivity, and affinity to CO2 adsorption. Also, as Titanium is recognized for its photocatalytic activity, we are reporting different incorporation methods of Titanium moieties within the UiO-66-based frameworks. Each method successfully produced crystalline material with enhancement in photocatalytic properties. The incorporation and the role of Titanium in the photocatalysis was confirmed by the electron paramagnetic resonance (EPR) and UV-Vis measurements. The photoactivity of the samples was examined by UV-Vis measurements showing a red shift in the absorption of the catalyst. This increase in the photoactivity was further confirmed with the DFT calculation showing a decrease in the band gap of the modified samples with respect to the parent UiO-66. Finally, the photocatalytic activity of the samples was tested in the photoreduction of the CO2 under visible light, the modified samples shows a significant enhancement (2.2 times) of the photocatalytic activity compared to the parent UiO-66.

Abstract (#19209)

Title: A NEW MEMBRANE TECHNOLOGY FOR OILY WASTEWATER TREATMENT

Authors: Fadhilah Alduraiei, ChiSiang Ong.

Saudi Aramco

Large volume of oily wastewater, often in the form of tight emulsion, are generated in oil industry during hydrocarbon production and refining processes. Membrane technology has emerged as an effective approach to remove the small sized oil droplets from water streams. In this presentation, we report a facile and robust method to modify surface membrane for this application.
The surface membrane modification was achieved via a simple coating of PVDF membrane using tannic acid (TA) followed by oxidation with sodium periodate (NaIO4). The modified membranes were investigated by water contact angle measurement and characterized using SEM, AFM, XPS and FTIR. The contact angle measurement showed that the TA modified membrane exhibits superhydrophilicity and

underwater oleophobicity. Results from FTIR and XPS indicated that the carboxylic groups were formed on the surface of the TA modified membrane due to the oxidation of quinone by NaIO4, which is the key to superhydrophilicity of the TA modified membrane surface.
The modified membrane was tested for oil-in-water emulsion separation. A high TOC rejection (? 99%) was achieved for different kinds of surfactant-stabilized oil-in-water emulsions as well as the surfactant-free oil-water mixture. The modified membrane not only showed good water flux and oil/water separation performance but also exhibited excellent recyclability and chemical stability. In addition, the developed method is versatile and can be applied to the different types of substrate material. This robust, simple, and green approach has a great potential to fabricate large-scale material surfaces for the industrial oily wastewater treatment.

Abstract (#19365)

Title: Smart Materials for Pipe Inspection

Authors: Hawraa Bin Saad, Enrico Bovero, Abdullatif A. Jazzar, Aziz Fihri, Abdullah A. Shahrani.

Saudi Aramco

One of the largest expenditures in the Oil and Gas Industry is associated with corrosion of metallic equipment and in particular metallic pipes. It has been estimated that the total yearly cost associated to maintenance and repair of corroding equipment is around US$ 1.7 billion per year, or US$ 5,500 per km of pipeline per year.
For this reason, switching to composite pipes, where possible, is extremely appealing. However, the lack of reliable inspection technologies for composite pipes determines a certain level of reluctance toward this replacement. As a result, the availability of such an inspection technology would not only reduce the number of failures in non-metallic materials, it would also eliminate the reluctance toward the change and thus materialize the immediate savings associated to the reduction in corrosion costs.
Here, we will discuss a novel non-destructive inspection and monitoring technology, developed by Saudi Aramco, with high and tunable sensitivity named Saudi Aramco Enhanced Nonmetallic Sensing technology (SENSe). While this technology has been developed primarily for the inspection of non-metallic pipes, its nature renders it adaptable to a wide variety of materials and fields. SENSe detects material deformation by rendering the surface responsive to visible light. The reading is performed utilizing devices specifically designed for each type of application. These devices with a custom developed software are capable of mapping existing defects and material's weak points in order to prevent failures.

Abstract (#19327)

Title: Synthesis of Novel Graphene-FeSiBiOBr Composite for the Degradation of Organic Pollutants from Waste

Authors: AbdulElah A. AlAhmed, Tawfik A. Saleh.

AlHussan Highschool

Water pollution has been a major environmental concern in the world. Industrial wastes, which consider as one of the main water pollutes resources, release tons of organic dyes every year. Due to their high toxicity, persistence and bioaccumulation effects on living organisms; it affects human and marine life negatively. Therefore, many studies have been trying to develop techniques to dissolve these contaminants. Photocatalysts nanocomposite is one of these essential techniques. This research focuses on finding a way to develop the graphene oxide based on bismuth oxybromide (G-BiOBr) nanocomposite by a magnetic core, which assumed to enhance the recyclable and the reusability processes. A Fe3O4 covered by a thin layer of SiO2 covered entirely with BiOBr were combined with graphene oxide, which results in a graphene-based on magnetic bismuth oxybromide (graphene-FeSiBiOBr) eventually. The synthesized composite was characterized using a scanning electron microscopy (SEM), energy-dispersive X-ray (EDX), and Fourier Transform infrared spectroscopy (FT-IR). Graphene-FeSiBiOBr was examined through methylene blue dye under visible light irradiation of 420 nm. As an experiment, seven reagent bottles filled with different methylene b concentration were mixed with 50 and 20 mg of graphene-FeSiBiOBr. Visible light irradiation, catalysts dosages, and methylene b were determined as parameters. The results showed a significant improvement on the degradation and adsorption efficiency of methylene b under visible light irradiation with 100% clarity, effortless recyclability, and reusability — also 7 minutes were determined as an adsorption time, which considers very brief compared to pure G-BiOBr. The improvement in the photocatalytic activity can be attributed to the magnetic core, which plays a crucial role in improving the composite structure and enhances its morphology. In conclusion, the synthesized graphene- FeSiBiOBr had shown excellent results in organic dyes degradation; thus this way could be used in the wastewater treatment process.

Abstract (#19271)

Title: Synthesis and Corrosion Behavior of Graphene Oxide Coating on Carbon Steel for Oilfield Applications

Authors: Muthukumar Nagu, Husnul Maab Wahab, Nayef M Alanazi, Abdulrahman K Huwaiji, Tulay Inan, Matteo Leoni and Turki Al-Khaldi.

Saudi Aramco

In this present study the corrosion inhibition of carbon steel in 3.5% Sodium chloride (NaCl) solution with carbon dioxide conditions by Graphene Oxide (GO) has been studied. Graphene oxide was prepared by

Modified Hummers Method and characterized by Raman spectroscopy, UV-Visible spectroscopy (UV-Vis), X-ray Diffraction (XRD) and Thermo-Gravimetric Analysis (TGA). GO coatings were deposited on carbon steel by electrophoretic deposition (EPD) method from GO/water suspension by making carbon steel as anode. The electrochemical corrosion behavior of carbon steel has been studied in the absence and presence of GO coatings by Tafel polarization and electrochemical impedance spectroscopy (EIS) analysis. The corrosion potentials of GO-coated carbon steel samples moved to more noble potentials and corrosion current of coated samples were found to be lower than uncoated carbon steel electrode suggesting that GO coatings are promising coatings against carbonic acid corrosion of carbons steel.

Abstract (#19392)

Title: Hybrid nanocatalysts included copper(I) oxide for effectively photocatalytic carbon dioxide conversi

Authors: Chan Kyu Lim, Hyunjoon Song.

KAIST

There has been intensive research on direct CO2 conversion reactions via photochemical, electrochemical and biological approaches. However, photochemical method using sun light in aqueous solutions is regarded as an eventual and effective way due to the prospect of using free and plentiful sun energy without damaging the environment. An ideal photocatalyst structure has been proposed as a combination of a light absorber (semiconductor) and a cocatalyst. Although proper combination of semiconductor and metal cocatalyst is essential, structures and morphology are also critical in determining catalytic properties. Among the current catalysts reported thus far, the most of efficient photocatalysts exhibited very low values of less than 0.01% in quantum efficiencies with negligible total conversion yields. If CO2 was effectively converted into useful chemicals by photocatalyst, we can make perfect artificial carbon cycle.
In our previous results, we have successfully demonstrated a ZnO-Cu2O hybrid nanocatalyst system, which exhibited remarkable catalytic activities with the quantum efficiency. Remarkably, the selectivity of CH4 production even in an aqueous environment exceeded 99%. However, ZnO-Cu2O catalysts had a limit in large band gap of ZnO and low chemical stability. In this study, we changed the catalyst framework to TiO2 and g-C¬3N4 instead of ZnO while keeping the cocatalyst at Cu2O. A TiO2 is a well-known photocatalysts because of chemical stability, high charge separation ability and environmental abundancy. Graphtic carbon nitride is the most intensively studied material in the field of photocatalyst recently because of their proper band gap for absorbing visible light and electrical conductivity. We successfully synthesized TiO2-Cu2O hybrid hollow shell nanostructure and Cu2O cubes decorated g-C3N4 nanosheet and applied it to photocatalytic CO2 conversion. The catalysts shows high activity and selectivity in methane production under neutral carbonated water. The proper combination of each semiconductor components and sophisticated control structures and junctions lead to remarkable photocatalytic performance.

Abstract (#19309)

Title: Decorated fibrous silica epoxy coating exhibiting anti-corrosion properties

Authors: Aziz fihri, Aziz Fihri, Dana Abdullatif, Hawra\'a Bin Saad, Remi Mahfouz, Hameed Badairy, Mohamed Bouhrara.

Saudi Aramco

Nature has always been an inspiration for scientists, and superhydrophobicity is one prime example of such interest, as exhibited in the lotus leaf. In fact, many researchers have been trying to imitate the hierarchial micro/nanostructures of the lotus leaf to reproduce similar superhydrophobic properties with the hope to obtain new materials with interesting and improved wetting properties. Over the recent years, considerable research has been made to produce metal oxides-based superhydrophobic nanocomposite surfaces due to their potential applications in a wide variety of sectors such as automotive, aerospace, building and construction and corrosion mitigation [1]. The preparation of such inorganic fibrous materials to be incorporated in the polymeric matrices could lead to a new generation of superhydrophobic materials with outstanding water repellency through the cooperative effects of their low surface energy and their surface roughness generated by the fibrous structure ?2,3?. However, the brittleness of inorganic surface fibrous particles considerably limits their practical applications. As such it is a persisting challenge to develop superhydrophobic fibrous nanocomposite materials while retaining their surface morphology. In this communication, we will describe a new efficient synthesis approach for a novel superhydrophobic fibrous silica polymeric coating. The structural characterizations and the anti-corrosive performance of this dendritic superhydrophobic fibrous coating on carbon steel will be also reported and discussed.

Keywords: Fibrous silica, Epoxy coatings, Carbon steel, Superhydrophobicity, Corrosion resistance.

Abstract (#19379)

Title: Porous Crosslinked Polymer as an Efficient Material for Carbon Dioxide Separation

Authors: Mohamed M. Abdelnaby, Naef A. A. Qasem, Bassem A. Al-Maythalony, and Othman Charles S. Al-Hamouz.

KFUPM

Porous organic polymers are considered an efficient solid sorbent for carbon dioxide separation for having lower regeneration energy, in addition to being environmentally friendly. Due to their high uptake and selective CO2 capture through their good water, chemical stability and synthetic diversity alongside the presence of multifunctional active groups. A new synthetic strategy has been developed to synthesize crosslinked porous organic polymer called KFUPM-1 by crosslinking pyrrole with 1,4-benzendiamine. The

resulting copolymer was fully characterized by 13C solid state nuclear magnetic resonance (NMR) and FTIR. KFUPM-1 is proven permanently microporous with a Brunauer-Emmett-Teller surface area of 305 m2 g-1. Because of the high concentration amine functionalities from the monomer moieties within the copolymer networks as well as the narrow pores, the copolymer expiated a high CO2 uptake up to 23.4 cm3 g-1 at 298 K and 1 bar, with exceptional selectivity (141) for CO2 over N2 at 298 K and dynamic capacity (15.1 cm3 g-1) in the presence of water (20 : 80 v/v CO2 : N2, 91% relative humidity, 1 bar, and 298 K. The performance of this polymer is maintained over 45 cycles without loss of selectivity, capacity, nor recyclability at room temperature; making it stand out among all porous organic materials used for carbon capture.

Abstract (#19329)

Title: Removing Hydrocarbons/Organic Contaminants from Water Using a Novel Ultrahydrophobic/Oleophilic Self

Authors: Abdullah Mohammad Alsinan.

Dhahran Ahliyya Schools

The widespread use of petrochemicals often leads to substance spills in aquatic environments during transfers or offshore drilling/exploration, resulting in catastrophic pollution, economical loss, and impacting aquatic ecosystems. According to the International Tanker Owners Pollution Federation, more than 7.3 billion liters of petrochemicals was lost as a result of tanker incidents from 1970 to 2018. The best reported conventional separation methods are on average of 60% efficient, where the petrochemicals extracted are chemically altered, losing its characteristics and value. Therefore, the development of an efficient technique is a necessity. This research aims on using hydrophobic functionalized polypropylene with WO3 and Multi Walled Carbon Nanotubes (MWCNT) in the separation of hydrocarbons/organic contaminants from water. The novel composite was synthesized by mixing MWCNT, WO3 and polypropylene homogenously. An Easy-load Masterflex Tubing Model with the composite inside one end was used to conduct the separation process. The final volume of both substances shows that the composite was able to achieve a high separation efficiency (99%). Each 100 grams of the composite was successfully able to separate more than 6,535 L/m2/h of petrochemicals from water without chemical altering. Regeneration was conducted on four hydrocarbons for 20-cycles/each components, which showed that the composite does not lose its ultra-hydrophobicity and functionality over time. A feasibility study indicated that the cost to manufacture the composite is significantly reduced comparing to the conventional methods. This study proved that the composite was highly efficient and cost effective, yielding a new novel system to successfully remove petrochemicals from aquatic environments.

Abstract (#NA)

Title: A flexible biomimetic superhydrophobic and the superoleophilic 3D macroporous polymer based

Authors: Fahd Alghunaimi, Nadeem Baig.

Saudi Aramco

Effective separation of the non-polar organic contaminants from the water has become a challenge due to the increase of industrial wastewater and oil spills. The development of a stable 3D surfaces for the oil/water separation has a great interest to researchers. Inspired from the lotus leaf, in this work a superhydrophobic stable and robust surface was generated by the combination of the silane, silica, polypyrrole and the polyurethane (ODTCS-SiO2-PP-PU). The constructed 3D network has displayed the superhydrophobic and the superoleophilic behavior with the high-water contact angle of 154.7?. The superhydrophobic behavior of the porous materials was found stable for months as it was kept under observation. Apart from the hydrophobicity analysis of the material, the various forms of the materials were investigated by the scanning electron microscope (SEM), Fourier-transform infrared spectroscopy (FTIR), and Energy-dispersive X-ray spectroscopy (EDX). Under the force of gravity, the hexane has displayed an exceptionally high flux of 102068 Lm-2h-1 through the ODTCS-SiO2-PP-PU. The macroporous network of the ODTCS-SiO2-PP-PU has displayed fewer chances of choking that is a common issue with the membranes. Moreover, its porous network has displayed good absorption capacity for the various non-polar organic solvents. The maximum absorption capacity was observed for toluene that was 34 times to its own weight. The separation efficiency for various non-polar organic solvents from the water was observed in the range of 99.5 to 99.8 %. The ODTCS-SiO2-PP-PU due to its superhydrophobicity, 3D porous network, extraordinary high flux, good absorption capacity and excellent separation capability has made a good candidate for the separation of organic and oil contaminants from the water.

Abstract (#19334)

Title: Synthesis and characterization of manganese oxide nanoparticles-coated on Albizia procera derived

Authors: Syed Shaheen Shah, Md. Abdul Aziz, Zain Hassan Yamani.

KFUPM

The electrocatalytic splitting of water provides a potentially cost-effective, renewable, and clean path for the production of hydrogen gas. In this process, the efficiency of water oxidation (2H2O?4H++4e-+O2) is important. Because the required proton to produce molecular hydrogen is generated in this step, the efficiency and cost of electrochemical water oxidation partially depends on the type of anode materials. Here we present a preparation of manganese oxide nanoparticles on Albizia procera derived carbon (MnOxNPs-C; anode materials) for electrochemical water oxidation, by a simple thermal decomposition method. Initially the carbon powder was prepared from the dried leaves of Albizia procera, heat treated

at 800 °C in the presence of N2 gas. For the preparation of MnOxNPs-C, certain amounts of Mn(CH3COO)2 and the prepared carbon powder were mixed together and thoroughly sonicated at room temperature to get a homogeneous solution. The completely dried mixture was then thermally treated at 300 °C to produce MnOxNPs-C. Morphological variations, formation of crystalline structure, elemental, and chemical analysis were studied using SEM, XRD, EDS, and XPS, respectively. The SEM analysis showed that the manganese oxide nanoparticles are well dispersed over the carbon. XRD results showed the single-phase formation of the Mn3O4, and Mn3O4 along with MnO phase formation, at low and high amount of the precursor materials, respectively. Four different samples (prepared catalysts) were tested for the optimization of electrocatalytic activities towards water oxidation. The sample prepared using the highest amount of manganese precursor over the carbon surface shows good stability and electrocatalytic performance for water oxidation.

Abstract (#19353)

Title: Preparation of nano-Co3O4-coated Albizia procera derived carbon by direct thermal decomposition meth

Authors: Ismail A. Buliyaminu, Md. Abdul Aziz, Zain Hassan Yamani.

CENT, KFUPM

Abstract
Hydrogen fuel production by electrochemical method is a promising approach for energy production and storage. An efficient water oxidation is needed for molecular hydrogen generation by electrochemical method as necessary protons are produced in this process. Moreover, the clean oxygen generated in this process is useful in clinical applications and fuel cell fabrications. Therefore, for the construction of efficient and economical electrochemical cells for hydrogen and oxygen production, it is important to develop an efficient anode system that can oxidize water efficiently. Herein, nano-Co3O4 coated-Albizia procera (Roxb.) leaves derived carbon anode materials were prepared using a simple and straightforward thermal decomposition of Co(NO3)2.6H2O at 300 ?C without any pre-reaction. Six different samples (electrocatalysts) were prepared by varying the amount of the Co precursor with the fixed amount of carbon using the same thermal decomposition parameters. The prepared samples were characterized by different techniques including X-ray powder diffraction (XRD), Scanning electron microscopy (SEM), Energy dispersive spectroscopy (EDS), Thermo-gravimetric analysis (TGA), X-ray Photoelectron spectroscopy (XPS), and Raman spectroscopy. TGA data revealed that nano-Co3O4-C is stable at temperatures ? 320 ?C. The calculated size of the prepared nano-Co3O4-C is ~10 nm. The prepared samples were immobilized on the filter paper derived carbon electrode to study the electrocatalytic properties of the samples. The electrocatalyst prepared using highest amount of cobalt precursor yields high activity towards water oxidation and good stability.

Abstract (#19384)

Title: Supercapacitor Based on Nitrogen-Doped Activated Carbon Materials Made from Albizia Tree Leaves

Authors: A.K. Mohamedkhair, Md. Abdul Aziz / Zain Hassan Yamani.

KFUPM

The simple preparation of renewable energy from solar, wind, tidal or geothermal resources and its efficient use has become a subject of interest within the scientific community due to the rapid depletion of limited natural resources and severe environmental concerns. The efficient use of generated energy significantly depends on the storage performance. As a result, scientists are interested in the development of inexpensive, environmentally friendly and high-performance energy storage technologies, including supercapacitors. In this work, preparation of nitrogen-doped carbon materials from Albizia procera leaves with enhanced electrochemical supercapacitance properties is reported. The doped carbon materials were prepared by pyrolysis of Albizia procera leaves at 800 °C, and the effect of the presence of activating agents such as ZnCl2 and NaHCO3 on the textural and structural properties, BET surface area, surface functional groups and electrochemical supercapacitance was examined and compared. The BET specific surface area results show that NaHCO¬3-activated nitrogen-doped carbon (NaNC) has a higher surface area than ZnCl2-activated nitrogen-doped carbon (ZnNC) and nitrogen-doped carbon prepared without an activating agent (WANC). Overall, the BET and microscopic analyses confirmed that NaNC is composed of carbon nanosheets with a large number of micropores and a certain amount of mesopores and macropores, which is completely different from the composition of ZnNC and WANC. On the other hand, the XPS analysis revealed the presence of nitrogen in NaNC, ZnNC, and WANC. As a result of its unique properties such as a high surface area, the presence of a high amount of nitrogen, and nanosheet-type morphology, NaNC exhibits a high specific capacitance of 231 F g-1 at 1 A g-1 current and excellent charging-discharging stability.

Abstract (#19385)

Title: Facile synthesis of ultrathin interconnected carbon nanosheets as a robust support for small and uni

Authors: Munzir H. Suliman, Mohammad Qamar, Alaaldin Adam and Mohammad N. Siddiqui.

KFUPM

Supports play crucial role in determining the catalytic activity, selectivity and overall performance of the supported catalytic nanoassemblies. Herein, ultrathin interconnected carbon nanosheets (CN) are prepared and used as a robust support for dispersion of iron phosphide (FeP) nanoparticles, and the resulting catalytic system is evaluated as low-cost electrocatalyst for hydrogen evolution reaction (HER). Carbon is derived from carbonization of sodium citrate in one-step, which is interconnected and in the form of ultrathin nanosheets (thickness <5 nm) with high surface area. Such morphological features of carbon steered the growth of small FeP nanocrystals with better dispersion qualities. As a result, the electrode comprising FeP-modified ultrathin interconnected carbon nanosheets (FeP/CN) exhibits excellent HER performance both in acidic and basic electrolytes; requires small onset and overpotential,

and possesses high turnover frequency (TOF), in addition to excellent operational stability. The performance of FeP/CN electrode is compared with that of commercial carbon-supported platinum (Pt/C) and supportless FeP nanoparticles. Superior performance of the electrode comprising FeP/CN is correlated to specific surface area, electrochemically active surface area, interfacial charge transfer resistance and TOF.

Abstract (#19416)

Title: Morphology mapping of solution sheared halide perovskite thin films for solar cell application

Authors: Issam Gereige, Hyeon Seok Lee, Esra AlHabshi, Issam Gereige, Steve Park, Byungha Shin.

Saudi Aramco

Large area scaling of hybrid perovskite is essential to bring the technology into commercialization. Various large-scale printing techniques have been successfully employed to fabricate high performance perovskite solar cell. In particular, solution shearing is a versatile technique in which many processing parameters can be tuned in order to produce films with desired structure and morphology. In this study, we have examined the impacts of substrate temperature and coating speed (i.e., how fast the blade is moving), two of the most influential process parameters, on morphology of the resultant perovskite films. Four distinct phases are identified in terms of surface morphology and a morphology-phase map is constructed with the aforementioned parameters. Occurrence of different morphology phases was explained by the rate and degree of supersaturation and the supply of solution to the meniscus, both of which dictate the rate of nucleation and crystal growth. An optimal phase window with specific parameters is chosen and the device performance with the solution-sheared perovskite film exhibits power conversion efficiency of 18.48%, which is beyond to that of reference device prepared by the conventional spin-coating process. A large scale perovskite film of an area of 57 cm2 is prepared with solution shearing and shows high uniformity.

Abstract (#19586)

Title: Removal of heavy metal from waste water by polyoxometalate Ionic Liquid supported on Saudi Bentonite

Authors: Fatma Bannani, Wafaa Althagafi and Hafedh Driss.

Jeddah University

The development of Polyoxometalates POM-based innovative functional materials is of signivicance to effectively utilize POMs in meeting various contemporary society challenges such as environment, energy, medicine and information technologies,
In this work, we present a multi decontaminant supported POM-ionic liquid (POM-ILs) composite. The prototype POM-ILs feature monolacunary Keggin-type anions [PW11O39]8- with heavy-metal binding

sites and antimicrobial tetraoctylammonium ions as cationic species. The two active component material is immobilized on porous Khulais Saudi Bentonite. The physicochemical properties of the synthesized product were characterized by powder X-ray di?raction (XRD) method, infrared spectroscopy (FT-IR), Scanning Electron Microscopy (SEM) and EDS (Energy Dispersive X-Ray Spectroscopy). Applicability of the as prepared material as adsorbent for the removal of hazardous heavy metal removal from aqueous solutions has been studied. Batch experiments for the adsorption study of Ni2+, Sr2+, Zn2+ ions were conducted to investigate the effect of contact time, Ph, initial heavy metal concentration and different temperatures (298 K, 303 K, 308 K, 313 K, 318K) on the adsorption process. The equilibrium data was successfully ?tted the Langmuir isotherm. The adsorption rate data was ?tted well to pseudo-second-order model indicating the process to be dominated by chemisorption. Thermodynamic parameters showed that the adsorption process was spontaneous in nature. The removal rate of the composite POM-IL@Bentonite is greater than that of free Bentonite, showing that the adsorption performance of natural Bentonite can be enhanced by modification of POM-IL.

Abstract (#19560)

Title: Broadband Spectroscopy Measurement of Gas Separation Membrane Materials

Authors: Ahmed J. Talib, Sebastien A. Duval, Milind M. Vaidya, Seung Hak Choi, Feras Hamad.

Saudi Aramco

Natural gas production requires multiple steps in order to clean the gas from its contaminants and achieve sales gas quality. These steps include sweetening (e.g. removal of acid and toxic gases), dehydration and hydrocarbon dew pointing or liquid recovery for rich gases. In most cases, gas sweetening is performed with the help of amine unit and dehydration with glycol type solvent [1]. For some specific separation applications, polymeric membranes can offer a cost advantage when the contaminant content is high, then hybrid process including membrane and absorption can reduced significantly both capital and operating expenditures. Membrane is then acting as a bulk removal or pre-treatment for the absorption [2]. In the other part of the spectrum when the contaminant levels are low in the range of 1,000 to 10,000 ppm level membrane technology can also reduce content of contaminants. These later applications refer to gas dehydration [2], helium extraction [3] or tail gas treatment of sulfur recovery plants [4]. Whatever the application, the instrumental part of membrane based gas separation technology is the micron size solid polymeric layer, through which gas components will diffuse at different rates enabling gas components separation. A better understanding of the polymeric material structure/properties relationship is essential to improve separation performance as well as to tailor membrane materials to reduce both physical and chemical ageing phenomena [5]. Broadband Spectroscopy targets at monitoring internal dipole mobility of materials under multiple stresses, e.g. temperature, time (frequency) or degrading environment and can provide insight regarding membrane materials behavior [6]. In this study, film casted polymers were evaluated by Broadband Spectroscopy. The effect of absorbed water by the polymer on its glass transition temperature have been evaluated. Depending on the polymer structure, the interaction of water on polymer varied and induced different depression of glass transition temperature. Knowledge of the in-situ glass transition is critical to define the operating range of a polymeric membrane materials: for operating temperatures below in-situ glass transition temperature, dimensional change, relaxation, physical ageing or creeping are minimized; for operating temperatures above glass transition physical ageing and irreversible mechanical damages can be experienced by

membrane materials. These effects can have direct consequences towards separation performance of the membranes.

Abstract (#19270)

Title: Synthesis of a novel polysuccinimide based hyper-crosslinked resin for the highly efficient removal of Congo Red and Eriochrom Black T from aqueous solution

Authors: Muhammad Mansha, Abdul waheed, Nisar Ullah

KFUPM

Abstract:
A novel hyper-cross-linked polyamide resin has been synthesized by the aminolysis of polysuccinimide (PSI) with N,N\'-bis(3-aminopropyl)ethylenediamine. The synthesized resin (PSI-PA), mesoporous in nature with a specific surface area (98.80 m2g-1), exhibits superior adsorptive performance for the efficient removal of Congo red (CR) and Eriochrom Black T (EBT) from aqueous solution. The resin has been extensively characterized by solid state 13C (CP-MAS) NMR, FT-IR, EDS, TGA and BET analysis. The surface chemical composition of PSI-PA before and after dyes adsorption was analyzed by XPS. Examination of experimental data of dyes adsorption onto resin by a variety of non-linear adsorption isotherms and kinetic models suggested that Langmuir model was well fitted to characterize the adsorption of both CR (R2 = 0.9966) and EBT (R2= 0.9934). The rate of adsorption of these dyes indicated that the equilibrium was attained within a few hours and the kinetic data well-fitted by pseudo-second-order rate equation. At room temperature, PSI-PA displays maximum adsorption capacity (Qmax) of 522.18 mg g-1 for CR at pH 9.0 and 460.34 mg g-1 for EBT at pH 6.0. Moreover, PSI-PA exhibited 82% removal efficiency for dyes in simulated effluents which hinted its potential and utility for industrial waste water treatment. Adsorption interactions of dyes onto resin have been studied by FESEM and XRD analysis.

Abstract (#19207)

Title: Progress in Catalytic Cracker Catalyst of 1D and 3D Nanocrystal Zeolites for Naphtha Reforming

Authors: Emad N. Al-Shafie, Ali N. Al-Jishi, Mohammad Z. Al-Bahar, Ki-Hyouk Choi, Mohamed A. Abdullah, Ali S. Alnaser, Oki Muraza, Mohammed A. Sanhoob, and Anas K. Jamal.

Saudi Aramco

The catalysts based of zeolites are the potential catalysts for the refinery and petrochemical industry applications. There are several challenges that limited utilizing zeolites due to cat-alyst stability and high coke formation. The study aims to develop 1D and 3 D nano crystal zeolite for the hydrocarbon conversion with better hydrothermal stability [1]. In order to overcome these intrinsic limitations, zeolite crystal size

was reduced to the nanoscale to shorten the diffusion path length to improve the accessibility of molecules and to accelerate the reaction rate. On the other hand, this vulnerability of zeolite framework toward hydro-thermal treatments in steam can open new doors to effectively modify and even to synthesize new zeolites [2]. The study explored the effect of synthesis parameters on the catalyst activity and the hydrothermal stability of nanoscale MFI zeolites of nano size one-dimensional and three-dimensional pores of zeolite ZSM-22 and ZSM-5. The hydrocarbon cracking catalytic was carried out by using fixed bed to improve the conversion, reaction selectivity, catalytic stream stability and coking rate with an emphasis the role of nanostructure zeolite. Also, the presentation will discuss the reaction mechanism of 1D and 3D shape selectivity of nanocrystal zeolites at moderate temperature and effect of steam addition to the zeolite stability for naphtha reforming.

Abstract (#19285)

Title: SABIC SSBR evaluation in high performance Tire Tread compounds

Authors: MP Pravin Kumar.

SABIC

Styrene Butadiene Rubber is one of the first synthetic general purpose rubber to be produced in the world. However, in little over two decades time, there has been significant development in this polymer, which is mainly driven by regulations and government mandates like CAFÉ in US and Tire labelling requirements in EU. Add to this, there have been more stringent requirements coming from Electric Vehicle (EV) development, which requires tire to have significant improvement in rolling resistance to conserve battery life of vehicles and improve non-stop running of vehicles without recharging. Unlike the conventional IC engines, these vehicles have very high torque transmission from electric engines, which requires tire treads to have excellent traction properties. With almost silent engines these vehicles, the only noise is from the tire running which also has to be minimum. Considering all the new regulatory and market requirements, SABIC produced licensed Solution SBR grades, namely SSBR3323H & SSBR3041H, which were evaluated for rolling resistance and traction properties against available competitor material. SABIC SSBRs exhibited excellent physical and mechanical properties. Relatively higher Styrene content, improved traction characteristic while higher vinyl content improved rolling resistance in high performance tire tread compounds evaluated in the study.

Abstract (#19587)

Title: Polyoxometalate Ionic Liquid supported on Saudi Bentonite for adsorbing removal of cationic dye

Authors: Abrar Eskandrani, Abrar Eskandrani.

Jeddah University

Aiming at developing benign multiple decontamination water material, using low-cost natural raw local materials, we prepared a modified Clay supporting polyoxometalate ionic liquid composite material, where each component targets a specific type of water contaminant. The composite material based on water-insoluble polyoxometalate-ionic liquid (POM-IL) consisting of antimicrobial tetraoctylammonium cations, and saturated Keggin-archetype polyoxometalate [PV3W9O40]6- anions, immobilized on Khulais raw Saudi Bentonite having an interesting dye removal capacities.
The lipophilicity of the POM-IL enables adsorption of organic contaminants. The prepared material was characterized by powder X-ray direction (XRD) method, infrared spectroscopy (FT-IR), Scanning Electron Microscopy (SEM) and EDS (Energy Dispersive X-Ray Spectroscopy). The POM-IL@Bentonite composite was tested for cationic dye removal from waste water. Batch experiments for the adsorption of Methylene Blue MB were conducted to investigate the effect factors containing the initial concentration, contact time, adsorbent amount, pH and Temperatures. The Kinetic study showed that the pseudo-second-order model described well the adsorption process. The experimental isotherm data were found to fit the Freundlich model well compared to the Langmuir isotherm model. The thermodynamic parameters illustrated that the adsorption was spontaneous and exothermic process. The results of the present study showed that modified Saudi Bentonite represents an excellent multicomponent low-cost adsorbent for cationic dye removal from waste water.

Abstract (#19434)

Title: Advances in Unicracking Catalysts and Process to Meet Changing Product Demands

Authors: Suheil Abdo.

Honeywell UOP

With softening demand for transportation fuels, petrochemicals production provides an alternative path to profitability for refiners and creates the maximum value uplift from crude. In this presentation, we will
• Review current global and Middle East refining and petrochemical trends, highlighting crude to chemicals strategies that would enhance diversification towards petrochemical production
• Explore recent advances in crude to chemicals technology, including Bottom of the Barrel processing and Refining and Petrochemical Integration
• Present project case studies that highlight the importance of intimate domain knowledge when determining the highest value integration strategy and show how we identified solutions that delivered increased value.
