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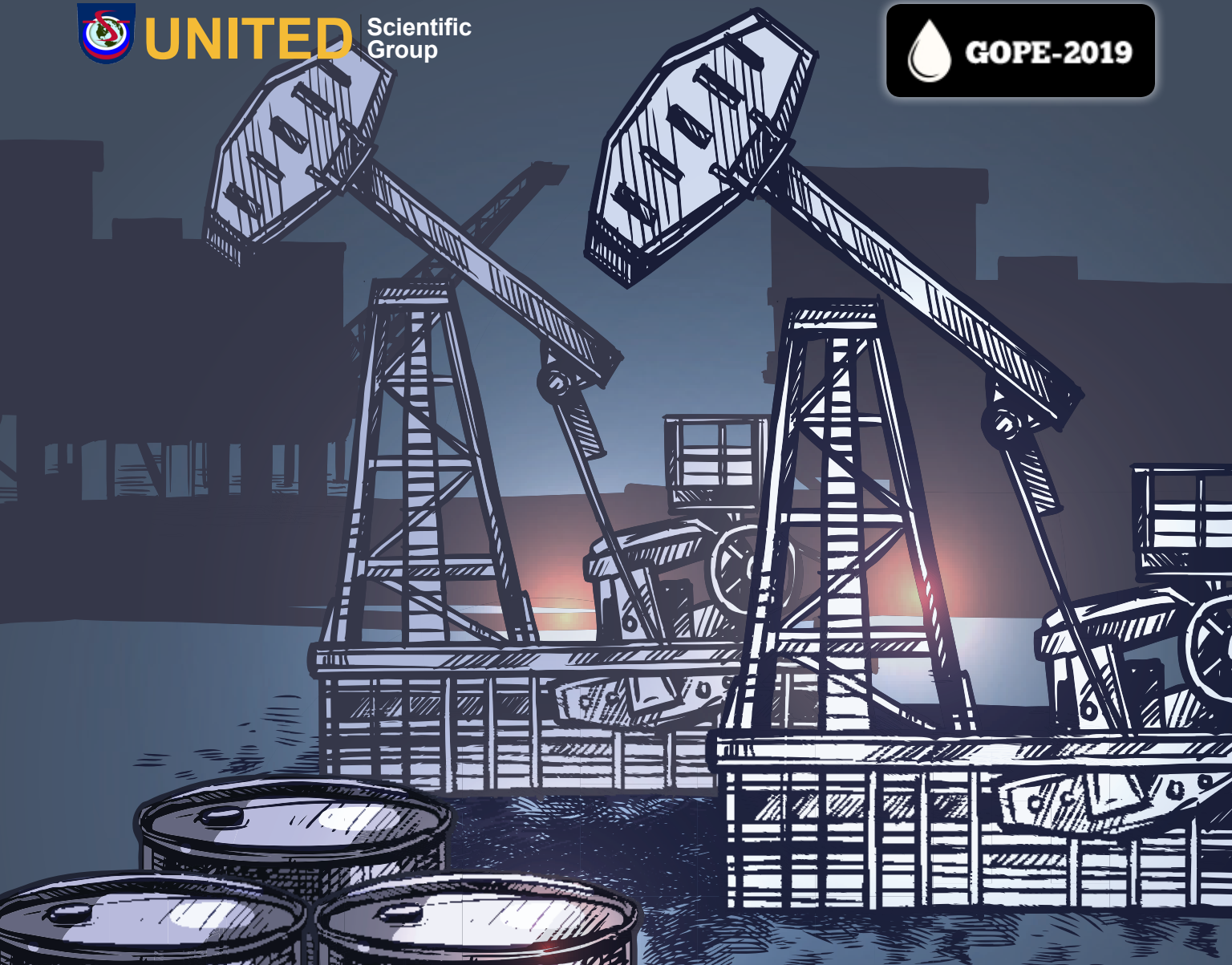

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February 18-20, 2019

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Index

Keynote Presentations .....01 - 10, 17-20

Featured Presentations .....11 - 15, 21-26, 33-39

Poster Presentations .....16 - 24

About Organizer .....40 - 41

DAY-1

MONDAY, FEBRUARY 18, 2019

The Use of Polymers for Enhanced Oil Recovery

Francesco Picchioni
University of Groningen, The Netherlands

Abstract

Chemical Enhanced Oil Recovery (EOR) is currently and mainly based on the use of partially hydrolyzed polyacrylamide as water-soluble polymer for mobility control. This choice is predominantly related to technological (thickening efficiency) as well as economic considerations. However, the presence of salt in the underground water significantly reduces the effect of such polymer on the solution rheology. This becomes even less when the polymer is used in combination with alkali. Therefore, the amount of polymer required is significantly higher than expected on the basis of simple rheological models, which in turn has a clear negative effect on the economics of the process. Against this backdrop, the search for alternative water-soluble polymers has been gaining a predominant attention at both academic and industrial level. In this work, we report on the latest development about the synthesis and application of novel polymeric products for EOR.

Biography

Francesco Picchioni has completed his PhD in 2000 from the University of Pisa (Italy) and postdoctoral studies from the Technical University of Eindhoven (The Netherlands). Since 2013 he is full professor and chair of the group Chemical Product Engineering at the University of Groningen (The Netherlands). He has published more than 100 papers in reputed journals. His research activities include the synthesis and application of new polymeric products in a variety of field including EOR.

Finite Element Simulation of Elastomer Swelling in Petroleum Drilling Applications

Sayyad Zahid Qamar*, Maaz Akhtar and Tasneem Pervez
Sultan Qaboos University, Oman

Abstract

In solid expandable tubular (SET) technology, a conical mandrel is forced through a petroleum tubular to expand it to the desired diameter. SET applications in oil and gas wells, such as water shutoff and zonal isolation, employ swelling elastomers as a sealing material. These are innovative polymers with the unique capability of swelling when in contact with fluids like water, oil, or acid. During tubular expansion against rock formation, compression of the swelling elastomer elements against the formation provides the required sealing. This compression can be achieved through expansion of the inner tubular, by swelling of the elastomer element against the formation, or through a combination of the two. Before deployment of SET-based swell packers, it is important to assess their possible behaviour under a given set of field conditions.

The current paper is part of the research work on expandable tubulars and swellable elastomers conducted at Sultan Qaboos University, Muscat, Oman. Results presented here are based on numerical simulation used to investigate the effect of various field conditions on the sealing or contact pressure generated between the elastomer element and the rock formation. These parameters include elastomer seal material, SET expansion ratio, elastomer compression ratio, formation type, seal length, seal thickness, and SET boundary conditions. No work of this nature is generally available in published literature, based on actual material behaviour of expandable tubulars and swelling elastomers used in the petroleum development industry. Results of this work can be used by field engineers, application developers, and researchers for proper selection and design improvement of SET and swelling elastomer applications.

Biography

Sayyad Zahid Qamar is currently associated with the Mechanical and Industrial Engineering Department, Sultan Qaboos University (SQU), Muscat, Oman. He has over 20 years of academic and research experience in different international universities. On top of his experience as a researcher/academician, he has been actively involved in research and accreditation work related to engineering education. His technical research areas are Applied materials and manufacturing; Applied mechanics and design; Reliability engineering; and Engineering education. As part of the Applied Mechanics and Advanced Materials Research group (AM2R) at SQU, he has been involved in different applied research funded projects in excess of 4 million dollars He is currently editing one volume (Renewability of Synthetic Materials) for the Elsevier Encyclopaedia of Renewable and Sustainable Materials. He has served as Associate editor, Guest editor, and Member editorial board for different research journals (including Materials and Manufacturing Processes, Journal of Elastomers and Plastics, the Journal of Engineering Research, American Journal of Mechanical and Industrial Engineering).

Strategic Development of Ni Catalyst System for CO2 and Biomass Conversions to Green Energy Hydrogen

Sibudjing Kawi*
National University of Singapore, Singapore

Abstract:

Utilization of biomass by gasification is an environmentally beneficial method for the production of syngas, which can be upgraded to produce a broad range of hydrocarbons such as methanol and ammonia by the Fischer–Tropsch process. At the same time, limiting the rise of CO_2 (carbon dioxide) concentration in the atmosphere by capturing CO_2 from various emissions is a critical challenge facing the world today. Hence, the past decade has seen a huge increase in research related to utilization of biomass and CO_2 as raw materials for fuels and chemicals.

The use of catalyst for tar cracking provides a promising way to make the process more economical and efficient as a catalyst can reduce the reaction temperature and increase the product yield. Additionally, CO_2 reforming of methane and CO_2 methanation to produce syngas and methane respectively, are the two important reactions to convert CO_2 into useful chemicals and have been studied a lot in last decades. To address the main issue to develop economic, active and stable catalysts for these topics, our group has developed several strategies to design and prepare stable Ni-based catalysts for CO_2 and biomass reforming applications, such as: Doping with base metals; Bimetallic catalysts; Catalysts derived from specific structures; we have found that catalysts derived from perovskite, hydrotalcites and phyllosilicate have a strong metal-support interaction; Organic-assistant synthesis; and Core-shell catalysts.

Biography

Kawi received his B.Sc. Chem. Eng. from Univ. Texas (Austin), M.Sc. Chem. Eng. from Univ. Illinois (Urbana-Champaign), and PhD in Chem. Eng. from Univ. Delaware. After 2 years of postdoc at Univ. of California (Davis), he joined Dept. Chem. & Biomolecular Eng. at National University of Singapore. He has published > 250 journal papers (h index = 58), 5 patents, 3 book chapters, edited 7 special issues (as a guest editor of Catalysis Today, Ind. & Eng. Chem. Research, J. CO2 Utilization, Environ. Sci. & Pollution Research, Topics in Catalysis, Catalysts) and presented several Keynote Lectures at international conferences. He serves on the Editorial Board of ChemCatChem, Reactions, Waste & Biomass Valorization and as an Associate Editor of Carbon Capture, Storage and Utilization (a specialty section of Frontiers in Energy Research).

Effect of Longwall-induced Subsurface Deformations on Shale Gas Well Casing Stability under Deep Covers

Daniel W.H. Su*, Peter Zhang, Mark Van Dyke and Todd Minoski
National Institute for Occupational Safety and Health Bruceton, Pittsburgh, PA

Abstract

This paper presents the results of a 2017 study conducted by the National Institute for Occupational Safety and Health (NIOSH), Pittsburgh Mining Research Division (PMRD) to evaluate the effects of longwall-induced subsurface deformations within a longwall abutment pillar under deep cover. Results from this 2017 study were compared to the results from a similar 2014 study under medium cover. The 2017 study was conducted in a southwestern Pennsylvania coal mine, which extracts 1,500-ft-wide longwall panels under 1,185 ft of cover. One 550-ft-deep in-place inclinometer monitoring well was drilled and installed over a 150-ft by 275-ft centers abutment pillar. In addition to the monitoring well, surface subsidence measurements and underground coal pillar pressure measurements were conducted as the 1,500-ft-wide longwall panel on the south side of the abutment pillar was being mined.

Prior to the first longwall excavation, a number of FLAC3D simulations were conducted to estimate surface subsidence, increases in underground coal pillar pressure, and subsurface horizontal displacements in the monitoring well. Comparisons of the pre-mining FLAC3D simulation results and the surface/subsurface/underground instrumentation results show that the measured in-place inclinometer (IPI) casing deformations are in reasonable agreement with those predicted by the 3D finite difference models, and that the measured surface subsidence and pillar pressure are in excellent agreement with those predicted by the 3D models, which serves to validate the 3D finite difference models. Results from this 2017 research clearly indicate that under deep cover, the measured horizontal displacements within the abutment pillar are approximately one order of magnitude smaller than those measured in the 2014 study under medium cover.

Biography

Daniel W.H Su received his Ph.D. Degree in Mining Engineering from West Virginia University in 1982. Upon graduation, he was employed as an assistant professor in the Mining Engineering Department of West Virginia University. In 1985, he joined CONSOL Energy Research and Development as a Research Engineer, and eventually became Manager of Geo-mechanical Engineering. Over his 30-year career with CONSOL Energy, Daniel has conducted numerous application-oriented coal mine ground control research as well as gas well stability research. In May 2015, Daniel retired from CONSOL Energy and Joined the Pittsburgh Mining Research Division of NIOSH in August 2015 as a Senior Service Fellow.

In Search of a High-temperature, High-pressure, High-viscosity Industrial Standard: NETL Contributions

Isaac K. Gamwo[1], Hseen O. Baleda[2], Mark A. McHug[3], Robert M. Enicka[4]
[1]*U.S. Department of Energy-NETL, Pittsburgh, PA*
[2]*Virginia Commonwealth University, Richmond, VA*
[3]*University of Pittsburgh, Pittsburgh, PA*

Abstract

This presentation summarizes the National Energy Technology Laboratory (NETL) contributions to a worldwide search for a reference fluid that mimics oil fluid properties at high-temperature and high-pressure conditions typically found in ultradeep oil reservoirs. As announced at the 2009 International Association of Transport Properties conference, a reference fluid is urgently needed in the petroleum industry to calibrate and validate viscometers and rheometers operating at elevated temperatures and pressures.

To meet this urgent need, NETL and eleven other laboratories worldwide commenced the search for a suitable candidate fluid. The NETL initially identified Krytox GPL 102, a perfluoropolyether, as a candidate fluid and subsequently applied two distinctly different measurement techniques that verified Krytox GPL 102 as a viable industrial reference fluid with a nominal viscosity of 20 mPa.s at 433 K and 200 MPa. Research laboratories in Australia, France, Greece, Spain, United Kingdom, and the USA confirmed our experimental results for this particular Krytox. However, there remains an important concern about the viability of using this perfluoropolyether as a reference fluid since Krytox GPL 102 is a polydisperse fluid with a molecular weight and molecular weight distribution that can vary slightly from lot to lot. Other researchers have proposed Tris(2-ethylhexyl) trimellitate (TOTM) as a standard reference material. Our NETL group has experimentally determined the density and viscosity of TOTM at temperatures to 527 K and pressures to 242 MPa and, importantly, has shown that TOTM exhibits a viscosity 50% lower than the desired target viscosity. Recently, NETL identified another potential high-temperature, high-pressure reference fluid. In this presentation we present a brief overview of our assessment of the fluid properties of this new potential reference fluid at ambient pressure.

Our preliminary results provide the basis for our strong recommendation for further high temperature, high pressure experimental studies to assess the suitability of this fluid to serve as an industrial standard reference material associated with oil production from ultradeep formations beneath the deep waters of the Gulf of Mexico.

Biography

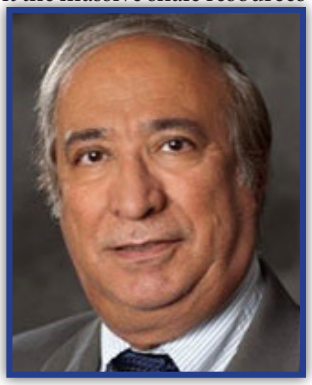
Isaac K. Gamwo is a research chemical engineer at the U.S. Department of Energy's National Energy Technology Laboratory (Pittsburgh, PA), where he recently led the Equation of State research group. He is a licensed professional engineer, a fellow of the AIChE, a director of the AIChE's Separations Division, and a member of the NOBCChE. He previously served as Assistant Professor at the University of Akron (Akron, OH) and at Tuskegee University (Tuskegee, AL). He earned his M.S. and Ph.D. in chemical engineering from the Illinois Institute of Technology (Chicago, IL). Dr. Gamwo co-authored the book Design and Understanding of Fluidized Bed Reactors (Verlag 2009) and co-edited the book Ultraclean Transportation Fuels (Oxford University Press, 2007). He is credited on over 100 articles and presentations.

Machine Learning and Data Analytic for Energy Applications

Fred Aminzadeh
University of Southern California, Loss Angels, CA

Abstract

About 20 years ago advances in Hydraulic Fracturing (HF) and horizontal drilling helped exploit the massive shale resources and ensuring energy security for the US. The question is what is the next transformative energy related technology for the next two decades? Is Effective use of Machine Learning (ML), Artificial Intelligence (AI) and Data Analytic (DA) for exploration, drilling, production and sustainability of energy resources is the possible answer? The answer is indeed, ML-AI-DA has the potential to make a significant positive transformative impact on different phases Exploration, Drilling and Production (EDP). While EDP has already benefitted from ML-AI-DA in different aspects of "Smart Old Fields", we only have scratched the surface. An effective alliance between energy companies and the artificial intelligence community can unleash a tremendous power to bring new resources and improve the recovery factor of the existing fields.



There are many aspects of ML-AI-DA that can be relevant. Among them are: Intelligent Signal Processing, Expert Systems, Soft Computing (Neural Networks, Fuzzy Logic, Genetic Algorithms), Cloud/Fog/Edge Computing, Natural Language Processing, Big Data, Deep Learning, Data Analytics and Data Mining, Case Based Reasoning, Internet of Things (IoT) and Man-Machine Interface. Tin the last five years, we have witnessed effective penetration of these technologies in other applications such as social media, marketing and security related applications. Oil and gas industry can be the next beneficiary the resurgence of ML-AI-DA. I will highlight two specific growth areas: Exploration, Recovery Improvement and Predictive pump failure.

Artificial intelligence and pattern recognition has been used in many exploration applications. Many of these techniques are used individually but, integration of these methods has proven very effective in capitalizing on the strength of each method. An important part of exploration is to develop an inventory of highly prospective areas as candidates for drilling and rank order them. The ranking is usually done based on the size of reservoirs and their net present value. The valuation takes various risk factors into accounts. The risk factors include "geologic risk", as well as other risks such as political risk, environmental risk, economic risk and regulatory risk among others. Geologic risk itself is divided into four main risk factors: structure, reservoir, source, and seal risk. ML-AI-DA can be used to quantify these factors separately and integrate the risk factor more importantly.

The talk will also include how recovery factor in different types of the reservoirs can be improved through proper use of different EOR techniques and monitor their effectiveness in real time using different AI Techniques. Finally, I will highlight use of ML-AI-DI techniques for failure prediction and performance optimization of different pumps allowing the system to auto-generate recommendations and reports when failure events and the extent of failure are predicted.

Biography

Fred Aminzadeh is Professor of Petroleum Engineering and Executive Director of its Global Energy Network (GEN.usc.edu). Dr Aminzadeh is also president and CEO of FACT (FACT-Corp.com) and FAR Technology (FARtechnologiesllc.com). He was the president of Society of Exploration Geophysicists (2007-2008) and represented SEG at the Unconventional Resources Technology Advisory Committee (URTAC). He is Fellow of IEEE, a Member of Russian Academy of Natural Sciences, and Honorary member of Azerbaijan Oil Academy. He received Society of Exploration Geophysicists (SEG) Honorary Membership in 2018. His technical expertise includes induced seismicity, seismic attributes inversion, AVO, reservoir characterization and monitoring, reserves evaluation, passive and 4D seismic, fractured reservoirs, unconventional fields and CO2 sequestration. Previously, he was manager of geophysical technology at Unocal (now Chevron). He was also president and CEO of dGB-USA (dgbes.com) and member of technical staff at Bell Laboratories. He consulted at several National Laboratories including LLNL, LBNL, LANL), ORNL) and NETL.) He holds 4 US patents, with another 6 pending. He has authored 14 books and over 350 publications spanning wide areas. He is also editor in chief of Journal of Petroleum Science and Engineering.

Progress Towards Nuclear – Oil Shale hybrid?

Janusz Grebowicz
University of Houston-Downtown, Houston, TX

Abstract

Hydrocarbons in shales can exist in one of three forms: gas, liquid or solid, depending on the size of the molecule. Most often they are mixture of all three. They are entrapped in the body of rock. Fracking liberates gas only, the smallest molecules but leaves behind the big molecules in rock after production cycle is complete. Large hydrocarbons are retrieved from the matrix in the retorting process at the temperature in excess of 320°C. Surface retorting is in practice for several decades. Ash, by-product of the process, is landfilled causing increasingly more severe negative environmental effects. In 1980s Shell Oil Co., has developed In-situ Conversion Process (ICP) in which retorting process takes place underground, hence greatly reducing the carbon footprint. However, since in ICP big masses of rock must be heated to high temperature, large amount of energy must be applied. Earlier estimates based on technology involving conventional electric heaters indicate that around 30% hydrocarbons produced will be consumed in the extraction process. It is therefore recommended that the hybrid system nuclear reactor – oil shale be developed and implemented. In this presentation energy, mass, thermal expansion, the nature of evolving gases taking place during heating the rock are discussed in the context of using nuclear reactor as a heat source for the ICP process. Among many environmental and economic advantages such system offers, the main factor for its employment is that it does not burn hydrocarbons. Fourth generation reactors offer real possibility for development of hybrid system in not so far future. Small reactor has been approved for production and mini- and micro-reactors are in advanced design stage.

Biography

Janusz Grebowicz has done his PhD from Polish Academy of Sciences, Lodz, Poland and post-doctoral studies at Rensselear Polytechnic Institute, Max Planck Institute, Mainz and University of Massachusetts. He was Head of Thermal Analysis lab at Shell West hollow Technology Centre in Houston, Texas and currently Professor of Chemistry and Physics at the University of Houston-Downtown (UHD). He has got an expertise in thermal analysis of materials with 72 publications and one monograph. To his credit includes the following: development of first ever systematic diagram of all phases and mesophases, defining 'Condi's crystal' mesophase state, and 'rigid amorphous fraction' in semi crystalline polymers. His present research interest is in thermal properties of materials: low molecular weight compounds, liquid crystals, polymers and geological materials.

Conventional Characterization of Unconventional Resource Shales

Roger M. Slatt* and numerous Geosciences Students
University of Oklahoma, Norman, OK

Abstract

For the past six years our student-led, consortium-sponsored team has researched geoscience properties of unconventional resource shales, mainly the oil-and gas-prolific, Devonian Woodford Shale in Oklahoma. Although many sophisticated, expensive instruments/techniques have been developed to characterize shales, we have relied on established, conventional methodologies. Documented applications include: (1) conventional methodologies, sometimes with modifications, are cost effective; (2) regional organic-rich, thick, sweet spots and preferred target landing zones are predictable based upon a robust depositional model developed from this research; (3) this model provides a good analog for common siliceous, and some carbonate-rich shales; (4) key geomechanical, organic/inorganic geochemical, compositional, petrophysical and geophysical properties and their interrelations influence fluid/rock distribution and interactions, fracability, and production; (5) rapid, early production decline can be at least partially explained geologically.

The conventional methodologies we employ are: basic sedimentology/stratigraphy of cores and outcrops, well log and seismic reflection mapping and cross section transects, inorganic chemistry by X-ray fluorescence and gamma ray spectroscopy, X-ray diffraction and thin section mineralogy; high resolution scanning electron microscopy, isotopes, biostratigraphy, organic/petroleum geochemistry, rock hardness, fracture/fault/fold analysis, and integrated mapping and modeling of these geobody

properties for volumetrics and fluid flow estimation. Laterally- and vertically-well exposed outcrops are particularly useful for resolving geological complexities at wellbore, interwell, to regional scales. Integration of these diverse data sets/interpretations is key to successfully applying a useful reservoir characterization. The scale of integration and characterization will depend upon the objective(s) of a project, which should ultimately lead to enhanced reservoir performance and operational efficiencies.

Biography

Roger M. Slatt is Gungoll Chair Professor in Petroleum Geology/Geophysics and Director, Institute of Reservoir Characterization at University of Oklahoma (OU) (2007-present). Prior OU positions were: Director of the School of Geology/Geophysics (2000-2006) and Eberly Family Chair Professor (2006-07). At Colorado School of Mines, he was Head, Department of Geology/Geological Engineering (1992-2000) and Director, Rocky Mountain Region Petroleum Technology Transfer Council (1995-2000). He has held industry positions with Cities Service and ARCO Oil and Gas/International companies (1978-1992), has published >120 articles and abstracts, is author/co-author/editor of six books on petroleum geology, reservoir geology, sequence stratigraphy, clastic depositional systems and geology of shale, and has been recipient of numerous awards from AAPG, SEG, RMAG, and SPE.

Formation of Carbon Nanotubes from Potassium Catalysed Pyrolysis of Bituminous Coal and High Temperature and High-pressure Rapid Hydrogenation Pyrolysis Bituminous Coke

Yongfa Zhang*, Yage Tang, Tiankai Zhang, Xuemei Lv, Yunhuan Luo, Ying Wang,
Jing Zhang and Guojie Zhang,
Taiyuan University of Technology, China

Abstract

In the present work, a novel method has been proposed, which can be used for generating carbon nanotubes (CNTs) using bituminous coal and coke (obtained from high temperature and high-pressure rapid hydrogenation pyrolysis) as the raw material and KOH as the catalyst precursor. The results of Scanning Electron Microscope (SEM) showed that a large amount of CNTs were formed in the products (RP) of catalyzed pyrolysis of coal. The results of Fourier Transform Infrared spectroscopy indicated that the groups of -CH3, -CH2 contained in the coal gradually disappeared during the catalyzed pyrolysis. Raman analysis showed that the graphitization degree of RP was higher than catalytic pyrolysis products of coke (CP), and the ratio of the intensities of G and D peaks (IG/ID) of the two products were 3.0 and 0.85 respectively. The results of SEM showed that a small amount of CNTs formed in the CP, which confirmed that the catalyst has the dual function of etching large molecular structure to generate carbon source and catalyzing the formation of CNTs. Different ways of adding KOH (impregnation/dry mixing) can catalyze the formation of CNTs. Studies shown that the mechanism of CNTs formation is: coal pyrolysis produces carbonaceous material R-C such as CH4, and R-C is catalytically cracked under the action of catalyst to form carbon atom C or carbon cluster Cx and deposit into CNTs. The growth process of CNTs conforms to "stepwise-growth" model. This method is a new method to convert abundant and cheap coal resources into high-performance CNTs.

Biography

Zhang Yongfa, Professor and PhD director of Taiyuan University of Technology, international cooperation expert of the Ministry of science and technology, Inductees of recruitment program of global experts in Shanxi province. He mainly engaged in basic theory research of coal carbonization and fluidized gasification, as well as engineering technology development of clean coal conversion. Manage the national innovation fund, National natural science foundation of China 10 items. Won the first, second prize at and above the provincial or ministerial levels 4 items. Apply and obtain the national invention patent 80 items. More than 100 papers published in international journals

Novel Porosity Investigation Tool for Petroleum Geosciences

Marja Siitari-Kauppi[1*], Paul Sardini[2], J. Sammaljärvi[1] and K-H. Hellmuth[1]
[1]University of Helsinki, Finland
[2]Poitiers, France

Abstract

The porosity of rock is the key factor determining storage and transport properties for oil and gas (i.e. the productivity) in the geological formation. Success of hydraulic fracturing operations is depending on the characterization of pre-operation properties and the creation of new migration pathways in the rock. Modelling approaches in petroleum geosciences need suitable quantitative information on the rock pore network. Quantification of the pore network requires different complementary methods working in different scales. Key quantities are size, spatial distribution, heterogeneity and connectivity of the pore network. The combination of different analysis methods can be used to infer novel structural information about rock allowing to assess the permeability of the rock matrix.

We have developed a versatile method based on the impregnation of the rock pore space by a methylmethacrylate resin labeled with C-14 (C-14-PMMA method) which is giving 2D images of the spatial porosity distribution with a resolution of about 20 μm in samples such as drill cores of up to tens of cm length. The porosity patterns and their possible anisotropy as obtained by film or electronic autoradiography have been used to model transport processes in heterogeneous rocks. We have applied the C-14-PMMA method to study a variety of crystalline and sedimentary rocks (e.g. claystone and sandstone) as well as various technical geomaterials (e.g. cement/concrete). Results have been combined with those obtained by X-ray tomography and complemented by scanning electron microscopic studies. We present here the principles of the method and various applications and modelling approaches.

A Revolution in Applied Petroleum Geochemistry Fostered by Diamondoids

J. M. (Mike) Moldowan[1*] and Jeremy E. Dahl[2]
[1]Biomarker Technologies, Inc., USA. & Stanford University, Stanford, CA
[2]Stanford University, Stanford Institute for Materials and Energy, USA

Abstract

Petroleum exploration is all about creating prospects that can yield new discoveries. Standard biomarker analysis and correlation by isotopes of oils and oil fractions are extremely useful, but they have already been available for nearly four decades and been applied to most of the mature basins in the world. Therefore, classical analytical methods are unlikely to support new exploration ideas. Repeating the same analyses in the same basins time and time again will most likely not result in startlingly new play ideas or discoveries. New geochemical techniques based on diamondoids can provide the necessary crucial information to reach those objectives that were previously unattainable and avail new exploratory opportunities in mature basins.

Quantitative diamondoid analysis (QDA) is used for determining the maturity of any oil sample in both conventional and unconventional applications. The high degree of accuracy needed for application of this method is achieved by spiking the liquids with deuterated diamondoids before GCMS analysis. Diamondoid correlation methods have an advantage over all others due to the thermal stability and recalcitrancy of diamondoids toward biodegradation. All bitumen and oil samples (condensate, biodegraded oil, black oil) can be correlated by diamondoids. Quantitative analysis of large diamondoid molecules (QEDA), which occur in several isomeric structures, can be used to determine new hydrocarbon sources and co-sourced oil accumulations. A second approach to correlation by diamondoids is to measure their stable carbon-isotope ratios. Application of diamondoid technologies often reveals oil-source mixtures that have been consistently missed in all previous basin studies.

Biography

Mike Moldowan attained a Ph.D. degree in Chemistry in 1972 from The University of Michigan. He became the eventual leader of the Chevron biomarker team from 1974 to 1993, which contributed major pioneering research on the application of biological marker technology to petroleum exploration. He joined the Department of Geological Sciences at Stanford University in 1993, where his research work on molecular geochemistry continued. In 2012, he founded the laboratory enterprise, Biomarker Technologies, Inc., which offers unique applications of advanced geochemical technologies to industry. In addition

to his more than 100 journal articles are two editions of "The Biomarker Guide" published in 1993 and 2005, which are often referred to as the "Biomarker Bible". In 2011, Professor Moldowan received the Treib's Medal, considered the top career award for Organic Geochemistry

Study on Water Holdup Detection Method and Downhole Tools Development of Oil-Water Two-Phase Flow Based on Multiple Transmission Lines

Wei Yong[1*], Yu Houquan[1], Chen Jiefu[2], Chen Qiang[3] and Liu Guoquan[3]
[1]Yangtze University, China
[2]University of Houston, Houston, TX
[3]China Petroleum Logging CO. LTD., China

Abstract

The water holdup of oil-water two-phase flow is an important parameter to evaluate the production state of oil wells in production logging. In order to enhance oil recovery, more and more oil fields adopt water injection and horizontal well production methods. This puts forward higher requirements for on-line detection of water holdup of oil-water two-phase underground, especially for high detection accuracy of sensor in the whole range, which can solve the problem of low resolution of conventional capacitance water holdup downhole tools under high water holdup conditions. For this reason, we analyze the propagation characteristics of electromagnetic waves on three kinds of transmission line, deduce the relationship between the amplitude and phase shift of the electromagnetic wave at the end of the transmission line and the permittivity of the medium around the transmission line in the mixed wave mode, and carry out corresponding experimental research. Both theory and experiment show that the method based on the amplitude of electromagnetic wave is not feasible and the method based on the phase shift of electromagnetic wave is feasible. On this basis, two kinds of water holdup detection downhole tools based on transmission line are developed. The test results show that the two tools have a resolution of less than 3% in the whole range of 0% to 100%. The two tools provide solutions for water holdup detection in horizontal and vertical wells respectively, which make up for the deficiency of capacitance and conductance tools.

Biography

Wei Yong (Corresponding author) received his B.Sc. degree in 2003 from Jianghan Petroleum Institute received his M.Sc. and Ph.D. degree from Yangtze University in 2006 and 2016 respectively. He is an associate professor in Yangtze University. His main research interests include new method and instrument for acoustic & electric well logging.

Late Carboniferous-Early Permian Reservoirs Associated with Infracambrian Salt Minibasins: Al Khlata Formation in South Oman Basin

Iftikhar Ahmed Abbasi[1*], Faisal Al Abri[2] and Alan P. Heward[3]
[1]Sultan Qaboos University, Oman
[2]Petroleum Development of Oman (PDO), Oman
[3]23 Croftdown Court, UK

Abstract

Infracambrian Ara Salt plays an important role in controlling basin architecture and deposition of sedimentary sequences in Oman Salt Basins. During late Paleozoic thick siliciclastic sediments of the Haushi Group (Al Khlata & Gharif formations) were deposited in minibasins created due to salt movement. In this study we describe Late Carboniferous-Early Permian glacial deposits of the Al Khlata Formation from South Oman Salt Basin, which is an important target for oil exploration. There are a number of uncertainties due to vertical and lateral variations in the glacial deposits and withdrawal and dissolution of underlying salt. Four distinct lithofacies have been identified from wireline logs and their distribution assessed with PETREL model. The Al Khlata Formation is about 800 m thick and is dominated by sandy diamictite (40%), shale (30%), silty diamictite (20%) and sandstone (10%). These deposits are interpreted as being deposited in glacio-lacustrine, glacio-deltaic and glacio-fluvial settings. The interval containing the highest proportion of reservoir sand is the P9 (15%), whereas the Rahab Member comprises mainly shale (70%) resulting in an excellent top seal to many hydrocarbon accumulations. Other shales or thick silty

diamictites form more localized intra-formational seals and increase the potential for further discoveries of oil to be made in areas of thick Al Khlata.

A regional 3D Structural Model has been created for the post-Ara Salt to pre-Al Khlata interval (Huqf, Nimr, Haima and Misfar Supergroup/Groups) and for the Gharif Formation to track the periodic removal of the Infracambrian Ara Salt and its impact on the overlying sequence. A detailed description of the depositional history and structural trap formation has been achieved, as the former peripheral synclines were progressively inverted to form turtle-back anticlines due to halokinesis in the south Oman Salt Basin.

Biography

Iftikhar Ahmed Abbasi works as Associate Professor in the Sultan Qaboos University, Oman. Iftikhar obtained his Ph.D. from the Cambridge University, UK. He authored a book on 'Stratigraphy and Historical Geology of Pakistan' and co-edited a volume on 'Tectonic Evolution of Oman Mountains' published by the Geological Society of London as its special publication 392.

DAY-2

TUESDAY, FEBRUARY 19, 2019

Fossil Fuelled Clean Energy and Underground Coal Gasification as a Solution

Michael Green

Managing Director UCG Engineering Ltd, UK and Chair of Clean Energy Special Interest Group of the Institution of Chemical Engineers

Abstract

Underground coal gasification (UCG) is an alternative and unconventional route for wellhead gas production. It relies on an underground conversion process of coal to gas, and the supply of oxygen from a second well, but the net result is little different from the production of reservoir or tight gas production from underground structures.

How should UCG now be viewed in the future energy mix, given that it readily produces synthetic gas of medium calorific value (up to 300BTU/SCF)?

Firstly, the process has been proven in numerous tests, trials and a few commercial projects throughout the world, and significant work continues. Secondly it meets the future fossil fuel requirement of a flexible power output (up to 75% turndown) to balance the unpredictable and variable renewable energy from wind and solar. Secondly the gasification product gases can be shifted to form a reliable supply of hydrogen for fuel cells, transport and many industrial processes. Finally, gasification is arguably the best way of generating a concentrated stream of high-pressure CO_2 from fossil fuels for enhance oil and gas recovery (EOR, EOGR), and carbon capture, utilisation and storage (CCUS).

This keynote address will set the scene for fossil fuels and coal in particular and outline the outcome of the recently completed UCG studies in Europe. It will provide an update on modelling of UCG geology and kinetics, the ongoing trials in S Australia, India and elsewhere, and propose that the time is right for a new commercial UCG project, possibly in North America.

Biography

Michael Green is Managing Director of UCG Engineering Ltd, a consultancy providing technical and management services on underground coal gasification. Previously, he was Director of the European UCG Field Trial in Spain, then principal advisor for the UK government initiative on UCG (2000-2005) and Founding Director of the UCG Association: a networking and conference centre for UCG.

In 2015, he was appointed Chair of the IChemE Clean Energy Special Interest Group, a worldwide group of 1,500 Chemical Engineers with interests in CCUS, fuel cells, fossil and renewable energy and hydrogen. Michael Green is uniquely placed to foresee the future role of fossil fuels in a low carbon world.

A Recent Progress in Advanced Bioethanol Production by Acetic Acid Fermentation from Lignocellulosics

Shiro Saka*, Eiji Minami, Harifara Rabemanolontsoa and Haruo Kawamoto
Kyoto University, Kyoto, Japan

Abstract

The conventional alcoholic fermentation by-produces carbon dioxide (CO_2) as in Eq (1). Thus, for establishing the low carbon society, a development of new technology is necessary. Given such a situation, we have developed a novel process of bioethanol production with acetic acid fermentation from lignocellulosics followed by hydrogenolysis of acetic acid to ethanol. This process includes a two-step hot-compressed water treatment (230°C/10MPa/15min and 270°C/10MPa/15min) to convert lignocellulosics to hexoses, pentose, decomposed products and lignin-derived compounds. In the subsequent fermentation, most of these products are anaerobically fermented into acetic acid in form of sodium acetate by free and immobilized co-culturing system (Clostridium thermocellum and C. thermoaceticum) using batch or fed-batch fermenter with pH controlled. The obtained acetate aqueous solution was then converted into acetic acid by three-compartment bipolar membrane electrodialysis, and further to bioethanol via hydrogenolysis with Lewis acid-supported catalyst (Ru-Sn/TiO_2 or Ni-Sn/TiO_2) in aqueous solution. Consequently, the following Eq (2) for glucose, for example, can be achieved without forming any CO_2. To evaluate a potential of this process, it was compared with the conventional alcoholic fermentation process, and found that, although the conventional process produces 250L bioethanol from one ton of dried lignocellulosics, this newly-developed process produces more than double. In addition, energy recovery is higher than the conventional process, with CO_2 emission unit (kg/GJ) being lower. Consequently, this new process can be promising to reduce CO_2 emission so as to mitigate environmental loading.

$C_6H_{12}O_6 \rightarrow 2CH_3CH_2OH + 2CO_2$ (1)

$C_6H_{12}O_6 + 6H_2 \rightarrow 3CH_3CH_2OH + 3H_2O$ (2)

Biography

Shiro Saka has completed his undergraduate study in Kyoto University, and PhD from North Carolina State University, USA and postdoctoral studies from McGill University, Canada. He has been professor in Kyoto University for 21 years and now professor emeritus of Kyoto University. He has published 244 original papers, 117 books, 92 review papers, 437 international conference proceedings, 53 patents granted. He is now Fellow of the International Academy of Wood Science, and his awards received are Wood Award 1980, USA, 2008 Japan Prize of Agricultural Science, 2008 Yomiuri Prize of Agricultural Science, 2008 Japan Institute of Energy Award and others.

Onsite Partial Upgrading of Bitumen Utilizing Drill Cuttings as a Catalyst

Maen Husein* **and Thomas Kaminski**
University of Calgary, Canada

Abstract

The currently industry practice is to extract bitumen, reduce its viscosity with a diluent, and then transport it to where it can be upgraded. Both the recovery of the diluent and its pumping cost to the site pose economic and environmental challenges. Accordingly, partial upgrading of the extracted bitumen to pipeline specifications onsite provides an attractive alternative. Previously in our research group, we showed that the addition of drill cuttings during thermal cracking of bitumen significantly enhances the upgrading process. Drill cuttings are a waste product from the drilling industry and carry a high percentage of active sites by the nature of their attainment. An onsite partial upgrading process, utilizing thermal cracking with drill cuttings as the catalyst potentially provides a more economically and environmentally viable alternative. Liquid yield, viscosity and °API gravity were the main criteria for determining the effectiveness of the partial upgrading process. A liquid yield of ~85 wt.% with °API of 26 and viscosity (at 15.6 °C) of 45 cSt was achieved, at the expense of 5 wt.% coke and 10 wt.% gas yields. While coke is an undesirable product, any gases produced could be recycled back to the process, for heating purposes.

Biography

Maen M. Husein is a Professor at the Department of Chemical and Petroleum Engineering, University of Calgary, Calgary, Alberta. He received his B.Sc. in chemical engineering from Jordan University of Science & Technology, Jordan, in 1995, and his M.Sc. and Ph.D. in chemical engineering from McGill University, Canada, in 1996 and 2000, respectively. His research interest is in the fields of Energy & the Environment. His group employs nanoparticles for heavy oil and bitumen extraction (e.g. polymer flooding & foam) and upgrading, enhancing the performance of drilling fluids and cement, and produced water treatment to enable effective recycling.

Replacing Cubic Miles of Oil

Ripudaman Malhotra
SRI International(Retired), Melno Park, CA

Abstract

The world currently consumes nearly 4 cubic miles of oil (CMO) equivalent of primary energy, and by 2050 the demand for energy is expected to increase to over 7 cmo. The oil and gas industry has supplied most of the energy and helped improve the standard of living for humanity. The world also faces dire consequences of climate change, and urgency calls are being made to stop using fossil energy sources. The global demand for energy cannot be met through measures promoting conservation and improving energy efficiency alone, nor can renewable sources of electrical power like wind and solar fulfill this need. Nuclear power can deliver the requisite energy, but concerns over plant safety, public health, long-term storage of waste, and cost make it unlikely that new nuclear power plants will be built in the US or Europe. I will address those concerns and show that most of them are misplaced or exaggerated. Moreover, newer designs of nuclear plants that are walk-away safe and can even use the nuclear waste as fuel obviate those concerns.

Biography

Ripudaman Malhotra has over 35 years of experience working on a range of energy-related projects encompassing process development, mechanistic studies, and chemical analysis of resources and fuels. He has worked extensively on the processing and analysis of fossil fuels, and advanced materials. His work on coal liquefaction and pyrolysis resulted in the identification of novel pathways for hydrogen transfer by which strong bonds in coals are broken. He is currently investigating pyrolysis and gasification of coals at elevated pressures under conditions using a radiant furnace that allows complete capture of all the products for detailed mass and element balance. Lately, Dr. Malhotra has been studying the applications of biotechnology in the areas of energy, chemicals, and the environment. He is the recipient of the 2015 Henry H. Storch Award from the Energy and Fuels Division of the American Chemical Society.

Produced Water Treatment Utilizing Flared Gas Fired Power Plant in the Permian Basin

Hossein Hosseini
The University of Texas of the Permian Basin, Odessa, TX

Abstract

The oil boom in Permian Basin parallels with horizontal drilling and hydraulic fracturing which require vast amount of water for their utility. The region is experiencing water stress/shortage which exacerbates water issue in the region. Currently, there is intentional flaring of the natural gas due to lack of a network of pipeline to capture and transport it. This flaring is harmful to the environment and human health. A network of piping system can transfer the "waste gas" as feed to the power plant. This research is proposing construction of a natural gas power plant along with a Multi-Effect Distillation (MED) facility, to generate electricity/treat produced water. With proper planning and engineering, waste gas can be used to generate electricity while treated water with differing quality may be used for oil and gas operations, industrial applications, or irrigation.

The Wasted Gas volumes and produced water in Permian Basin is estimated at 80 X106 Mcf 1 and 6.94 X109 bbl. 2 in 2016 respectively (1.9 X106bbl./d oil3 with 10 to 1 water to oil production ratio).

The benefits of such undertaking are several folds; for example,
Ø Significantly reduce produced water disposal volumes
Ø Mitigate risk of induced seismic activities/earthquakes
Ø Enhance public safety
Ø Protect environment
Ø Significantly decrease water handling costs for petroleum industry
Ø Increase fresh water available for civilian use

The 429 MW (th) Advanced gas/oil combined cycle plant will cost about $ 445 X106 4 with maximum water treatment capacity of 1.3 X106 bbl./day 5. The cost for water treatment is estimated at 0.175 $/bbl. 6

Biography

Hosseini is currently an assistant professor of Petroleum Engineering at the University of Texas of the Permian Basin. He earned his Ph.D. in Petroleum Engineering from Colorado School of Mines in 2001 and MS and BS degrees in Petroleum Engineering from the University of Kansas in 1993 and 1987 respectively. He has been in academics at the University of Colorado in Denver and Colorado Technical University in the Past. He has worked as a Frac engineer for Halliburton and as a research Expert for National Iranian Oil Company Research and Development Directorate.

Prediction of Performance and Exhaust Emissions of a High-Horsepower Diesel Engine Used in Hydraulic Fracturing Application Using Artificial Neural Network–Based Machine Learning Approach

Asanga Wijesinghe*, Fanxu Meng, Carolyn LaFleur and, John Colvin
Houston Advanced Research Center, The Woodlands, Houston, TX

Abstract

Compression ignition diesel engines are extensively used in a variety of applications in modern oil and gas industry. However, just how these new engines and their emissions control technologies perform in day-to-day oil and gas industry operations is not well documented. Here, an Artificial Neural Network (ANN) machine learning model is developed to successfully predict the performance and exhaust emissions of high-horsepower diesel engine used in hydraulic fracturing applications. A series of tests were conducted on an engine equipped with the intrinsically safe real-time emission monitoring instrumentation package, suitable for use in a hazardous environment, to acquire the direct measurement of gaseous emissions and soot from engine exhaust with other engine operation parameters. Using the data obtained from the conducted experimental studies, a three-layer ANN model was developed. The back-propagation ANN network with Levenberg-Marquardt training algorithm was used

to train the data with the activation functions Logistic sigmoid (logsig) and linear transfer function (purelin) in the hidden layer and output layer respectively. The prediction result of the neural network model which has 25 neurons in hidden layer was found to be in good agreement with the experimental data. Since performing these tests is both costly and time-consuming, by using engine load and engine speed as predictor parameters, experimental results can be estimated. In conclusion, ANN modeling can be used successfully to predict performance and emission of diesel engine. The data generated by this method is used to develop a more accurate emissions inventory for oil and gas operations.

Biography

Asanga Wijesinghe is a research associate for engine and emission measurement technologies at Houston Advanced Research Center (HARC). He obtained his B.S. in physics from University of Peradeniya, Sri Lanka and his M.S. and Ph.D. in Physics from the University of Houston. Since coming to HARC, he has been involved in many energy and air-related research project with a focus on engine emission technologies and air quality. His current researches include testing, evaluating and modeling engine performance and emissions in diesel and dual-fuel engines, optimizing nano-particle fuel additives, and monitoring regional air quality with HARC mobile laboratory.

Combustibility Investigation of Future Low-Sulphur Fuel for Marine Propulsion

Hiroshi Tashima[1*], Takahide Aoyagi[1], Daisuke Tsuru[1] and Kousuke Okazaki[2]
[1]Kyushu University, Japan
[2]Japan Coast Guard Academy, Japan

Abstract

It made a huge impact on marine propulsion fields in 2016 that the Sulphur content in marine fuel would be restricted to 0.5 mass% or less from 2020 even outside of ECA (Emission Control Area). The refinery process of such low-Sulphur marine fuel, often called hybrid fuel, is yet to be fixed, since it depends on the architecture and the desulphurization potential of each existing refinery plant. Regardless of the plant conditions, however, FCC (Fluid Catalytic Cracking) facility is necessary to produce the hybrid fuel. A middle distillate component called LCO (light-cycle oil) or a residue called CLO (CLarified Oil) of the FCC process should be mixed with other desulphurized components to keep the Sulphur content of the fuel within the regulation limit. After all, it is definitely important to investigate the ignitibility and combustibility of the hybrid fuel to secure the safety of marine transportation in the near future.

In the present study, LCO and CLO were sampled from an actual refinery plant and blended with a base component of moderate combustibility with different mixing ratios to capture the basic burning behavior of the future hybrid fuel. Based on the combustion experiments using a 2-stroke uni-flow test engine and a RCEM (Rapid Compression-Expansion Machine), the combustion behavior of the two potential components of the hybrid fuel was visualized and the hints for better combustion control to were clarified.

Enhancement of Cement Properties by Means of Nanoparticles

Maen Husein[1*], Ahmed Mehairi[1], Bill O'Neil[2] and Stefano Priolo[2]
[1]University of Calgary, Canada
[2]Trican Well Services Ltd., Canada

Abstract

The application of nanotechnology in well cementing operations enhances the mechanical properties of the cement; thus, achieving better zonal isolation and protection of the environment. It has been reported that nanoparticles (NPs) increased compressive and tensile strengths while decreasing porosity and permeability of the cement sheath. Nevertheless, there is consensus in the literature that improper dispersion of the NPs within the cement sheath negatively impact the performance of the cement. Accordingly, there is a pressing need for innovative process to incorporate the NPs into the cement matrix such that intimate dispersion is achieved.

In this work we adopt a novel approach for preparing the NPs in the cement matrix. The results showed significant improvement in compressive strength, porosity, permeability, resistance to cyclic compressive stress and uniform dispersion of

the NPs within the cement matrix. In addition to mitigating the dispersion problem, the approach for NP synthesis proposed here leads to inexpensive NPs, hence reducing the cost of the technology. Ultimately, this project addresses the two main problems associated with NP application in engineering projects; the cost and the extent of dispersion.

Biography

Maen M. Husein is a Professor at the Department of Chemical and Petroleum Engineering, University of Calgary, Calgary, Alberta. He received his B.Sc. in chemical engineering from Jordan University of Science & Technology, Jordan, in 1995, and his M.Sc. and Ph.D. in chemical engineering from McGill University, Canada, in 1996 and 2000, respectively. His research interest is in the fields of Energy & the Environment. His group employs nanoparticles for heavy oil and bitumen extraction (e.g. polymer flooding & foam) and upgrading, enhancing the performance of drilling fluids and cement, and produced water treatment to enable effective recycling.

Realization of Near-zero Emissions with High Thermal Efficiency by Optimizing Jet Location, Geometry and Injection Timing in Direct-injection Hydrogen Engine

Yasuo Takagi*, Masakuni Oikawa and Yuji Mihara
Tokyo City University, Japan

Abstract

Amid the activities advanced worldwide in recent years to mitigate global warming, promote cleaner air and reduce the depletion of energy resources, hydrogen is looked to as one solution to these issues as an energy source of next-generation. Studies are under way to apply hydrogen as a fuel in a wide range of applications such as automotive engines and stationary gas engines for generating electricity. The authors have previously proposed a plume ignition and combustion concept named PCC combustion in which a hydrogen fuel jet injected in the latter half of the compression stroke of a direct-injection hydrogen engine forms a richer mixture plume and combusted to reduce cooling losses. In the present study, thermal efficiency was substantially improved, and NOx formation was reduced with PCC combustion by optimizing such characteristics as the direction, number and diameter of the injected jet and controlling the injection timing and by combining with combustion of lean mixture. Output power declined by lean mixture was recovered by supercharging in keeping NOx emissions remained at the same level, while thermal efficiency was improved furthermore by slightly re-optimizing jet conditions. As a result, hydrogen engine which does not emit any CO2 and particulate matter emissions in principle is worth to be called near-zero emission engines in both name and reality.

Biography

Y. Takagi completed MC in ME, Graduate School of Hokkaido Univ., Japan in 1970. In Nissan Motor Co., Ltd. Yasuo had worked for 31 years to develop technologies to reduce emissions and improve thermal efficiency of SI engines and fuel cell based on technology of optical diagnostics and CFD numerical simulation. Yasuo moved to Musashi Inst. of Tech. (Current Tokyo City Univ.) in 2001 as professor and continued research on fuel cell and hydrogen engine. Prof. Takagi received Ph-D from Hokkaido Univ. in 1987. Currently Yasuo is a Prof. Emeritus of Tokyo City Univ., fellow member of SAE, J-SAE and JSME

Endogenous Timing in the European Natural Gas Market: Consistent Variational Conjectures Equilibrium

Viacheslav Kalashnikov[1,2,3*], Mariel A. Leal-Coronado[1], Arturo García-Martínez[1] and Nataliya Kalashnykova[4]
[1]*Monterrey Institute of Technology and Higher Education, Mexico*
[2]*Central Economics & Mathematics Institute (CEMI), Russia*
[3]*Sumy State University (SumDU), Ukraine*
[4]*The Autonomous University of Nuevo León(UANL), Mexico*

Abstract

For an abstract natural gas market, we investigate which timing emerges in equilibrium when a socially responsible (SR) firm competes against a profit-maximizing (PF) company. The SR firm maximizes its profit plus a fraction of consumer surplus (CS). When a simultaneous competition takes place, we look for the Consistent Conjectural Variations Equilibrium (CCVE).

We find that if the SR company ponders equal weights on profits and CS, then the game has two equilibrium states arising in the simultaneous competition in either period 1 or period 2. However, if the SR player behaves like a PF rival, that is none of them is socially responsible, it turns out that there are two different equilibrium patterns: (i) under the leadership of the firm with a relatively large technical advantage, and (ii) whenever one of the players has a relatively low technical advantage or none at all, each of the two companies could function as a Stackelberg leader of the game.

The obtained results are illustrated on the examples from the modern European natural gas market.

Biography

Viacheslav Kalashnikov got his Ph.D. degree in Operations Research in 1981 from the Institute of Mathematics of Russian Academy of Sciences, and his Dr. Sc. (Habilitation Degree) in OR in 1995 from the Central Economics and Mathematics Institute, Moscow. His works in the areas of bilevel programming and variational inequality problems are well-known in the optimization community. He is the author of 4 monographs and more than 90 papers published in prestigious journals in the area of optimization. He has advised 10 Ph.D. and 14 master students at various universities of Russia, Mexico, and Ukraine. He belongs to the highest level III of the National Roster of Researchers of Mexico (SNI).

Approximating Nonlinear Relationships for Optimal Operation of Natural Gas Transport Networks

Kody Kazda* and Xiang Li
Queen's University, Canada

Abstract

The compressor fuel cost minimization problem (FCMP) for natural gas pipelines is a relevant problem because of the substantial energy consumption of compressor stations transporting the large global demand for natural gas. The common method for modeling the FCMP is to assume key modeling parameters such as the friction factor, compressibility factor, isentropic exponent, and compressor efficiency to be constants, and their nonlinear relationships to the system operating conditions are ignored. Previous work has avoided the complexity associated with the nonlinear relationships inherent in the FCMP to avoid unreasonably long solution times. A mixed-integer linear programming (MILP) based method is introduced to generate piecewise-linear functions that approximate the previously ignored nonlinear relationships. A novel FCMP model that includes the piecewise-linear approximations is applied in a case study on three simple gas networks. The case study shows that the novel FCMP model captures the nonlinear relationships with a high degree of accuracy. Compared to a theoretically exact simulation the novel FCMP model produces solutions with at most 1.02% error. A common simplified FCMP model is applied on the same simple gas networks and is found to produce solutions with errors as high as 47.50%. Not only are the common simplified FCMP model's results inaccurate, but they are found to always be infeasible on the theoretically exact simulation. The increased accuracy of the novel FCMP model does not come at a significant increase in solution time, with all three test cases being solved in comparable times to the common simplified model.

Biography

Kody Kazda is a master's student in the Department of Chemical Engineering at Queen's University in Canada, where he is supervised by Professor Xiang Li. His work has focused on developing novel linearization techniques to approximate nonlinear relationships so that their behavior can be captured without the complexity associated with the nonlinearity. He has demonstrated the value of such methods on natural gas transportation problems, specifically the compressor fuel cost minimization problem. He has spent time in Norway applying these methods to the industrial software tools used by Gassco to optimize the operation of the Norwegian natural gas pipeline system.

Experimental Evaluation of Ferrous and Ferric Ions on Oilfield Mineral Scale Inhibitor Performance

Ping Zhang[1*], Yuan Liu[1], Amy T. Kan[2] and Mason B. Tomson[2]
[1]University of Macau, China
[2]Rice University, Houston, TX

Abstract

Mineral scale deposition is one of the most severe water-associated flow assurance changes in oil and gas industry. Scale deposition can lead to not only throughput reduction of a pipe flow system and but also wellbore reservoir damage. Mineral scale control in oilfield operations typically rely on the application of mineral scale inhibitors. The performance of scale inhibitors can profoundly impact the efficiency of scale inhibition and hence the success of flow assurance operations. Both forms of iron species, i.e., ferric and ferrous ions, can be present in oilfield produced waters. Iron species presence in produced water can substantially impair scale inhibitor performance. With regard to ferric species, there are limited studies on the investigation of the mechanism of the detrimental effect of ferric species on scale inhibitors. As for ferrous species, the results of the existing studies of ferrous ion impact are controversial, particularly in barium sulfate system. This presentation will detail the experimental procedures and the results of the laboratory evaluation of ferric and ferrous ions on both phosphonate and polymeric scale inhibitors. The focus will be given to the mechanistic understanding of ferric ion impact and also the control of dissolved oxygen level in ferrous ion system. Furthermore, the impact of chelating chemicals in reversing the adverse impact of iron species on scale inhibitor will be presented. The content of these studies can provide the necessary theoretical basis and technical insights to minimize the detrimental impact of iron species on the performance of scale inhibitor.

Biography

Ping Zhang is an assistant professor in Faculty of Science and Technology, University of Macau. He obtained his M.S. and Ph.D. degrees both in Civil and Environmental Engineering from Rice University in Houston, Texas, in 2008 and 2011, respectively. He obtained his professional engineer (P.E.) license in the dual disciplines of Chemical/Environmental Engineering in the State of Texas in 2016. He is also a Chartered Chemist (CChem) of Royal Society of Chemistry of the U.K. since 2017. His research interests are solid precipitation and deposition, oilfield mineral scale control and environmental aquatic chemistry

CFD Modelling of Pilot-Scale Three-Phase Separators

Tariq Ahmed, Paul A. Russell, Faik Hamad and Samantha Gooneratne
Teesside University, UK

Abstract

This work uses experimental analysis and Computational Fluid Dynamics (CFD) modelling to investigate the separation performance of three-phase pilot-scale separators operating at different flow conditions. The first separator (Pilot-Sep-A) is a three-phase separator equipped with flat plate inlet diverter and an overflow weir with a length to diameter ratio of 3. The effects of gas, oil and water flowrates were determined on the separation efficiency for this separator. The second separator (Pilot-Sep-B) is equipped with an inlet diverter, mist extractor and a bucket and weir configuration with a length to diameter ratio of 2. For Pilot-Sep-B, the effect of oil flowrate, water flowrate and weir height were determined on the separation efficiency. The two pilot-scale separators are used for demonstration purposes and were selected for this work due to their availability.

The experiments were designed using Minitab Factorial design of experiments (DOE). Eight experiments were conducted

at random for each separator at different levels (low and high) of the factors investigated. Randomisation was carried out to provide protection against extraneous factors that can affect the results. For each run, oil samples were obtained and centrifuged to determine quantity of water in the oil outlet. This was then used to determine the separation efficiency. For the CFD modelling, numerical solutions were initialised with predetermined oil and water levels using the patching tool. A sensitivity analysis on multiphase and turbulence models indicated that Eulerian multiphase model with standard k-ε turbulence models predicted the best results. A mesh independence test was also carried out to ensure the results are independent of the mesh size.

The experimental and CFD predicted results in form of cube plot, pareto chart and main effect chart for the separation efficiency were compared for both separators. The factors investigated showed significant effects on separation performance. The oil flowrate was found to have the greatest effect on the separation efficiency for both separators. This is followed by the water flowrate and finally the gas flowrate and weir height for Pilot-Sep-A and Pilot-Sep-B respectively. A maximum deviation between the experimental and CFD predicted results of 18% was obtained when Pilot-Sep-B was set at high oil and water flowrate and low weir height. A white rag placed at the gas outlet indicated no liquid carry over at the gas outlet for both separators. This is consistent with the CFD predicted results. Finally, this work highlights the ability of CFD modelling to predict the separation performance of pilot-scale separators which can then be utilised to improve and optimise gravity separators.

Biography

Tariq Ahmed obtained his MSc in Petroleum Engineering at Teesside University in 2012. Thereafter, he started working at Bayero University Kano in the Department of Chemical and Petroleum Engineering. He is currently a 3rd year PhD Student at Teesside University and his research is on Optimisation of gravity phase separators.

Utilizing Flared Gas for Power Generation in the Permian Basin

Karolina De La Rosa, Kim Hepner and Aylin Villalobos
The University of Texas Permian Basin, Odessa, TX

Abstract

Flared gas is a hot topic. Approximately 260 MM SCF of natural gas is flared daily in the Permian Basin. This volume of flared gas is constantly on the rise, creating both environmental and health concerns. Flared gas is a viable commodity and may be used to reduce environmental and health concerns by being converted into power. Instead of burning off the flared gas, flared gas can be used as energy to propel a turbine or generator and therefore produce power. The power generated can be used on-site or even for powering facilities. Several factors including the hydrogen sulphide content, corrosion, pressure, and the BTU's raise concern for the use of flared gas as energy and must be considered. Producing power utilizing the excess flared gas can be highly beneficial to not only the oil and gas industry but also to society.

Biography

The UTPB Petroleum Engineering students have been conducting this research since October 2018. Karolina De La Rosa plans to graduate from UTPB in December 2019. In her spare time, she enjoys traveling and spending time with family. Kim Hepner is a wife and mother of two children. In her spare time, she enjoys traveling with her family. She plans to graduate from UTPB in December 2019. What encouraged her to work on this project was the possibility of making a positive change to benefit of society. Aylin Villalobos plans to graduate from UTPB in May 2020.

The Concept of an Intelligent System for Controlling Steam Injection at the Yaregskoye High-Viscosity Oil Field

Denis S. Kormshchikov*, Lev Yu. Levin[1] and Artem V. Zaitsev
[1]Russian Academy of Sciences, Russia

Abstract

Lukoil company extracts heavy crude oil at the Yaregskoye field using steam-assisted gravity drainage (SAGD) technology and thermal mining technology. The paper presents the concept of an intelligent system for controlling steam injection for a test compartment of this oil field, where SAGD is used. The goal of the research is the effective heating of the reservoir and increase of oil recovery by means of controlling the intensity of steam injection. The main idea consists in the interaction between the numerical model of heat and mass transfer processes in the reservoir and experimentally measured temperature along the steam and production wells. Optical fiber technology is used for distributed measurements of temperature in real-time mode. Measured and post-processed temperature distributions are used to calibrate the parameters of the numerical model. The numerical model is used to forecast and display the 3D temperature and oil saturation fields, to give recommendations on changing the mass flow and the temperature of the steam. The system is able to provide the monitoring data and concomitant recommendations in the form of a weekly report for oil companies. The proposed concept is based on our experience in fiber-optic measurements and simulation of heat and mass transfer processes in oil reservoirs. We have developed an intelligent monitoring system for the frozen wall formation in the process in mine shaft sinking. This system uses distributed optical fiber measurements and was implemented for two shafts of Petrikov potash mine of Belaruskali Company. We have developed and put into practice a model of heat and mass transfer in the oil reservoir and mine excavations network for the compartment of the Yaregskoye oil field, where thermal mining technology is used.

Biography

Denis Kormshikov was born in 1989 in Perm, USSR. In 2011 he graduated the Perm State Polytechnic University. In 2015 he defended his Ph.D. thesis on the topic "Research and development of aero gas dynamic safety systems for underground mines".

Management of Microclimate Conditions in Mines when Thermal Mining Method of Oil Extraction is used

Mikhail Semin*, Yuri Klyukin and Boris Kazakov
Mining Institute of the Ural Branch, Russian Academy of Sciences, Russia

Abstract

The Yaregskoye field is located in the south of the Timan-Pechora, Ukhta District of Komi Republic, 20 km off Ukhta town. The main peculiarity of the field is the high viscosity of the oil in the reservoir conditions – 16000 mPa.s. This led to the use of methods of the heating oil reservoir. From 1968 to the present time, the bulk of the oil reservoir is exploited using the thermal mining method. Thermal mining method assumes drilling a series of directional wells into the oil reservoir and injection high-pressure steam to heat the oil and reduce its viscosity. Then, the heated oil is extracted from the reservoir by the means of a series of production wells drilled from the mine. The extracted oil is transported through a system of mine roadways by means of gravity and pump stations at the shaft bottom. Then oil is pumped on the surface. Such dense network of wells, drilled from the surface and from different parts of mine, allows increasing efficiency of oil recovery: the averaged oil recovery index at the Yaregskoye field has reached by now the value 0.54 when oil recovery indices for separate regions of the field exceed 0.7. The dense network of wells and high temperatures of injected steam led also to the heating of the reservoir. It results in a bad microclimate conditions in mine ventilation network: high temperature and humidity of the air. In this report, we discuss the efficiency of different measures to normalize the microclimate conditions in mine ventilation networks.

Biography

Mikhail Semin was born in 1989 in Perm, USSR. In 2010 he graduated the Perm State University and got a bachelor's degree. In 2012 graduated the Saint Petersburg State Polytechnic University and got a Master of Science degree. In 2016 he defended his Ph.D. thesis on the topic "Justification of the parameters of mine ventilation systems in case of fan reverse".

The Prevention of Evaporation of the Spilled Oil, Radiation Cross-Linking of Molecules of Organic Impurities of Reservoirs on the Surface of Small-Cat Wooden Chips

[1]Khagani F. Mammadov* and Aygun A. Mammadova
Institute of Radiation Problems of Azerbaijan National Academy of Sciences, Azerbaijan

Abstract

Addition of small amount of water solution of the salts of potassium, sodium oxides or quaternary ammonium organic alkali associated with the acid group of silicic acid for a short period of time practically completely (96-100%) coagulates the organic colloidal system, spilled petroleum products and modifies the components of the oil product, reducing their fluidity and evaporation. The spilled oil products are localized in the form of huge viscous, amorphous bunches and frozen spots laying the surface of the land plot with relatively small dimensions and settle on the bottom of the reservoirs. The developed method allows to reduce the area of soil contaminated with spilled oil products, evaporation of light hydrocarbons, hence the degree of danger of fire and prevent the spread of oil throughout the reservoir.

At irradiation of the contaminated water reservoir with is observed relatively high values of the weight of removed petroleum products which indicates the presence of chemical sorption in addition to the physical adsorption on the surface of wood chips. This important effect can be considered at radiation purification of water contaminated with various organic compounds, crude oil and phenol.

Biography

Doctor of chemical science, head of laboratory of Institute of Radiation Problems of Azerbaijan National Academy of Sciences, Khagani F. Mammadov in 1978 graduated from Moscow Institute of Chemical Technology named after D.I.Mendeleev, specializing in "Radiation Chemistry". He defended the thesis of the candidate of chemical sciences on "Radiation Chemistry" at the Moscow Scientific Research Institute of Physical Chemistry named after L.Y.Karpov in 1989 year. Kh.F.Mammadov was awarded the degree of Doctor of Chemical Sciences by decision of State Attestation Commission of Azerbaijan Republic.

The main research directions and achievements:

-Investigation the chain radiation-chemical processes in systems with different allotropic forms. Radiation stitching of elastomeric macromolecules at extreme high pressure;

-Radiation and photolytic methods of treatment of natural gas from hydrogen sulphide;

-Production of molecular hydrogen from water by radiation and radiation-chemical methods.

He is the author of 97 scientific articles and materials, 2 monograph and 3 scientific inventions.

The Study on Exhaust Emission of Diesel Engine in Idle State Using Palm Biodiesel

[1]HaengMuk Cho* and ChangChun Xu
[1]Kongju National University, South Korea

Abstract

Biodiesel is a renewable, sustainable fuel made from a variety of crops and animal fats that is biodegradable and non-toxic. Biofuels are environmentally friendly compared to fossil fuels. Therefore, this paper studies the performance after blending palm biodiesel and diesel with bio-oil and the exhaust emission characteristics and harmful component reduction after combustion. Compare with diesel performance and emissions characteristics. The physical and chemical properties of palm trees were determined and the volume ratios of 20% (B20), 40% (B40) and 60% (B60) were mixed and the properties of the palm oil mixture were compared with diesel fuel (B0). Therefore, the performance of these fuels is evaluated in a multi-cylinder diesel engine under various engine speeds and idle conditions. The properties of palm biodiesel and mixtures thereof meet the ASTM D6751 standard. The engine performance text results show that the B60 produces a slightly lower brake-to-fuel consumption value than diesel fuel over the entire speed range. Engine emissions show that all of the palm oil mixture's carbon monoxide (CO), unburned hydrogen (HC) and nitrogen oxides (NOx) are compared to pure diesel fuel. The results indicate that the B60 mixture is the most preferred mixture of other palm oil blends. Carbon monoxide (CO) increases with increasing speed but decreases slightly in the B20 state. Unburned hydrocarbons (HC) and nitrogen oxides (NOx) cause a reduction in the amount of exhaust gas. Fuel can replace diesel fuel in unmodified engines to reduce emissions to the environment.

Biography

Haeng Muk Cho is Currently working as Professor in Division of Mechanical and Automotive Engineering in Kongju National University in South Korea. He has successfully completed his Administrative responsibilities as Proffesor. His research has included Car Alternative Fuel, Bio-diesel, Car Emission Control, Hybrid Vehicles.

iTRAQ-based Exploration of Key Proteins in Pseudomonas aeruginosa on Petroleum Degradation

Jun-Di Wang* and Cheng-Tun Qu
Xi'an Shiyou University, China

Abstract

In this work, iTRAQ analysis was used to identify the key proteins responsible for Pseudomonas aeruginosa P6's high efficiency on petroleum degradation. Fifty-two proteins were identified as the differentially expressed proteins with 42 up-regulated and 10 down-regulated by iTRAQ analysis and classified by bioinformatics analysis. The results indicated that the functions of most differentially expressed proteins were responsible for P. aeruginosa P6 survival under petrolic conditions and utilization petroleum as carbon source in a better way. The proteins mainly help P. aeruginosa P6 on carbon source metabolism and nutriment uptake in a petrolic condition. The findings reveal the key proteins and the molecular mechanism of P. aeruginosa P6 degradation petroleum and set a clear direction for future research.

Biography

Jun-Di Wang is from Shaanxi Key Laboratory of Environmental Pollution Control Technology and Reservoir Protection of Oilfield, Xi'an Shiyou University are working on environmental protection of oil and gas fields.

Environmental Pollution and Refinery Operations in an Oil Refining Region of Liberia: A Focus on Liberia Petroleum Refining Company

Sencee A. Gebeh
Liberia Petroleum Refining Company, Liberia

Abstract

The environment is considered as man's important asset that must be protected for his life support.

Unfortunately, the situation is different where oil refinery and petrochemical plants operate. Environmental pollution in these areas poses serious threat to the ecosystem, often with undesirable effects. This paper, therefore, takes a look at the refinery operations in Monrovia, The Liberia Petroleum Refining Company (LPRC). The study adopts simple descriptive statistics in data analysis and discovers the prevalence of gas flaring, noise and vibrations as well as soil contaminations with liquid and solid waste disposal from the refinery. Policy recommendations are set forth based on research findings with a view to minimizing pollution in the study area.

Biography

Sencee A. Gebeh is a Liberian Native and is an oil and gas practitioner, he studied at the University of Dundee in Scotland where is obtained an MSc degree in Oil and Gas Management in 2015. He is currently studying Environmental Science at the CUTTINGTON Graduate School in Monrovia Liberia

Comprehensive Diagnostic and Lesson Learned of Water Shut-off campaigns in Umm-Gudair Field in Kuwait

Al-Azmi*, Ali Abdullah, Tiwari and Brajesh Kumar
Kuwait Oil Company, Kuwait

Abstract

Umm Gudair is one of the largest fields in West Kuwait Directorate. The field has been producing for more than 60 years and the associated water production has significantly increased with time. Large water production is increasing operating cost of the field severely and is over-loading surface facility. In addition to this excess ESP horsepower requirement for lifting fluids, corrosion related issues, and damage of wells completion activities are increasing. To mitigate these constrains, water management is crucial. Therefore, in order to reduce water production, operating cost, and increase oil production, a big water shut-off campaign was carried out.

Approximately more than 60 different water shut-off jobs including mechanical WSO, polymer WSO, and ICD installations for existing horizontal wells carried out during 2015 to 2017. The results of those water shut-off jobs were quite effective and appreciable in terms of both enhancing oil potential and reducing the water cut. Those water shut-off jobs succeeded to maintain annualized sustained average plateau production rate and reduced the overall field water cut from 65% to 50%.

Accurate diagnosis, integration of information such as historical well work-over jobs and completion, production data, and reservoir data are important for design of successful water shut-off treatments. Cement placement techniques during the work-over of extremely sub-hydrostatic reservoirs that exist in Umm Gudair field plays an important role in success of water shut-off jobs. All data were put on one platform, analyzed and reviewed prior to executing treatments, and after the treatments to extract lesson learnt for upcoming water shut-off jobs.

The paper deals with the lesson learned from the water shut-off campaign. The Performance of these wells were analyzed to examine how efficiently it achieved the objectives of the water shut-off and evaluated for setting up the guidelines. The paper also discusses the process that should be implemented for the water shut-off jobs in future.

A Bilevel Optimal Control Approach to Solving the Natural Gas Cash-Out Problem

Yosefat Nava-Aleman[1*], Viacheslav Kalashnikov[1,2,3], Francisco J. Benita[1], and Patrick Mehlitz[4]
[1]Monterrey Institute of Technology and Higher Education, Mexico
[2]Central Economics & Mathematics Institute (CEMI), Russia
[3]Sumy State University (SumDU), Ukraine
[4]TU Bergakademie Freiberg, Germany

Abstract

The aim of this work is threefold: (i) first, it formulates the natural gas cash-out problem as a bilevel optimal control problem (BOCP); (ii) second, it provides interesting theoretical results about Pontryagin-type optimality conditions for a general BOCP where the upper level boasts a Mayer-type cost function and pure state constraints, while the lower level is a finite-dimensional mixed-integer programming problem with exactly one binary variable; (iii) and third, it applies these theoretical results in order to find possible local minimizers of the natural gas cash-out problem.

The Natural Gas Cash-Out Problem (NGCOP) consists in a search of a Stackelberg-type equilibrium in a hierarchical game (a bilevel model), in which the leader (the natural gas shipper) strives to maximize its net profit for a fixed time interval by playing with arising imbalances in a set of gas pipeline's meters. However, the follower (the gas pipeline administration) seeks to minimize the last day imbalances subject to a preliminary contract with the gas shipper. In order to reduce the final imbalances to the desired minimum, the gas pipeline charges the shipper with certain cash-out penalties. Therefore, the leader solves the continuous-time bilevel optimal control (BOC) problem based on the optimal response of the follower at the end of the contract term. The numerical solution of the BOC problem is usually obtained after a corresponding discretization reducing it to a (linear) bilevel mathematical problem (BLP).

Biography

M.S. Yosefat Nava-Aleman obtained his bachelor's degree and master's degree in mathematical sciences in 2010 and 2013, respectively, from The Autonomous University of Nuevo Leon (UANL) in Monterrey, Mexico. Since August 2016, he pursues his Ph.D. studies in Engineering (DCI) at Monterrey Institute of Technology and Higher Education (ITESM), Campus Monterrey, where he is working in the area of Optimization, Bilevel Programming and Applications to real-life problems. Within the Ph.D. term, he is now having his research stay at the Department of Industrial, Manufacturing, and System Engineering of Texas Tech University in Lubbock, TX. The poster presents the recent results obtained during his Ph.D. course

DAY-3

WEDNESDAY, FEBRUARY 20, 2019

Bioelectricity Generation from Organic Soil and Living Plants

Md. Azizul Moqsud
University of California, Berkeley, CA

Abstract

We need green energy for the sustainable future. The threat of the global warming problems and the increased number of the people has made the things more important to find the sustainable source of energy for the global community. In this particular research, we have tried to generate the green energy with the help of the microorganisms. The materials used is mainly organic soil and living plants. Due to the metabolic activities of the microbes, electrons can be generated. The flow of electron can be the source of energy as a bioelectricity. On the other hand, the living plants can be also sued as a new source of green energy. Photosynthesis can generate carbohydrates in the green leaves and the carbohydrates moves to the root zone, the geo bacteria biodegrades the organic s. Then electrons releases and we can collect the electrons from the anode and cathode with the help of external circuit. Organic soil has been used as a source materials and carbon fibre and bamboo charcoal has been used for the electrode materials. It was observed that the electricity was generated, and we can use that electricity to power the temperature monitoring sensors.

Biography

Md. Azizul Moqsud is currently working as a visiting scholar in the department of Civil and Environmental Engineering, University of California, Berkely. He is an associate professor in the Yamaguchi University, Japan. He has more than 120 technical papers in the field of energy and environment. His major research interests are green energy, bioremediation and sustainable world. He has been nominated the best teacher awards in Yamaguchi University in 2017, 2016, 2015. He has been awarded the best paper award and excellent presentation award in different international conference.

"Smart" nano-oxyhydride Catalysts for Hydrogen Production from Bio-resources

Louise Jalowiecki-Duhame[1*], Noura Haidar[1], Yaqian Wei[1], Wenhao Fang[2] and Sébastien Paul[1]
[1]UCCS - Unit of catalysis and chemistry of the solid of Lille, France
[2]Yunnan University, China

Abstract

Increased attention is focused on hydrogen production technologies from renewable resources. To this purpose different series of nickel based nano-oxyhydride catalysts (CeNiX(Al,Zr)HZOY and Mg2AlNiXHZOY) were developed and applied to the highly efficient and sustainable H2 production from molecules issued from bio-resources such as ethanol1-7 and methane8. The "smart" catalysts require low energy input by allowing the use of the chemical energy released from the reaction between hydride species stored in the nano-material and O2. The influence of different parameters on the activity and selectivity was analysed, such as the Ni content, the presence of dopant, and the H2 in-situ pre-treatment of the catalysts, as well as the reaction temperature or feed compositions. As an example, the production of H2 can be obtained with stable total conversion of ethanol with an oven temperature at only 50°C. Moreover, different physico-chemical characterizations were performed allowing a proposition of active site and mechanism involving cations in strong interaction, hydride species and anionic vacancies.

Biography

Louise Jalowiecki-Duhamel obtained her doctoral degree in 1984 and her "Habilitation" in 1996 at the University of Lille 1. She is a CNRS (Centre National de la Recherche Scientifique) researcher since 1984, working in the heterogeneous catalysis field. Studying various catalytic reactions such as hydrogenation, isomerization, hydrotreatment, selective oxidation reactions, she has proposed some relationships between catalytic orientation and active site structure involving hydride species and anionic vacancies. She is the author and co-author of more than 80 scientific articles, 8 patents, and more than 100 communications in international and national congresses.

Study of an Integrated Tower Solar Energy Combined Cycle System with the Simultaneous Integration Solar Energy with Top and Bottom Cycle

Liqiang Duan*, Kun Xie, Jing Sun and Yulei Liu
North China Electric Power University, Beijing, China

Abstract

In this paper, based on a conventional integrated solar combined cycle system (ISCC), a novel integrated tower solar energy combined cycle system (ITSCC) with the simultaneous integration the solar energy with top and bottom cycle of combined cycle system is proposed. The system models are developed, and different system performance evaluation indices are proposed. Then in the condition of the same solar radiation the thermal performance of new system is analysed and compared with the reference ISCC system and gas-steam combined cycle (GTCC) system. Furthermore, the operating characteristics of the new system in the summer solstice are deeply investigated in consideration of the heat variation from direct solar radiation and the effect of the ambient temperature change on the solar collector system. The efficiency of solar energy utilization and the thermodynamic properties of different systems are analysed. The result shows that, in the summer solstice the natural gas input of new system is less 3.28% than that of GTCC system, and the net output power is increased by 1.5%, the solar-to-electric efficiency and the exergy efficiency can achieve 27.3% and 28.4%, respectively. In addition, the annual performance of new system is also better than that of the reference system.

Biography

Liqiang DUAN, is a professor, School of energy power and mechanical engineering, North China Electric Power University. He got his Ph.D. degree from Institute of Engineering Thermo physics, Chinese Academy of Sciences in 2002, obtained his master's degree from North China Electric Power University in 1999, and acquired his bachelor's degree from Taiyuan University of Technology in 1996. Now, his main research interests include the optimization and evaluation of advanced energy system; clean coal power generation system, such as integrated coal gasification combined cycle system; distributed energy system; hybrid system integrated with solid oxide fuel cell, and advanced energy system with Zero-CO2 emission.

Plasma Gasification of Biomass in Air Medium

A.B. Ustimenko*, V.E. Messerle, N.A. Slavinskaya and Zh.Sitdikov
Kazakh National University, Combustion problems Institute, Kazakhstan

Abstract

The work is about complex thermodynamic and experimental studies of fuel biomass (FBM) plasma gasification. FBM is awdust and chips.

The aim of thermodynamic calculations was to determine the integral parameters of the gasification process: equilibrium composition of the gas phase of the gasification products, the degree of carbon gasification and specific power consumption for the process. The calculations showed that the maximum yield of the synthesis gas at plasma air gasification of FBM is achieved at a temperature of 1600K. Synthesis gas with a concentration of 71.6% (CO – 41.9, H2 – 29.7) can be obtained.

Experimental studies of FBM gasification were performed on the installation, main elements of which are a plasma chemical reactor with productivity by FBM up to 50 kg/h and long live DC plasmatron of 70 kW nominal power. Gas analysis showed the following composition of the gas at the exit of plasma installation, vol.%: CO – 42.0, H2 – 25.1, N2–32.9. Specific heat of combustion of the synthesis gas produced by air gasification amounts to 9,450 kJ/kg. Degree of FBM carbon gasification is 96.6%. Specific power consumption for FBM gasification in the plasma reactor according to the results of experiments amounted to 1.53 kWh/kg of working substance. In the experiments, as well as in calculations, no harmful impurities were found in the products of FBM plasma gasification.

Biography

Alexandr Ustimenko was graduated from Kazakh State University, Physical department in 1984, received PhD in 1991. In 2012 he defended thesis on Doctor Degree on technical sciences on topic "Plasma-fuel systems for effectiveness increase of solid fuels utilization". Since 1991 he has been with Plasma technics R&D as CEO and since 2002, he has been a leading staff scientist and head of the division of thermal physics and technical physics of Research Institute of Experimental and Theoretical Physics at Physical Department of al-Farabi Kazakh National University.

Modified Fe_2O_3 and ZnO Photoanodes for Photoelectrochemical Water Splitting

Yongdan Li[1,2*], Jingran Xiao[1], Yang Li[1] and Le Zhao[1]
[1]*Tianjin University, China*
[2]*Aalto University, Finland*

Abstract

Photoelectrochemical water splitting has been regarded as a promising strategy to obtain hydrogen and thus solves the energy concerns related to the sustainable development of the humankind. However, the low efficiency seriously impedes its commercialization progress. Fe_2O_3 (hematite) and ZnO are among the most widely studied photoanodes, whereas the former suffering from poor electrical conductivity, short lifetime of the carriers, short hole diffusion length, and sluggish water oxidation kinetics whilst the latter wide band gap. We focus on developing various approaches including composition tuning, morphology control, and heterojunction preparation, and cocatalyst incorporation, to solve these issues.

For Fe_2O_3 photoanode, proper amount doping of Ge, incorporating CuO as a sacrificial template agent, rapid cooling from 800°C during fabrication can tune the morphologies and thus increase the efficiency. Furthermore, loading an amorphous FeCoW oxy-hydroxide nanolayer on Fe_2O_3 film significantly improves the performance. The onset voltage is 0.67 V vs. RHE and the applied bias photo-to current efficiency of the composite is 2.7 times higher than that of the bare Fe_2O_3.

For ZnO photoanode, ZnO:Ga/ZnO isostructural nanojunction with core-shell structure, and deposition of a carbon quantum dot on the composite can significantly increase the current density; the current density of the latter is 0.16 mA cm^{-2} under visible light at a bias of 1.0 V, comparable to that of ZnO under AM 1.5G simulated light.

Biography

Yongdan Li is the Chair professor of Aalto University, Finland and an adjunct professor of Tianjin University, China. He received his Ph.D. degree from Tianjin university in 1989. In 1993, he became a full professor of Tianjin University. He became a tenured professor of Aalto University in 2017. His current research focuses on clean and efficient energy utilization, including catalytic conversion of biomass, photocatalysis, solid oxide fuel cells and flow batteries. He has published more than 240 refereed papers which have been cited about 10,000 times. He serves now as an associate editor of Catalysis Today

The Role of Natural Convection on the Crude Oil Gel Strength in the Riser

Lalit Kumar[1*] and Lomesh Tikariha[1]
Indian Institute of Technology Bombay, Mumbai, India

Abstract

The increasing demand of petroleum product requires sourcing out unconventional heavy crude oils (C20-C40). These higher molecular weight, n-paraffin (commonly known as wax) is major source of problem in transporting crude oil as petroleum resources shifted from onshore to offshore. At reservoir temperatures (70oC-150oC) and pressures (50-100 MPa), wax molecules are dissolved in the crude oil. The crude oil flows through a subsea pipeline resting on the ocean floor at a temperature of 4oC to 10oC. The difference between crude oil and surrounding ocean temperature results in heat transfer from crude oil to ocean. This heat transfer may cause decrease in crude oil temperature below wax appearance temperature (WAT). The solubility of wax decreases drastically as the temperature decreases below WAT. Wax precipitation is more prominent during shut down period when the crude oil is held at static condition. Volume spanning network of precipitated wax modulates the rheological properties of waxy oil. The complex shear and thermal history dependent rheological properties of gel play a critical role in determining the driving force to restart flow in the gelled pipeline. To restart flow in the gelled pipelines a higher pressure is required to break the gel structure. Therefore, in order to understand the restart process, it is important to accurately predict the strength of waxy gel. However, there is no theoretical work which simultaneously includes shear and thermal history while predicting the gel strength. During flow shut down the natural convection create shear history which influences gel strength. In this work, a numerical simulation is carried out in order to predict transient evolution of gel structure by including the effect of shear history due to the natural convection and thermal history on the gel rheology.

Biography

Lalit Kumar is an assistant professor in the Department of Energy Science and Engineering (ESE) at IIT Bombay, India since

May 2016. He completed his B.Tech and M.Tech in Chemical Engineering from IIT Kanpur in 2002 and 2004, respectively. He completed his PhD in Chemical Engineering from NTNU Trondheim, Norway in 2014. Dr. Kumar's research interest primarily lies in wax deposition, pipeline shut in and flow restart process at subsea conditions. In addition to this, Prof. Kumar's interest also includes topics in thermochemical heat storage and oil-water separation.

Safe and Economical Design of Surface Multi-well Production Flow-line Network

Oluwaseun Olanrewaju Alade
University of Miskolc, Hungary

Abstract

In the oil and gas industry, production flow-lines are pipelines that connect a single wellhead to a manifold or process equipment. In a larger oil and gas field, multiple flow lines may connect individual wells to a manifold, and then a gathering line may transfer the flow from the manifold to a pre-process stage or to a transportation facility or vessel. Flow lines may be in a land or subsea field and may be buried or at grade on the surface of land or seafloor. Flow lines are located at the well site and tied to specific wells. It may be a metallic pipe or a hose. Most flow lines are very short in length, but others may be run for kilometres in onshore applications. A flow line is sized based on the maximum flow rate that is likely to be produced from the producing well. In heavy oil applications, a flow line may be insulated to retain the heat of the formation in order to prevent plugging. If the line is too large, the velocity could be slow enough where separation might occur or particulate may settle out in the pipe, which causes corrosion issues. Flow lines may sit directly on the dirt, be buried, on supports or placed on sleepers. Most modern installations will place the flow line on supports or sleepers. Production flow-lines are usually affected by various defects during their life-times. Corrosion, vibration, sand production, slug formation, poor insulation design and poor allowance for maintenance are the serious problems facing production flow-lines. These defects usually result in huge maintenance costs and large financial losses due to long production downtimes. The present study therefore focuses on the safe and economical design of multi-well production flow-line network with a focus to incorporate and address the various defects in the design. A flow-line network, connecting five different producing wells to a gathering station would be developed in this present study. The general layout of the five producing wells, the gathering station and the flow line network will be developed in both 2-D and 3-D using CAD software. Attention would be focused on stress analysis by CAEPIPE software (finite element software), so that various stress values, forces and deflections are analyzed at each node to make the multi-well production flow-line network design at safe operating and economic conditions.

Biography

Oluwaseun Alade is a civil/structural engineer with over 8-year post-graduation experience in reinforced concrete design, steel design, construction, construction planning and supervision. The following is the education background.

Ø 2017 2019: University of Miskolc / Master of Science in Petroleum Engineering

Ø 2004 2009: University of Ibadan / Bachelor of Science in Civil Engineering / Second Class Upper

Ø 2002 - 2004: The Polytechnic Ibadan / Diploma in Civil Engineering / Upper Credit

Ø 1996 - 2001: Lagelu Grammar School / Senior Secondary School Certificate Examination (SSSCE)

Ø 1991 - 1996: Queen of Apostle / Primary School Leaving Certificate

Lithium-Ion Batteries for Ex Field

Kim Fumagalli[1*] and Roberto Sebastiano Faranda[2]
[1]Excen srl, Italy

Abstract

Lithium-ion batteries have been largely studied in the past years, with the aim of improve the level of safety guaranteed during their operation. Among the different developed technologies, lithium iron-phosphate (LFP) is today considered the one with the best safety performances: test and measurements on damaged cell demonstrate that the amount of heat released during thermal runaway is significantly lower with respect to other lithium technologies, e.g. the old lithium cobalt-oxide (LCO). Anyway, safety issues are still present, and the main topic is to avoid the rise of hazardous events, which may be associated to

short circuits, over-charge/over-discharge electric currents and overheating. These dangerous conditions may lead to exothermic chain reactions inside the storage system, which then may release toxic and/or flammable gases and finally catch fire.

To reduce the possibility of battery failure, lithium systems are equipped with a control device called Battery Management System (BMS), which continuously manages the state of health of the battery, guaranteeing that it operates in the safety range provided by the manufacturer. Moreover, the BMS includes protection devices which break the battery electric circuits in case of unexpected over-currents.

The goal of this paper is the evaluation of the most safety type of Lithium technology in order to reduce the possible ignition source in the environment with presence of explosive atmosphere. Furthermore, it is important to understand the capability of BMS to remove the ignition risk residual and what is its minimum Safety Integrity Level (SIL) in order to grant a enough reliability. Anyway, the Paper describes the usable type of protection for the electrical components of the system according to IECEx Scheme and ATEX Directive in order to avoid the ignition of an explosive atmosphere.

Biography

Kim Fumagalli graduated in Electrical Engineering from the University of Milan Polytechnic in 2005. He has obtained the Ph.D. degree in Electrical Engineering at Politecnico di Milano, Milan, Italy, in 2009. He is the Product Certification Manager of Excen S.r.l . His research areas include LED Source and LED Lighting System, Electrical and Lighting systems for Ex environment, Batteries and Cells, Industrial Trucks and Internal Combustion Engines for Explosive Atmosphere, Ex Products Certification and Testing. He is a member of the IEC Work Group WG40, WG37, MT60079-1, MT60079-14, MT60079-17 and MT60079-19. He is a member of Standards Committee of CEI (Italy) CT31 and SC34D. He has authored several papers.

Research on Multi-Energy Complementary Power Generation System Using Wave Energy and Solar Energy

Ghulam Ahmad* and Huang Lei
Electrical Engineering Department, Southeast University, China

Abstract

In the past few decades, renewable energy sources (RESs) such as solar and wind power have become commercially competitive in the energy market due to their various advantages over traditional energy sources. Meanwhile, other forms of RESs i.e., marine energy gain substantial attention their development is in initial phase. Wave energy among different forms of marine energy offers several advantages such as perseverance, predictability and high availability and becomes a popular choice for supplying electrical energy in future. However, the main challenge is to overcome the RESs intermittency problem.

Wave energy conversion (WEC) system and solar power along with the battery energy storage system (BESS) can overcome the RESs intermittency problem. Power available from RESs such as solar power and wave energy varies dramatically depending on the weather condition and sea state respectively. Therefore, to maintain terminal voltage at the system level and a constant active power output full-scale back-to-back converter are interfaced with the power grid. Here the main issue is to balance the instantaneous power flow difference between the terminals of the converters because the input power of the converters from the generator of the WEC varies. Charging and discharging the capacitor in the power conditioner is a method for instantaneous power flow balancing in back-to-back converters. However, the physical space required for the capacitor in the converters to absorb the power flow difference is a main drawback. Therefore, in this paper, to overcome the physical space drawback, solar power along with battery energy storage devices for the WEC is integrated and tested. From the simulation results obtained through Matlab/Simulink tool, it can be inferred that the overall hybrid framework is capable to complement the power.

Biography

Ghulam Ahmad received the bachelor's degree with First Class Honours in Electrical Engineering from University of Gujrat, Punjab, Pakistan, in 2015. He has accomplished funded project during bachelor's degree. Currently he is working towards the master's degree in Southeast University, Nanjing, China and hopefully will complete the program in July 2019.

Biomass to Finish Fuels via Hydrofaction™: Upgrading Pathways and Refinery Integration

Julie Katerine Rodriguez Guerrero*, Sergios Karatzos, Bob Moll and Steen Iversen
Steeper Energy Canada Ltd, Suite 220, 906 12th Ave S.W. Calgary, AB, Canada

Abstract

Efficient and economic utilization of biomass and organic waste resources to produce liquid biofuels has become attractive for industry and governments that wish to decarbonize long-haul transportation. Renewable crude oil produced from woody biomass via Hydro faction™ (Steeper Energy's proprietary hydrothermal liquefaction technology) needs to be upgraded/refined before it can be used in transport fuel applications. Although the renewable crude oil has a low oxygen and high calorific value compared to other bio-oils, and in many ways resembles its fossil counterparts, it has distinct properties that need to be addressed during the upgrading process. Such properties include high viscosity, high Total Acid Number, oxygen content around 10 wt.% and low sulphur content. These properties can lead to operational challenges such as reactor temperature control; upgraded oil recycling; considerable decrease of viscosity after oxygen and TAN reduction and, deactivation of commercial sulphide catalysts due to low sulphur content of the biocrude (< 200 ppm). An extensive program for characterizing and upgrading the biocrude oil to "Drop in" transportation fuels or blend stocks has been performed. One of the aims of this upgrading program has been to employ different upgrading strategies including stand-alone and refinery co-processing in order to maximize the yield of renewable diesel that is on or close to specification. The presentation will cover the main results to date from these upgrading strategies including longer-term stability tests (>700 hours). These results demonstrate the upgradability of the oil with both commercial and novel (biocrude-adapted) catalysts.

Biography

Julie Katerine Rodriguez, Ph.D. is the Project Manager at Steeper Energy for Upgrading of Hydro faction™ crude oil. Her role is to develop new integrated technologies to optimize pathways for upgrading of renewable crude oil into dropping fuels and refinery integration. She manages collaborative research projects with the Universities of Calgary and Alberta, leading pilot plan tests on hydro processing of renewable crude oil. Moreover, she leads and participates in testing and development of desalting/deashing and dewatering of biocrudes as well as evaluation of quality of biocrudes and upgraded products. She actively collaborates in industrial and academic research proposal projects.

China's Shale Gas Development and the Prospects Forecast

Zhao Qun*, Wang Hongyan and Yang Shen
Petro China Research Institute of Petroleum Exploration Development, China

Abstract

As the development of China's population, economic, energy and environment, natural gas as the cleanest fossil energy, its demand is growing rapidly and then the gap between production and demand is widening. From the analysis of the basic situation of the development of Chinese shale gas, development policy, demonstration test, based on the current development of shale gas resource, requirements and policy status analysis, to predict the future development of shale gas prospects. The general thought: (1) By the end of 2017, the country's proven reserves of shale gas is 9200×108 m3, it achieves a annual production of 90×108 m3, and the production is expected to reach 200×108 m3 in 2020.(2) The shale gas resources are abundant, and the natural gas demand is huge, and the state makes great efforts to support shale gas development, so shale gas has entered the period of strategic opportunities of development. But it is still faced with poor resources conditions, such as only Marine shale play in the south Sichuan basin has been developed, there is not any breakthrough in other area. (3) Preliminary forecasting the annual output is expected to reach 500×108 m3 in 2030, and 800 ×108 m3 in 2040.

Biography

Zhao Qun graduated from the China University of Geosciences in Beijing and got a doctor degree of mineral resource prospecting and exploration. He works in the Research Institute of Research Institute of Petroleum Exploration Development, PetroChina now. He has been doing research on the planning and strategy of unconventional oil & gas for more than 10 years. He has participated in the compilation of the Shale gas Planning (2016-2020) of CNPC and the Shale Gas Development Planning (2016-2020) of China.

Hypothesis of nature of coal, oil and gas

V.I. Butakova and A.I. Kirillova
Eastern Scientific and Research Institute of Coal Chemistry, USSR

Abstract

Russian scientists proposed polyene model of coal structure (1) according to which vitrinites of coal contain in monomeric part single or double spiral as well as staggered plane chains containing systems of poly-coupling (PCS) with 9-15 C=C bonds. Polymer constituent is an association of diverse structures formed as a result of intermolecular interactions between molecular chains. Significant share of polymer part constitute associations of three, four and more chains presenting complicated assemblies. All this is suggesting that coals were formed on the basis of carotenoids – carotenes, neurosporenes, licopenes.

As a result of searching of possibilities of the formation of molecular chains with coupling system close to that of carotenoids as well as possibilities of intermolecular interactions between them and, moreover, in different parts of the world the hypothesis that it became possible in water basin as a result of vital functions and die-off of cyanobacteria, which stated actively propagate in global ocean of our planet 3.5 gigayears ago was put forward (2) . Cyanobacteria consisting of elemental acaryocytes successfully synthesize organic compounds applying electromagnetic radiation, H2O, CO2 with the recovery of oxygen and protons. Carotenoids are pigmental structure of cyanobacteria without which photosynthesis is not possible. In the period, when oxygen was present in Earth atmosphere and ozone layer absorbed ultraviolet part of electromagnetic radiation PCS with 9-11 double bonds was present in the structure of carotenoids. At die-off of cyanobacteria the insoluble in water carotenoids were subjected to partial oxidation with elongation of PCS chain and recovery of methane (3). Aqueous media provided intermolecular interactions between molecular chains containing long PCS with the formation of complicated assemblies being the basis for the formation of coals.

On the basis of hypothesis of genesis of coals as a result of vital functions and die-off of cyanobacteria the hypothesis of nature of oil arose. The formation of oil started in earlier period compared to coals, when oxygen and ozone layer were absent in the Earth atmosphere, ensuring passing of ultraviolet radiation. For absorption of ultraviolet radiation cyanobacteria as pigments contained carotenoids with short length of poly-coupling system (phetoine, phytophluine). Aqueous medium at that period had more reducing properties as oxygen partially removed from water basin into atmosphere of the Earth. The reducing medium of water basins forwarded hydrogenation of PCS in carotenoids and provided the formation of hydrocarbons and oil.

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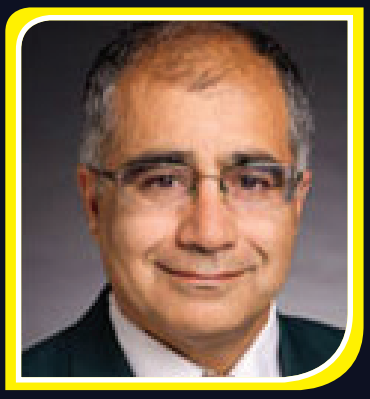

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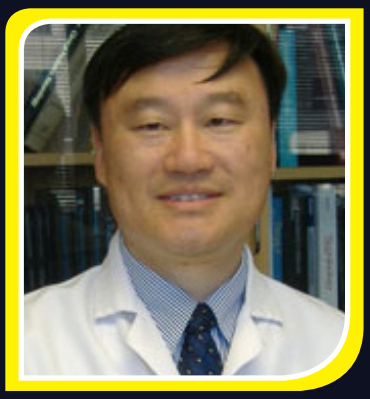

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