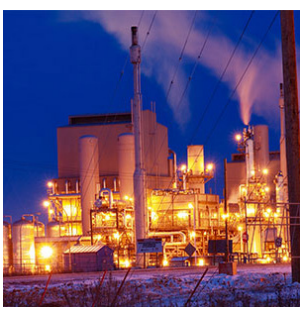
Accepted Abstracts

Oil and Gas 2019





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Arid ecosystem resiliency to total petroleum Hydrocarbons disturbance: A Case study from the State of Kuwait associated with the second gulf war

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The world's largest Hydrocarbon disturbance occurred in the deserts and offshore waters of Kuwait during the Second Gulf War in 1990-91. In this research, RS and GIS techniques were utilized to explore how native desert vegetation was recovered from hydrocarbon contamination after the Second Gulf War. By using RS techniques, change detection analysis was conducted to understand the changes about the coverage and extent of the TPH contamination and vegetation recovery. These changes were traced from 1991 until the hydrocarbon was no longer visible on the ground surface in 1998. GIS spatial analysis was conducted to determine the major ecosystem factors that influenced the vegetation recovery along with the removal of hydrocarbon disturbance. According to the results, autogenic recovery occurred at both sites within a few years and that desert native vegetation was found to have the ability to adapt and recover from hydrocarbon pollution. Native vegetation recovered across 31% of the TPH contaminated areas at Umm Gudair, and 34% at Wadi Al Batin. The changes in TPH contamination were significantly correlated with the soil type, vegetation type, geological substrates, geomorphological features, and annual precipitation. The vegetation recovery of dominant desert communities in the study area was influenced by soil type, geomorphological feature, and TPH contaminated areas. Interestingly, the results showed that these desert communities can recover in areas contaminated by TPH at a higher rate than non-contaminated sites in the study area. Such a study can provide important inputs to the restoration and revegetation programs in arid landscapes.

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Advanced reservoir modeling and management of complex reservoirs

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The petroleum industry is known to be the biggest user of computer models. More importantly, unlike other big-scale simulation, such as space research and weather models, petroleum models do not have an option of verifying with real data. Because petroleum engineers do not have the luxury of launching a 'reservoir shuttle' or a 'petroleum balloon' to roam around the reservoir, the task of modeling is the most daunting. Today, practically all aspects of reservoir engineering problems are solved with reservoir simulators, ranging from well testing to prediction of enhanced oil recovery. For every application, however, there is a custom-designed simulator. Even though, quite often, 'comprehensive', 'All-purpose', and other denominations are used to describe a company simulator, every simulation study is a unique process, starting from the reservoir description to the final analysis of results.

Simulation is the art of combining physics, mathematics, reservoir engineering, and computer programming to develop a tool for predicting hydrocarbon reservoir performance under various operating strategies. This course familiarizes participants with steps involved in the development of a reservoir simulator, ranging from formulation to history matching. They learn about conventional approach as well as recently introduced 'engineering approach'. It is called the "Engineering Approach" because it is closer to the engineer's thinking and to the physical meaning of the terms in the flow equations. Both the engineering and mathematical approaches treat boundary conditions with the same accuracy if the mathematical approach uses second order approximations. The engineering approach is simple and yet general and rigorous.

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Trusting markets: Energy security and strategic storage from a financial option perspective

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There are many approaches to measuring energy security: Some researchers use geologic and technical factors while others focus upon consumption and import dependence. Common to these approaches is the emphasis upon exposure to petroleum supply disruptions and the scope for mitigation but not to the probability of its occurrence. As petroleum markets have shown themselves resilient to quite extreme secular events, we ask if an alternative approach might be useful in quantifying energy security. We apply financial option theory to three eventful periods to learn the expectations of market participants to disruptions. We find the forward-looking views of petroleum participants to be accurate with regard to both price persistence and the ability of markets to absorb shocks, lending support to the proposition that markets can be trusted to deliver both secure and affordable supplies of petroleum. In light of the major structural changes to petroleum markets in the last half-century, our results cast doubt upon the need for emergency inventories unless justified to dampen market volatility on public good grounds.

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Silica Enhanced high temperature oil well cement systems based on particle packing theory

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As the oil and gas exploration moves towards deep wells and ultra-deep wells, the operators are increasingly demanding high temperature stability of the cement. This presentation mainly focuses on investigating the high temperature strength stability of set cement. Oil well cement systems suitable for high temperature applications were produced by adding silica admixtures with different particle sizes, whose dosages were optimized based on particle packing theory. Set cement samples cured under high temperature and high-pressure environment at 200°C and 50MPa for different durations of 7, 14 and 30 days were prepared and analyzed. The engineering properties of different formulations were evaluated based on standard API testing methods, such as thickening time, fluid loss, sedimentation stability, compressive strength and permeability etc. Additionally, continuous ultrasonic strength testing and XRD phase analysis were conducted to study the cement strength evolution as a function of time and the mechanism of strength retrogression under high temperature and high-pressure conditions. Test results indicate that the addition of fine silica particles such as silica fume helps to improve particle packing of the cement mixture and thereby improve engineering properties of the formation such as fluid loss and strength stability. Research outcome from this paper may help provide scientific ground for improving cementing quality in deep wells, ultra-deep wells and other complex conditions and achieving long-term zonal isolation in oil and gas wells.

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A forward modeling method based on electromagnetic theory to measure the parameters of hydraulic fracture

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Hydraulic fracturing is the pivotal technology of tight unconventional reservoir, and accurate monitoring of fracture morphology is related to fracturing effect evaluation, well productivity prediction and the follow-up measures. Compared with traditional methods, electromagnetic monitoring can obtain the Effective Propped Volume (EPV) that actually reflects the productivity, solve the abuse such as low fracture identification accuracy, limited by the specific time. This paper introduces an physical and numerical model that uses electromagnetic characteristics to accurately monitor the parameters of the fracture. A triaxial transmitting - triaxial receiving instrument which is approximate to the construction site is set up, the relationship of electromagnetic monitoring signals and the fracture parameters is obtained. By placing the transmission source plane perpendicular to an appropriate coordinate axis in a three-dimensional rectangular coordinate system the length and height of the fracture could be monitored by the signal of the long receiver while the transmitting source surface being perpendicular to the Z-axis. The azimuth could be inverted according to the magnitude of the signal peak when the transmitting source surface is perpendicular to the X-axis. The sign of azimuth could be determined by setting a M-axis (the Z axis rotates counter-clockwise 45 degrees in the XZ plane).

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A probablisitic approach for optimal operation of gas processing plant under uncertain inlet-outlet conditions

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Natural gas plant operations contribute hugely to the economies of many developed nations that depend on hydrocarbon resources. The plant operation is usually subjected to continuous variations in upstream conditions, such as flow rate, composition, temperature and pressure, which propagate through the plant and affect its stable operations. As a result, decision making for optimal operating conditions of an in-operation plant is a complex problem and it is exacerbated with the changing product specifications and variations in energy supplies. This work presents a new solution method to the problem, which is based on chance constrained optimization. A deterministic model is initially developed from process simulation using Aspen HYSYS and later converted to a chance constrained model. The probabilistic model is then relaxed to its equivalent deterministic form and solved for optimum solution using GAMS. The optimum solution is determined probabilistically using chance constraints that are held at a user-defined confidence level. Optimal solution is represented graphically as a trade-off between reliability of holding the process constraints and profitability of the plant. Two case studies are presented to demonstrate the new method. Optimization results show that uncertainty of plant parameters significantly affect the economic performance of the plant operation. The solution approach developed in this work is able to increase the reliability of maintaining the profit by more than 95% confidence level. As a result, the risk of constraints violation is reduced from more than 50% using the typical deterministic optimization to less than 5% with the developed chance constrained optimization model. In addition, the results from this study indicate that the variation of material flow from the plant inlet has greater impact by more than 86% on profit change compared to variation from the plant outlet, which is less than 2%. Senstivity analysis result show on how to reduce the effect of N2, CO2 and C5+ by holding the corresponding constraint at a certain confidence level. The developed solution method can aid as guidelines to flexible plant operation decision making for the in-operating plant by satisfying all the process constraints at certain confidence level.

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Comparative risk evaluation and sensitivity analysis of the Libyan EPSA IV and its modified model LEPSA I

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This research extends the analysis of the fourth model of Exploration and Production Sharing Agreement (EPSA IV) and our proposed modification of the Libyan Exploration and Production Sharing Agreement (LEPSA I) to field applications. The paper focuses on risk evaluation and analyzing the sensitivity of the fiscal terms of EPSA IV model (cost recovery, A factors, and B factors) and the fiscal terms of LEPSA I model (initial production share, the geologic probability of success, and the oil reference price) on the profitability indicators of Net Present Value (NPV) and Internal Rate of Return (IRR). The deterministic analysis method and stochastic analysis method using the Monte Carlo Simulation have been used in this study. The two methods were used to show the probability distribution of the NPV and IRR on the basis of the random variables of fiscal terms in the two models of EPSA IV and LEPSA I, respectively. The simulation output of the development field scenario of enhanced oil recovery using CO2 injection showed that the cost recovery is a very sensitive term on the NPV and IRR in the EPSA IV model. But, the A and B factors in the EPSA IV model have different sensitivities on the NPV and IRR. The B factor 3 and B factor 1 are more sensitive on the NPV and IRR than are other factors. The B factor 4 and A factor 4 have shown less effect on the NPV and IRR than the other factors. Moreover, the simulation output showed that the initial share and reference price are more sensitive to the NPV and IRR than the probability of success on the basis of the LEPSA I model.

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A new R&D collaborative paradigm; a more artful model

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Oil and gas companies have been facing major challenges to adapt to the dramatic decline in oil prices and the need to drastically cut costs and mitigate risk. R&D has been sought to develop the required technologies for solving both current and future challenges in the petroleum industry. Oil and gas competition for exploration continues to drive the need for new technology to lower operating costs and increase finding and recovery rates. R&D in industry has been primarily driven by technology development and marketing while the academia research may have different objectives. Over the last two decades university-industry collaboration has grown considerably. Oil and gas Operators are motivated to invest in R&D to improve their operations in different aspects. Service companies want to increase their market share by developing technologies through R&D. They also invest in technology to develop patents, later turned into products or licensing possibilities that will return a stream of revenue for years.

The competitiveness and innovation of the petroleum industry has contributed positively to operation efficiency and excellence. R&D collaboration has been a platform that enables close alignment to allow knowledge exchange and coordination to take place, reduces the risks of inconsistencies across value chain steps, improves efficiency by elimination of duplicative efforts, and decreases chances of misunderstanding. Institutional R&D collaboration provides incentives and opportunities to augment the R&D collaboration portfolio with other partner types because the novel, generic knowledge and new technologies generated can be exploited in more applied R&D collaborative projects with other partner types. In addition, building up R&D alliance capabilities requires recognition of the distinct differences in collaboration processes depending on the partner type. The challenge remains as to integrate performance analysis and the analysis of the drivers of R&D collaboration within a single framework and system of equations and evaluate opportunities to better assess R&D collaboration paths to provide more tangibles. Future R&D collaboration should consider the dynamics of the growth in firms' heterogeneous R&D collaboration portfolios, with the performance consequences of alignment and chronological patterns forming a promising avenue for further realization.

This paper reviews the current research collaboration models in the E&P industry and its limitations. Additionally, it proposes a new research collaboration model to establish a research platform on which different parties of interest meet. This is basically to ensure that all R&D are aligned with business needs and to get the utmost of the research work from promoting the national research and developing researchers and to have oriented outcomes that satisfy the interest of national R&D and service providers.

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Seismo radial grain velocity fractal dimension for characterizing Shajara reservoirs of the Permo-Carboniferous Shajara Formation, Saudi Arabia

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The quality and assessment of a reservoir can be documented in detail by the application of seismo radial grain velocity. This research aims to calculate fractal dimension from the relationship among Seismo radial grain velocity, maximum seismo radial grain velocity and wetting phase saturation and to approve it by the fractal dimension derived from the relationship among capillary pressure and wetting phase saturation. Two equations for calculating the fractal dimensions have been employed. The first one describes the functional relationship between wetting phase saturation, seismo radial grain velocity, maximum seismo radial grain velocity and fractal dimension. The second equation implies to the wetting phase saturation as a function of capillary pressure and the fractal dimension. Two procedures for obtaining the fractal dimension have been utilized. The first procedure was done by plotting the logarithm of the ratio between Seismo radial grain velocity and maximum Seismo radial grain velocity versus logarithm wetting phase saturation. The slope of the first procedure = 3-Df (fractal dimension). The second procedure for obtaining the fractal dimension was determined by plotting the logarithm of capillary pressure versus the logarithm of wetting phase saturation. The slope of the second procedure = Df -3. On the basis of the obtained results of the fabricated stratigraphic column and the attained values of the fractal dimension, the sandstones of the Shajara reservoirs of the Shajara Formation were divided here into three units.

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Characteristics of Asphaltenic oils and challenges in their production and processing

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Heavy oils normally contain a large amount of heavy hydrocarbon compounds rich in aromatics including asphaltenes. Characteristics and behavior of such oils are significantly different from those of light oils. In this presentation characteristics and nature of several asphaltenic oils from different parts of oil are examined and methods of estimation of their properties needed for production and processing are discussed. Stability of oil with respect to asphaltene precipitation and paramters that can be used to determine such stability will be discussed. In addition difficulties that asphaltene creates for oil production and processing and as well as some suggestions to overcome these difficulties will be presented.

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Appraisal of key operational parameters in a large-scale steam flood pilots in Kuwait Heavy Oil field

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The first phase of development of the viscous oil resources of Kuwait is planned to be delivered through cyclic steam and steam flood technology. The objective of this study is to evaluate the impact of steam flood operational parameters (steam pressure, injection rates, steam quality) on the recovery performance, aiming to maximize oil recovery whilst lowering operating cost.

Based on a dynamic simulation model, which was calibrated with field data of the pilots, a study using a sensitivity analysis tool was conducted to evaluate steam flood operational parameters for two adjacent steam flood pilots. The model covers multiple pilots with different well spacing and depletion intervals in a common area, so that the effects of interference can be included and evaluated. An objective function of Cumulative Net Oil (CNO) has been used to evaluate the impact of various key operational parameters on the pilot performance.

Based on different sets of study cases conducted from the sensitivity analysis, it was observed that the producer bottom hole pressure is key parameter to optimize the Cumulative Net Oil (CNO) in the steam flood operation. From this study, the pilots steam flood performance (CNO) could be potentially improved from the pre-steam flood forecast base case by changing the setting of the injection rate, producer bottom hole pressure, injection bottom hole pressure and steam decline rate. In this study, the values of the CNO improved about 40% for 10-acre pattern and 36% for 5-acre pattern, respectively.

The study summarizes how the sensitivity analysis can be used to evaluate the impact of key operational parameters in a steam flood operation and to help the decision making for current and future thermal commercial projects.

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Digital rock technology and artificial intelligence for Reservoir application

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Oil and gas is one of many sectors of industry to adapt to the smart revolution. In a market driven by the pressure of increasing production while keeping costs down, new technologies are rising as solution for time and money reductions and more today with big influence toward age of digital transformation. Currently circumstances are turning oil and gas industry to rush for automation of sampling and reservoir rock analysis process, by applying tools such as big data analysis by Artificial Intelligence, machine learning and digital rock technology. The digitalization of rocks in 3D volume along with computation of petrophysical properties, and cluster of data, is increasing the understanding of formations in multi-scale resolution, breaking through the challenges of complex pore systems reservoirs. The integration of data from macro to micro scale, can reduce uncertainties in production and reduce time during a reservoir formation evaluation making use of all the trend technologies mentioned above. The current work has the goal to present a new workflow of smart digital technology, developed by Ingrain-Halliburton to optimize evaluation process. The different solutions will be addressed with case studies in reservoir rocks applied by Ingrain.

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Inorganic salt forming investigations: Validating the photomicroscopy technique

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Inorganic salts fouling is one of the operational problems that pose major challenges to flow assurance of oil and gas exploration and production. In order to act effectively in the mitigation of this phenomenon, it is important to understand its behavior under the conditions in which they occur, i.e, on the "In Situ" pressures and temperatures. Photomicroscopy technique can be an effective tool to achieve this goal as it has the ability to provide measurement of the equivalent diameter of a particle - even if it is under to high pressures and temperatures. As this is not a widespread technique, as current laboratory methods are based on measurements under ambient conditions, a photomicroscopy validation procedure is proposed. The aim is to compare photomicrography to a consolidated technology for determining particle or Drop Size Distribution (PSD or DSD). The procedure consists of the dispersion of solid calcium carbonate ($CaCO_3$) in water and simultaneous analysis by photomicroscopy and dynamic light scattering. Comparison of the PSD diagrams of the two techniques validates the procedure for ambient pressure and temperature. The next step is to perform this procedure on a pressurized and heated reactor.

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Green Surfactants (ILs) as advanced new screening aspects for EOR progress

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Investigating the suitability and efficiency of ionic liquids (ILs), as EOR chemicals for extra crude oil recovery, subsequent to primary production is, by at the present time, a talented and attractive economic process. This carried out process, based on selected chemicals, is conditioned with various properties. The use of non-toxic surfactants, beside other conditions such as reservoir environment is of main concern in that purpose. The led research is conducted with principal of screening method, where several ionic liquids were tested. The examination was with the considered chemicals in contact with Saudi Medium crude oil. Ammoeng 102 ILs was found to be the ionic liquid of choice based on its solubility, stability at wide range of temperature and its effectiveness in lowering interfacial tension with crude oil. Effect of Ammoeng 102 concentration, solution salinity and brine salts contents; pressure and temperature on Ionic solution- crude oil IFT were investigated. During the experiments, brine selected solutions were used as dilution phase for different concentrations of Ammoeng 102. Results at reservoir condition (2000 psig and 60°C) indicated that IFT values of Ammoeng 102 solutions decrease exponentially with concentration: Lower for higher salinity ionic solution and slightly polynomial increase with increasing CaCl2 ratio in salts composition. Temperature and pressure show minor effect with linear IFT decrease with increasing temperature at constant pressure and linear increase with increasing pressure at constant temperature. In addition, effect of Ammoeng 102 solutions on crude asphaltene content were also investigated at different salinities, different ionic liquid concentrations and reservoir temperatures. Results indicate that Ammoeng 102 is capable of cracking the asphaltene and reducing its content in crude oil even when present in low concentrations

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