ECHO)))

Outstanding Student Chapter

SPE Suez University Student Chapter Magazine | Issue 7 | February 2015

INTERVIEW WITH D. NATHAN MEEHAN
2016 SPE INTERNATIONAL PRESIDENT

PRELUDE: A WORLD'S WORTH TALENT AND TECHNOLOGY

FIELD APPLICATIONS OF DIFFERENT RESERVOIR CHARACTERIZATION TECHNIQUES

NANOTECHNOLOGY: FROM THE LAB TO THE OIL FIELD
THE THEORETICAL BECOMES PRACTICAL

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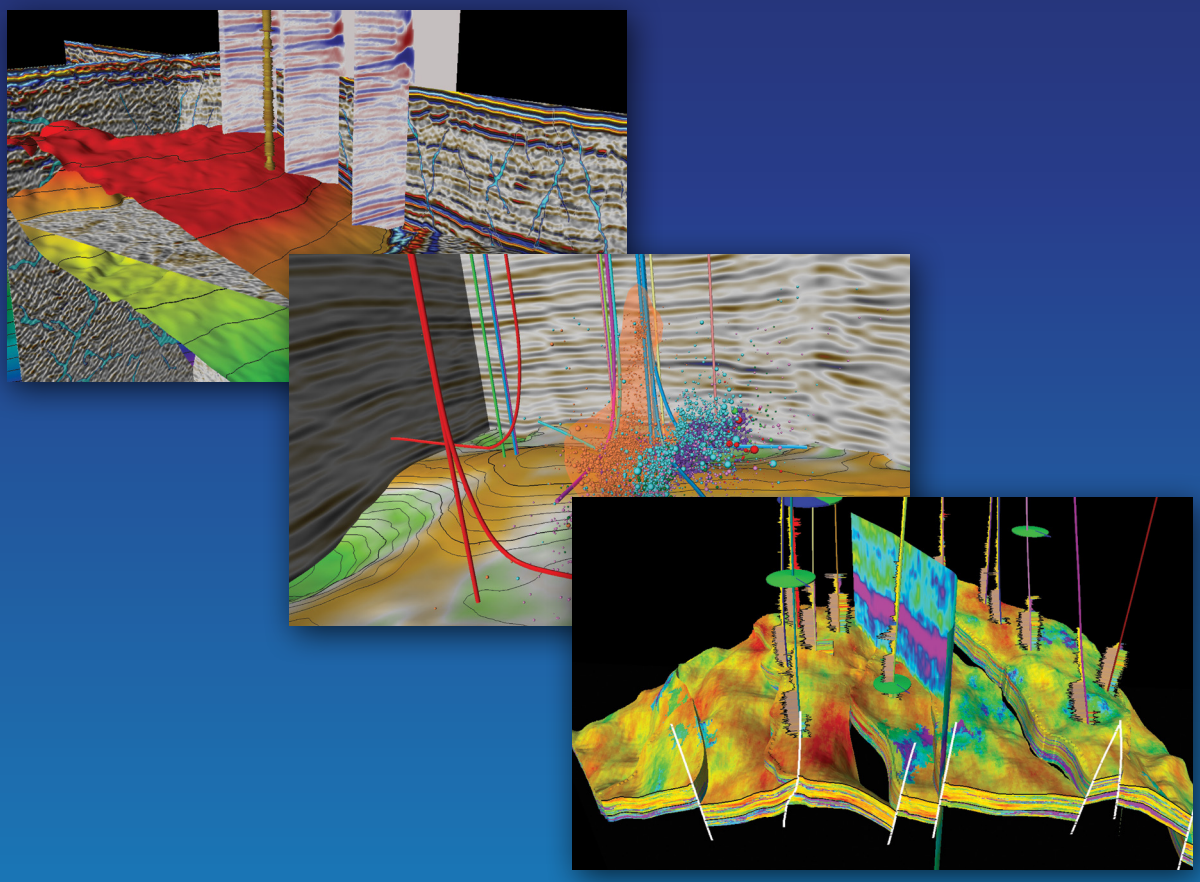

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A Visitor Looks out Towards a Flare Stack on The "Oseberg A" Offshore Gas Platform Operated by Statoil ASA in the North Sea 140 kms From Bergen, Norways.

Ahmed M. El-Gamal
Chapter President

WHY WE DO WHAT WE DO

What is the key to achieve true success? Is it hard work or lots of practice? How can you discover the real purpose of what you are doing? I am not talking about your job, your responsibilities, nor your goals. I mean the reason why you are doing something or being involved in it.

Back to the end of the 19th century, when the early attempts of piloted flying had started, S*amuel Pierpont Langley* had what many people think to be the recipe of success. He was given 50,000 $ by the war department in USA to invent a piloted airplane. Being in Harvard, he had been in contact with great minds of that time and hired the best engineers and technicians in the world. But how couldn't we hear about *Langley*?!

On the other hand, few hundred miles away in Dayton Ohio, *Orville* and *Wilbur Wright* –known as the *Wright Brothers*- could hardly earn their livings. They had started to build their dream from the earnings of their bicycle shop. Moreover, none of the *Wright Brothers*' team had attended college. Consequently, no one cared for them, unlike *Langley* who was followed by The New York Times. However, they believed that there was a great difference. Despite both of the two teams were enthusiastic to achieve success in work, the sense of purpose mattered and imposed its role. The *Wright Brothers* were motivated by a different belief; if they invent that airplane, it will change the course of the world. However, *Langley* was only thinking of reaching money and fame. People at that time, who believed in the *Wright Brothers'* dream, encouraged them heartily. Meanwhile, the other team just worked for the paycheck. Eventually, after the brothers had developed their flying machine into the first practical fixed-wing aircraft on December 17th, 1903, the fame looked for them due to their inventions!

As petroleum engineers, we are present in the world for an essential target: to have an important role in people's lives. We should be proud of our mission in life; to be a part of the petroleum industry world, working continuously to secure the daily energy demands all over the world. How proud we are! And how glorious it is to be one of its pioneers one day!

While searching for Petroleum, you are revealing the most valuable hidden treasure buried thousands of feet underground for millions of years, aiming to explore the energy of the future to make life easier. We empower the humanity to understand itself better and explore the universe further more beyond its limits.

Through the international petroleum conferences I have participated in, I have been able to meet several industry leaders. They have all agreed that nowadays, the petroleum industry is having a tough time meeting the rising demands. At the same time, domestic production continues to experience a natural decline. So, it is time to think untraditionally to overcome industry challenges and innovate like never before. Also keep in mind that if you wake up in the morning driven by a wrong purpose, you will be another *Langley*; another copy that nobody remembers.

Throughout the past six years, six editorial teams were pushed by a belief of exchanging the technical knowledge with the audience through this magazine. They cannot be more proud, as they see their simple idea of a students' technical magazine evolves to become a masterpiece, and one of the most widely spread technical magazines worldwide.

Finally, I would like to thank ECHO Editorial Team who has spent lots of concentrated working hours to come out with this valuable and outstanding product with such a splendid quality in its seventh issue. Besides, I shall thank the high board members for their great efforts, and hereby I have to mention the Chapter Vice President, *Mohamed Elkasaby.* I appreciate his unprecedented support throughout this season. These all are the people who truly know why they do what they do, which keeps their flare of motivation illuminated forever. I hope you enjoy this issue with exclusive articles from petroleum industry professionals worldwide.

And always remember that each new day takes you one more step toward your dream. Wake up with a sense of purpose, do your best and enjoy executing your plans!

Nazih Gamal Azer
ECHO Editor in Chief

The Dream-Weavers

Some people are like thermometers; similar and their performance is determined by their environments. Other people are like thermostats, which affect their environments, instead. Every person can either create reality, sketch his own future or have his life's circumstances create him.

Success is not comparing between our achievements to those of others, "Success is a period of tranquility, inner peace, and harmony that a man lives." It is all about your vision. Highly effective people usually seek the grasp of their real value, discover their inner powers, and explore the treasures they possess in their bottoms, rather than realizing successful achievements. Identifying your real value will help you create your own future, leave an impact wherever you are, and inspire people to have the strength not to give up if they encounter obstacles on their way.

Let's start with your authenticity! Authenticity attracts support, faith, and love from others. Its allure comes from people's ability to trust and relate to you on a deeper level. When you try to be someone that you are not, you give up your power. All of your power is in being yourself. The closer you are to being yourself, the more powerful you are. Your true power lies in your unique and authentic self.

Your thoughts are a treasure. Your thoughts and your way of thinking must lead to positive attitude which helps you cope more easily with the daily affairs of life. It brings brightness to your eyes, optimism and constructive changes into your life. Our whole being broadcasts good will, happiness, and success. It is certainly a state of mind that is well worth developing.

You always have to seek the peace of your mind. When they do not disturb the tranquility of the mind, thoughts flow steadily and you experience inner happiness. A person possessing peace of mind is calm and self-control. Having peace of mind, you will retain inner balance under almost all conditions, and you will be hardly affected by negative circumstances and situations. You reach higher levels of detachment, life becomes easier, your vision widens, and your mind becomes under your control. We simply need to remember that peace is our natural state.

Your words also can be a great source of ultimate blessings and inspiration for others. A simple encouraging word can change someone's life and these blessings keep spreading, passing the barriers, and overcoming all retarding negative energies. Never underestimate the power your words can have. Words can change the world; when *Gandhi* spoke on nonviolence, when *Gutenberg* created the printing press and gave the power of thought back to the people, and when *Neil Armstrong* took his first steps and spoke his first words on the moon. So, do not hesitate to encourage people and give them a push towards their goals; because a simple word that may seem priceless could have a very large impact and do unbelievable miracles. The treasure of your pure heart must reveal goodness everywhere. Talk can be valuable. Talk can be rich, worthwhile and a gift to the world. So do us all a favor and open up your mouth. Speak!

It is very important to touch on the power of your imagination. Imagination is a precious treasure and a creative power that we all possess, but it is often in a dormant state. A well-developed and strong imagination does not make you a daydreamer or an impractical person. On the contrary, it strengthens the creative abilities, and is a wonderful tool for recreating and remodeling your life and circumstances. Imagination has a magical effect and its value surpasses all tangible treasures on Earth. It can change your whole life, and transform circumstances and events. It is used extensively in creative visualization, affirmations, and guided meditations. When you know how to work with it, you can make your heart's desires come true.

All these treasures are integrally linked to form a wise man, a mature person, a man of value! Your real value does not lie in credit cards, having a large house or an eminent position at work. Your real value is your inner powers. We are born male or female; we must choose to become men and women. You become a man or a woman when you take responsibility for your life. This involves taking responsibility for your attitude, choices and actions. Take the first step and believe in yourself. Renew your strength and be mindful of "your dream-weavers" which have to be developed and reinforced to push you towards the biggest challenge you are facing in your life … YOUR DREAM.

D. Nathan Meehan

2016 SPE International President

By Ahmed M. El-Gamal

D. Nathan Meehan, a distinguished SPE member who served on the SPE Board of Directors, and was 1987–88 President of the Golden Gate Section. He has more than 38 years of global experience in reservoir engineering and horizontal well expertise. He is the current President of CMG Consulting and Senior Executive Advisor to Baker Hughes' Executive Management. Meehan will serve as the 2016 President of the Society of Petroleum Engineers.

"My vision is that serving others and helping people become self-reliant, is a way to repay some of the great opportunities I have been given in the past. This is one reason I love serving in SPE."

1. Tell us about your journey at SPE.

I studied physics in college, and went to Georgia Tech. I received a Master's degree in petroleum engineering from the University of Oklahoma and joined SPE as a student in the fall of 1975. One of our professors handed out applications to all the new students and said, "If you are going to be a petroleum engineer, you need to join SPE." I won the graduate student paper contest and gave my first SPE speech at the Western Regional meeting in Bakersfield. At that meeting, I spoke to *Ershagi* and *Omoregie*, petroleum engineers, about a method they developed. When I went back to the office, I achieved great results by applying their method to a task I was assigned. Later, I presented my results to many senior engineers in the company who were impressed about it as they weren't familiar with it. I got hooked on SPE!

2. How did you manage to be the SPE International President?

I worked with Union Pacific Resources, former leaders in horizontal well drilling, for 24 years. I traveled the world as a distinguished lecturer and brought a world-class of hydraulic fracturing experts together. All this gave me the opportunity to participate in SPE workshops, forums and conferences. I was lucky enough to have *M. Scott Kraemer*, a former SPE President, as my mentor and friend. He encouraged me to join the SPE Board of Directors, and I became a consultant. When I joined Baker Hughes, the CEO encouraged me to apply to be the SPE President.

3. How do you see the role of SPE in the Middle East and Egypt?

The Middle East, as a famous geologist once said, is "the oil habitat". It is vital to the future of the oil and gas industry as well as to SPE. SPE has a rich history in Egypt, and I am convinced it will continue to expand to be an integral part of the industry. Many developments in our industry were due to the experiences held in Egypt.

4. Tell us a motivational anecdote from your life experience.

When I started as a petroleum engineer, I had a clear goal: I wanted to be "District Engineer." This job was ministerial for all engineering efforts in a geographic area, and my desire for it couldn't be compared to any other job. I worked hard to be the best engineer I could, and I became the youngest District Engineer in the company. Since then, the steps to Area and Region Engineer, and then the company's Engineering Manager seemed like a natural progression. I preferred that route to the more lucrative line management roles sought by my peers. I had a chance to be at the highest level of engineering management for two great companies, but realized that none of the jobs were appealing to me as I wasn't necessarily a good candidate for them. What I loved was solving technical problems, and I got a chance to do that as a consultant. I guess I would still be a consultant except that my current employer, Baker Hughes, engaged me as a consultant to help them build a reservoir business. This job is enjoyable as I helped them acquire Gaffney-Cline, Geomechanics International, RDS, JOA, and other companies. I liked the people I worked with, which made it seem natural to join BHI. This job also gave me a chance to address industry challenges from a different perspective than I had been able to do previously, and I love it!

5. Would you tell us about your vision in life? What is your mission to achieve it?

I want to enjoy the projects I work on, and help others. My vision is that serving others and helping people become self-reliant, is a way to repay some of the great opportunities I have been given in the past. This is one reason I love serving in SPE. But what the readers may not know is that my wife and I spent eighteen months living in Asia coordinating our Church's humanitarian projects. We supported massive efforts to provide wheelchairs, clean water, asthma education, vision care, and emergency relief. This was the best time of my life as we worked with volunteers; NGOs and other agencies. Right now, I am trying to help deaf people in Houston with employment opportunities. I know that many SPE members give generously of their time and resources to support various humanitarian effort. I am proud to be a part of such an organization.

6. How do you see the impact of Suez university chapter? What are your expectations for SPE Suez this season, especially after achieving the outstanding student chapter award 2014?

I know of six University chapters in the Egyptian section. The award recognition and activity levels speak for themselves. I am impressed by the activity levels and commitment to volunteerism. The Outstanding Student Chapter Award doesn't come about without both great student leadership and a high level of activity. The important thing isn't my expectations for SPE Suez---it is your expectations. ''Will you maintain high levels of activity'' generate creative things to do that span the technical, social, and service areas? I think it is important that SPE is relevant and useful to the members. Ultimately that is more important than the awards.

7. How does SPE International plan to increase the support they provide to the students worldwide?

SPE has enlarged its support for students. Student memberships are free. Vast technology resources, support for volunteers, chances to mentoring or e-mentoring, building relationships with Young Professionals, and discounts on textbooks are offerd by SPE for students. It also provided opportunities to compete in PetroBowl and student paper contests, and online communities.

8. Our slogan for this season is "Innovate Like Never Before". How do you see the role of innovation in our industry?

Innovation is our lifeblood. I often speak of it and give examples of how things have been invented. However, the most successful companies are not necessarily the ones who innovate, but the ones who learn and apply technological developments. We cannot follow up the future's energy demands with the present technology. In the future, innovations in nanotechnology and advanced material science, data analyzing, and well intelligent applications will improve our industry and follow up with the future's energy demands.

9. Would you like to tell something special to our readers?

Providing a safe, affordable energy is important. Quality of life correlates well with clean energy. Many people get sick and die because of harmful energy. Although renewable energy resources predict optimistic growth, the primary energy source will be fossil fuels, and oil and gas. I have great confidence in our ability to solve technical challenges. I think students need to become aware of the challenges in the "social license to operate." We, as oil and gas professionals, must share our values and provide safe, affordable energy. I encourage you to become familiar with many excellent sources of information on energy, fracturing, offshore activities, and a lot more by visiting "www.energy4me.org". This site offers factual information that will assist you.

10. What is your advice for the students and members to have a successful career?

• Do your best to become as technically strong as you can. Your company hires you as an engineer, not as a philosopher. When and if you become a manager, you will be grateful that you didn't neglect the technical skills that SPE helps.
• Find a mentor. I wasn't looking for a mentor when Scott Kraemer took me under his wing. He had a career of helping young engineers. You should consider SPE's e-mentoring program.
• Never stop learning. You would be shocked how many times in my career I was able to use something I had just learned. You don't have to go back to school to learn. Always ask questions when you don't know something. Participate in workshops, forums, etc.
• Give back. Volunteer for SPE and other organizations you believe in, and make a difference. I do not believe I will ever be able to give back as much as I have received. But I do believe that some of the most enjoyable things in my life have happened when I tried to help others especially through my long journey at SPE.

Improving Reservoir History Matching of EM Heated Heavy Oil Reservoirs via Cross-Well Seismic Tomography

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Most of the world's largest reserves are composed of different viscous oil types and found in many environments across the globe and extracting these resources is of substantial interest for the industry. Increasing recovery rates from existing oil reservoirs by extracting viscous components is a key challenge for the oil and gas industry. One method for recovery is the Electromagnetic (EM) heating via high frequency EM radiation. It is the process of applying a high-frequency electrical field to the reservoir formation, causing the molecules of the fluids and rocks to vibrate, thus leading to an internal generation of heat. The generated heat leads then to an increase in temperature of the oil-bearing formation, resulting in a reduction of viscosity. It further enables a more uniform heating of the medium, allowing the targeting and heating of certain parts of the reservoir using directional antennas. It has attracted attention due to its wide applicability in different environments, efficiency, and improved controllability of the heating process.

EM heating has been conducted for real reservoir studies in Russia, and the United States. *Bridges et al.* conducted field tests of tar sand heating at Asphalt Ridge, Utah, USA, showing that the temperature could be raised to more than 473 K with recovery rates being around 30-35 % after only 20 days. It was expected that the continuation of heating would have further increased recovery rates with minimal power losses experienced. While there have been extensive laboratory and field studies on the effects of EM heating on oil reservoirs, relatively limited researches have been done for understanding and modeling the effects of EM heating on reservoir history matching and forecasting. Changing reservoir fluid properties by heating effects may significantly alter reservoir structure and saturation, leading to increased uncertainty in production forecasts and estimation of reservoir properties.

Since the industry works on improving formation knowledge, accurate tracking of oil reservoirs, optimizing production, and reservoir imaging techniques have attracted extensive research efforts, especially Crosswell imaging techniques. Crosswell seismic imaging operates by placing a source (acoustic wave source) and receiver in different wells. The source emits acoustic waves that propagate through the rock formation, which are then detected by the receiver. A change in the fluid content and fluid distribution leads to a change in arrival times and amplitude changes. Despite the significant advances in seismic technologies, a major problem faced with seismic waves is the poor distinguishability between hydrocarbons and injected water. We have developed a history matching framework for EM heated heavy oil reservoirs incorporating seismic data attribute responses for improved reservoir forecasting via an Ensemble Kalman Filter (EnKF). The framework is capable of handling the arbitrary heterogeneity and extensive simulations for a variety of different heating levels, exhibiting enhanced forecastability and reduced uncertainties.

The framework of the EM heated reservoir model incorporating seismic is illustrated in **Figure 1.** Upon specifying the geological model, the parameters are forwarded to the reservoir simulator that interfaces directly with an EM heating module. The reservoir states and parameters are then transferred to the seismic module, followed by a history matching update step. The updated status and parameters are then returned back to the reservoir simulator, and then stepped forward in time.

In order to determine EM heating, we assume an installation of an array of microwave antenna heating modules that uniformly heat the reservoir. Given the power emitted from the heating modules, we use the thermodynamical relationship based on Fourier's Law, given by: $C_{vh}\,\Delta T = \Delta Q$, (1)
Where C_{vh} is the volumetric heat capacity, ΔT is the temperature difference, and ΔQ is the amount of heat transferred from the heat source. The volumetric heat capacity is computed as the harmonic average of the oil and water phase subjected to water saturation. After obtaining the temperature of the heated formation, the viscosity of the water and oil phase can then be computed using Andrade's relationship: $\mu_\alpha = A_\alpha e^{B\alpha/T}$, (2)
Where μ_α is the viscosity of the phase α (α=o,w), T is the temperature of the formation, and A_α, B_α are parameters estimated using a regression analysis given the data.

A study was conducted on a reservoir 2 km in length and width, and around 25 m in Z direction, and represents a Cenozoic sedimentary rock reservoir structure found in the Arabian Peninsula. The rock structure is assumed to be consisted of sandstone with porosity and permeability

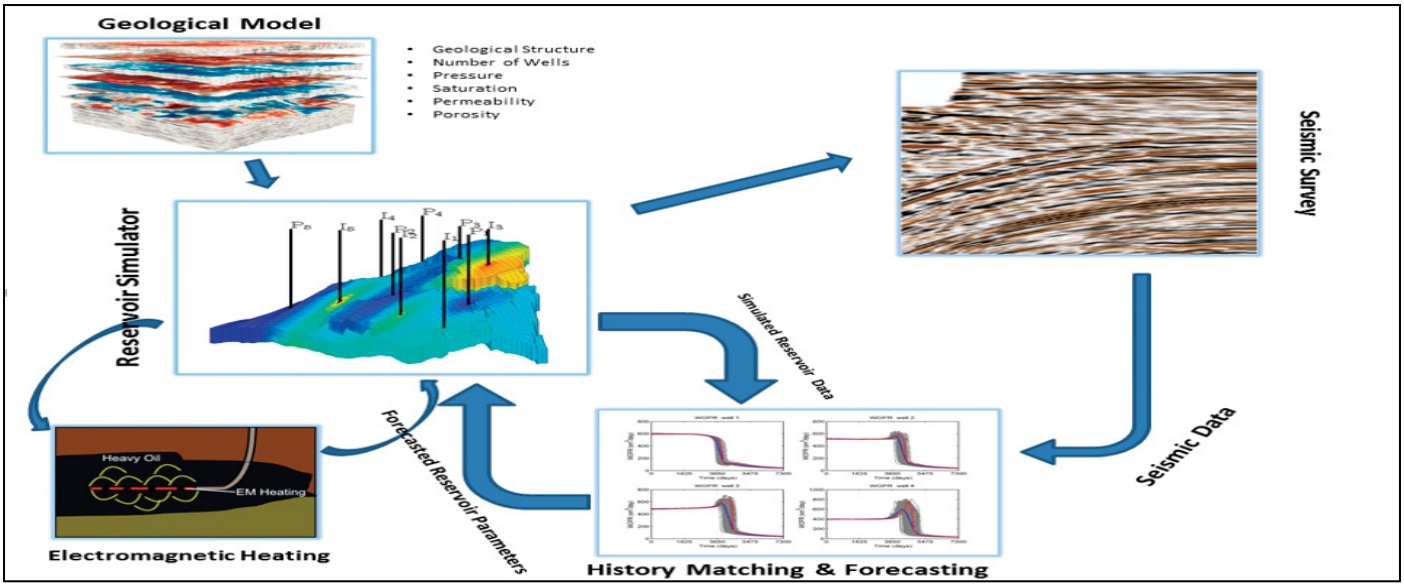


Figure 1: Flowchart Representation of the EM Heating History Matching Incorporating Seismic Surveys

values obtained from initial simulations via Petrel. The porosity values range between 0.08 and 0.32, and the permeability distributions contain values within the range from 145 to around 892 milliDarcy. We start our evaluation of the results by analyzing the changes in reservoir production for increasing power applied to the reservoir and present a comparison. The gradual increase in the power applied to the EM heaters leads to a significant increase in the flow rates and displacement of the hydrocarbons. The reduction in viscosity and consequently higher velocities is manifested in an increase in the ensemble spread, causing production drop from considerably less than a year to almost 6 years. Since fluid velocities increase, the history matching shows poorer performance by providing inaccurate production level estimates. The initial viscosity decrease is strong, leading to a significant increase in the fluid velocity (as shown upon application of 10 kW in **Figure 2**). The exponential relationship between the viscosity with respect to temperature

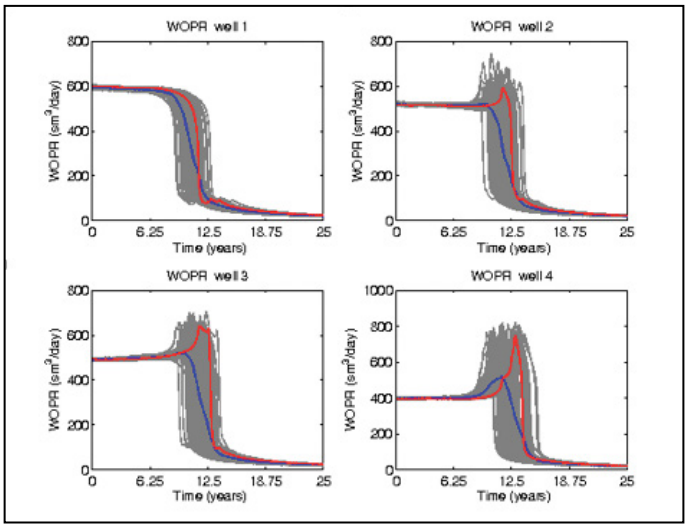


Figure 2: Production Levels for a Producer Well for Increasing Power Applied (10 KW Ensemble Size 20)

leads to a leveling out of the viscosity with the marginal fluid velocity increasing nearly to zero. This effect yields only a marginal uncertainty increase. To evaluate the impact of the ensemble size on the EnKF performance, we figured out the history matches for the four different producing wells, as estimated by the EnKF with three different ensemble sizes 40, 80 and 120. Comparing the obtained individual figures displays the challenges the assimilation of an only production has in enhancing matching for increasing ensemble size. When using only well information, the different ensembles may fail to capture longer production times.

Production decrease may be misestimated by as much as five years, and this could lead to considerable production losses.

In addition, the strong production increase may not be captured at all for well data, only matching, which may evolve into a hazardous situation, and due to the emergency measure may damage the well – the reservoir interface. With the incorporation of seismic data, the matches and prediction are considerably improved, and the essential reservoir dynamics are captured. Since the matching of production levels only may be aligned tighter to the true reservoir pressure during marginal water cuts and decommissioning time, the seismic data's ability to capture the propagating waterfront assists in capturing the delayed pressure increase. This may avoid overpressuring the reservoir, which causes a potential blowout and hence, economic losses. We present in **Table 1** an overview of the average matching improvements obtained from the simulations. The results clearly indicate an overall improvement in history matching from the inclusion of Crosswell seismic data.

Average Matching Enhancement using Seismic data(compared to production data matching only, Ensemble Size: 80)

.	10 kW	30 kW	70 kW	100 kW
Oil Prod.(Avg Wells)	17.75 %	23.08 %	42.94 %	30.58 %
Water Cut (Avg Wells)	18.70 %	24.41 %	46.13 %	34.30 %
Injector Pressure	-35.06 %	-11.51 %	10.36 %	10.40 %
Cumulative Oil Prod.	27.23 %	42.26 %	83.20 %	55.17 %
Cumulative Water Cut	22.64 %	31.84 %	60.43 %	45.76 %

Table 1: Average Matching Enhancement Compared to Only Production Data Matching for Different Power Levels.

To conclude, we have presented a history matching framework for EM heated heavy oil reservoirs incorporating Crosswell seismic data that generate the EnKF. Gradual increase of the emitted heat leads to an increase in the velocity of the oil phase that consequently increases the production output of the wells. With increasing flow rates, the ensemble spread increases significantly and shows a significant impact of heating on reservoir forecasts. The presented history matching framework for heavy oil reservoirs incorporating EM heating and Crosswell seismic data enables comprehensive study of the effects of heating on the production as well as the ability to efficiently and accurately history match, and forecast production from heavy oil reservoirs.

Prelude:
A World's Worth Talent and Technology

Josh Etkind
LNG Technology Manager,
Shell

Creating the world's first floating liquefied natural gas (FLNG) project continues to be one of the most ambitious engineering projects in the world. In order to get the unique combination of talent and technology needed to contribute to this project, Shell brought together technical skills and innovative components from around the world. As the project develops further, Shell is now up-skilling local talents and businesses through partnerships with universities and regional training opportunities.

Making FLNG a reality is no simple feat. Shell has had to innovate hard and invest heavily, shrinking an onshore LNG plant to about a quarter of its size. However, Shell is uniquely positioned to make it a success, given their commercial capabilities, their LNG, offshore, deepwater, and marine technology, and their proven ability to successfully deliver mega projects. Many of the technologies used in the FLNG facility are those that have been used onshore, but some have been modified in order for the processes such as liquefaction and offloading to occur at sea.

Size Matters When it Comes to Stability

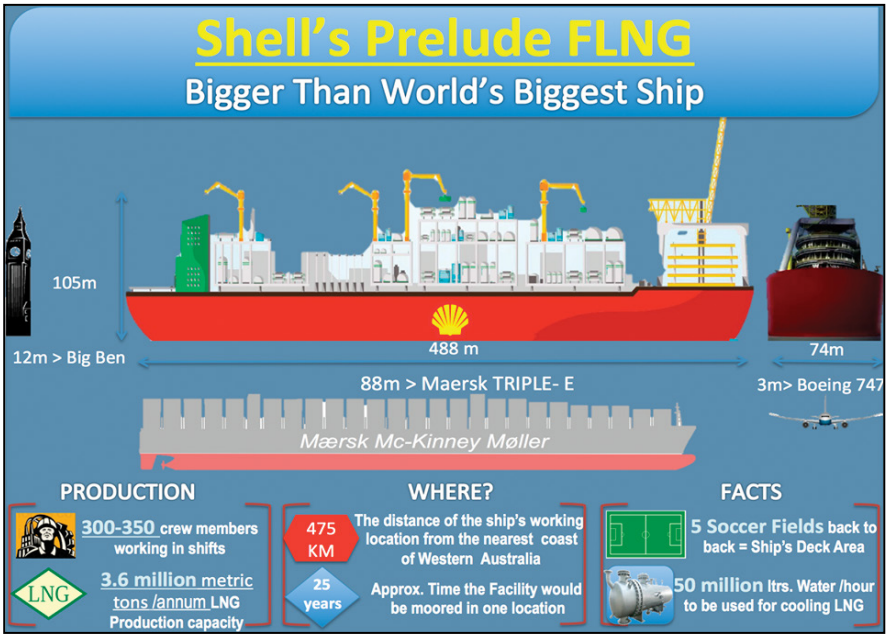
With increased size, comes increased stability. Measuring nearly half a kilometre in length, 74 metres wide, and weighing more than 600,000 tonnes with its cargo tanks full, Prelude will be the largest offshore floating facility ever built. Around 260,000 tonnes of steel are being used in the construction of the facility; that is around five times the amount of steel used to build the Sydney Harbour Bridge.

Precision is Paramount

Around 5,000 people are involved in the construction of the Prelude FLNG facility in South Korea, in addition to 1,000 on the Turret Mooring System, subsea and wells equipment. Watching the team at the Samsung shipyard in Geoje, South Korea as they measure accuracy to the millimeter shows how precision is paramount, and the team's expertise and dedication are crucial to the success of the project.

Bon Voyage

It is not surprising that, following thousands of hours of design and development, Didrik Reymert, Project Director, cannot hide his awe and pride when he looks at Prelude. "It is amazing. It is very big, it is very impressive and it is really a fantastic achievement by everybody". The construction of the processing plant is now underway. Once the project is completed and moored 200 km off the coast of Western Australia, a whole new phase of the project will begin, working towards a point when 3.6 million tonnes of liquefied natural gas will be processed each year, along with 1.3 MTPA of gas condensate and 0.4 million tons per annum of LPG.



The Largest Floating Structure In The World

First Gas From Shell's Prelude Project is Expected in 2016

A Local Legacy

The Prelude FLNG project will provide significant benefits to Australia, creating around 1,000 jobs and providing many opportunities for Australian businesses. According to an independent analysis by ACIL Tasman, over the 25-year life of the project, Prelude FLNG will add more than $45 billion to Australia's GDP. In Western Australia, to build local capacity and expertise to support the Prelude FLNG project, Shell is investing millions of dollars in local universities and institutes, such as the Challenger Institute of Technology and the University of Western Australia. Jo Walker Smith, a lecturer at the Challenger Institute, said "It is great seeing the 'light bulb' moment, when the technicians see the link between the fundamental science and engineering. This link underlies the processes they may have been operating for many years. You can see how this improved understanding will assist in ensuring that Prelude operates at its maximum potential".

Shell's Floating Industrial Area: Prelude

Shell has also partnered with the University of Western Australia (UWA) to sponsor PhD research related to offshore hydrodynamics, offshore structures and the behaviour of floating liquefied natural gas facilities. The aim is to ensure a ready and local supply of expertise at the forefront of this emerging technology by creating a centre of excellence for FLNG.

Preparing for Production at Prelude

After years of planning, preparation and integration, Jim Marshall believes FLNG will soon be the norm for gas production. Even though Prelude's construction is still continuing, Marshall's role already entails building the organizational capability to bring Prelude into production.

Nanotechnology: From the Lab to the Oil Field (The Theoretical Becomes Practical)

Abdelrahman I. El-Diasty
Research Assistant,
American University in Cairo (AUC)

Few years ago, applications of nanotechnology in Oil and Gas Industry were considered mysterious and the common thought was that it would take very long years to find some of these applications in the real oil field.
Today, there are many innovative products applying nanotechnology under way in the E&P sector and playing a vital role in oil field operations.

So What are the Basics of Nanotechnology Applications?

Nanotechnology encompasses nano-scale science, engineering, and technology, and involves imaging, measuring, modeling, and manipulating matter at nano scale (National Nanotechnology Initiative NNI, 2010). Due to their nanometer length scale, nano-materials often demonstrate unique and unpredicted properties.
Baker Hughes is one of the leading suppliers of oilfield services, products and technology to the worldwide oil and gas industry. Moreover, it is at the forefront of nanotechnology-oriented products suppliers in the oil field. In this article, I will be listing some of the latest unique products with focus on some of Baker Hughes commercially available products and their impact on the field operations.

• Drilling Fluid Products

Remarkably, the oil industry has used nanotechnology in drilling muds for the past 50 years. The nanoparticles in drilling muds are made of clays and are naturally occurring 1 nm-thick discs of Aluminosilicates. However, the recent and promising applications of nanotechnology in drilling are likely to utilize synthetic nanoparticles, where size, shape, and chemical interactions are carefully controlled.
For instance, Baker Hughes Drilling Fluids service provides many advanced additives to overcome drilling problems. Baker Hughes provides Nanoshield product which is synthetic polymer used in drilling fluids. It disperses into sub-micron sized particles allowing infiltration and sealing of microfractures in shale. Recent field studies supported by laboratory studies indicate the ability of nano-size sealing polymer along with other additives to minimize the Geomechanics related challenges such as downhole losses and severe hole washout (SPE-172242-MS).

• Multistage Hydraulic Fracturing

In 2011, Baker Hughes IN-Tallic™ disintegrating frac balls stood out as an example of how nanotechnology can do things that otherwise would not be possible.
Baker Hughes IN-Tallic™ are composed of Controlled Electrolytic Metallic (CEM™) nanostructured material that is lighter than Aluminum and stronger than some mild steels, but disintegrates when it is exposed to the appropriate fluid. The disintegration process works through electrochemical reactions that are controlled by nanoscale coatings within the composite grain structure. The nanomatrix of the material is high strength and has unique chemical properties that conventional materials do not. The IN-Tallic balls maintain shape and strength during the fracturing process, and then disintegrate before or shortly after putting the well on production. The frac balls disintegrate over time by exposure to Brine fluids, so the disintegration occurs with most fracturing and wellbore fluids and no special fluid mixture is required. The Baker Hughes FracPoint™ multistage fracturing system using the IN-Tallic™ frac balls, provides quick and continuous hydraulic fracturing using ball-activated frac sleeves. After the system has been installed, stages are isolated using openhole packers or cement. The sleeves are then activated; using various-sized frac balls dropped from the surface as the fracturing treatment is pumped, providing nonstop fracturing operations. After fracturing is complete, production can begin immediately, and the IN-Tallic™ frac balls disintegrate in the well

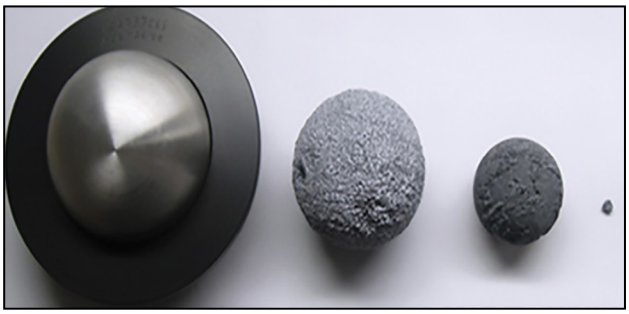


Figure 1: The IN-Tallic Frac balls Disintegrating Over Time by Exposure to Brine Fluids (www.BakerHughes.com)

to ensure a clear flow path without through-tubing intervention. This fracturing system —which eliminates rig up and rig down between stages— reduces overall pumping time while maximizing reservoir contact to increase drainage. The Baker Hughes SHADOW™ series frac plug is a permanent millable plug designed to be left downhole during production, completely eliminating the plug drillout phase of plug-and-perf completions. The plug features a large flow-through Inside Diameter (ID) and uses IN-Tallic™ disintegrating frac balls so production can flow with the plugs in place, saving time, and eliminating the cost and risk associated with Coiled Tubing (CT) intervention.

In 2013, Schlumberger patented ELEMENTAL degradable technology to be used with multistage stimulation system frac balls. This Aluminum-based material degrades completely within hours or days, depending on ball size, temperature, and other downhole conditions, eliminating the risk of stuck frac balls and the need to mill them. Moreover, Baker Hughes has commercial fines-fixing agents which use the high surface force of a special solid material manufactured to nanometer particle size to capture or fixate formation fines. The nano-sized material is added to hydraulic fracture proppant packs or gravel packs on the fly to stabilize formation fines. The nanoparticles, due to their extremely high aggregate surface area, can be made to act as "nano-sponges", work by catching and retaining fine formation particles at the point of contact with the gravel or proppant. This action prevents fines from migrating into or through the gravel or proppant pack where plugging could occur near the wellbore or at the sand-control screen.

• Gas Lift Operations

In oil wells with gas lift system, when it is required to unload the completion fluid or to assist the well to flow, wireline intervention is required to remove the dummy valves and install the live gas lift string. This can be time-consuming and can pose risks to existing infrastructure. Production is also delayed while a new live valve unit is installed.

The Baker Hughes Transmatic™ Gas Lift Valve, which uses nanotechnology in its temporary internal plug, can be installed in wells to function as a "smart" dummy valve. The Transmatic valve automatically converts to a live valve through disintegration of the temporary internal plug. This completely eliminates wireline intervention and workover costs to replace dummy valves with live valves. The Transmatic GLV has proven its advantages within many field case histories. The key to its success goes to the smart nanostructured composite material, In-TallicTM material. In-Tallic material is chemically resistant to drilling mud, slightly reactive with fresh water, and will disintegrate in salt water in 12-50 hours as illustrated in **Figure 2**, making it an ideal designer material, perfectly engineered for offshore gas lift valve application.

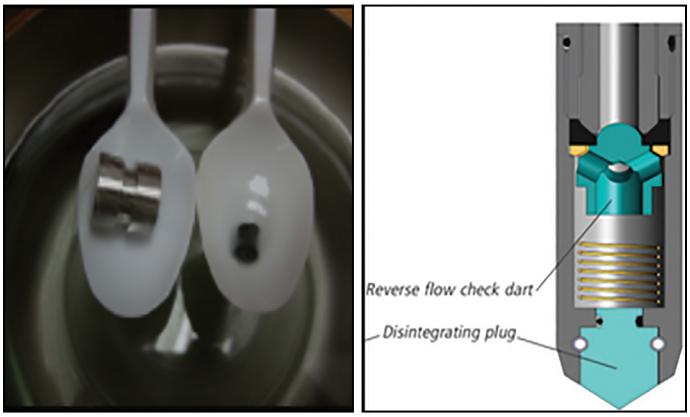


Figure 2: The Effect of a 5% Hydrochloric Acid Solution on the Plug. After One Hour, the Plug is about 85% Disintegrated (www.BakerHughes.com)

• Enhanced Oil Recovery

Nanoparticles in an aqueous dispersion (nanofluids) have been investigated as an EOR method. Nanofluids have successfully been developed in laboratories, and the upcoming challenge is to develop techniques for cost-efficient industrial scale production of nanofluids. "The Chinese were the first to use these particles in field studies," says Arne Skauge, Director of CIPR. The studies showed that they work, but there were still many unanswered questions about how and why. They began to categorize the particles' size, variation in size, and structure. Also, the nanomaterials make great tools for the development of underground sensors, and the formation of imaging-contrast agents due to their substantial alternation in optical, magnetic, and electrical properties. Nanomaterials combined with smart fluids can be used as extremely sensitive sensors for pressure, temperature, and stress downhole under harsh conditions.

In 2006, Saudi Aramco - EXPEC ARC introduced the concept of Reservoir Robots (Resbots) and kick-started the industry's first initiative aimed at testing the potential for in-situ reservoir surveillance, or "illumination." **Figure 3**

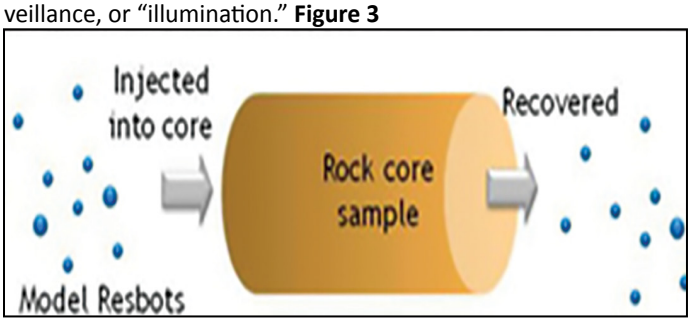


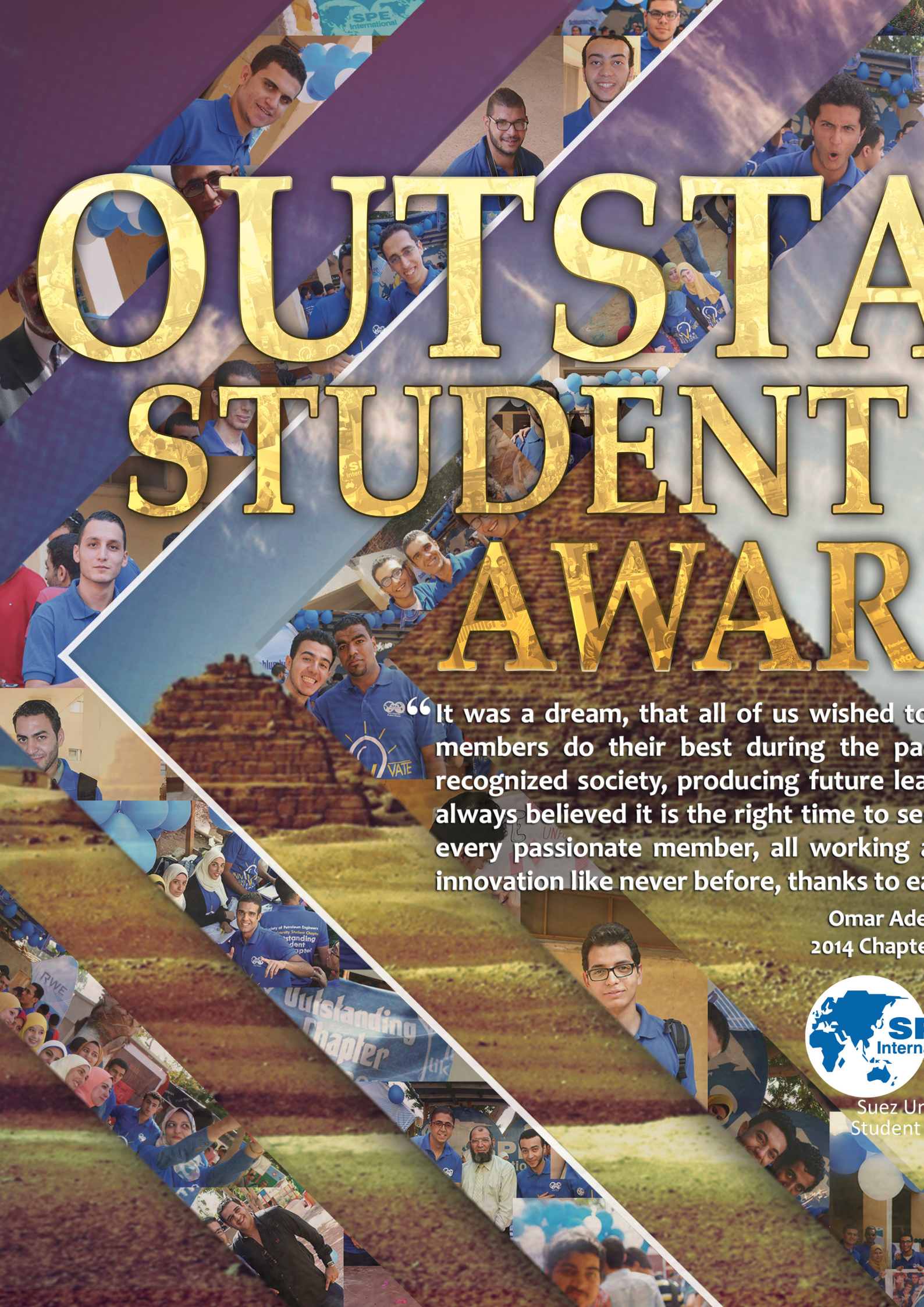
Figure 3: This Illustration Depicts the Injection Of Nanoparticles into Reservoir Rock and the Recovery of the Particles (www.aramcoexpats.com)

In 2008, EXPEC ARC has successfully researched several important aspects of these Resbots necessary for their successful journey into the underground, including size, concentration, chemistry, interactions with the rock surfaces, pore-scale movement, and speed of transport in the reservoir.

In 2010, 5 kg of A-Dots (Resbots) were mixed in 255 bbl. of seawater and injected into an observation well in the Ghawar field. Pumping continued until the A-Dots had moved about 20 ft. into the reservoir, and the well was shut in. Three days later, the well was allowed to flow and samples were collected over a 2-day period. Laboratory analysis showed nearly 90% of them were recovered. The current research step is the long-distance test. The A-Dots will enter a reservoir though a water-injection well to see if they are able to flow in large numbers to nearby production wells. If the A-Dots perform as expected, it would be a significant step toward the development of future generations of Resbots.

In conclusion, Nanotechnology has been providing endless potential solutions to the biggest challenges in the Oil and Gas industry. Nowadays, many major international companies are competing against time to best utilize nanotechnology concepts through different petroleum disciplines from Exploration, to Reservoir, Drilling, Completion, Production and Processing and Refinery so that they can confront the rapidly increasing domestic demand for oil all over the world. The number of published nanomaterials studies may be rising exponentially, while the number of products using them is small in comparison. But, this should not make anyone into thinking that great potential does not exist.

While dropping energy prices make investors and analysts check to see what the break-even price is for oil production in each play, further development is necessary for practical and economic implementation of these emerging applications in the field. The "nanoworld" clearly brings to the E&P industry exciting new opportunities and challenges.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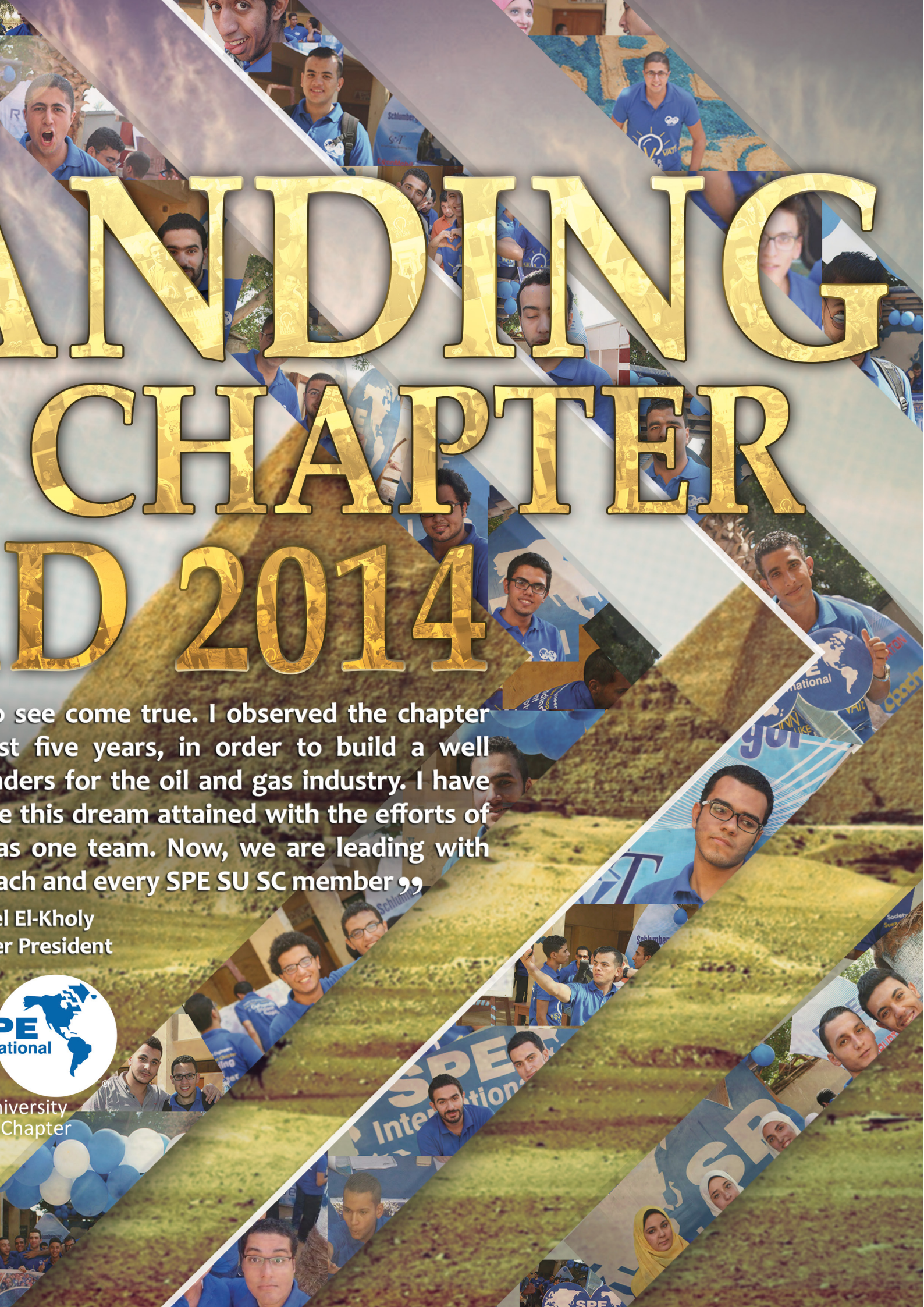
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Chapter

CASE STUDY

Field Applications of Different Reservoir Characterization Techniques

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Enhanced reservoir characterization, is an essential requirement for better oil recovery from heterogeneous reservoirs. Several engineering techniques have been developed and used widely worldwide for reservoir characterization identifying hydraulic flow units, including Characterization Number (CN). In 2003, *Shedid and Almehdiab* developed a new concept called Characterization Number (CN) represented below. It includes square root of permeability by porosity in addition to other important parameters of the reservoir and its flowing oil.

$$CN = 1.0067 \times \left(\frac{\rho_o \sigma_{o-W}}{\mu_o^2 Cos\,\theta} \right) \left(\frac{K_{ro}}{K_w} \right) \sqrt{\frac{K}{\varphi}}$$

It is important to point out that k_{rw} and K_{ro} are respectively the relative permeabilities of water and oil at their end-points. ρ_o, σ_{o-W}, and μ_o are the oil viscosity, oil-water Interfacial Tension (IFT), and oil viscosity respectively.

The end-points of relative permeability curves of oil and water are considered as an indication of the wettability of the reservoir rock. Application of the reservoir Characterization Number (CN) requires oil density to be expressed in Kg/m^3, viscosity in centipoise, IFT in N/cm, and permeability in milliDarcy. The challenge in this technique is that it is frequently assumed it is working properly and capable of identifying the flow units. However, in practice, static rock properties are not representative of dynamic flow conditions and ignore the fluid properties in the reservoir. In addition, many models ignore these properties and sometimes different reservoir heterogeneity scales are mixed.

The main objectives of this study are to provide analytical evaluation and investigate the accuracy of field application of the Characterization Number technique. Actual field data from three heterogeneous oil reservoirs from Egypt, Iran and United Arab Emirates (UAE) are analyzed and used to investigate the accuracy and field implementation of this technique. The actual field results indicated that the application of Characterization Number technique (CN) has proven to be the most accurat in the identification of flow units with minimum scattering degree of data points. It gives an additional advantage of plotting data on a Cartesian Scale.

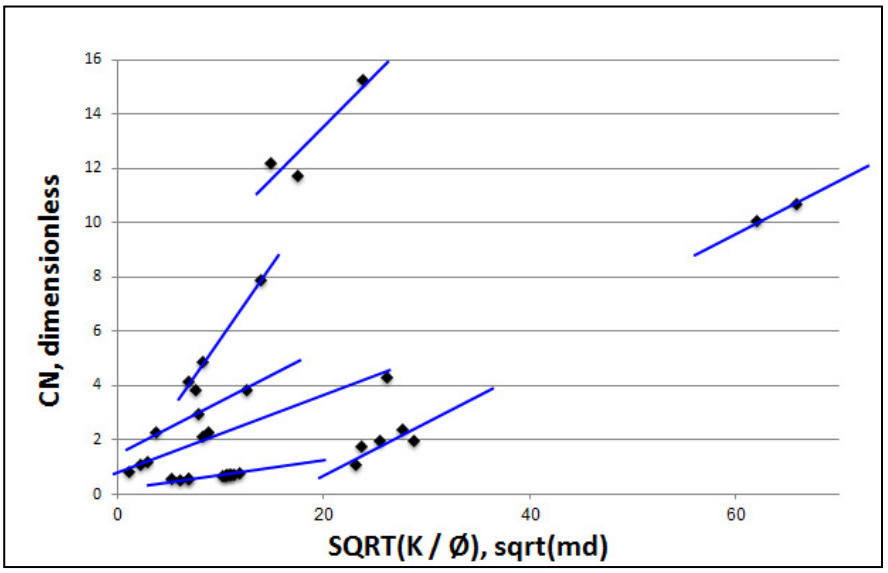

Figure 1: Characterization Number vs. SQRT(K/Ø) in Egyptian Reservoir.

Beginning with the Egyptian oil field, discovered in late 1960s and started producing in December, 1974 at initial production rate of 25 Mbbl/day, four different reservoirs (two producing from Nubia C, and two producing from Upper Cretaceous). Nubia reservoirs are the main producing horizons in this field. A complete set of data of this field is used to apply different reservoir characterization techniques.

The Characterization Number (CN) is calculated using data from the field, and plotted versus SQRT(K/Ø). The application is capable of delineating seven flow units. The reason for this more refined reservoir description in **Figure 1** is that the CN considers almost all the important variables of the reservoir rock such as Porosity, Permeability, contained fluid (oil viscosity and density) and other rock properties (relative permeability of oil and water, wettability, and oil-water IFT).
Considering another field, an Iranian giant carbonate reservoir, *Asgari and Sobhi* developed a fully integrated approach for the development of rock type characterization. **Figure 2** indicates characterization Number (CN) technique (2003). It indicates that the

CN is capable of identifying four flow units. This is another success for this technique to define flow units.

Another proof of the efficiency of CN technique is the UAE field. This Field is one of the major oil-producing reservoirs onshore in the UAE, where hydrocarbon accumulations lie in the Lower Cretaceous formations. The reservoir is a saturated oil reservoir with a huge gas cap and has an anticline structure. This is a carbonate heterogeneous oil reservoir.

Permeability and porosity of the reservoir rock have beenconsidered as two of the most important parameters for characterization.

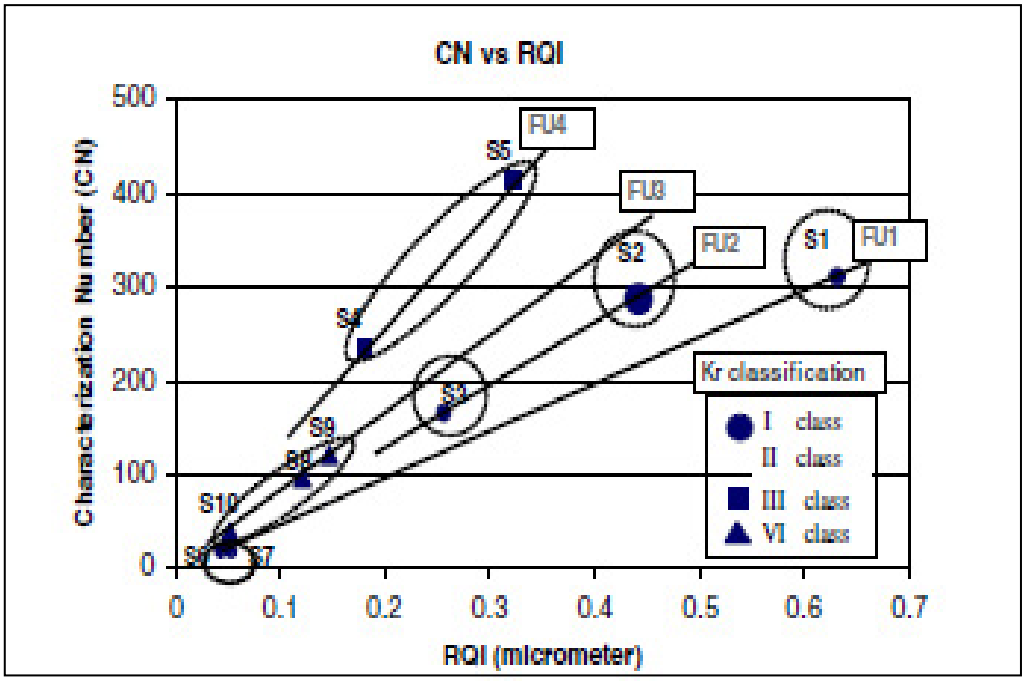

Figure 2: Four Flow Units With The Separation of Dynamic Rock-Types Within Those Based on The Variability of Relative Permeability Curves

One can also use combinations of two or more rock properties to gain insight into the characterization of flow through porous media.

The Characterization Number (CN) is calculated and plotted versus SQRT(K/Ø) for reservoir using provided data from the field as shown in **Figure 3**, stating that this facies consists of three distinct flow units. The first flow unit is passing through wells 131, 136 and 137 unless there is a geological barrier. The second flow unit is different in its properties and it is for well 136.

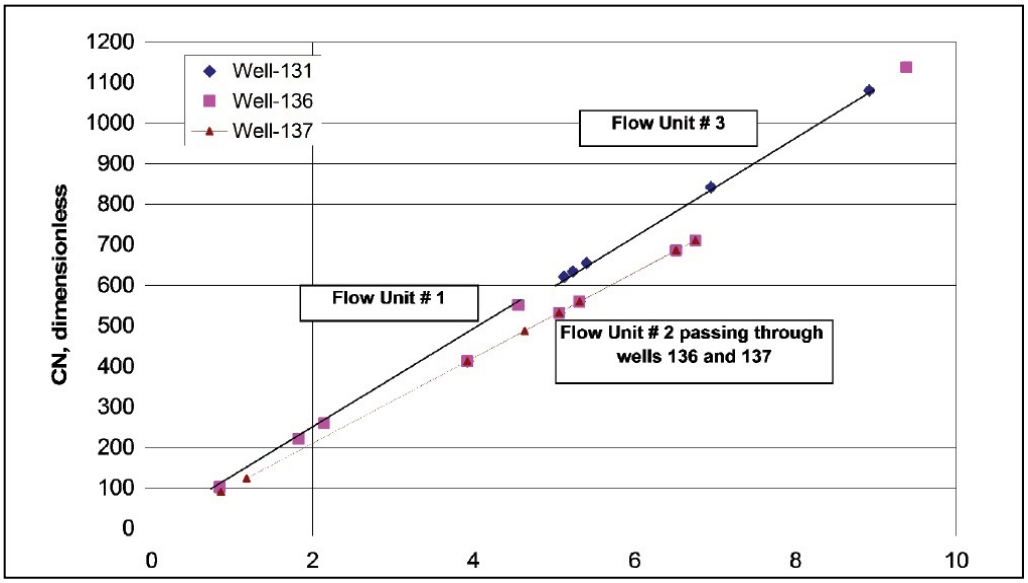

Figure 3: Characterization Number versus SQRT(K/Ø) for Reservoir.

The CN concept uses a Cartesian plot and provides a low scattering degree. The CN technique also has another advantage of plotting more rock/fluid variables involved in the CN versus dual parameter of SQRT(K/Ø)

As a conclusion, the following results and interpretations were obtained from the study and the analysis of the three fields mentioned above:
1. Characterization Number (CN) proved to be the best technique in the enhanced reservoir characterization from the results stated above.
2. Characterization Number (CN) technique has indicated a very good identification of flow units for both sandstone and carbonate heterogeneous oil reservoirs.
3. For the used technique, stress effect has to be included and involved in future model/technique to consider the subsidence and overburden effects over extended life of producing reservoirs.

Stratal Pressure Support Using Gaseous Nitrogen Technology

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Ivano-Frankivsk National Technical University of Oil and Gas, Ukraine.

The complete and profitable extraction of hydrocarbons from previously-explored oil and gas deposits is a problem, which this generation faces. However, Sustaining Stratal Pressure provides a cheap and effective way to increase the product. It prevents retrograde condensation in the stratum, bottom hole zone, and well trunk, resulting in an increase in the volume of extraction of tank gas by 10-15%, and a gas condensate extraction by 20-30%.

Sustaining Stratal Pressure (SSP) is a cycling process of injected non-hydrocarbon gases, for example, Nitrogen. The efficiency of the cycling process may be increased at the expense of injection into the stratum of outside inert gas. The Nitrogen injection into the stratum will give the opportunity to decrease the activity of the selective irrigation of the most percolated strata at the expense of its production, due to nitrogen dislodging. The introduction of maximum condensation pressure of these technologies is not justified at all; in the applied fields, it allows to increase their condensate extraction as much as two times. The volume of hydrocarbon gas may be used as tank gas. Cryogenic methods can help in avoiding the conservation of stores of hydrocarbon gas during SSP in a cycling process.

Regarding the cycling process, it is practical to use Pumping Compressor Stations (PCS) during cycling process of the objects with small resources. The method of exploitation of the gas condensate deposits includes producing and input wells drilling, perforation, gas selection from producing wells, and volume of injection and extraction regulation. The recycling gas may be characterized as follows:

Figure 1: Classical scheme: Dry natural gas taken from the total volume of the extracted gas, compressed, and injected into the stratum.

Figure 2: This is the offered scheme: inert gas is purified, received by air separation compression, and injected into the stratum. The whole volume of the extracted natural gas is then supplied to the consumers.

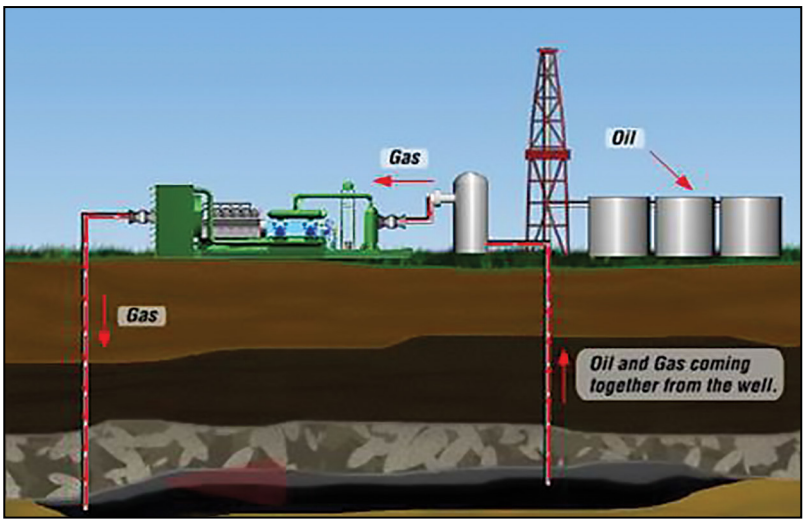

Figure 1

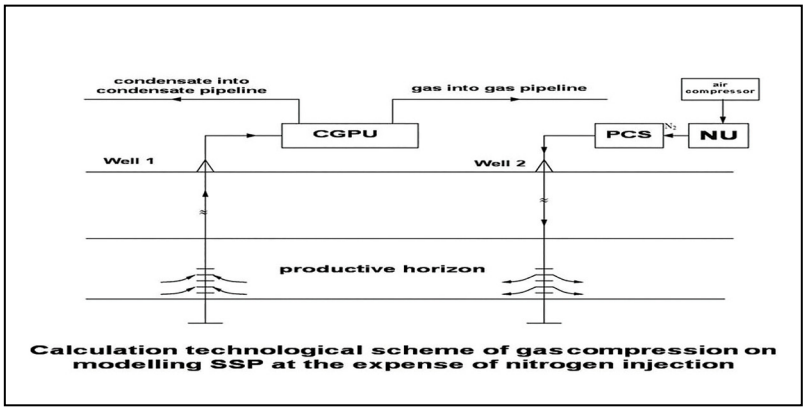

Figure 2

The process leads to:

1) Nitrogen production by membrane units.

2) Supplying Nitrogen to APCS and PCS and injected through the distributer.

3) Chromatographic control of gas quality and automated regulation of the efficiency of a compressor unit of Nitrogen injection. Nitrogen is supplied to the Pumping Compressor Station (PCS) and is injected into the input well through the distributor.

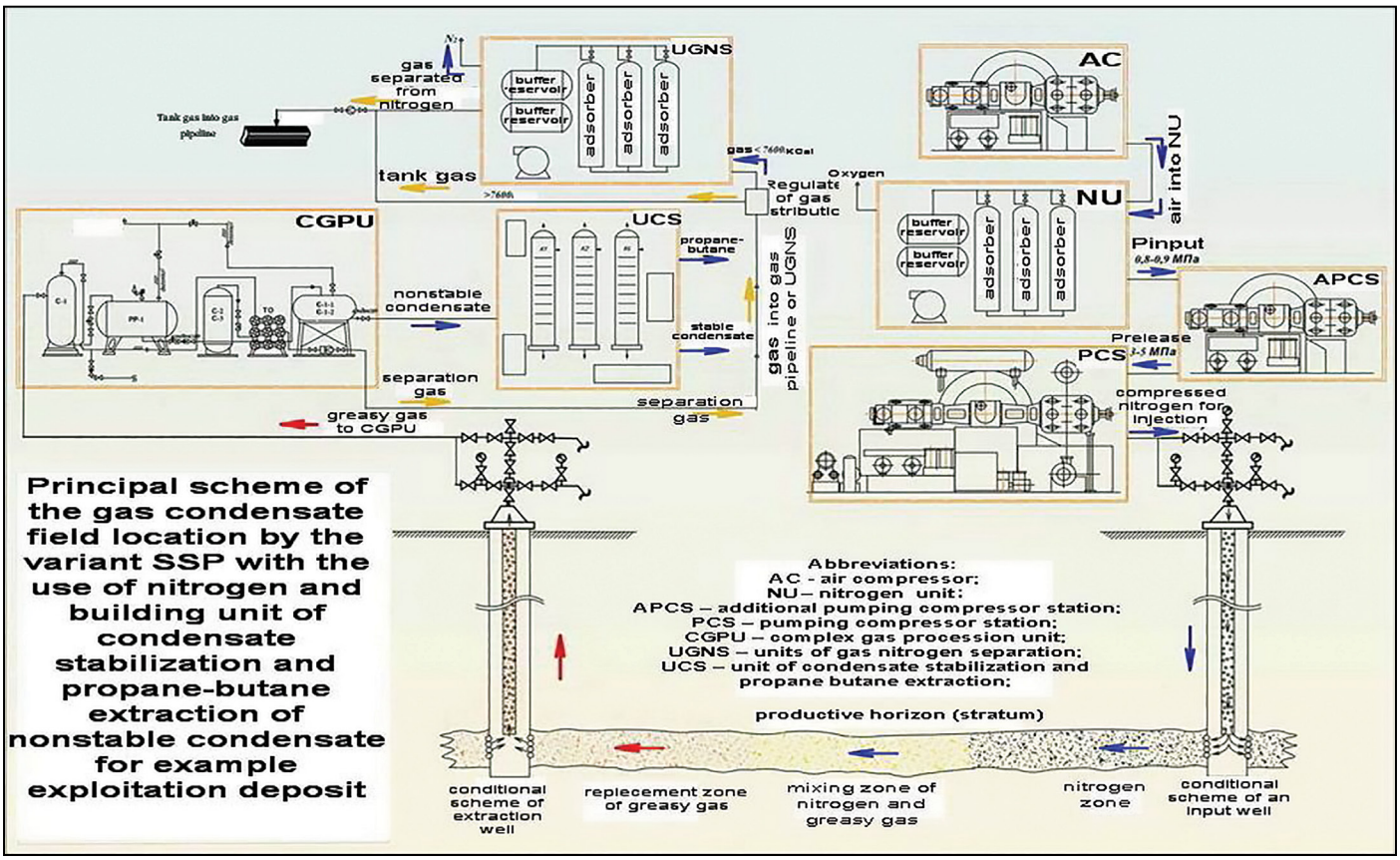

Figure 3

In **figure 3**, it is clear that the principal technological scheme of the gas condensate field location is the basis of modeling stratal pressure sustaining by nitrogen injection into deposit (35-40 MPa). According to this scheme, air compressed to pressure 0.8-0.9 MPa in the air compressor station is supplied to the industrial Nitrogen Unit (NU), where it is separated. The Oxygen content in the Nitrogen received at the NU shouldn't exceed 3%.

Nitrogen pressure at the output of NU is 0.3-0.5 MPa. With the help of chromatography, we own control of the gas quality, and regulate the efficiency of the compressor unit of Nitrogen injection. After the gas and condensate process at CGPU, the gas mixture is injected into the gas pipeline and condensates into the condensate pipeline.

Annual exploitation expenses for maintenance of the projected object are defined by the method of compiling cost estimate in factual prices. The table presents estimates of annual exploitation expenses (first year of exploitation).

№ n/n	Names of indeces	Value
1	Efficiency of the unit, amount of gas thousand m^3/day	24,0
2	Additional number of personnel (people)	5
3	Total cost, hrvns, including:	13 250 000
4	Project-prospecting work, hryvns	300 000
5	Construction and installation work hryvns	1 500 000
6	Equipment, hryvns	10 950 000
7	Others, hryvns	500 000
8	Capital investment (without value-added tax), hryvns	11 041 667
9	Cost of fixed assets, hryvns	11 041 667
10	Annual exploitation expenses, hryvns	9 310 835
11	Gross profit (in progression), hryvns	12 990 157
12	Net profit (in progression), hryvns	10 808 600
13	Term of recoupment of capital investment, years	1,1
14	Electrica energy, kWt/hour	9 460 800

*1$ = 8hryvns

To conclude, the Sustaining of Stratal Pressure by Nitrogen injection into the stratum to replace the extracted gas, improves the economical indices of the hydrocarbon extraction in the gas condensate fields of various capacities. It also increases the net production of hydrocarbons which is of a great benefit in different conditions.

A Novel Way to Reservoir Stimulation: LPG Gel Based Fracturing

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Pandit Deendayal Petroleum University,
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Searching for an alternative fracturing fluid to water is one of the biggest researches carried out in the Oil & Gas Industry. One research was conducted regarding the Liquefied Petroleum Gas (LPG). The process gels the LPG using Diester Phosphoric acid for efficient fracture creation and proppant transport. The unique properties of LPG create an ideal fluid for complete cleanup; the removal of this fluid from the invaded zone is easily achieved along with the hydrocarbons. LPG Gel process creates more effective fracture lengths, enables long term production of the well, greatly improves the recovery up to 100%, minimizes usage of water up to 0%, and solves all water related problems to conventional fracturing process.

Early reservoirs had good petroleum content and very high permeability that allowed easy production of the site, but now, the industry is increasingly working with depleted wells with small pores and low permeability. Consequently, production is becoming difficult and hydraulic fracturing is becoming prevalent.

The science of hydraulic fracturing predominately focuses on fracture geometry and proppant placement to maximize production rates and cumulative production. The theory requires a conductive path from the fracture network to the wellbore. The fracture length or volume needs to fully contribute to achieve maximum production. An opportunity exists to optimize production in fracture volume models by choosing the properties of the base fracturing fluid to minimize formation interaction. It is important to recognize that LPG is formation compatible and can be left indefinitely in the reservoir without the concerns of water imbibition or formation incompatibility.

LPG Properties and Application as a Fracturing Fluid

Liquefied Petroleum Gas (LPG) is a mixture of petroleum gases existing in a liquid state at ambient temperature and moderate pressure. HD-5 spec Propane is the most common LPG product, applied to 100% gelled LPG hydraulic fracturing. Propane has a critical temperature of 213°F (**Figure 1**) which limits its use above that temperature. For applications above 213°F, Commercial Butane, whose critical temperature of 350°F, is mixed with Propane.

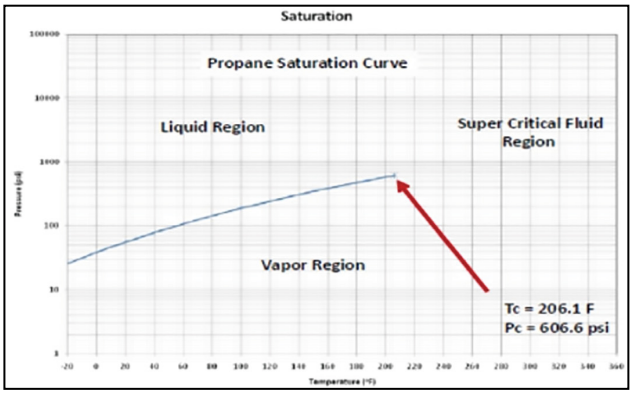

Figure 1: Propane Liquid Vapour Saturation Curve

All LPG products are tightly fractionated, resulting in a high degree of purity (+90%) with predictable properties and performance when used as a base fluid for hydraulic fracturing.

The ability to gel LPG, so that it can be used as an efficient carrier of proppant, is based on maintaining LPG in a liquid phase during all aspects of the hydraulic fracturing process, particularly at reservoir conditions. Propane is stored at ambient temperature, (e.g. 70°F), where the minimum storage pressure of 125 psi is required to maintain it as a liquid. When applying Propane as a fracturing fluid, it is stored, gelled, and proppant blended at a constant pressure of 280 psi. It is then pressurized to the required surface injection pressure for fracturing. **Figure 2** is an example of a typical fracture treatment at 7000 ft depth and 140°F. This illustrates that Propane remains in the liquid phase during all the previously illustrated processes.

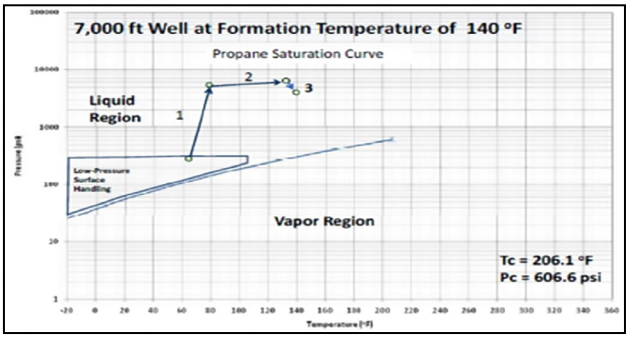

Figure 2: Example of a 7,000 ft Well at 140° F
1-Blender thru high pressure pumps to the wellhead
2-Wellhead thru tubular into fracture
3-Fracture and leak-off to reservoir conditions

Once the fracture treatment is complete, the Propane is highly soluble with the formation hydrocarbon. In the case of a natural gas formation, the Propane and natural gas (predominately Methane) combine to create a unique liquid vapour saturation curve for the mixture. The vapour saturation lines for a range of Propane/Methane mixtures are presented in **Figure 3**.

Some liquid will exist when the corresponding pressure and temperature are above a vapour saturation line. Pure vapour exists at all points below and to the right of the vapour saturation line. This graph shows that when Propane mixes with Methane, the corresponding mixture's vapour saturation line moves up and to the left, away from the original 100% Propane curve. The resulting mixture will have cleanup properties of a lower critical temperature fluid, improved gas density, viscosity, and no surface tension. The specific gravity of Propane is 0.51, presenting it as the lightest fracturing fluid. A low specific gravity fluid, such as Propane, allows the formation to be in an under-balance state during cleanup. If a well loads up with Propane, the surface pressure should be drawn below 100 psi. This results in self-regulating cleanup condition without swabbing or gas lifting requirement. Intuitively, when LPG is used as a hydraulic fracturing fluid, there is no necessity for additional energizers of Nitrogen or Carbon Dioxide. LPG can be recovered along with formation hydrocarbons directly down the sales line. The ability to recover the LPG down the sales line avoids environmental issues such as flaring and fracture fluid disposal, and presents the opportunity to recover propane as sales gas. Viscosity of any fracturing fluid is important: it is the lowest possible viscosity the fluid can achieve once the gelation system breaks.

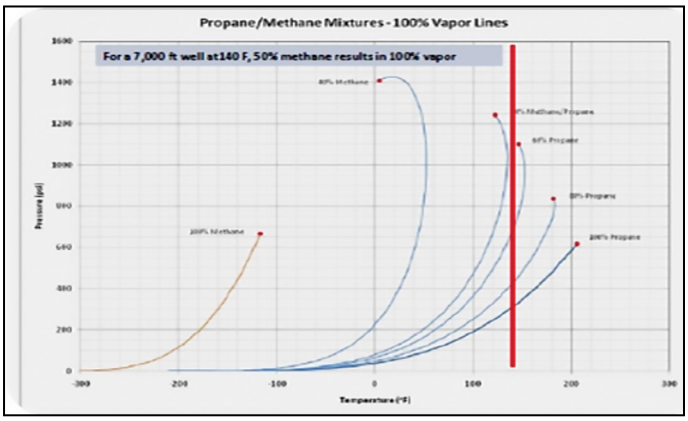

Figure 3: Propane-Methane Mixtures at Formation Conditions

In **Figure 4**, viscosities of typical base fluids are compared to Propane and Butane. By comparing viscosities at 104 °F, water has 0.657 cp while propane has 0.087 cp, leading to an order of magnitude difference. Laminar flow of the fluid through porous media is described by Darcy's law and is mathematically expressed as: $\Delta P/\Delta L = \mu V/k$

Where P = pressure, k = permeability, L = length, μ = viscosity, and V = velocity.

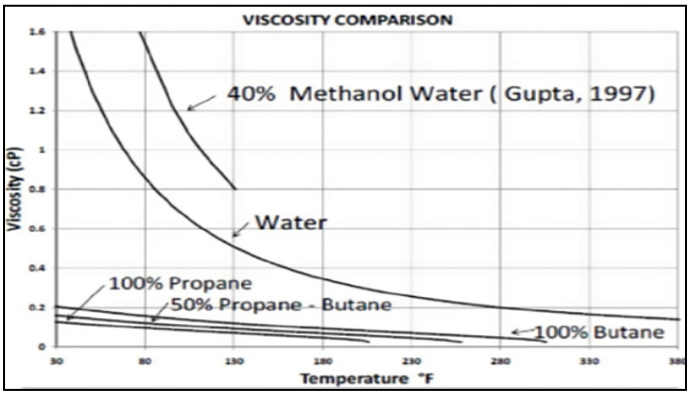

Figure 4: Comparison of Viscosity

Based on Darcy's law, a decrease in velocity will lead to a decrease in differential pressure required to move the same volume of fluid, assisting post fracture fluid clean up. Moreover, once Propane and formation hydrocarbons mix, the viscosity of the mixture will result in a further reduction of required pressures.

Surface tension exhibited by the fracturing fluid greatly impacts capillary pressure effects in the reservoir. Selecting a fluid with low surface tension will reduce the pressure needed to mobilize fracturing fluid for clean-up. Capillary pressure exhibited by fracturing fluids in reservoirs is often considered when selecting the fluid. In many applications, capillary pressure will result in blocking pores and natural fractures thus reducing productivity. Unfortunately, these trapped fluids are typically difficult to remove. Capillary pressure behavior is unique to each reservoir and is based upon the characteristics of both, the formation and fluid. The capillary threshold pressure, which defines the needed differential pressure to mobilize the fracturing fluid, can be estimated using the Laplace-Young Equation: $\Delta P = \frac{2\gamma\cos\theta}{r}$

For porous media, the flow path dimension is the effective pore radius and can be generally related to permeability by the modified Kozeny-Carmen Correlation: $K = r^2_{eff} / 8r$

Tight hydrocarbon reservoirs (e.g. shale reservoirs) exhibit permeabilities less than 0.1 mD with effective pore radii less than 0.1 microns. In this range, water based fracturing fluids exhibit threshold capillary pressures that exceeding 100 psi. During injection, LPG has properties similar to conventional hydrocarbon fracturing fluids. Gelled LPG is synthesized by taking advantage its unique features: chain length, purity, surface tension and viscosity. A picture of gelled LPG is presented in **Figure 5.**

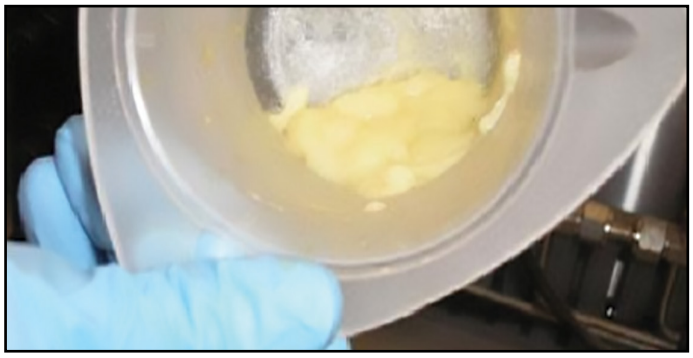

Figure 5: Laboratory View of Gelled Propane at Atmospheric Conditions

Gelled LPG Fracturing Process and Equipment

All equipment used within LPG fracturing is built for purpose and is uniquely operated to meet the functional and safety requirements. Multiple storage tanks are used to store and feed the LPG into a specialized sand blender. A pressurized Nitrogen Blanket is applied to all the LPG storage tanks as a safety feature, and to maintain the LPG in the liquid phase. The novel Sand Blender used in this system is a pressurized system in which the proppant required for the fracture treatment is preloaded, purged, and pressurized with Nitrogen. A controller meters the proppant into the gelled LPG liquid stream. Specialized high pressure pumping units are then used to inject the gelled LPG into the wellbore at surface pressures sufficient formations, to hydraulically fracture the formation. A hydraulic fracture treatment followed by LPG recovery can be beneficial in terms of operational expediency, treatment economics, logistics, and environmental care. There are two primary methods to achieve post-frac LPG Recovery: either direct to pipeline, or direct to flare. Each method has specific benefits which best fit for different situations and circumstances. However, where LPG recovery is not desired, the well flow back stream is directed to the flare. Fortunately, less overall gas is flared due to the significant reduction in cleanup time compared to conventional fracturing.

Eni Signs Two New Concession Agreements

Eni has signed two concession agreements for the North Leil and Karawan Blocks offshore Egypt as a result of the EGAS 2013 bid round. North Leil and Karawan Blocks cover areas of 5,105 and 4,565 square kilometers, respectively. Eni is the operator and holds 100% equity in North Leil and 50 percent equity in Karawan, where it partners with BP. The two blocks, which will be operated by Eni's subsidiary IEOC, are located in the deepwater offshore of the Mediterranean, west of the Shorouk Block, which Eni acquired last year. The signature of these two new concession agreements follows that of Southwest Meleiha Block recently awarded, further strengthening Eni's position in Egypt, a country of historic and strategic importance for the company, and relaunching Eni's exploration activities in the Egyptian's offshore. Eni has been present in Egypt since 1954 and is the main producer in the country with an equity of approximately 210,000 BOE/d.

Oil Spill Trial Looms for BP

Lawyers for the government and oil giant BP are preparing for trial in New Orleans that could add more than $13 billion in penalties to the billions BP already has shelled out as a result of 2010 Gulf Oil Spill. Federal lawyers say BP should pay as much as $4,300 per barrel spilled after the Deepwater Horizon rig explosion at BP's Macondo well. Based on a court finding that 3.19 million barrels polluted the Gulf, the penalties could reach $13.7 billion. BP will argue for a lower figure in the upcoming trial. It says its costs already have hit $42 billion, including a $14 billion response and cleanup. Its pre-trial briefs say a low-end penalty would accomplish the Clean Water Act's purposes: deterring environmentally dangerous behavior and encouraging effective responses.

Obama Administration Outlines New Proposal For Offshore Oil And Gas Leasing

The Obama administration released a draft of a five-year plan for oil and gas lease sales that would open areas of the Atlantic Ocean and offshore Alaska to drilling. The draft plan includes 14 potential lease sales in eight planning areas. It also declares certain portions of the Chukchi and Beaufort seas off limits for sales, which the Interior Department said is a recognition of the "unique and sensitive environmental resources" in those areas. This is just the first step in planning the next five-year lease sale; the plan could still be revised, and it wouldn't begin until 2017.

In a statement, Interior Secretary, Sally Jewell said the plan "is a balanced proposal that would make available nearly 80 percent of the undiscovered technically recoverable resources, while protecting areas that are simply too special to develop". Environmental groups criticized the inclusion of the Atlantic and Arctic regions. The groups argue that Atlantic drilling would threaten tourism and fishing industries along the Eastern Coast, and companies are not prepared to drill safely in the Arctic, either. Meanwhile, the American Petroleum Institute said that the proposed plan should have included a broader region of the Atlantic coast as well as the Pacific. The proposal will be open for public comment through March 28.

Saudi Arabia Increases Oil Output to Crush US Shale Frackers

Saudi Arabia has secretly increased its oil production to 9.8 million barrels per day, 300,000 barrels more than its output measured by OPEC. It is the highest level of output since last October, in a push to win back market share in its oil price war with US shale frakers. Speaking at a conference in the kingdom, Khalid al-Falih, chief executive of Saudi Aramco, said: "Supply and demand, and the rules of economics will govern. It will take time for the current glut to be removed". The kingdom has been the main catalyst within the cartel for pursuing a policy of allowing oil prices to fall, in order to take back market share from producers outside OPEC, such as the US and Russia.

In November, OPEC members agreed to leave output unchanged at 30 million bpd, triggering a dramatic slump in the price of oil. Brent crude was trading at around $48 per barrel. Falling prices have already hit the oil industry in the North Sea hard. BP has laid off 300 staff already in Aberdeen and informed its 80,000 employees worldwide of a pay freeze throughout 2015. More job losses and project delays are expected across the industry. However, experts have warned that a sharp cutback in investment could see prices rebound to new highs over the longer term. Speaking to The Telegraph in London, Abdalla Salem El-Badri, secretary general of OPEC, said: "If we cut production then there will be spare capacity and producers will not invest, or postpone projects. The market will rebound back higher that the $147 we saw in 2008"

Kuwait Energy New Discoveries in Egypt

Kuwait Energy discovered hydrocarbons at its ASA-1 st3 exploration well on the Abu Sennan license, offshore Egypt. Tests of the Abu Roash "E" and "C" formations produced flow rates of 1,605 BOPD and 2,164 BOPD, respectively. The well is Kuwait Energy's seventh discovery in the license. Kuwait Energy (50%) is operator with partners Dover Investments Ltd. (28%) and Beach Energy (22%).

Total E&P Egypt Signs Nile Delta Exploration Deal

EGAS signed the deal with Total for gas exploration in the Nile Delta, a ministry statement said that the government is keen to develop untapped finds to reduce its reliance on imports but has struggled to persuade companies to invest in the biggest finds, which are offshore, because the amount it pays them barely covers the investment costs. Economic turmoil has also caused the government to fall into arrears with existing producers.

Argentina: Best Candidate for Next Shale Boom?

The U.S. Energy Information Administration has estimated that Argentinean shale formations possess approximately 27 billion barrels of oil and 802 trillion cubic feet of gas (technically recoverable). The geology has been assessed as excellent, possessing a thickness ideal for the commercial production of hydrocarbons. A combination of existing infrastructure and political interest make these shale prospects the most promising outside of the United States and Canada.

As for the oil price decline, Argentina appears to have a degree of insulation, with insiders saying that the country's budding shale industry remains viable with West Texas Intermediate at $60 per barrel. Argentina has pipelines that shale developers can use, around 24,500 miles of them (the biggest network in South America). As conventional gas production has declined, such pipelines are underutilized, primed for a hydrocarbon rush from shale. They also provide export market access. In short, existing pipelines lower the capex requirement for shale developers and provide readymade market access.

Celebrating The OSC Award 2014

SPE SU SC celebrated its 11th season opening day with The Outstanding Student Chapter Award granted by SPE International. This award is a prestigious recognition from SPE International for our great and distinguished level of performance in planning, participation, and achievements during the past seasons in order to bridge the gap between academic and career life.

The opening day program started with a massive ground branding campaign about SPE International and its benefits, and the role of SPE SU SC in our University during the past ten years. It was followed by the opening ceremony with networking games and releasing recruitment applications for students at the Suez University. We received more than 250 applicants.

Egypt Petroleum International Conference (EPIC)

EPIC
Egypt
Petroleum
International
Conference

EPIC 2015 is a spectacular mega event of this season. It is being held at the American University in Cairo (AUC) on February 10th – 12th 2015. It is organized by SPE SU SC in conjunction with SPE AUC SC. "EPIC" is not just a conference; it is a worldwide idea of building bridges between industry and academic world, and sharing knowledge in a professional atmosphere. It brings experts and industry leaders in Egypt and Middle East to share best practices, technological advances, new ideas and innovative applications to enhance inquiries about energy issues in the world.

EPIC has an objective to build great awareness towards the importance of global energy and increasing the global recognition about energy and our eagerness to strive for an excellent future. It provids young generation a platform to explore E&P insights as well as establishing professional networks.

Halliburton LWD and DD Course

Halliburton, our academic sponsor amazes us with a certified course about Logging while Drilling and Directional Drilling. It is a three-day course that is held at Faculty of Petroleum and Mining Engineering. The first day was held at the first semester and started with an induction session about Halliburton Egypt and how service companies operate. Then it was followed by the first session of the course that was about basics of LWD by Eng. *Ezzeldein Ibrahim,* Senior LWD Technical Engineer. The second and third days will be completed throughout the second semester of the academic year. They will include sessions about DD new technologies, tools and challenges by Dr. *Diab Saad*, DD Country Manager and Mohamed Shafik, Directional Drilling engineer. This fruitful course will be followed by a Halliburton DD laboratory visit, where the students will be able to attend practical workshops.

MIDOR Day

Through SPE SU SC efforts to serve students of refinery engineering department by linking them with the biggest companies in the downstream segment, we managed to organize a full day for MIDOR Company at the faculty campus. The day started with an HR session entitled "Young Today … Leader Tomorrow", that was presented by MIDOR Human Resources Manager, Dr. *Hanan Abd El-Moniem*. Then, there were three technical sessions about pumps fundamentals and technologies, compressors and steam turbines presented by Eng. *Mohamed Hafez*, Senior Machinery Engineer.

Halliburton Egypt Cementing School

Supported by our academic sponsor, Halliburton Egypt, SPE SU SC was able to furnish 15 certified two-day school opportunities to our students at the petroleum engineering department. On the first day, instructors conducted concentrated sessions on cementing operations, evaluation and remediation.
On the second day, there was a tour at the cementing devices and tools yard followed by a visit to the cement laboratory. There, the trainees had practical workshops and were able to perform laboratory experiments under the supervision of their mentors.

Tracks System and Educational Meetings in Our Chapter

Based on our slogan this season "Innovate like Never Before", SPE SU SC officers have generated a new idea for the chapter's structure, taking new and innovative steps forward to endeavor the chapter members with the capability to shift their work to different segments providing a simulation for actual career life. We, have introduced SPE Tracking System. The system is composed of 6 tracks: Academy, HR, IT, Marketing, Operations, and Sales. Each head, leader, and member is involved in this system. The movement from one track to another is based on an assessment to check the member's saturation of the skill he gains. It transfers the member to another suitable track to continue his development journey. As a result, this proved to increase the members' extraordinary commitment to work and developed their personal and technical skills. The second new idea is the monthly educational meeting that focuses on developing the members in their tracks and having fun together.

NAPESCO Fishing School

SPE SU SC managed to bestow 30 opportunities for the students of petroleum engineering department to participate at NAPESCO Fishing School where they were divided into two groups. The trainees attended sessions on fishing jobs and their challenges and learnt about different fishing tools and techniques. On a yard visit, they had practical workshops to explore fishing tools and the bottom hole assemblies where they were allowed to experience practical work, themselves. The school ended with an induction session presented by Mr. *Dave*, NAPESCO and technical advisor, who explained the challenges that a fisherman may face during his job. Moreover, he gave an overview on the company and how it operates in Egypt.

Annual Technical Conference and Exhibition (ATCE)

A new achievement realized by SPE SU SC, is our members' participation at the SPE Annual Technical conference and Exhibition (ATCE) 2014 which was held in Amestrdam, Netherlands. Delegates fom our chapter were able to attend different sessions in addition to attending officers workshops and leadership workshops. It was a great opportunity to meet the industry professionals. It was a fruitful journey for the whole chapter where our delegates worked on transfering the experience and knowledge the performance through the awards recieved there.

Our Chapter Records in SPE Scholarships

It was our glory to know that Ahmed El-Gamal, was announced as SPE Star 2014 for the MENA Region. Star Scholarships support those pursuing degrees related to oil and gas industry until completion of the degree for which awarded, up to a maximum of four years. Also, Ahmed Hussein was granted the Star Fellowship Award for the Middle East Region which supports graduates academically.

Since the beginning of this season, we had worked on a branding campaign about the SPE International benefits and among that campaign was a session held by Ahmed El-Gamal about Star scholarship, its benefits, how to apply, tips to earn it and how you can make the best use of such great opportunities provided by SPE.

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