ECHO

SPE Suez Canal University Student Chapter Magazine

Issue 3 | March 2011

EGYPT: A VIGILANT READING INTO A BRIGHTER FUTURE

SUCKER ROD PUMPING SYSTEM
For Deep High Volume Wells

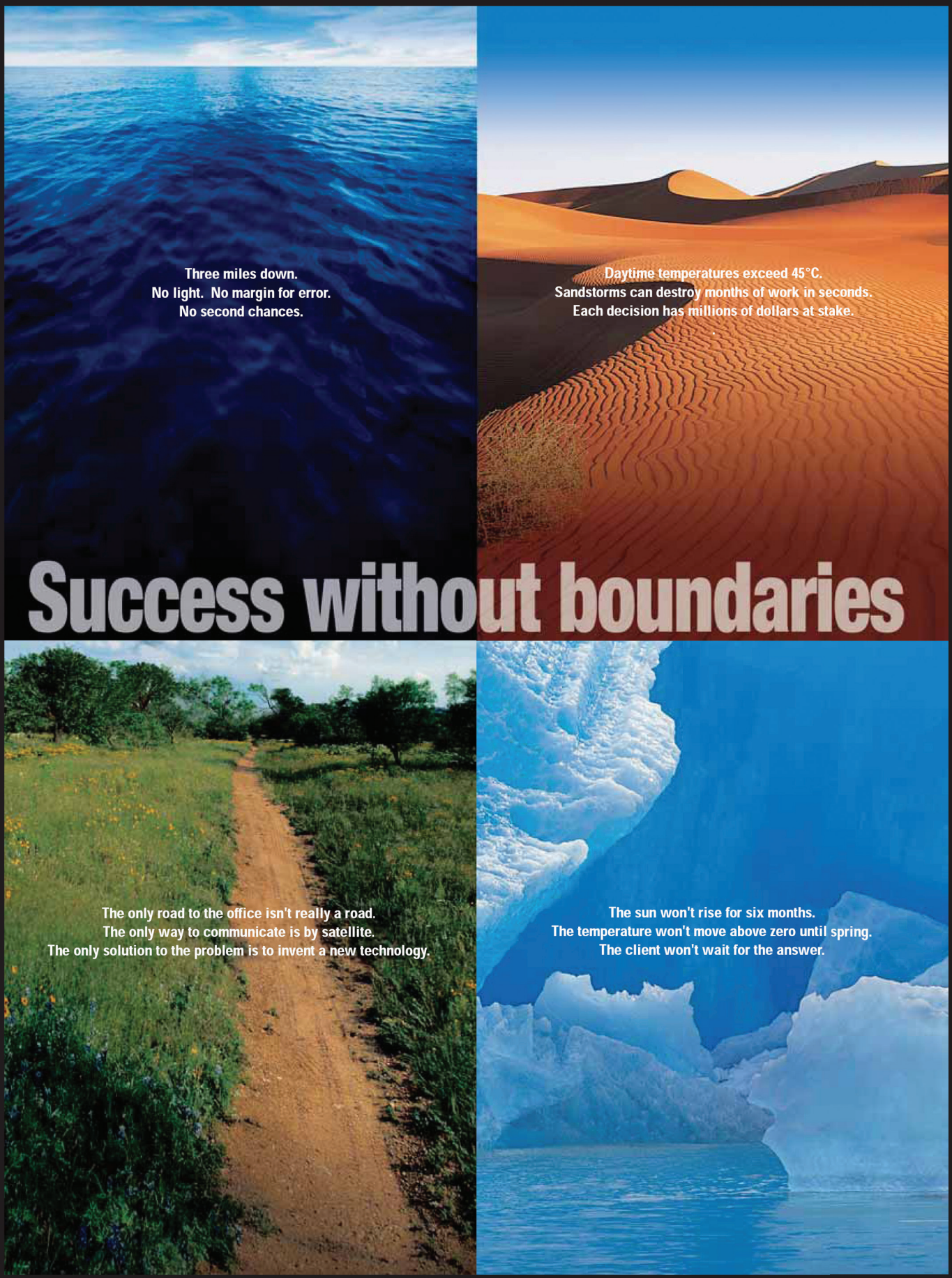
AN INTERVIEW WITH MR. WAEL SHARABASH
Drilling & Measurement Operations Manager, East Siberia Region, Russia, Schlumberger

PETREL SIMULATION PROGRAM

UPGRADED OIL RECOVERY
From Heavy Oil Sands

TIPS FOR A SUCCESSFUL ENGINEER

PUBLISHED BY
Suez Canal University Student Chapter
Society of Petroleum Engineers



It's about as far from an ordinary career as you can get.

It's not for everyone. But if you're ambitious, innovative, and truly open-minded, a career at Schlumberger just may be right for you. Here you'll find yourself taking on some of the most complex engineering and technical challenges in the world. And you won't have to wait to test your ability. Our recent graduates are expected to perform from day one.

As the leading name in oilfield services, clients expect us to deliver results under the most demanding situations in business. We give you the training, the support, and the opportunities to make an impact. The rest is up to you. At Schlumberger, success is without boundaries.

Schlumberger

Success without boundaries www.slb.com

ECHO contents

[Egypt: A Vigilant Reading Into A Brighter Future]

When historians look back upon this turning point in the life of the Egyptian people, they shall not, by any means, stop at the 25th of January 2011; they have to dive deeper into the roots of history and thoroughly investigate the precursors of this revolution to fully understand the uniqueness and singularity; yet, comprehensiveness and diversity of this white peaceful revolution! Starting with the state of the political drought that we are still suffering from and demolishing the political process to a point of which it literally lost all its meaning, not to mention defrauding the people of their own will, passing by the epidemic overspreading of an endless list of vices and decadent acts that have gradually destroyed the very fabric of the Egyptian society, and last but not least; introducing a new heinous form of corruption as the illegal child of the forbidden marriage between power and money specially in that last decade that has witnessed a frightening degree of bureaucratic collectivism that was slowly depriving the society from its pivotal class; the middle class! It is truly a shame that they will come to the conclusion that the bygone regime was nothing but malignant tumor that was rapidly spreading its corruptive cells among the body of this glorious nation and the question remains, should it be dealt with a surgeon scalpel or the butcher's knife. However, I am not a historian, nor I claim to be a veteran politician who holds the key to solving all our problems, but I do have a modest vision that does not require much in terms of qualifications to be able to see it. I have contained it into four main points:

ENTRENCHING "TAHRIR" VALUES

It takes an act of a single man to achieve greatness, but it dictates an act of many to reach the step of miracles and nothing short of a miracle is what we have here between our hands. With the blood of martyrs cleansed a courageous sun of a fearless dawn, a dawn that preaches of a new Egypt. From the ashes rose a phoenix, a mini "Utopian" community, united by a common cause despite of the many differences in the ideologies, as well as, social, cultural, economical and even religious backgrounds of the people who represent all walks of life. This phoenix I speak of is not the people themselves, but rather the binding hungry desire for change that wanted to put an end to our seemingly unending negative silence and bottomless stoicism attitude towards everything wrong and radical in our society. "Tahrir" will always be linked in our minds with this explosion of the unity between different societal levels of civilians in a state of magical harmony, it always remain a strong undoubted up holding to all virtues and values that form the backbone of any modern free civilized society. I could dedicate pages and pages solely to emphasize this point, at the end of the day, we will all come to the conclusion that these precious human values, those are the values we need to guide our national freight to a shore of safety.

INDOCTRINATION AGE IS OVER

When I first sat down trying to write this article, needless to say I was overwhelmed, quite taken with the magnitude of the shear magnificence of this event, dare I even say; intimidated and afraid that this is a subject that lies way beyond my capabilities. For a while I thought about dismissing the whole idea on the count of "Who am I to provide any sort of literature regarding this still ongoing events?!" and it honestly dazzled me that I was able, not long ago; to stand up, along with the rest of my brothers and sisters, to a tyrant whose negligence and disrespect to the most basic universal human rights borders on the psychopathic! Yet, I found myself afraid of giving my own insights about this innocent pure revolution that astonished the whole world. Free world leaders stood in awe and admiration while dictators were shocked to their foundations. Then why was I afraid? Simply because I realized that, and for the first time in my life, I was truly free and with this long sought freedom comes responsibility! For I am now entitled to my own opinion, not only that, I am now responsible to form a well thought, thoroughly considered and educated one. I shall no longer be easily misguided or led to form false beliefs. Seeking out the truth is a burden we must all bare!

NEW MANAGEMENT AND EFFICIENCY

Any enterprise, even as big as a whole nation, stands on two main poles; potentials and expectations, and when the two do not meet we reach an impasse and failure becomes an inevitable reality. The ousted regime lacked the vision and failed, dare I even say, refused to nurture any sort of talent or potentials to meet an already low level of expectations. Abandonment of principles such as; seniority, bureaucracy and centralized management is a necessity if we truly want to catch up with the BRIC countries (Brazil, Russia, India and China) before the wheel of history turns its back to us in a blinding pace.

RAISING AWARENESS AND FIGHTING ILLITERACY

When rebuilding a nation time becomes a luxury we cannot afford, and carrying an overweight of illiterate and uneducated or unaware portion of the society becomes an obstacle that must be dealt with immediately and with strong firm hand. This hand is none other than NGOs and community services associations and societies much like ours. Such organizations must spare no effort or means to help utilize this endless supply of heritage and culture that is the Egyptian people in the sake of achieving the great purpose of retrieving our place among the leading nations. To sum up this point and clarify it simply; a better man means a better production means improving the quality of life!

While we set here lay plans for our future and turn over a sad page in our history we must not forget; the heroes who sacrificed their own blood to pave the road for this future, Egypt's finest men and women who cracked the giant wall of history so that a new sun might shine and turn an everlasting darkness into a long gone spring. You deservedly carved your place in this new chapter of our nation's history, heart and soul. You will always be mourned and remembered, thank you! We will take it from here.

Mohammed S. Alshobaky

Upgraded Oil Recovery from Heavy Oil Sands

Ahmed A. M. Algibaly
Professor
Faculty of Petroleum and Mining Engineering, Suez Canal University
Petroleum Engineering Department

A case study is simply the study of the particularity and complexity of a single case, coming to understand its activity within important circumstances. Thus, identifying appropriate strategies for the resolution of the 'case' while having the ability to weigh pros and cons of the remedial options and strategies, enabling you to recommend and present a rationale for the best resolution. Every engineer must have a tool as powerful as this one among their tool kit as they tackle the problems and challenges that they face, that is why we dedicated a section solely for presenting case studies that might be of great benefit or interest to you.

Introduction

About nine heavy-oil sand reservoirs exist near Ras Gharib, in the western desert, Egypt. One of them is Assran oil field which is currently under development by Scimitar Oil Company. These oil sand reservoirs are good candidates for thermal recovery methods.

In addition, oil spills on land may be another candidate for clean-up by thermal methods. Gulf war in 1991 resulted in the firing of more than 600 oil wells in Kuwait. The crude oil gushed from these wells and accumulated in desert low lands forming over 300 oil lakes of a total area of 49 km^2. The amount of oil contaminated soils in the oil lakes and their peripheries was estimated in the range of 40 to 50 Million metric tons. Various oil extraction and soil remediation technologies were evaluated to find the most suitable solution for treatment of the heavily oil-contaminated soil and sludge.

It appears that thermal desorption by retorting process is one of the most promising technologies to be suitable for oil lakes soils. The retorting process is based on heating the oil-sand mixture up to 500-600 ^{O}C in the vicinity of an inert gas under atmospheric pressure. A great deal of laboratory and field work has been done on oil extraction from oil-shales and tar-sands by this process.

The objectives of the present study are: (a) To perform an experimental study that considers the process variables which govern the performance of the retorting process such as heating rates, operating pressures, specific properties of the soil matrix, etc. (b) To develop a mathematical model that can fit the experimental data and characterizes the oil produced during the retorting process.

Pyrolysis Mechanisms

The quantitative prediction of the thermally recovered oil and its quality by a pyrolysis mechanism is directly related to the economic evaluation of a retorting project. Three successive pyrolysis stages were identified for fuel formation at the combustion front during the in-situ combustion process. These stages were classified as oil volatilization, visbreaking, and coking.

"It appears that thermal desorption by retorting process is one of the most promising technologies to be suitable for oil lakes soils"

Experimental program

The experimental apparatus used in this study is schematically illustrated in Fig. 1. Experimental runs were carried out on model oil-sands as well as genuine oil-sand samples collected at different depths from bottom beds of the oil lakes.

A constant heating rate was established. The sample temperature and pressure within the cell were monitored during the reaction as well as the produced fluids. The experiment was terminated when the produced fluids stopped.

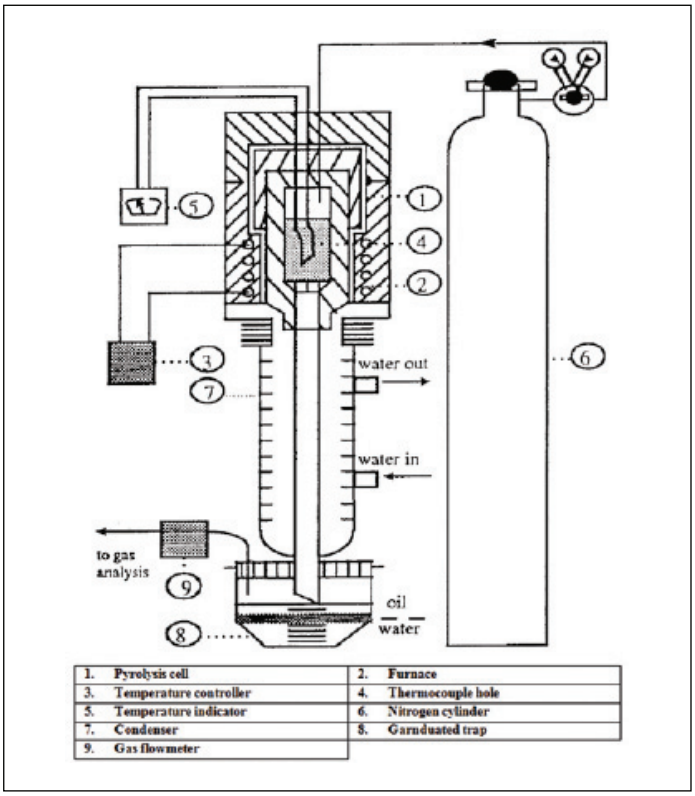


Fig. 1. Experimental Setup

Results

Fig. 2 shows the oil and water recovery results obtained from sample collected at the top sample of bed-137. It shows that connate water starts flowing after about 10 minutes from the beginning of the experiment. All water was recovered before the start of oil production.

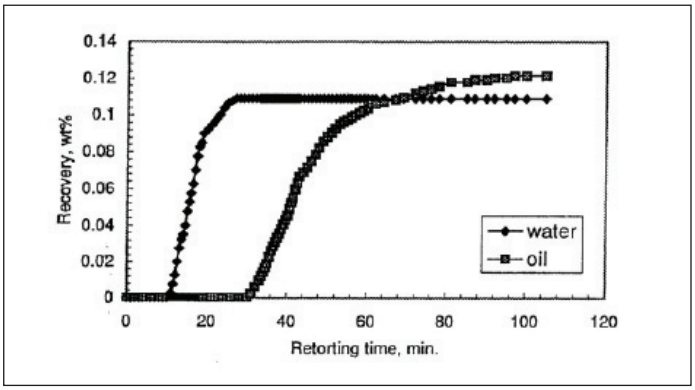


Fig. 2. Oil and Water Recovery from Top Sample of Bed-137

Effect of Operating Pressure: In the present study, it has been found that with relatively high gravity oils (≈24 °API), an increase in the operating pressure caused rise in coke deposition. Similar results were obtained for Athabasca bitumen being subjected to unstable burning at slightly higher pressures.

Experimental observations showed that when the operating pressure was increased the distillation peak was low in amplitude, and spread over a long time interval.

Effect of Heating Rate: For light and medium gravity oils in oil-sand samples the effect of heating rate is mainly reflected through the less time of process duration. Severe thermal cracking of crude oil during retorting process results in unwanted deposition of coke in the porous medium. Further to oil consumption by coke, it may reduce the permeability of the porous medium.

Effect of surface area: The magnitudes of p and q reflect the characteristic effect of surface area on the retorting process. For instance, if the soil matrix consists of a large variety of fine particles and split agglomerates with a wide range of cracking rate, q is likely to be Large. This behavior is consistent with the previous experimental observations.

Conclusions

(1) Potential oil recovery has been obtained from the laboratory work with reasonably moderate time required for the retorting process.

(2) Four main transitional stages were observed under constant heating rate in an inert atmosphere.

(3) The kinetic model developed for the pyrolysis of oil sand samples fitted well the experimental data.

(4) Results revealed that an optimum heating rate of 10 to 12.5 °C/min could yield good process performance as low coke precipitation and higher oil recovery were obtained.

(5) For oil sand sample of moderate values of oil content, an atmospheric operating pressure was found to be appropriate. For sludge and heavily oil-contaminated samples, high operating pressure is recommended.

References

1. Puskas, K.; A1-Awadhi, N.; Balba, M. T.; A1-Daher, R.; Iwabuchi, M.; Kumamoto, S.; Kuwabara, M.; and Sueyoshi, M.: "Exploratory Work on Physical/Chemical Treatment of oil Sludge," The Joint Kuwait-Japanese Symposium on Restoration and Rehabilitation of the Desert Environment, KISR, Kuwait, March 3-4, 1996.

2. Salib, P. F.; Barua, S. K.; and Furimsky, E.: "Retorting of Oil Shale from New Brunswick, Canada," Canad. J. Chem. Engg., Vol. 64, Dec.1986, pp.1001-1007.

3. Li, S. and Qian, J.: "Study of the Pyrolysis of Maoming Oil Shale Lumps: FueI, VOI.70, Dec. 1991, pp.1371-1375.

4. Shu, W.R. and Hartman, kJ: "Thermal Visbreaking of Heavy Oil during Steam Recovery prosesses," Paper SPE 12783 presented in California Regional Meeting, Long Beach, CA, April 11-13, 1984.

Acknowledgment

The Author is grateful to Eng. Mohammed Alshabrawy for the help in summarizing this article

Sucker Rod Pumping System for Deep High Volume Wells

Mohammed Ghareeb
Lufkin Industries

Abstract

Worldwide there are almost 920,000 producing oil wells, about 87% of these wells are operated using different artificial lift methods and roughly distributed as: 71% are producing using beam pumping system, 14% using electrical submersible pumping (ESP), 8% using gas lift and 7% using all other forms of lifting systems.

This study was undertaken using advanced predictive methods, high strength rods, optimum pumping mode, and unit geometry to optimize the performance of beam pumping systems for deep high volumes oil wells. Three geometries of different surface pumping units were analyzed and studied including, conventional, Reverse Mark and Mark II units. Each geometry of those three types has been subjected to different design features that affect torque and different linkages affecting its kinematics behavior. The highest strength sucker rod string, beam unit geometry, stroke length, pumping speed and subsurface pump size were varied and analyzed jointly to obtain optimum pumping parameters capable to produce maximum fluid at different well depths. This study has also considered and applied many other variables including; well depths from 1,000 to 15,000 ft, three different rod grades, water cuts from 0.0 to 100%, different pump sizes from 1.25 to 5.75 in, stroke lengths from 100 to 260 in, and non-API sucker rod grades.

The results indicated that the lifted liquid volumes and pump seating depths for deep wells can be effectively increased using the beam pumping systems. The surface unit geometry has shown a crucial effect of increasing the produced quantity from deep wells. The study recommended using conventional pump unit for shallow depths up to 8,000 ft. The enhanced geometry pumping units of Mark II and reverse Mark have been proven to be the superior type when it comes to dealing with deep high volumes wells because it requires the least torque to lift the same quantity from different well depths. The study also presented successful field applications for deep wells producing high volumes.

Introduction

Downhole pumps are a common means for enhancing the productivity of a well by reducing the bottom hole pressure. Two types of pumps are used including positive-displacement pumps (which include sucker rod pumps and hydraulic piston pumps) and dynamic displacement pumps (Economides et al, 1993).

Beam pumping system is the first and may be the last artificial lift system. A century ago the most universal mechanism for artificially lifting fluid was the standard Shadoof. The earliest documented walking beam and sucker rod pumping system is described in Egyptian historical writing dated 476 AD.

In the past, the ability of beam pumping systems to produce high volumes from deep wells was limited due to two main reasons:

(1) the high rod and fluid loads.

(2) the lack of deep understanding of the behavior of complex sucker rod system and the involved nature of the reservoir with its contained fluids and inflow performance.

Nowadays, the existence of the following elements leaded to producing high volumes of production from deep wells:

87% of oil wells are artificially lifted:

71% beam pumping system

14% electrical submersible pumping

08% gas lift

07% other forms of lifting systems

(1) development of relatively long stroke with enhanced geometry pumping units that have good quality tensile strength sucker rods as well as more accurate predictive software.

(2) accurate on-site monitoring and control tools.

(3) pumping using large plungers with high pumping speeds.

The ability of a sucker rod pumping system to produce a fluid is constrained by:

(1) the stroke length.

(2) the rod free fall from a given well.

(3) the plunger diameter of the bottom-hole pump.

(4) the strength of the sucker rods.

(5) unit geometry.

For any given unit geometry, critical pump speed is controlled by two variables:

(1) stroke length.

(2) the well forces, such as friction, buoyancy, etc., that retard rod fall (Byrd, 1968).

Byrd (1968) reviewed some field studies to conclude the practicality of high volume production with sucker rods. He reported that the new development in pumping units with 240-in maximum stroke had structural capacity exceeds 47,000 lb, with a torque rating greater than 2.5 million in-lb, which is capable of producing quiet high volumes from relatively deep wells. He also indicated that practical sucker rod pumping approaches 13,000 ft, and capacities of producing 5,000 and 6,000 B/D from shallow to medium depths easily. In addition, volumes of 9,500 B/D were considered practical with sucker rod pumping equipment at that time. The study did not cover the rod buckling tendency, as it will be covered in this study.

In the present, the structure and geometry of a modern pumping unit reaches 260-in maximum stroke with structural capacity exceeds 47,000 lb, and the torque rating greater than 2.5 million in lb. The plunger diameter for some bottom-hole pumps (casing type) runs as high as 5.25 in, a bigger size can be built based on the manufacturing capacity. It might be the greatest improvement in the sucker rod, which may have a tensile stress of some 150,000 lb.

Beam pumping system is the first and may be the last artificial lift system. A century ago the most universal mechanism for artificially lifting fluid was the standard Shadoof. The earliest documented walking beam and sucker rod pumping system is described in Egyptian historical writing dated 476 AD.

System Design Considerations

The typical sucker rod system design involves using a predictive computer program (API or wave equation) to generate possible solutions for sizing the surface and subsurface equipment. Based on the field and engineering experiences, if the production predicted by the program is acceptable, without exceeding the equipment limitations and rod running without buckling, then the design is completed.

This study was made using SROD software (Lufkin) to determine the system capabilities to produce maximum practical fluid from different depths, 1000 ft to 15,000 ft. Since sucker rod strength is the limiting factor in high volume beam pumping, the highest strength sucker rod string, the beam unit geometry, stroke length, pumping speed and subsurface pump size were analyzed jointly to obtain optimum pumping parameters to produce maximum fluid at different depths of the well. Table1 presented the criteria used in the design.

Depth	From 1000 to 15,000 ft
Rod grad	C, D and N97
Pumping intake pressure	200 psi
Well head pressure	150 psi
Oil API	40
Gas/Oil ratio	0 - 3000 scf/stb
Water cut	0 - 100 %
Subsurface pump size	1.25-5.75 inch (for the larger plungers, the application may require the use of on-off tools)
Pumping units	Lufkin conventional, Mark-II and reverse mark
Pumping speed	5 - 20 SPM
Stroke length	100 - 260 inch
Sucker rod	All API grads plus N97 with 0.9 service factor

Table. 1. Criteria used in the design.

A number of general assumptions were applied in making these calculations:

(1) In all cases the tubing was considered anchored, thus no tubing stretch.

(2) Casing can accommodate the required tubing size.

The system was designed for three different cases as follows:

(1) All the produced fluid was water with fluid gradient of 0.433 psi/ft.

(2) The system produced fluid with 50% water cut where gas/liquid ratio (GLR) is zero.

(3) The system produced fluid with 100% oil and Gas/Oil ratio (GOR) is zero.

Three different surface pumping units geometries were studied including, conventional, Reverse Mark and Mark II units. Each of these three geometry units has different design features that affect torque and different linkages that affect its kinematics behavior. Because each well is different, one of these unit types may out perform in comparison to the others for a given set of well data and for the end user's design goals. When designing a Beam Pump installation, different geometries were considered to determine the best performance for the intended result.

Result and Discussion

Figure 1 compares the capacity of the three different geometries and indicates that at shallow well depths of 1,000 and 2,000 ft, the conventional unit produces higher production than or at least comparable to the other two types. This

recommendation is also valid up to 6,000 ft well depth. However, at deep well depths greater than 8,000 ft, the production from the three types is very comparable.

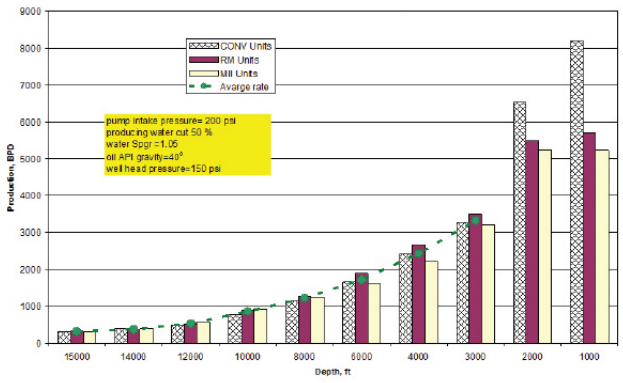


Fig. 1. Comparison the capacities of the three different geometries.

As shown by Figure 1, and as might be expected, in general, in high production rate, shallow wells, the conventional pumping geometry works good and it can handle up to more than 8200 BFPD with the subsurface pump seated at 1000 ft depth and dynamic fluid level about 1500 ft from surface. This value of production is not the end limit of the equipment, unit, rod and tubing all can handle more volume. For example in order to produce 8,200 BFPD the calculated required torque was 1,190,000 in-Ib and the peak polished rod load was 20,346 Ib. Then still there is a room for more torque and structure load In comparison with the current present units which can handle up to 1,820,000 in-Ib and 47,000 peak load.

Consider the rod string condition, the rod string was grade D loaded with 80% of its maximum load. Even the rod still can lift more loads, where still 20% room in that grad and more than 50 % for the ultra high strength rods. The size of the subsurface pump was 5.75 in. All those numbers show that there is no problem of the equipment to handle more volume.

For deep well, high tensile rod string is used in the design. For that high tensile rod string, it is extremely important to design rod string taking into consideration rod handling. If there is any corrosion environment expected, an effective chemical treatment is recommended. However currently in the market, there is a quite high quality sucker rod which can withstand corrosion for a certain limit suck as grade KD 90.

Many studies in the literatures (Derek et al., 1988; Pope, 1993) and field practices (Nolen, 1969; Wan, 1986, Murtha et al, 1987), concluded that the enhanced geometry pumping systems has been proven to be an economically feasible type when the unit is capable to lift fluid form medium to deep wells (+6000 ft) and this type geometry features create a more uniform torque (usually create less peak torque for a given set of well conditions than a conventional unit).

The design shows that fluid lifting capacity of a rod pumping system is limited by several factors. The main limiting factors are:

(1) the pumping speed.
(2) the strength of the rod material.
(3) the structural capacity of the pumping unit.
(4) rod buckling.

The system design accounts for all effects using various pumping parameters having impact on pumping rate and included in the design of the rod string as well. At this point the rod string is designed by setting the rod stresses equal at the top of each taper section for high-strength rod materials. These parameters are checked against the limiting factors:

(1) Peak polished rod load versus the unit's allowable structural load.

(2) Peak net torque vs. the speed reducer's torque rating.

(3) Pumping speed is compared to its critical value by checking the calculated minimum polished rod load. Obviously, critical pumping speed is detected when minimum polished rod load approaches zero as a result of the carrier bar leaving the polished rod clamp.

(4) Rod buckling, Sinker bar is considered for rod string shown tendency of buckling.

Effect of Surface Unit Geometry

The design output match with all published literatures (Allen, 1969; Gibbs, 1977; Murtha et al., 1987; Derek et al. , 1988; Pope, 1993) and field practices (Nolen, 1969; Wan, 1986, Murtha et al, 1987), where all agreed that the enhance geometry pumping systems proved to be the economical type of pumping units lifting fluid form medium to deep wells. Where geometry features of that type create a more uniform torque and thus usually create less peak torque for a given set of well conditions than a conventional unit. It normally requires less motor horsepower and uses less energy than a conventional unit doing the same work. Figures 2, 3 and 4 present a comparison of required torque, peak polished rod load, and required motor power of the three above-mentioned pumping unit's geometries for different well depths, respectively. The comparison was based on attaining fixed target production at three different depths, of 200, 700 and 1,500 BFPD at 5,000, 10,000 and 15,000 ft depth, respectively.

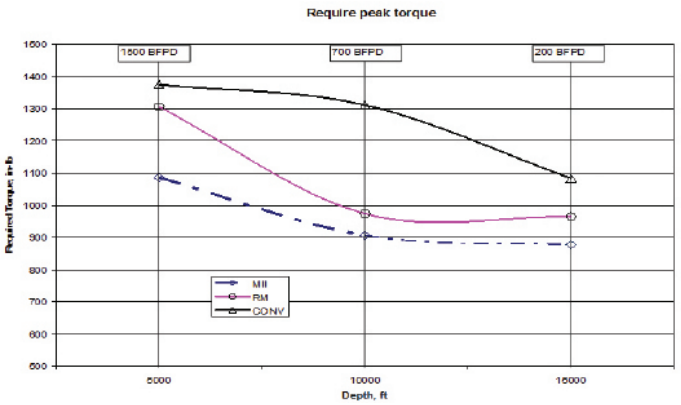


Fig. 2. Required peak torque versus depth.

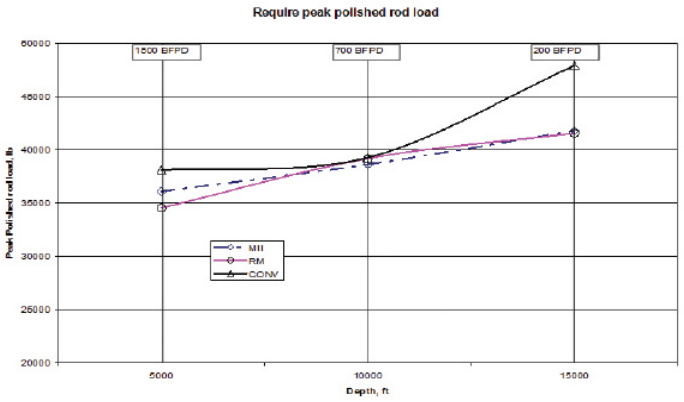


Fig. 3. Required peak polished rod load versus depth.

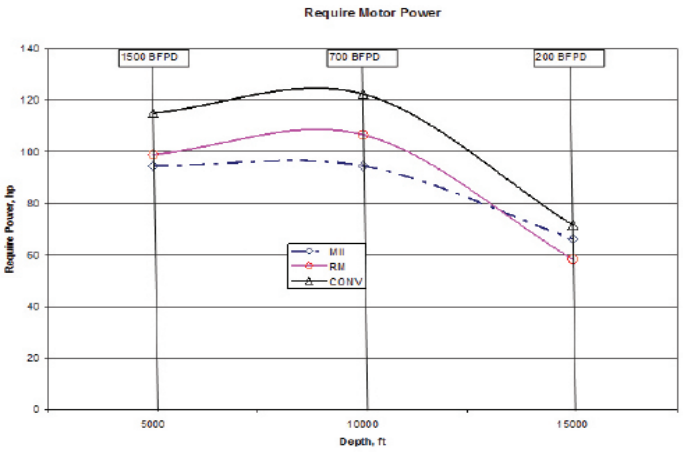


Fig. 4. Required motor power versus depth.

As shown in Figure 2, the MII pumping unit is the superior unit as the least required torque to lift the same quantity from the different depths while the conventional one showed poor performance. This is because, the front mounted Class III lever system geometry of that unit insure optimum torque carrying capacity. The reverse mark geometry lies in the middle between the Mark and the conventional type. With respect to the load as shown in Figure 3, it is shown that up to about 8,000 ft the reverse Mark geometry require the lowest load to lift the same quantities of fluids. More than 8,000 ft and up to about 13,000 ft MII will require less but not far than the RM geometry and still the conventional far than the two geometries. All those reflect in the required motor power as shown by Figure 4.

Conclusions

This simulation study was achieved using actual field data. It analyzed and studied the performance of conventional, Reverse Mark and Mark II pumping units under different well conditions and variable pump characteristics. The following conclusions can be drawn as follows:

(1) The depth from which beam pumping system effectively lift fluid can significantly be increased by using high strength rods, optimum pumping running parameters and enhanced unit geometry.

(2) The problems of lifting high rates from shallow wells are quite different than that of lifting from deep wells. Therefore, the use of modern equipment and operating practices allow fairly large volumes to be pumped.

(3) The conventional pumping unit is recommended for shallow well depths up to 8,000 ft because it provides the highest quantity under the same operating conditions of Mark II and Reserve Mark pumping units.

(4) The Mark II pumping unit has provided the superior lifted quantity than other types of Reverse Mark and conventional ones because it required the least torque to lift the same quantity from different well depths up to 8,000 ft.

(5) Historical cases have proven successful application of producing high volumes from deep wells using different bean pumping systems.

References

1. Takacs, G.: Sucker-Rod Pumping Manual. PennWell Books, Tulsa Oklahoma, 2003.
2. Clegg, J. D. "High-Rate Artificial Lift" Journal of Petroleum Technology (March): 1988, pp. 277-82
3. Lufkin Industries Inc., http://www.lufkin.com/oilfield/index.html
4. Byrd, J. P. High volume Pumping Sucker Rods, SPE 2104, The SPE Eighth Secondary Recovery Symposium, Wichita Falls, TX, USA, May 6-7, 1968,.
5. Byrd, J. P. "Pumping Deep Wells with a Beam and sucker Rod System." SPE 6436. Amarillo, Texas: Deep Drilling and Production Symposium of the Society of Petroleum Engineers, April 17-19, 1977.
6. Economides, M. J., Daniel, A. D., Ehlig-Economides, C. Petroleum Production Systems, Prentice-Hall of Australia, Sydney, 1993.
7. Gott, C. I. "Successful Rod Pumping at 14,500 ft" SPE 12198. San Francisco, California: 58th Annual Technical Conference and Exhibition of the Society of petroleum Engineers, October 5-8, 1983.
8. Ditmore T. L. "Field Operating Experience Using New Ultra-High Strength Sucker Rods" SPE 4536, Fall Meeting of the Society of Petroleum Engineers of AIME, 30 September-3 October, Las Vegas, Nevada, 1973.
9. Lufkin Automation, http://www.lufkinautomation.com/srod.asp

Mohammed Gharib is Eastern Hemisphere Technical Director Artificial lift Applications artificial lift expert - Middle East and North Africa for Lufkin Industries, Inc. Gharib has been with Lufkin for 5 years and has worked in design, optimization, service, and sales. He has also spent a good part of his career analyzing wells and recommending actions to be taken to optimize different artificial lift systems (ESP, Sucker rod, PCP, and Jet) and enhance well performance. He has spent 19 years working with Agiba Petroleum Company before he joined Lufkin. He is a production engineering and operations lecturer for two different universities in Egypt. He is SPE - Egyptian Section program chairperson. He published and presented several technical papers.

The Application of Streamline Reservoir Simulation Calculations

in the Management of Oilfield Scale

Tharwat Fawzy Ragheb
Senior Petro-physicist & Reservior Engineer
British Petroleum; BP

Abstract

Inorganic scale precipitates in oilfield systems such as down hole in the reservoir, in the production flow tubing, and in surface facilities occur because of thermodynamic changes that affect the flowing brines. These changes may be induced by temperature or pressure changes, or by mixing of incompatible brines which may lead to the precipitation of $BaSO_4$ or $SrSO_4$.

The objective of this paper research is to study the application of a streamline simulator that has the appropriate chemistry modeling capabilities to realistic reservoir scenarios. The calculations are performed to demonstrate where and under what conditions scale precipitates take place in the reservoir, and what will be the resulting impact on the chemical composition of the produced brine.

Introduction

Water flooding is a common method for providing pressure support for oil reservoirs, of which certain production problems may arise after water breakthrough. “The main problem arising from water flooding is that of scale formation caused by incompatible brines mixing, which more gradually occurs if the injected water contains ions that further react with ions in the formation water resulting in the precipitation of inorganic scale – thus making the brines incompatible” (Yuan and Todd, 1991).

To understand the previous statement, take for example, if sea water which is rich in sulphate ions is injected into a reservoir with formation water that is rich in barium ions, this will eventually cause the formation of precipitates of barium sulphate in the formation and/or the production wells. “Understanding where and when the scale is more likely to form is very important, since the formation of scale close to or in a production well will reduce its productivity, and in the extreme cases will cause the loss of the well” (Mackay and Sorbie, 2000).

In this paper research, various scenarios will be considered where modeling of in-situ scale precipitation is conducted using the FrontSim reservoir simulation software (FrontSim 2000), this software includes a specialized brine composition and a scale precipitation model to enable such calculations to be made, whilst taking advantage of the reduction in numerical dispersion that may be obtained by performing streamline simulations as opposed to finite different calculations.

Streamline Simulation

Streamline simulation as stated by (Milliken et al, 2000 and Thierry et al., 1996) is an alternative approach to the conventional finite difference technique. The modeling of fluid flow in hydrocarbon reservoirs as stated by (Mattax and Dalton, 1990) is an Implicit Pressure Explicit Saturation method of simulation in which initially, as with finite difference models, the pressure field is solved implicitly over the whole grid. The next step is where the difference arises, in that the pressure field is then used to trace the path that a single fluid would follow as it flows across the reservoir producing streamlines. The saturations are

“Understanding where and when the scale is more likely to form is very important, since the formation of scale close to or in a production well will reduce its productivity, and in the extreme cases will cause the loss of the well” (Mackay and Sorbie, 2000)

then mapped from the grid onto the streamlines, flow along the streamlines is calculated, and then the updated saturations are mapped back to the model grid. "FrontSim" performs this calculation using front tracking in which, the fluid flow is modeled as a series of saturation fronts moving along the stream lines. This approach has two important features giving the advantage that the reservoir model can be coarser without smearing out the zone where the ion concentration has been depleted. This can be a significant handicap in conventional finite difference calculations of scale precipitation (Bertero et al, 1998; Sorbie and Mackay, 2000).

An Example of The Calculations made

A series of one-dimensional, two-dimensional (Areal and vertical) and three-dimensional calculations, in addition to sensitivity runs to test the impact of formation water and injection water compositions have been performed. However, in this paper we present results for a single formation water composition, with a Ba^{+2} concentration of 80 mg/l which when mixed with full sulphate seawater would give a moderate scaling risk, and a base case injection water concentration of SO_4^{-2} of 40 mg/l which corresponds to the typical concentration of SO_4^{-2} that might be expected from a Sulphate Reduction Plant. This run is compared with the results of injecting full sulphate seawater in which, the SO_4^{-2} concentration is 2800 mg/l.

The Results of The One-Dimensional Modeling

This test model is a one dimensional model consisting of one hundred cells. The test consists of a connate water saturation of 0.25, and the permeability and porosity are 100 mD and 20% respectively, which are uniform throughout the model. The results of this calculation as represented in Figure 1 show a rapid increase in seawater fraction after water breakthrough takes place, which results in a rapid increase in sulphate concentration at the production well. Considering Figure 2, we observe that the Ba^{+2} concentration decreases very rapidly when SO_4^{-2} breaks through. However, note that there is not a significant difference between barium and sulphate concentrations with and without the precipitation calculations; therefore little in-situ precipitation must be occurring. This is a consequence of the fact that in a one-dimensional system there is a little mixing of injection and formation brines.

"The main problem arising from water flooding is that of scale formation caused by incompatible brines mixing, which more gradually occurs if the injected water contains ions that further react with ions in the formation water resulting in the precipitation of inorganic scale – thus making the brines incompatible" (Yuan and Todd, 1991)

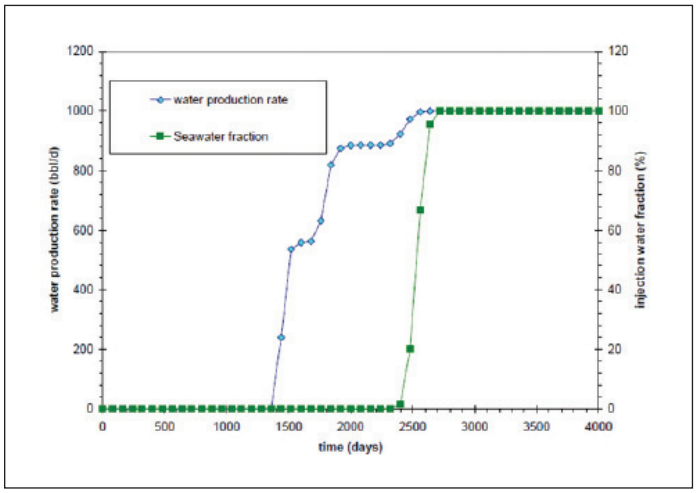


Fig. 1

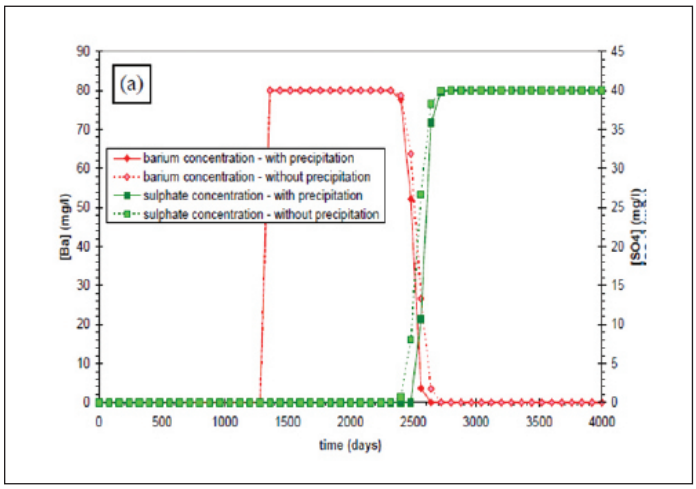


Fig. 2

The Results of The Two-Dimensional (Areal) Modeling

This test model is a two-dimensional model consisting of 20x20x1 cells. The model has randomly varying permeability values consisting also of a connate water saturation of 0.25. The results of this model are represented in Figure 3, which shows a more gradual increase in seawater fraction after water breakthrough takes place. Figure 4 represents a significant amount of precipitation that may be observed around the producer, also there is a longer time period of co-production of Ba^{+2} and SO_4^{-2} ions at the production well in this two-dimensional areal displacement model indicating a greater degree of mixing.

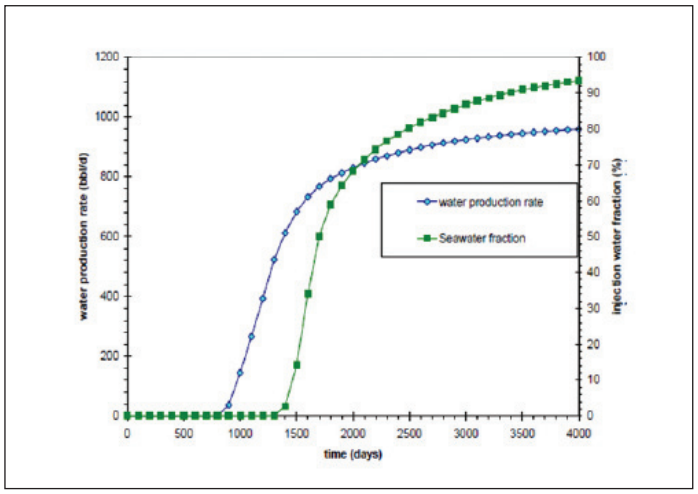


Fig. 3

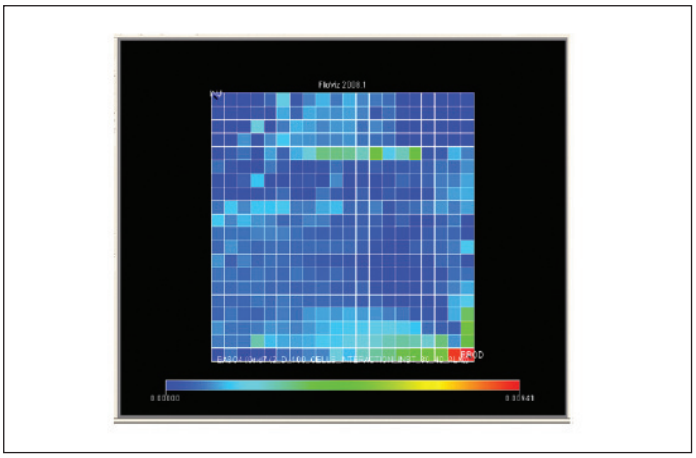


Fig. 4

The Results of The Two-Dimensional (Vertical) Modeling

This test model is a two-dimensional model consisting of 20x1x10 cells; again, the model has randomly varying permeability values, this time constrained by layers. The results of this model represented in Figure 5, have shown steeper increase in seawater fraction after water breakthrough takes place than the 2D areal model. There is a smaller difference between the predicted concentrations with and without in-situ precipitation, meaning that there is less precipitation in the reservoir than in the 2D areal system. The impact of this is that there is a greater amount of mixing in the well itself due to brines in different layers breaking through at different times.

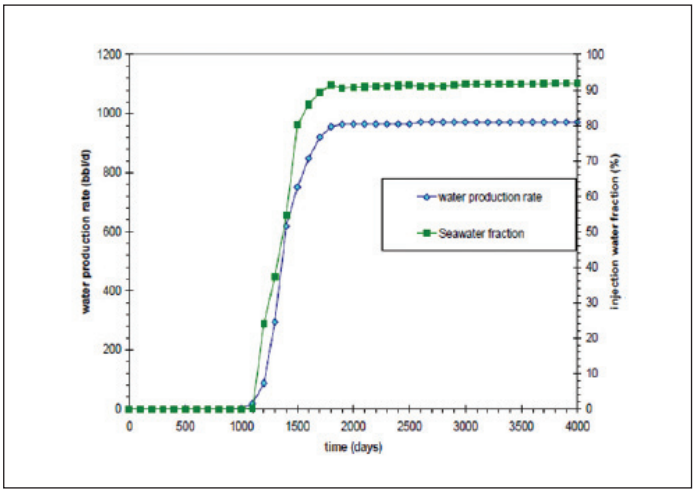


Fig. 5

The Results of The Three-Dimensional Modeling:

This test model is a three-dimensional model consisting of a 20x20x10 cells in a quarter five spot pattern with a connate water saturation of 0.25. Various sensitivities have been run to test the impact of injected SO_4^{-2} concentration at 40, 80 and 2800 mg/l, but the concentration of Ba^{+2} is kept constant at 80 mg/l. We observe in Figure 6 a smaller difference between the predicted concentrations with and without in-situ precipitation than occurs with finite difference models (Mackay, 2003a, Mackay, 2003b, Mackay et al, 2003). The reason why differences arise is because streamline simulation introduces less by way of dispersion effects than the finite difference models used previously. In the 2800 mg/l case (corresponding to injection of full sulphate seawater), there is now an abundance of SO_4^{-2} ions, so proportionally more Ba^{+2} ions are stripped by the reaction (there are more SO_4^{-2} ions available to react with Ba^{+2} ions).

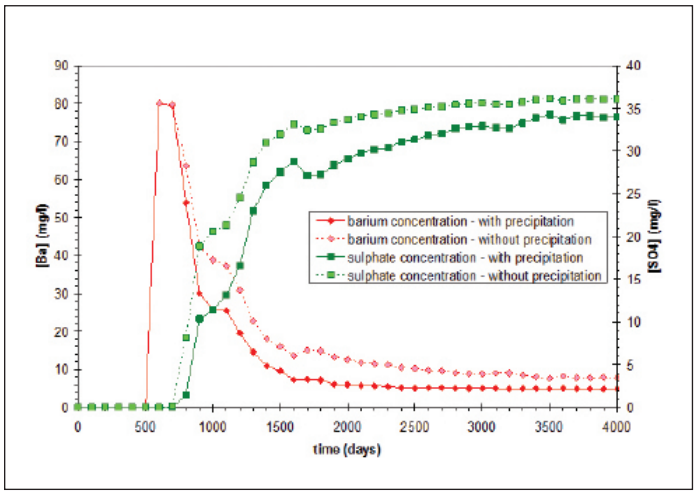


Fig. 6

Conclusions

(1) This study considers the in-situ precipitation of barium sulphate scale, which may occur due to the mixing of two incompatible brines, this often occurs when injecting seawater into a reservoir to maintain pressure above bubble point, sweep the hydrocarbons towards the producers, and provide lift energy at the producers.

(2) We have shown by means of a simple model (one-dimensional model) that there is no significant difference between the barium and sulfate concentration with and without the precipitation calculations, and hence little in-situ precipitation occurs in a simple one-dimensional (Buckley-Leverett type) displacement flood.

(3) We have run two different two-dimensional models: one is areal and the other is vertical. The main result of these calculations is that the two-dimensional vertical model shows a steeper increase in seawater fraction after water breakthrough than the two-dimensional areal model, indicating greater mixing hence (in-situ deposition) due to areal streamlining compared to vertical layering.

(4) In the three-dimensional models we observe that there is a smaller difference between the predicted concentrations with and without in-situ precipitation than occurs with finite difference models (Mackay, 2003a, Mackay, 2003b, Mackay et al, 2003). We also note that the relative loss of SO_4^{-2} ions in-situ is now negligible.

References

1. Appleyard, J.R. and Cheshire, I.M.: "The Cascade Method for Accelerated Convergence in Implicit Simulators", SPE paper 12804 presented at the 1982 European Petroleum Conference, London, UK, Oct. 25-28.
2. Bertero, L., Chierici, G.L., Gotardi, G., Mesini, E. and Mormino, G.: "Chemical Equilibrium Models: Their Use in Simulating the Injection of Incompatible Waters" SPE Reservoir Engineering, pp.288-294, Feb.1998.
3. FrontSim 2008, Reference Manual, Schlumberger GeoQuest Reservoir Technologies, 2008.
4. Mackay, E.J.: "Modelling of In-Situ Scale Deposition: the Impact of Reservoir and Well Geometries and Kinetic Reaction Rates" SPE paper 81830, SPE Prod. & Facilities (February 2003) 18 (1) 45-56.

Sahara Petroleum Services Company S.A.E "SAPESCO" is a regional leader with over twenty five of experience in providing the oil and gas industry with a wide range of oil field using state-of-the-art techniques and proven technologies. SAPESCO is an indigenous Egyptian multi-discipline oilfield solutions provider operating under global standards while continuously raising the benchmark of customer satisfaction.

SAPESCO's headquarters are located in Cairo-Egypt with ongoing operations and branches in Syria, Libya, Kingdom Of Saudi Arabia, Abu Dhabi & Iraq.

SAPESCO 's operational bases are strategically located in Cairo, in the heart of main oil & gas fields with local support infrastructure, positioned to provide a rapid response to clients' operational requirements.

Now SAPESCO has over 2000 employees working in six countries providing a variety of oilfield services. SAPESCO's operating divisions cover the widest spectrum of services currently available in the region carrying out the most sophisticated upstream and downstream services, always with the highest regard to Health, Safety and the Environment.

Today, SAPESCO offers a broad array of services and integrated solutions for oil and gas exploration, development and production with ongoing operations and branches covering the MENA region. SAPESCO's effective and expansive existence provides localized access points that meet demanding situations with the shortest lead times.

- 1990 The 1st capital intensive service provider in the region.
- 1993 The 1st offshore coil pipeline in the Middle East (2nd in the world).
- 1994 The 1st geographical expansion by opening the Syria branch.
- 1996 The 1st in applying the drill motor on coil tubing.
- 2000 The 1st Pre-Commission Service in the Egyptian Gas Industry.
- 2001 The 1st pressure control inspection & certification facility in the region.
- 2003 The 1st DP vessel - in partnership with DOF.
- 2004 The 1st local cased hole contract in Iraq with Oapco Co..
- 2003-05 The 1st to manufacture & export > 50,000 m of slotted pipe in Iraq.
- 2005 The 1st Egyptian work class ROV.
- 2008 The 1st integrated offshore project in Libya (>20 Mill $).
- 2009 The 1st offshore well testing by a local player in a hazardous field (16% H_2S).
- 2009 The 1st offshore regional player in Turkey (Black Sea).
- 2009 Member of the Egyptian Consortium established to work with Eni in Iraq.

SAPESCO
SAHARA PETROLEUM SERVICES
WWW.SAPESCO.COM

Mr. Wael Sharabash

Drilling & Measurement Operations Manager, East Siberia Region, Russia Schlumberger*

Mr. Sharabash, we are pretty sure that most of our readers are well aware of your reputation, but to those minority who do not know, will you be kind enough to share your professional background with us?

I am a graduate of Ain Shams University. I graduated in 1998 with a B.Sc. in Electronics & Telecommunications Engineering. I kicked off my career as an application engineer with a company that specialized in control systems. However, my dream at the time was to join the Telecom industry which came true when I joined Motorola only to realize it was not the job that I dreamed of in terms of job satisfaction, career progression and of course compensation! In 2000, I decided to take a shift in my career by applying to work for Schlumberger as a Field Engineer. I started in December 2000 as a Field Engineer Trainee with the Drilling & Measurements segment as MLWD engineer. My field career with Schlumberger lasted approximately three years during which I worked in three different locations (Egypt, Sudan & Qatar). I started my office-based assignments as an Engineer-In-Charge and Operations Support Engineer in Qatar. Then I was transferred to Al-Khobar, Saudi Arabia as Training, Development & Staffing Manager.

Later on I was moved back to operations as Field Service Manager in the same location until almost two years ago when I was transferred back to my home country Egypt as Recruiting Manager.

Few years back you took a career changing decision, as you stood on the cross roads between technical (engineering) and managerial paths, what were the factors that helped you take such a huge drift?

Let me tell you something that I would like to share with all fresh outs and that is; your engineering major does not necessarily dictate your engineering career. This is a fact of life in today's business environment. Universities provide engineers with the engineering basics they require to penetrate the job market or to be specific a freshly graduated

***At the time our team interviewed Mr. Wael, he used to fill the position of the Recruiting Manager, East Africa & East Mediterranean, Egypt - Regional position handling Egypt, Sudan, Syria, Jordan, Lebanon, and Iraq.**

engineer should posses the engineering way of thinking and scientific approach to the problem at hand regardless of his or her major. Now as they advance from graduation to work there is obviously a technical career they have to undergo first. Throughout this technical career both the graduates and their employers will come to discover and realize the true potentials of those graduates. Once true potential is realized, proper profiling against the job vacancies in the organization can be achieved. There are engineers who are technically oriented and would like to remain on the technical side of engineering, while others may prefer to pursue the academic side towards their M.Sc. and eventually PhD. degrees and there are those who show both the interest and potential to be in management. The key here is to honestly evaluate your own abilities and identify your true potential accordingly. As far as I am personally concerned, if I could go back in time, I would have still made the same choices with the exception of only one change; I would have applied to join Schlumberger at a much earlier stage in my career, i.e., right after graduation.

When we read your professional past, we could not help but to notice that shortly after graduation you lined up to join two iconic industry pioneers Motorola and SLB , each in its field, looking back; in your opinion, what was the pre-graduation methodology that secured you that career path ?

I used to utilize the summer vacations in such a way to prepare myself for the job market after graduation. So college was to prepare myself academically to get my degree, however summer internships were definitely the gateway to secure a good job after getting that degree. My first internship was in the HVAC field where I used to work with the technicians on chillers and air handling units installations. My second internship was related to electrical control panels design. During my third summer vacation in college I managed to secure an internship in the States. Surprisingly this time the internship was not engineeringrelated as it was in the travel business! Nevertheless, the experiences and skills I gained were remarkable to the extent that I made sure to travel to the States every summer afterwards for an internship. During those internships – engineering or not - I have become aware of the fact that multinational organizations offer the best environment for a successful career and therefore I focused on the skills such organizations target in their potential recruits and developed them. In short, summer internships diversified my portfolio in a way that developed both my technical and non-technical skills to a level that allowed me to successfully pass the recruiting process of multinational organizations.

During your journey with SLB, you have been to a lot of places, including Saudi Arabia – Qatar – Sudan – Egypt, how was that beneficial to you both personally and career wise?

I like to think that a career with Schlumberger is a four dimensional (4D) career. To clarify, the career moves forward on different fronts to enhance the qualifications of the employee both professionally and personally. The first dimension is geographical where Schlumberger employees are expected to move around whenever and wherever our clients need us. The second and third dimensions are somehow interrelated and those are the function within the organization and the product associated with this function. For instance my previous job as Field Service Manager had a totally different function from what I do today as Recruiting Manager; the same applies on the product of my work or the deliverables. The last dimension is obviously time which is required to build a career. Looking closer at those four dimensions: Geography, Function, Product and Time gives you a clear picture how a career with Schlumberger can be beneficial.

It is always a wise move to know as much as you possibly can about a certain company and its recruitment processes before applying for a position there, what can you tell us about the processes you have, as SLB is well known for its tough recruitment system and its shockingly high standards, we are sure that our readers both under and post graduates would be extremely interested in knowing the criteria you refer to in hiring and accepting applicants?

> **"Schlumberger's #1 value is people. People who thrive on the challenge to excel in any environment and their dedication to safety and customer service worldwide is our greatest strength."**

Well if you look at 10 newly recruited engineers in Schlumberger I assure you that you will see 10 different profiles. If that tells you one thing, it is that we do not have a checklist of qualifications and/or skills that we have to verify in each applicant before a hiring decision is made. However, if I would define the common factor(s) among all those recruits, it will definitely be career ambition, innovation and true open mind. Also talent, specifically a strong blend of cognitive thinking and interpersonal skills, is also a critical criterion. Schlumberger's #1 value is people. People who thrive on the challenge to excel in any environment and their dedication to safety and customer service worldwide is our greatest strength. A new comer in Schlumberger will not have to wait to test his or her ability as they are expected to perform from day one.

As the word's leading name in oilfield services, clients expect us to deliver results under the most demanding situations in business. Therefore we simply target the best graduates, i.e.,

crème de la crème!

May you tell us about career diverting GFE and COR "Career Orientation Review"?

"GFE" stands for General Field Engineer which is supposed to be the ceiling promotion for our field engineers before they make it to management, meaning that our engineers progress starting from being trainees, when they first join SLB, to become field engineers, senior field engineers and eventually end up to be General Field Engineers. They are expected to achieve that goal within 36 months from their joining date. For SLB to recognize anyone as a GFE, they have to acquire minimum knowledge that certifies them to be worthy of that title and that knowledge is not only technical, but also goes to a lot of other non-technical aspects of the job. Therefore, our field engineers have to go through what we call "GFE Controls", which is simply a set of interviews with several number of our departments' managers to stand on the engineers' ability to comprehend and understand the big picture behind what they are doing in the front line, not only that but also to measure their understanding of Schlumberger policies and standards. After they manage to successfully pass these interviews, they have to present a GFE project to the management team, much like the graduation project you do in college, only this project has to add value to SLB or the client, better yet, both. As for the "COR" which stands for Career Orientation Review, it is a review that should be done, more or less, every 3 to 5 years in the engineer's career. It is basically done to align the employee career preferences with the company preferences. In other words, it is a process through which both the employee and the company get to explore the career opportunities available or may be available that would be in the best interest of both the employee and the company. Obviously the possible career opportunities discussed in CORs are business-driven and must make business sense as well.

As a recruitment manager for quite some time now, you must have detected a common pattern of the most common mistakes that candidates slip in during interviews or on their resumes, what are those mistakes and what is the best way to avoid them?

Generally speaking, regarding the mistakes of resume writing, I believe that a lot of applicants do not even take time to check what type of format they should be using as fresh graduates. I come along many fresh graduates' resumes that have the same format as that of a University Professor. They are missing the point that the resume's purpose - especially for a fresh graduate - is only to get you to the interview stage, not to land you a job opportunity. Based on my experience; for fresh graduates, 4 to 5 pages resumes are definitely not recommended. A two page resume should be more than enough for a fresh graduate. It is also of a great importance to show the extracurricular activities they have participated in outside of the academic cycle.

As for the interviews, the most common mistake I come across is lack of preparation for the interview. Sometimes I come across interviewees that only visited Schlumberger website once when they applied online for the job but never took the time to explore other links within the website! Applicants must understand that it is very normal to be asked questions about the company you are applying for during the interview.

The market status is very shaky and unsettled since the beginning of the global economic crisis, how did that affect your recruitment criteria, and most importantly, what are the new policies that was introduced to your layoffs processes here at SLB to adapt to this economical rollercoaster?

Obviously recruiting numbers last year were low compared to 2008 & 2007. The reduced objectives for 2009 constituted a major challenge in such a way that the immense pressure to ensure 'quality joins' in 2007 & 2008 gave way to only 'best quality joins' in 2009.

Headcount reduction is a normal exercise that all companies have to go through whenever there is a downturn. Obviously 2009 was no exception. That being said, I must highlight that Schlumberger is a performance-based company and therefore our culture is meritocratic.

Last but not least, we are interested in knowing your opinion about the importance of organizations such SPE and what is your advice for us to ensure that we keep on progressing as an SPE student chapter?

I think that this, student associations I mean, is what we lacked about 10 years ago, the bridging between academia and industry. Even if it did exist back then, it also took the form of lectures, drawing eventually less and less attention to it. On the other hand; what you, as a students' chapter, are doing today is a much better tool in sealing the gap between academic lives and your -soon to be- career lives, and it is definitely required as it gives students a glimpse on what the industry is looking for, giving you a rare chance to stand on solid ground as you enter the job market, as by the time you will graduate, you would have already sat down with different people from the industry, which will allow you to make an informed decision regarding your future. What you are doing now is very vital, keep it up, consume more time in it, if you can of course, as it has to go in parallel with your studies. I am thrilled to see it actually happening. There has been a noticeable increase in activities from both CU's and SCU's SPE students' chapters, so obviously SPE is pretty active these days and I honestly hope to see this with other engineering disciplines here in Egypt.

Keep up the good work!

Quick Take

SLB: A lifestyle where equal opportunity and global citizenship is a reality.

Innovation: I see it happening on a day to day basis in SLB.

Future's energy: Whatever the future of energy is going to be, I am certain that SLB will be a major player.

6 TIPS FOR A SUCCESSFUL ENGINEER

The petroleum industry has had a long record of achievements in developing technologies that have made a significant breakthrough in different technologies, to address the twin challenges of identifying and developing the next generation of leadership, and assigning its most talented people to the most strategic projects. The lack of talent is one of the top business obstacles facing the entire oil and gas industry, whilst the demand of identifying those with specific technical skills or those who have the aptitude to learn new skills has increased greatly. The one may wonder how to keep up with the current demands of the market especially that the market's standards became very high and sophisticated. In the following paragraphs, there are some tips for engineers which might become handy.

TIP 1: READ

Knowledge is power, and to have knowledge the one must have information which can only be possessed by reading, and with today's available sources the information is easy to reach. Gather as much information and researches about the field you are working in, and read them carefully in order to have the technical information in theory and its practical application. Try to know everything regardless how small it is, this will make you aware of the instructions you are giving and above all will have the power of persuasion.

TIP 2: RECORD

At the beginning of your career the lack of experience will make you fall in some mistakes, don't be depressed, but write them down and write the causes and the errors impact. The difference between successful persons and the none successful ones is that they write down their mistakes to learn from them and above all, not to fall in the same mistakes again.

TIP 3: BE RESPONSILBLE

Having a high sense of responsibility is a motivation which gives us a push forward, it will also make your work not only done, but will also monitor your work and make sure that it's going correctly.

TIP 4: DEVELOP YOUR SKILLS AND LEARN NEW ONES

This tip will only come into action as a result of reading and applying, each one of us has got a specific skill but you just need to identify it and to figure out how to put it into use to make yourself unique among the others. Through time you will gain experience and things will start to become clear, then and only then your vision will be clear and with vision come ideas.

TIP 5: PLAN

It's the most important tip for anyone working in any field. The plan is your map, to get ahead in your career you must have a clear, reasonable, ambitious, and an achievable plan. Without a clear map in your mind you might lose your way to success.

TIP 6: MANAGE YOUR TIME

Time could be your enemy or your friend, and it's better to make friends than enemies. Manage your time between different activities, and concentrate on the results not on being busy, this way you can get the most promising results.

At the end, we would like to add that each one of us has got special talents and abilities. If one could develop them properly, he can use them to achieve all his goals in life, and if you are committed to mastering the circumstances of life, to realizing the dreams and leading a fulfilling and creative life, you must uncover these special talents and abilities and dedicate yourself to developing and sharpening them.

Developing Oil Fields with Down-Hole Water Sink (DWS) Technique

Economical Feasibility Study using Simulation Model

Amr A. Essa
Teaching Assisstant
School of Sciences and Engineering
American University in Cairo; AUC

Young talented creative minds are the main artery that feeds the success of any industry, the inexhaustible spring of innovation that keeps the world rapidly growing and spinning around us, here at this magazine we are trying to be the beacon that shades the light on those minds.

INTRODUCTION

Water coning is one of the most critical problems that occur in many oil fields. Water coning is usually caused by large drawdown in the oil bearing zones where the reservoir has active bottom water drive.

The conventional method that is used to prevent or delay water coning is completing the upper section of the pay zone in question and producing with a rate below the critical rate. However, producing oil below its critical rate has proven to be not economical. Luckily, alternative methods have been investigated by many authors such as down-hole water sink (DWS) completion. The DWS primary mechanism is done by giving an adversary drawdown pressure in the oil zone and producing the water separately from the water zone as a dual completion configuration (above and below the oil water contact). Moreover, the drawdown pressure created in the water would allow higher oil production rate. The success key of DWS is a segregated flow in which only oil is produced from the top perforation and only water is produced from bottom perforation. So a stable oil water contact can be maintained throughout the production life. On the other hand, successful application of DWS requires massive water production which consumes the reservoir energy and cause severe pressure drop.

In this article, economical feasibility study is done on developing oil fields with DWS technique. Additional costs of dual completion, water handling, maintenance; necessity of water injection to maintain the reservoir pressure, etc, is compared to the profit gained from higher production rate and higher recovery. The final objective is to decide how effective is the DWS technique and when it is recommended to use it, i.e., to put the criteria for using this technique. The study is done on a simulation model of chosen sector in Balaiem marine oil field-Zone 2. Simulation model is built using Schlumberger's Eclipse 100 simulator.

DOWN HOLE WATER SINK COMPLETION (DWS)

This method uses a dual completion configuration (above and below the oil water contact). In this configuration the well section above OWC is completed in the oil bearing zone and produces oil, while the well section below OWC is completed in the water saturated zone which serves as a drain to control the rise of the water cone. Schematic comparison between the conventional completion (single completion) and the DWS completion is shown in Fig.1 which illustrates one of the DWS completion types that can accommodate the separated flow of oil and water, producing oil from the top perforation through annulus and producing

water from the bottom perforation through the tubing.

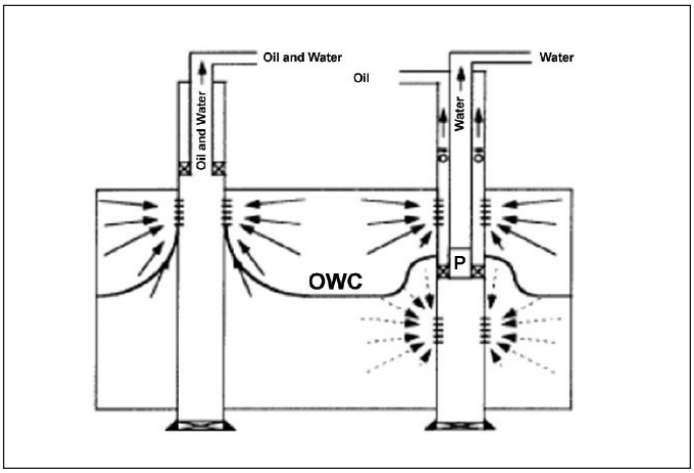


Fig. 1

Coning control is performed by adjusting water production rate to oil production rate in order to prevent the water cone from breaking through the oil into the oil perforations. Physically, water perforations alter the flow potential field around the well so that at each point, the upward vertical component of viscous force generated by the flow into the upper perforations is reduced by the value of the downward vertical component of the second viscous force generated by the flow into the lower perforations. At equilibrium, a stable water cone is maintained around and below the oil producing perforations. The result is that the water cone is suppressed and oil water contact is stabilized. Fig.2.

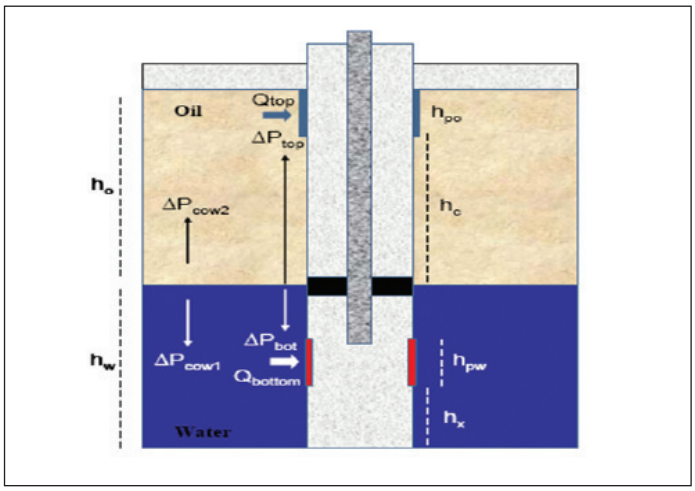


Fig. 2

There are several potential advantages of this method:
(1) Oil production rate increases without water breakthrough.
(2) Well life extends far beyond its value without coning control.
(3) Oil recovery per well (and for the whole reservoir) increases due to the following mechanisms:

A. Production can be continued with high levels of static OWC (caused by the bottom water drive invasion), even when this level reaches the oil perforations

B. Well productivity will be highbecause the near-well zone permeability to oil is not reduced by water encroachment.

(4) Produced water will not be contaminated with crude oil, de-emulsifiers and other agents used in oil production. Therefore, it will more likely meet effluent discharge limitations imposed by the environmental regulations in the area.
(5) The water/oil ratio will be reduced with the new method.

The purpose of this study is to evaluate the coning control potential of this method, as well as to compare its performance to the conventional method of oil production under the conditions of bottom water drive. Mathematical simulation is used to predict the method's performance.

Performance of Down Hole Water Sink

The performance can be understood by the inflow performance relationship (IPW) Fig.3. It is a plot of water drainage from the bottom perforations verses oil production from the top perforations. The area inside the IPW defines production schedules for segregated inflows of oil and water into the well. The areas above the IPW define production schedules for reversed coning i.e. oil breakthrough into the water drainage completion. The areas below the IPW define production schedules for water breakthrough to the oil completion. For example, consider a well in which water drainage from bottom perforation is equal to zero (equivalent to conventional completion). From the IPW, this well can produce oil from top perforations with maximum flow rate of 58 bbl/day which is critical rate. Above this value, water cone begins to form and the production is in the water coning area. If water is drained from bottom perforations with a flow rate of about 400 bbl/day, water cone will be suppressed and well can produce oil with higher rate of about 90 bbl/day without water coning. Higher water drainage from water sink would allow even higher production rate of oil. However, this is limited where very high water drainage would cause reverse coning. IPW is generated using simulation models.

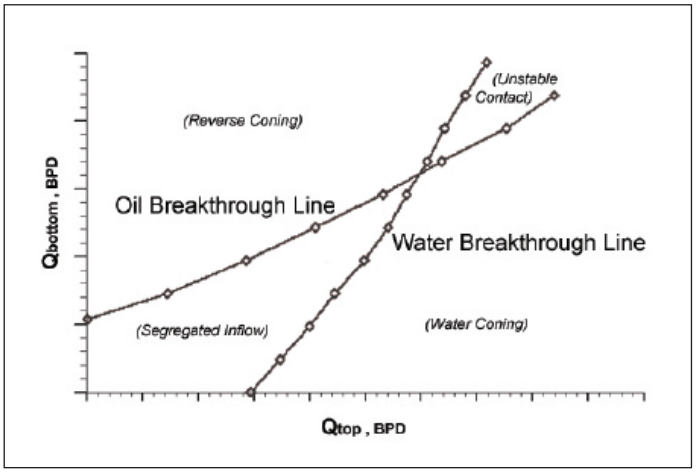


Fig. 3

Optimization of Down Hole Water Sink

Down water sink can be considered as active mechanism to control water coning. Using this technique, we can have almost a total control over the water cone. However, successful application of DWS requires massive water production which consumes the reservoir energy and causes severe pressure drop. So water injection becomes necessary. All these factors and some other represent additional costs to the operator; therefore the process must be optimized to achieve effective and economical operation.

The following are the factors that affect (DWS) performance:
(1) Perforations Locations.
(2) Perforation Thicknesses.
(3) Oil and Water Flow Rates.

ECONOMICAL FEASIBILITY STUDY

This section describes the results of economical feasibility study on developing oil field with down water sink technology. Additional costs of dual completion, water handling, maintenance; necessity of water injection to maintain the reservoir pressure, etc, is compared to the profit gained from higher production rate and higher recovery from application of DWS. Finally we can decide how effective is the DWS technique and when it is recommended to use it i.e. to put the criteria of using this technique. The study is done on a simulation model of chosen sector in Balaiem marine oil field-Zone 2. Simulation model is built using Schlumberger Eclipse 100 simulator.

Runs Description

Evaluation of DWS is done according to the following scenario: Wells (in both completions) are controlled to produce maximum available production with 0% water cut. Water from bottom perforation is re-injected into the formation to maintain the pressure. The question which arises is "Does the profit gained from higher recovery cover the cost of DWS and make additional profit?" Results are discussed in the next section. A fact has to be mentioned here that wells don't operate at zero water cut in reality. This fact doesn't affect the result of the study because at any given value of water cut, the production rate using DWS will remain higher.

Results

Simulation is run for 25 years with two producers & two injectors. Initial production rate for conventional and DWS completions was 500 bbl/day and 1000 bbl/day respectively, production rate is reduced progressively by the simulator to maintain zero water cut. Generally, production rate in case of DWS is twice as that of conventional completion. Total field oil production was 12,223,897 bbl, 6,142,783 bbl for DWS and conventional completion respectively.

Fig. 4 and Fig. 5 show respectively how the wells' oil production rate and total field oil production varies with time depending on whether the completion technique is conventional or DWS.

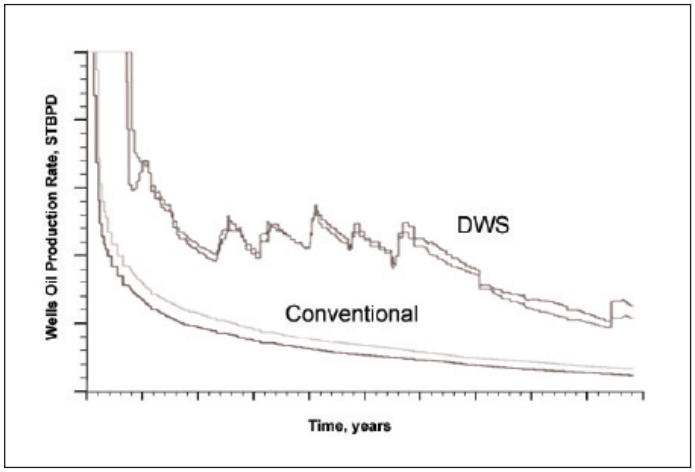


Fig. 4

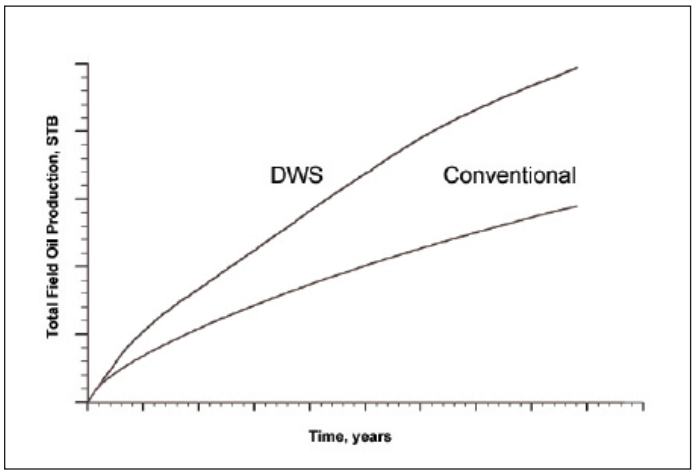


Fig. 5

Given the information in Table 1:

	Conventional	DWS
Oil Price, $/bbl	75	75
Cost of water Injection, $/bbl	no injection required	0.25
Cost of water separation, $/bbl	0.50	0.50
Annual maintenance cost, $	10,000	12,000
Add perforation job, $	no add. perf. required	650,000 (after 6 years)
Drilling cost, $	6,000,000	6,000,000
Completion cost, $	500,000	1,000,000
Interest rate, %	10	10

Table. 1

After the simulator run, results were summarized in Table 2:

	Conventional	DWS
Total oil production rate, bpd	6,142,783	12,223,897
Total water production rate, bpd	25,446	267,418,770
Final field pressure, psi	4300	3000
Discounted cumulative profit, $	167,126,69	292,309,046

Table. 2

According to this result, developing such fields using DWS is strongly recommended as it can increase the ultimate recovery and/or accelerate the production. Production acceleration can be of great importance especially in field with related risk issues.

However, it should always be remembered that the story is no more than optimization process, the main objective is to achieve the best performance and the most economical. Therefore, this result is not applicable to all fields as it may be uneconomical in other fields. The first criteria for DWS application are high pressure reservoirs with active water drive.

ChapterNews

SPE Suez's Employment Fair (SSEF)

Wait for our employment fair that was postponed on the light of the situation in Egypt as we preferred to reallocate our assets and efforts towards helping in the recovery of our country. This fair will be for petroleum and non-petroleum related industries in the fields of engineering, accounting and human resources. Providing an environment where chances for different companies to meet their needs and for all graduates, students and experienced individuals who are interested to find an appropriate opportunity to apply for a job at the participating companies or internship opportunities for students are available, while companies will be given the opportunity to choose from a wide variety of graduates and undergraduates with the availability of interviewing areas (if wanted). And about the venue, it's going to be held at an open air area at one of the most amazing places in Cairo (Intercontinental City Stars - Cairo). The fair will take place beside the lake where the SPE SCU employment day will offer a place for recruiting, collecting candidates, CVs and handing out your publications.

ADIPEC 2010

ADIPEC 2010, the 14th Abu Dhabi International Petroleum Exhibition and Conference, which was attended by the former SPE SCU president Ahmed Magdy was held in Abu Dhabi aiming at gathering the largest number possible of national and international oil producers, major international service companies and international manufacturers covering all segments of the industry. At the center of the oil-generating region of the world along with easy access to Saudi Arabia, Abu Dhabi is the best place to hold ADIPEC. Hundreds of U.S. companies are already present and prospering in the Gulf and the demand for U.S. quality products is supported by incredible financial resources.

SPE Academy

SPE Academy crew have been home and dry to come back in a new dress organizing courses and workshops that are held by industry experts and students that complement their efforts to meet the needs of the attendants and help them in gaining the best out of these courses and workshops. SPE Academy crew successfully held the courses like IDP (Integrated Drilling Package), Stuck Pipe, Pump Technology, Petroleum Products Treatment, and Petroleum Production Facilities.

Gold Standard Status Award

Gold standard status award is a prestigious award that was given to 15 chapters only all over the world out of 191 chapters. The first time to be given to an Egyptian chapter, and the only chapter, "that means it is the best chapter in Egypt 2009/2010" Suez Canal University Student Chapter is on the top of the middle east ranking for the gold standard awarded chapters "only five chapters".

Miscellaneous

E-Library: It's no longer hard to search for references with SPE E-library in our booth.

English Club: Think, speak, present, and share your ideas in English. Just participate!

Paper contest: Winning the second place in the Sub-regional SPE Paper Contest.

Workshops: The first steps in graphical and web design with our workshops.

Training for All Program: Providing about 70 internship opportunities (15 SLB, 11 Halliburton, 10 Agiba and so on).

Learn & Lead: Enhancing communication, presentation, negotiation, and team work skills with our Learn & Lead Council.

MOC (Mediterranean Offshore Conference) - May 2010: Sharing knowledge and experience between students, companies' representatives, and engineers.

Petrel Simulation Software

Ahmed H. Abdul'aal
Faculty of Petroleum and Mining Engineering
Suez Canal University

Industrial obstacles and challenges are demeaned everyday by the virtue of new technological advances and engineering breakthroughs. The role of those wonder solutions is increasing with a head spinning speed. The mark of a true successful engineer is to always be up to date, tirelessly catching up with a firm steady grip to every work-related cutting edge invention and time saving outbreak.

One of the factors which revolutionized today's petroleum industry is modeling software. Modeling software helps petroleum engineers to get a better visualization for the subsurface structures helping making better interpretation for finding the hydrocarbons hence saving time and optimizing the process.

One of the latest modeling software is Petrel. Petrel is a cutting-edge modeling software package that consists of unified seismic interpretation, geological modeling, and reservoir engineering software. So for every geologist, geophysicist and reservoir engineer, Petrel package will be the tool.

Petrel delivers fast, intuitive, and productive geophysical interpretation, geologic modeling, reservoir engineering, and innovative domain science for more accurate reservoir characterization. It is capable of interpreting work flow efficiencies and allowing rapid assessment of exploration acreage. Not only it runs multiple iterations to rank and risk prospects but also it can run uncertainties easily around velocity, structure, porosity, or any other relevant property.

Petrel creates powerful workflows that impact the business by providing completely unified seismic to simulation workflows which unravel scalability and performance, maximizing investment in hardware by leveraging the latest graphics and multicores.

In addition to geological modeling and workflows, there is also geophysical workflows models with scalable 2D and multiple 3D volume seismic interpretation that delivers fast, intuitive seismic interpretation allowing rapid prospect identification as well as integrated seismic inversion workflow improving the understand of rock properties.

Before starting the production process, the question that needed to be answered first is where is the most promising area to start drilling that's why we need to get powerful 3D modeling for making better decisions regarding where to start, and this can be performed through Petrel, it provides multipoint geostatistics combining hard well data with analogs to distribute properties based on seismic attributes for improved reservoir characterization.

So, in summary, Petrel is a powerful package that helps every reservoir engineer, geologist and geophysicist to get a better visualization and analysis about the reservoir's properties and performance and it provides:

(1) Bases to increase reservoir performance by improving asset team productivity. Geophysicists, geologists, and reservoir engineers can develop collaborative workflows and integrate operations to streamline processes this is provided by: Petrel Seismic to Simulation Software optimizing

exploration and development operations.

(2) Identifying and recovering hydrocarbons requires an accurate, high-resolution geological model of the reservoir structure and stratigraphy. The Petrel geology capabilities, all seamlessly unified with the geophysical and reservoir engineering tools, enable an integrated study by providing an accurate static reservoir description that evolves with the reservoir this is provided by Petrel Geology and Geological Modeling.

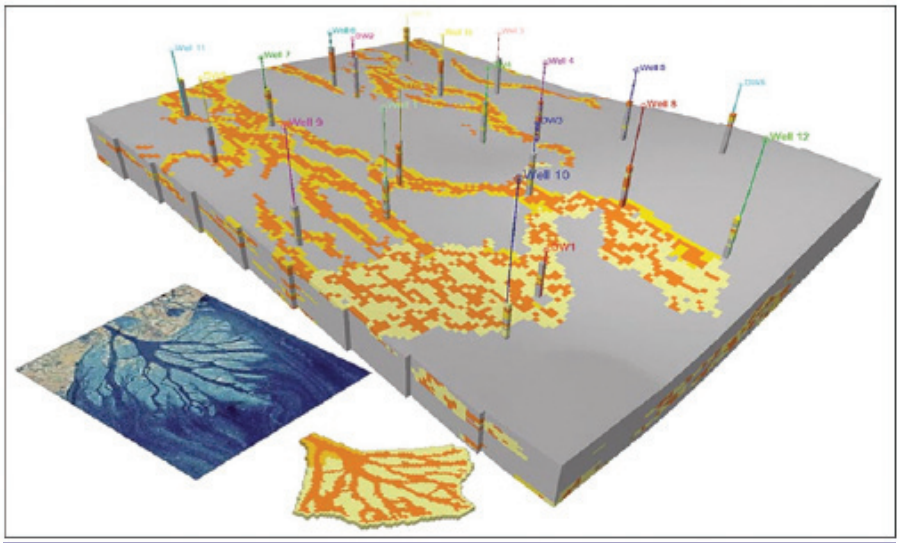
(3) Fully integrated with the geological and engineering tools, Petrel geophysical software allows for rapid 2D and 3D seismic interpretation. Sample your seismic data directly into a 3D reservoir model to predict pay and bias reservoir property distribution using a geostatistical approach.

An extensive library of seismic attributes and volume rendering techniques can help identify hydrocarbon indicators and fracture patterns. A fully scalable solution, Petrel software takes you seamlessly from regional exploration to reservoir development through Petrel Geophysics.

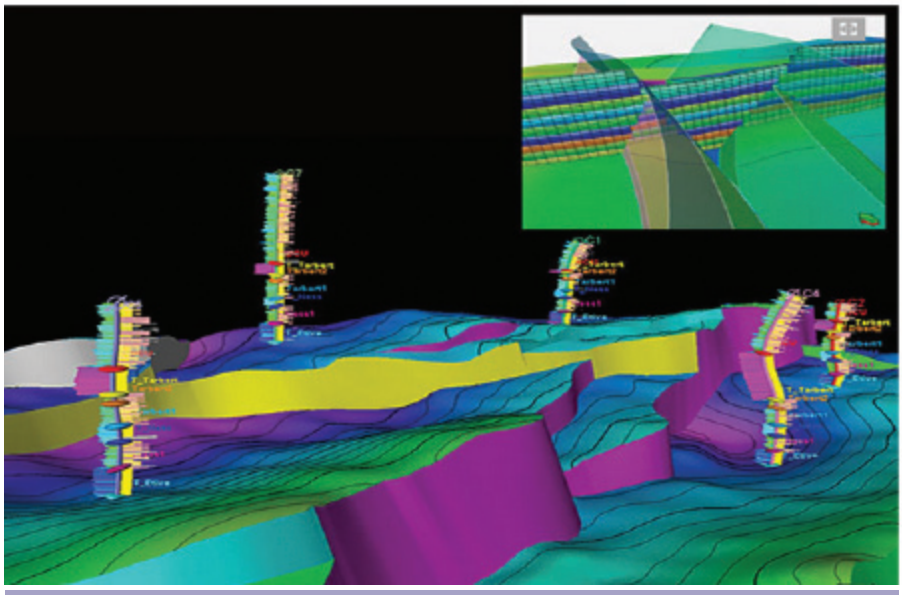
(4) Performing streamline simulations, reduce uncertainty, and plan future wells with the Petrel simulation workflow. Recreate geologically accurate models using advanced upscaling techniques for full reservoir simulation this is done through Petrel Reservoir Engineering.

(5) Well path design, drilling visualization, and real-time model updates. Petrel workflows improve operational efficiency by setting an environment to visualize and understand relationships between the drilling processes in the earth context. Also provided by Petrel Drilling Workflows.

On the last version of Petrel 2010, new features and properties were added not only to facilitate the modeling process, but also to ease complex calculations, and these features are:



Multipoint Statistics Functionality
The new Multipoint Statistics (MPS) Functionality uses images and drawings to model intricate geometries such as channel complexes or turbidite systems



Structural Framework Functionality
The new Structural Framework Functionality handles complex, faulted fields and converts faults into stair-step faults for efficient reservior simulations.

Reservoir engineering

• Enhance reservoir contact and recovery using complex well capabilities and automated design, placement, and completion optimization.

• Perform sensitivity and uncertainty analysis; use proxy-models in simulation cases and static volumetrics.

• Improve productivity using new and enhanced capabilities in reservoir simulation workflows.

Field development planning

• Characterize stratigraphic and structural details—extract geobodies from seismic, use analogs to evaluate reservoir potential.

• Characterize fractured reservoir properties using seismic data and statistical modeling.

Development drilling

• Accurately model overburden to reduce drilling risks with the Drilling Visualization plug-in.

• Place wells precisely, evaluate and modify the well path while drilling.

Evaluate trip, reservoir, charge, and seal

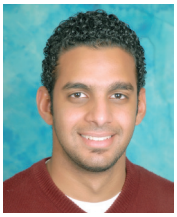
• Manage huge seismic volumes and multiple regional datasets from basin to prospect.

• Validate hydrocarbon charge.

• Build your structural framework automatically while interpreting.

• Evaluate fault properties and seal integrity with the Fault Analysis module.

• Leverage scalability and multi-user collaboration.



Mostafa Magdy
ECHO CEO, Chapter President
Faculty of Petroleum and Mining Engineering
Suez Canal University

Ahmed Hussein
ECHO Art Director
B.Sc in Petroleum Engineering
Faculty of Petroleum and Mining Engineering
Suez Canal University

Mohammed Alshabrawy
Communication Editor
Teaching Assisstant
School of Sciences and Engineering
American University in Cairo; AUC

Mohammed S. Alshobaky
Editor in Chief, Chapter Executive Officer
Faculty of Petroleum and Mining Engineering
Suez Canal University

Mahmoud A. Gaballah
ECHO Assistant Director, Media Co-ordinator
Faculty of Petroleum and Mining Engineering
Suez Canal University

Areej Abdulhamid
ECHO Interviewer
Technical Procurement Specialist
Olympic Group

Mohammed Darwish
Deputy Editor in Chief
Faculty of Petroleum and Mining Engineering
Suez Canal University

Mostafa Mohsen
ECHO Assistant Director
Faculty of Petroleum and Mining Engineering
Suez Canal University

Ahmed Magdy
ECHO Interviewer, ECHO advisor
Junior Field Engineer
SAPESCO

Sherif M. Alsayed
Senior Editor, Chapter Vice President
Faculty of Petroleum and Mining Engineering
Suez Canal University

Islam Youssef
Editor
Faculty of Petroleum and Mining Engineering
Suez Canal University

Ahmed H. Abdul'aal
Senior Editor, Academic Committee Head
Faculty of Petroleum and Mining Engineering
Suez Canal University

Mohammed Tarik
Communication Editor, Chapter Secretary
Faculty of Petroleum and Mining Engineering
Suez Canal University

How To Contact Us

Mailing Address : P. O. Box 43721
Salah Nesim Street, Al-Zaitiat,
Faculty of Petroleum and Mining Eng.

E-mail: suezcanalstudents@spemail.org

Website: spesuez.org

Tel: +2 010 076 314 6

OUR SPONSORS

HALLIBURTON
Schlumberger
Weatherford
Kuwait Energy Egypt
DANAGAS
AGIBA
EGYPT OIL&GAS
PETROMAINT
SAPESCO

Credible information for your investments

www.egyptoil-gas.com

Publications
Research & Analysis
Daily News Web Portal

EGYPT OIL&GAS
www.egyptoil-gas.com

Egypt Oil & Gas is the only Egypt-based and Egypt focused oil & gas information provider, offering timely, accurate and useful oil & gas information to the Petroleum Sector

Delivering Upstream Performance

Kuwait Energy Company (K.S.C.C), is one of the largest independent exploration and production companies in the Middle East established in 2005. Kuwait Energy is the fastest growing non-governmental exploration and Production Company in the Middle East with operations across the Middle East, Eastern Europe, and Pakistan. Today, the company has a total of 19 exploration blocks in seven countries, 11 producing assets in six countries, and operates 10 fields in four countries.

Kuwait Energy Egypt (KEE) is the operating arm of KEC in Egypt; it was established in May 2006 and has acquired many important hydrocarbon assets since then. Three of these interests are located in the western desert with a 50% working interest in the Burg Al Arab Concession, 72% in the Abu Sennan Concession and 49.5% in the East Ras Qattara Concession. KEE is also the operator of the GPC Production and Exploration Service Agreement for Eastern Desert Area "A", adjacent to the Gulf of Suez , with 70% interest, and is a partner in the Mesaha concession, on the borders of Egypt and Sudan, with 30% working interest.

KEE had announced seven discoveries in Egypt since the start of its exploration program in the country. Six of which are in East Ras Qattara (ERQ) Concession in Western Desert, Egypt. It had found Shahd, Ghard, Rana, Shahd SE, Rana SE and El Zahaa fields, with a combined daily production rate up to 5,800 barrels of oil. The latest discovery is Al Zahraa Field with a daily production rate of 2,615 barrels of oil. Currently KEE is developing Al Zahraa Field. Kuwait Energy's share and working interest of the field is 49.50% and it is operated by Sipetrol.

The seventh discovery is in Area A (Shukhair NW), with a daily production rate of 4,200 barrels of oil, and expected reserves of 8 million barrels of oil. Kuwait Energy is the operator of the GPC Production and Exploration Service Agreement for Eastern Desert Area "A", with 70% interest. This was part of the assets purchased from Oil Search Mena in 2008. The discoveries in Area A started about 50 years ago by different international companies. Today, with the new technologies used by Kuwait Energy, and by its dedicated staff, the Company was able to find new discoveries in this brown field area.

KEE has more exploration activities in Egypt at the moment, and it is expected to have more discoveries in the future.

KEE achieved one year without any recordable incidents (lost time incidents, medical treatment incidents, restricted work incidents).

9 b road 261, New Maadi, Cairo – Egypt
Telephone: (+202) 25171 996/7/8 Fax: (+202) 25164 059

Kuwait Energy
Egypt