Pressure as an Indicator for Water Breakthrough for Horizontal Well Completion

By

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the requirements for the
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CERTIFICATION OF APPROVAL

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Approved by,

____
(Muhammad Sanif Maulut)

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

December 2008

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

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MUHAMMAD YUSOF B. ABD RAHIM

ABSTRACT

This report basically discusses the preliminary research done and basic understanding of the chosen topic, which is study focus on pressure profile for a horizontal well. The objective of this project is to develop intelligent oil wells that can detect water from up to several hundred metres away and react before it contaminates production and focus on pressure profile for horizontal well. The method in this project is to make reservoir simulation by looking the pressure profile at each segment. The simulation of this type of basic case reservoir will be taken and the comparison between the actual data will be taken and it show that the segment pressure drop exhibit declining slope profile at the port of water breakthrough and at the same time , at the segment away from water breakthrough exhibit inclining pressure profile. The result from this simulation show that the segment pressure drop exhibit declining slope profile at the part of water breakthrough and at the same time, at the segment away from water breakthrough, exhibit declining pressure profile. From this project, it can conclude that SPRD can be used as an indicator of water breakthrough for horizontal well.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to my project supervisor, Muhammad Sanif Maulut, for his guidance, inspiration and support through the course of this project. In addition, for his invaluable advice, understanding, patience and encouragement from the beginning of my involvement in this project.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

The demand for energy is large, and will become larger in the future. Most of renewable energy sources are still in too immature stage to make it a serious alternative. For these reason oil and gas will remain essential in meeting global energy requirement in the decade to come. While in this oil and gas company industry, field become much smaller and oil reserve decrease gradually, while current oil price is not often economical to exploit them. Therefore oil companies are making great effort to reduce the cost for developing and maintaining oil and gas field. This lead to the existence of the so called intelligent or smart well technology which creates better economic way of extracting oil and gas from the earth's oil.

1.2 PROBLEM STATEMENT

Oil companies produce around three barrels of water for every barrel of oil, which reduces productivity and requires careful disposal. More oil could be removed if wells could prepare for an influx of water, according to the researchers. Now day, most oil wells are very primitive and cannot react to potential contamination. Although oil companies use valves, Multi Phase Flow meter in well walls to control the flow of non-oil fluids, they cannot accurately predict the flow of such liquids beyond a few metres from the well. The way to manage a reservoir is very different to other complex industrial processes, such as an oil refinery or chemical plant, because of the high level of uncertainty and reactive nature of our response to changes in conditions. This study is trying to investigate pressure profile as parameter to indicate water breakthrough even before the water enter the production line and this is will give a lot of benefit because the cost of processing water will be reduce. From this project, we can actually plan some advance plan to deal with the water by plugging or installing inflow control valves in IWST completion.

1.3 OBJECTIVE AND SCOPE OF STUDY

Upon completing the project, a few objectives need to be achieved. The research is to check each pressure in multi well segment when water breakthrough the segment and compare each pressure data. The main objectives of this research are to make simulation to identified pressure as an indicator water breakthrough and then:

1. To investigate the effect of water breakthrough at the segment pressure profile.
2. To study the possibility of using segment pressure profile as an indicator of water breakthrough.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The overall objective of this project is to minimize production of unwanted fluids such as conning water and channelling gas. Oil companies produce around three barrels of water for every barrel of oil, which reduces productivity and requires careful disposal. More oil could be removed if wells could prepare for an influx of water, according to the researchers. Most oil wells are very primitive and cannot react to potential contamination. Although oil companies use valves in well walls to control the flow of non-oil fluids, they cannot accurately predict the flow of such liquids beyond a few metres from the well. In this ongoing project we plan to use a pressure as an indicator for water breakthrough to enhance the oil production and to reduce the water production

2.2 Seismic and electro kinetic sensors

Electro kinetic sensors can detect changes in electric potential for hundreds of metres in reservoirs around wells. As water passes through porous rock a current forms, caused by the flow of ions into the fluid relative to the stationary ions stuck to the rock grain surface. Water has a higher electric potential than oil or gas, and this will be detected by the sensors. Seismic sensors measure the refraction and reflection of a sound wave when it encounters rock layers, yielding a picture similar to a geological cross-section.

The researchers claim that as well as providing details of the reservoir's rock layers, seismic sensors could also extend the range of the electro kinetic sensors beyond several hundred metres, by using the sound waves to oscillate ions in the rock grain. The oscillation creates an alternating rather than direct current, releasing more ions from the pore wall of the rock and producing a higher potential difference - and a stronger signal.

2.3 Down-hole Fluid Analyzer

According to Gary Covatch (2003)

APS's Downhole Fluid Analyzer technology provides the critical piece of the reservoir production puzzle in terms of enabling the determination of fluid fractions in combination with temperature, pressure and fluid flow, all without the use of active downhole components. The technology has potentially broad market appeal.

Permanent down hole sensors provide the operator with a better understanding of subsurface conditions. With a more complete understanding of dynamic down hole conditions, operators can manage the remote opening and closing of down hole valves or the down-hole processing of reservoir fluids. These sensors allow the operator to:

1. Better understand performance through the monitoring of produced fluid properties such as temperature, pressure and composition.
2. Obtain data on individual well performance in multi-well installations, such as offshore platforms, where production is typically commingled from multiple well bores prior to reaching the surface separator.
3. Selectively and remotely control drawdown and production from individual production zones, which can help optimize the design of surface processing equipment.
4. Reduce or eliminate the need for remedial procedures requiring costly well interventions and temporary curtailment of production.

Additional applications that have been identified include:

1. Providing residual oil monitoring in water production from down hole separators where this water is destined for disposal by reinjection into the formation.
2. Monitoring produced fluids in sub sea completions where surface installations are prohibitively expensive and production can typically be monitored only on a multi-well or commingled basis.

3. Monitoring fluid levels in down hole pumps to prevent them from running dry.
4. Providing multiphase monitoring of hydrocarbon fluids being pumped at the surface to gathering stations.
5. Monitoring hydrocarbon contamination in produced fluids from industrial processes.

2.4 Optimum Control of Unwanted Fluid Production in Reservoirs

According to Sanjay Srinivasan

The overall objective of this ongoing project is to minimize production of unwanted fluids such as conning water. Advances in intelligent well technology and simulation of reservoir-production system enable optimum inflow allocation of produced fluids through controlling flow trajectories in reservoirs. However, real-time optimum control of flow is still challenging. To this end, we have developed an advanced method for optimization of production based on a feed-back optimum control concept. A model-based method allows optimization of inflow-control-device operation in conjunction with strategic updating of reservoir-smart well model under uncertainty. In this method, the response of production system to control variables is described by a high-order model. The validity of this method is tested on the dynamic optimum control of gas and water coning using a physical two-dimensional layered bead-pack and automatic inflow control valves. Distributed flow or pressure sensors are used to actuate the valves. Both dynamic (time-dependent valve settings) and static (fixed valve setting) control under uncertainty are investigated.

2.5 The calculation of the reservoir pressure

Although the mathematical determination of the reservoir pressure is a little complex the principles involved are very simple. The theory is basically the theory developed by Otto Frank in 1899 to quantify the idea of the Windkessel suggested by Giovanni Borelli in the 17th and Stephan Hales in the 18th century.

We consider the whole of the arterial system with volume V and compliance C = dV/dP. The flow into the arteries from the heart is Q_{in} and the flow out through the capillaries is assumed to be resistive so that $Q_{out} = (P - P_\infty)/R$, where R is the resistance of the microcirculation and P_∞ is the pressure at which flow through the capillaries ceases (not necessarily the venous pressure). The conservation of mass requires that

$$dV/dt = Q_{in} - Q_{out}$$

Using the above assumptions this can be written as an equation for the reservoir pressure P

$$dP/dt + (P - P_\infty)/RC = Q_{in}/C$$

This equation can be solved explicitly if $Q_{in}(t)$ is known .

During diastole, when $Q_{in} = 0$ the solution is simple an exponential decay

$$P_{res} = P_{res,0}e^{-t/\tau} + P_{res,\infty}$$

where τ = RC. The compliance of the arteries is the capacitance in the electrical analogy of hydrodynamics and this time constant is just that of a simple RC circuit, an approach that has been used extensively in the study of blood flow.

Calculation of the reservoir pressure when Q_{in} is known

If $Q_{in}(t)$ has been measured simultaneously with the pressure, the calculation of the reservoir pressure is simple. Determine τ from the measured pressure during diastole; determine R from the mean blood pressure and the cardiac output (determined by integrating Q_{in}); determine C from R and τ and finally calculate P_{res} from the integral solution of the differential equation .This approach has been used in laboratory studies where it was possible to measure both pressure and flow into the ascending aorta simultaneously. Unfortunately, Q_{in} is not easily available in the clinic and so it would be very useful to have a way of determining P_{ref} without knowledge of Q_{in}.

CHAPTER 3
METHODOLOGY

3.1 Overall Project

Basically this project has been divided into three main phases. The initial phase of this project will be held in the first semester and mainly focusing in the preparations, literature review studies, and concept studies. In the end of the first phases of the project, the interim report will be produce to give a rough idea regarding the project scope. This initial stage will be the basic fundamental or preparation stage for the next level of the project which is including the experiment and evaluation about the regarding topic.

The first project phase is to planning and preparing Gantt chart and after that literature review study like doing literature review study with survey online journal or published journal. Survey also has been carry out on the conference proceeding and some references from books, reports and internet.

The intermediate project phase or experiment and evaluation phase will be carry on during the next 2nd semester of the FYP course and will include all the necessary experiment such as physical and mechanical testing. All of the result that obtain from the 2nd phase will be recorded and analyze further in the final phase of the project.

3.2 PROCEDURES

3.2.1 Literature review study

Until this progress report written, the most of the progress done are on the literature review study, which included the research about suitable in tumescent material that can be use, type of steel pipes, coating process, and testing method that will be carry on. Most of the research is completed and some of it still in progress. The research are based on the journals, conference proceeding, books and reports, and internet. All the finding or results are included at the Finding/Result, Discussion, and Literature Review sections of this report.

Throughout the progress that I had done until the report is written, the gathering the available resources or information related to my project have a little bit difficulty due to no specific research or investigation done that involve specifically in the interface studies between in tumescent coating and steel pipes substrate. In order to overcome the problem, I choose to expand the investigation area into different angle of prospective in order to build the fundamentals of my current studies.

3.2.2 Schlumberger ECLIPSE 100 Simulation Software & Exercise

Initially, the author experienced ECLIPSE tutorial 1. the purpose of the tutorial session is to familiarize the author to the basic simulation of ECLIPSE. For tutorial 1, the existing basic ECLIPSE coding is analyzed and how the model generated is exercised. The basic term such as permeability, capillary pressure, bottom hole pressure and lot more are exposed for familiarization for the real model simulation.

The FLOVIZ is another part of software that is used to visualize the simulation. It works after the command in ECLIPSE is approved without any error. The simulation model an be viewed in a number of option like, change of pressure, or mostly used like the changes in saturation profile. Next is the introduction to OFFICE, a tool that functions as results producer in term of graph. All those simulations and graphs can be viewed in chapter 4 later on.

In tutorial 1, plenty of parameters and specification have been studied and simulated in the layered reservoir types. The result obtained showed various effect in the conceptual model due to change in the parameter mainly affecting the field production rate and water breakthrough. From the tutorial as well, the author was able to study the basic and fundamentals of the reservoir properties such as the effect of the changes made in the permeability zone in the conceptual reservoir model.

Afterward, the author has being introduced to a sample reservoir. This is where the author had worked on this model by simulating a few parameter namely pressure, water cut, multi-well segment & segment pressure drop.

3.2.3 Simulation keywords

The simulation keyword that will be discussed here are on the important ones which involve modelling complex reservoir only. First is WELLSEGS which defines the segment structure of a multi-segment well. The Multi-segment Well model is a Special Extension, which is available in both ECLIPSE 100 and ECLIPSE 300. It provides a detailed description of fluid flow in the well bore.

The keyword is followed by a number of data records to describe the segment properties and geometry of the well. Each record is terminated with slash (/), and the set of record must end with an additional blank record containing just a slash.

```
WELSEGS
-- Name     Dep 1    Tlen 1    Vol 1    Len&Dep    PresDrop    FlowModel
    PROD    7010      0.0        1*       INC        HF-    /
-- First    Last    Branch    Outlet    Length    Depth    Diam    Rough   Area   Vol
-- Seg      Seg     Num       Seg                 Change
-- Main Stem
   2        12      1         1         20.0      20.0     0.3     1.0E-3    /
-- Top Branch
   13       13      2         2         50.0      0.0      0.3     1.0E-3    /
   14       17      2         13        100.0     0.0      0.3     1.0E-3    /
-- Middle Branch
   18       18      3         9         50.0      0.0      0.3     1.0E-3    /
   19       22      3         18        100.0     0.0      0.3     1.0E-3    /
-- Bottom Branch
   23       23      4         12        50.0      0.0      0.3     1.0E-3    /
   24       27      4         23        100.0     0.0      0.3     1.0E-3    /
/
```

Figure 3.1 EXAMPLE to define-multi lateral well with a main steam and three horizontal lateral branches

COMSEGS defines location of completion in a multisegment well. This keyword defines the location of the completion in a multi well-segment well, and instructs ECLIPSE to allocate each completion to a well segment. The well's segment structure must previously have been defined with the WELSEGS keyword. The location of the well connection to each completed grid block is defined within the well by the branch number and the length down the tubing to the start and end of the connection.

The keyword is followed by a number of data records to describe the segment properties and geometry of the well. Each record is terminated with slash (/), and the set of record must end with an additional blank record containing just a slash

EXAMPLE A multi-lateral well with connections in three horizontal lateral branches.

```
COMPSEGS
-- Name
    PROD   /
-- I   J   K   Brn    Start     End       Dirn     End      Connection
--             No     Length    Length    Penet    Range    Depth
-- Top Branch
   2   5   2   2      30        1*         X       6     /
-- Middle Branch
   2   5   5   3      170       1*         X       6     /
-- Bottom Branch
   2   5   8   4      230       1*         X       6     /
/
```

Figure 3.2: COMSEGS keyword

WSEGDIMS set dimensions for multi-segment well. This keyword is required if the Multi-segment Well Model is used It reserves storage space for the multi-segment well data. The data must be terminated by a slash (/) and consists of three items, NSWLMX, the maximum number of multi-segment well in the model, NSEGMX, the maximum of segments per well and NLBRMX, the maximum number of branches (including the main stream) per unit-segment well.

Example

```
WSEGDIMS
 2   30   3 /
```

Figure 3.3: WSEGDIMS keyword

3.3 Model Description of basic conceptual reservoir

Using ECLIPSE 100 software, the model for simulation is constructed in the form of basic 3D model consists 150 cells. The thickness is 1 unit cell. This is a basic cross section model between the injector and the producer in tutorial 1.

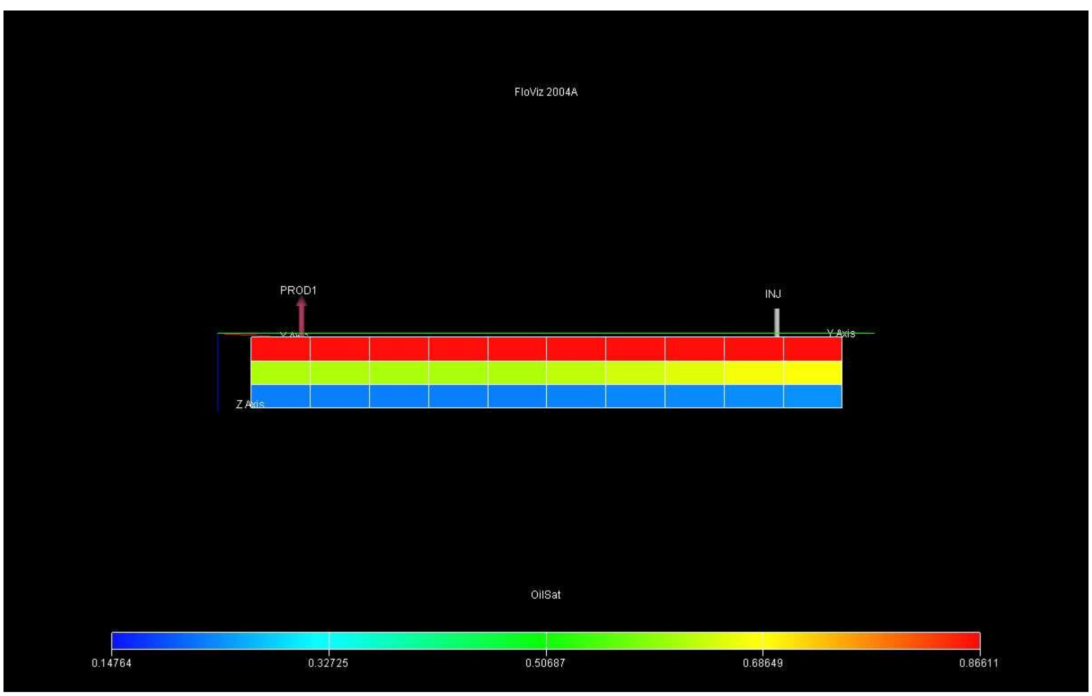


Figure 3.4: Basic Conceptual Model

In modeling the actual model, firstly the number cell NX (5), NY (10) and NZ (3) are being set in the *DIMENS* keyword. This is done by introducing keyword Aquacons and this reservoir is mainly aquifers drive reservoir. Aquifers have been place at the bottom of sand layer to maintain reservoir pressure. Aquifer support was chosen because we want to have an even water advancement from below.

3.4 Well Selection

There are 9 multi well segments that will use in the basic conceptual reservoir. Therefore, the author has to identify the suitable multi well segment for water breakthrough by adjusting the permeability of the reservoir. Basically, there are keys of identifying the suitable wells namely the water production rate of individual segment, well water cut and the oil production rate whether justified to be applied with smart well. A further analysis is explained in chapter 4.

3.5 Application of Multi-Segment Well in the Model

A multi-segment well can be considered as a collection of segments arranged in a gathering tree topology, similar to the node-branch structure of a network in the Network option. A single-bore well will, of course, just consist of a series of segments arranged in sequence along the well bore. A multi-lateral well has a series of segments along its main stem, and each lateral branch consists of a series of one or more segments that connects at one end to a segment on the main stem It is possible, if required, for lateral branches to have sub-branches; this may be useful when modeling certain inflow control devices as part of the network of segments. The segment network for each well may thus have any number of ‘generations’ of branches and sub-branches, but it must conform to gathering-tree topology—no loops are allowed. This study also need to measure pressure profile for each segment.

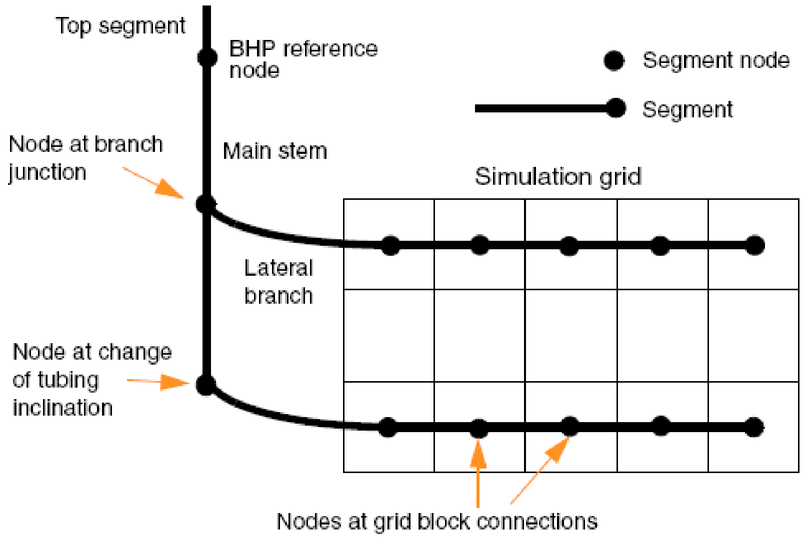


Figure3.5: Multi Well Segment

Each segment consists of a node and a flow path to its parent segment's node. (We use the term 'flow path' here rather than 'branch', as the latter term is reserved for lateral branches in multi-lateral wells, each of which may contain several segments.) Segment's node is positioned at the end that is furthest away from the wellhead. Each node lies at a specified depth, and has a nodal pressure which is determined by the well model calculation. Each segment also has a specified length, diameter, roughness, area and volume. The volume is used for well bore storage calculations, while the other attributes are properties of its flow path and are used in the friction and acceleration pressure loss calculations. Also associated with each segment's flow path are the flow rates of oil, water and gas, which are determined by the well model calculation.

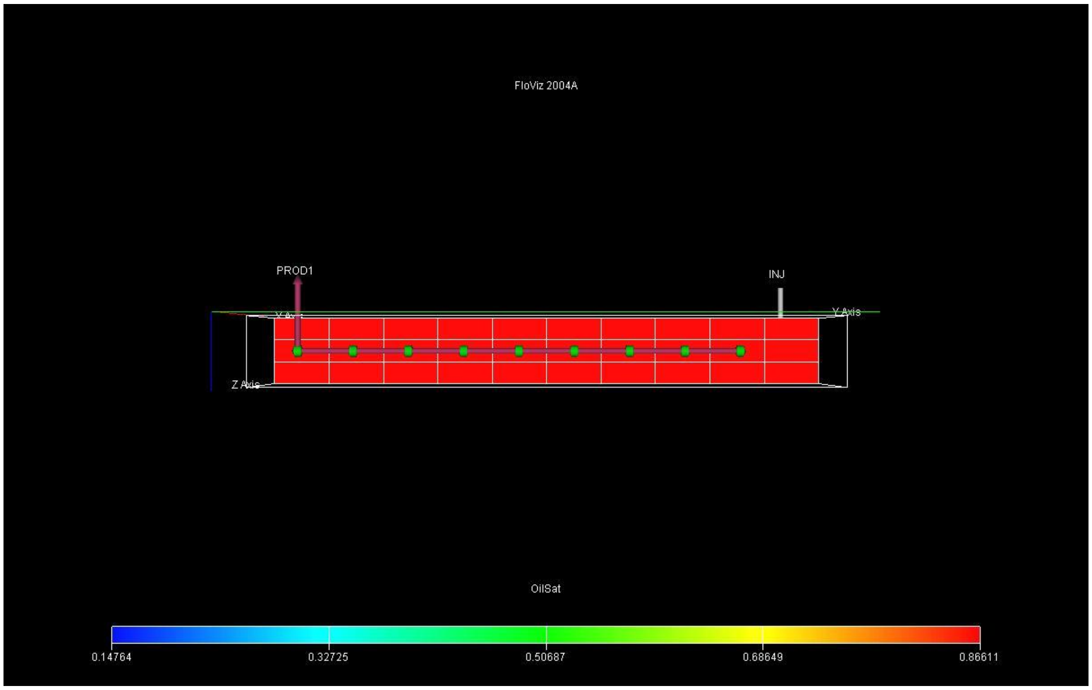


Figure 3.6: Basic Conceptual Reservoir Model

2.6 Sensitivity analysis

Case 1: Water breakthrough at segment 5

Case 2: Water breakthrough at segment 6

Case 3: Water breakthrough at segment 7

Case 4: Water breakthrough at segment 2 and 9

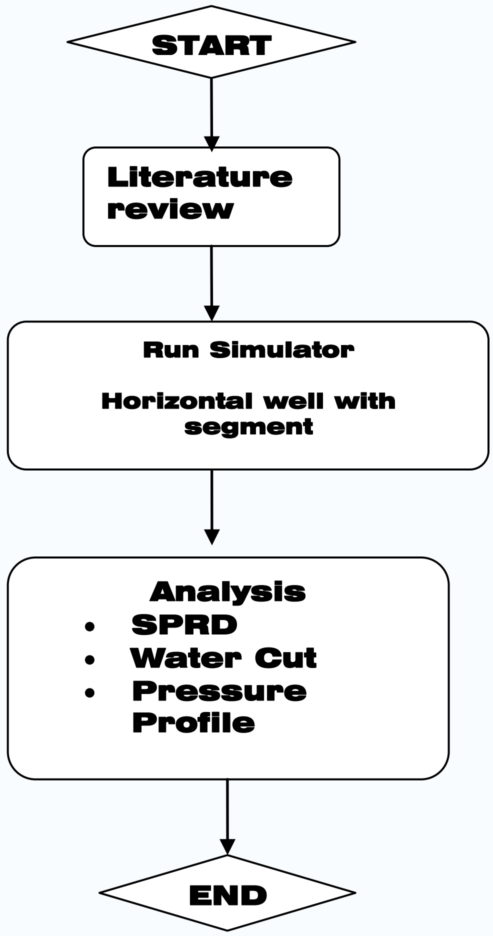
Case 5: Water breakthrough at segment 9

Case 6: Water breakthrough at segment 1

Case 7: Water breakthrough at segment 4

In order to set the water breakthrough, the author have change the permeability in each case to create the channel for water breakthrough

3.6 Process Flow Scheme



3.7 : Gantt Chart

		WEEK														
		1	2	3	4	5	6	7	MID-SEM BREAK	8	9	10	11	12	13	14
1.	Selection of project topic															
2.	Preliminary research work															
3.	Submission of preliminary report															
4.	Project work															
	- Research about the pressure															
	- Data collection															
5.	Submission of progress report															
6.	Seminar 2															
7.	Project work continue															
	- Simulation Done															
	- Compare Data & Recommendation															
8.	Submission of Interim Report															
9.	Oral Presentation															

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Water Detection in perfect horizontal well

In this case simple horizontal well has been modelled using schedule application and simulations have been run in eclipse simulator. This horizontal well is penetrating the whole reservoir along y-axis at constant depth. Simple and straight horizontal well was taken in this case study to analyse thoroughly the factor which cause the pressure drop across the well and determine water breakthrough location and this well was divided into 9 segments.

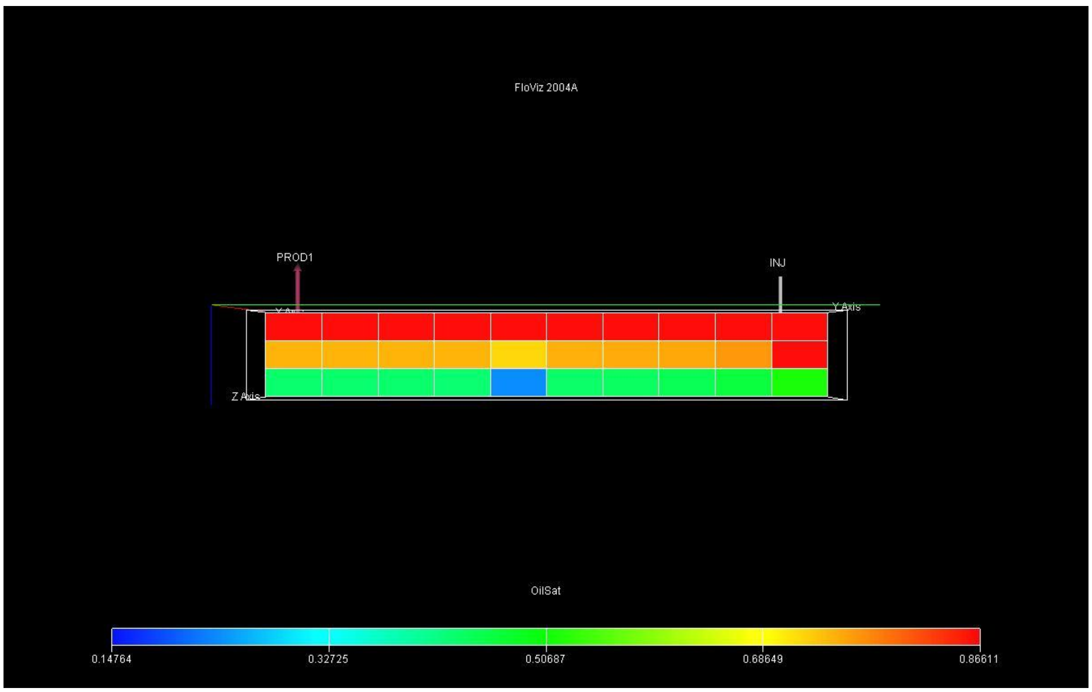


Figure 4.1: water breakthrough in horizontal well after 300 days

Figure 4.1 shows water breakthrough at segment 5 after 300 days. First of all, pressure signature in various segments was analysed to detect water breakthrough. But analysing pressure in different segment did not show a clear indication of water breakthrough. As it was not possible to detect water breakthrough by analysing the pressure profile, in the next step it was decided to analyse pressure drop profile (SPRD) in various segment. SPRD is a pressure difference between two consecutive segments. For example SPRD of segment 6 will be equal to the difference in pressure of segment 6 and segment 5 i.e.

SPRD of segment 6 = SPR of segment 6 – SPR segment 5

Where SPR = Segment Pressure Drop

As first water breakthrough occurred at segment 5, all segment before and after segment 5 were analysed. Analysis showed very interesting signature and a correlation was found in the SPRD profile of the segment and water breakthrough. Segment 9 (which is after water breakthrough point) and segment 2 (which is before water breakthrough point) were considered to establish a correlation between SPRD and water breakthrough. After running the simulation water ended through segment 5 at about 300 days.

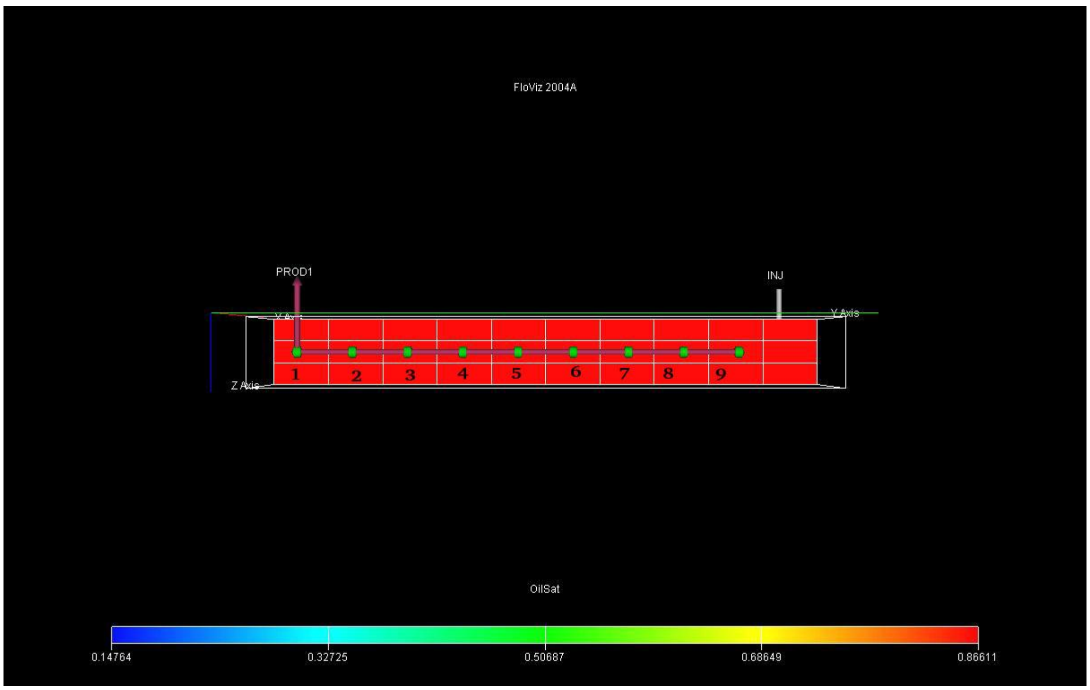


Figure 4.2: Location Of segment

By analysing the segment pressure drop (SPRD) profile, a special trend was observed in the segment was in-front of the segment 5. As shown in the figure 4.3, SPRD profile of segment 2 starts moving upward when the water breakthrough occurred in segment 5 after 300 days.

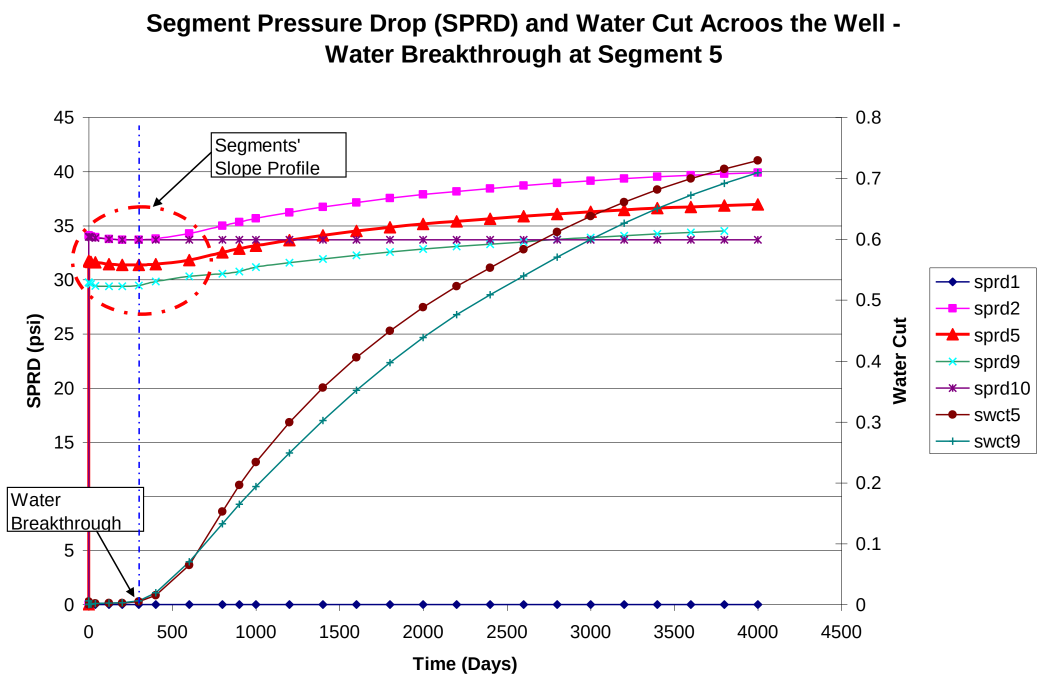


figure 4.3: Water Breakthrough at Segment 5

To get better and constant result, author had done another 6 case study for analysed pressure after the water breakthrough at that segment. Adjusting the permeability at certain segment to influenced the water coming in that segment at each case study.

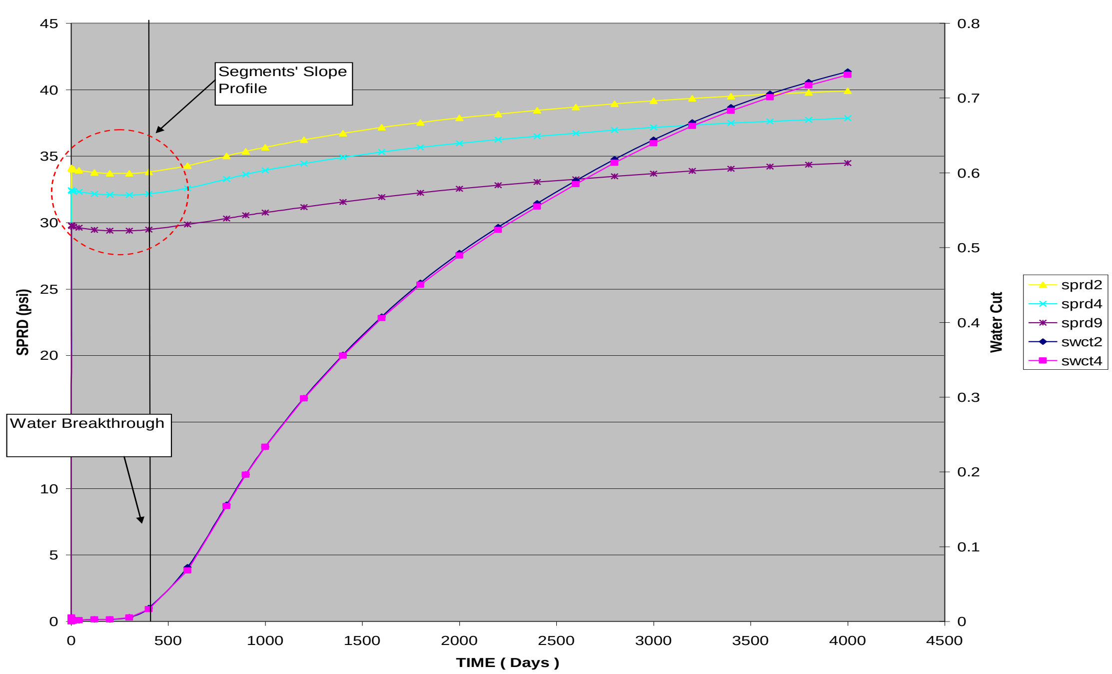


Figure 4.4: Water Breakthrough at Segment 4

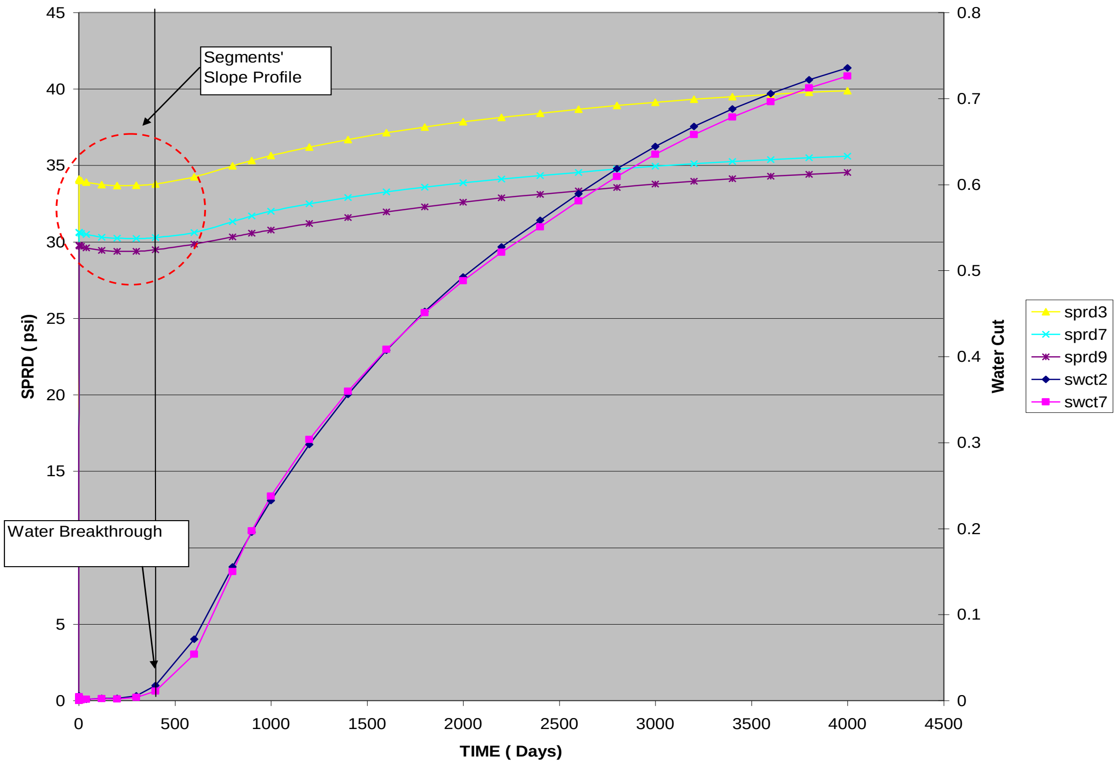


Figure 4.5: Water Breakthrough at Segment 7

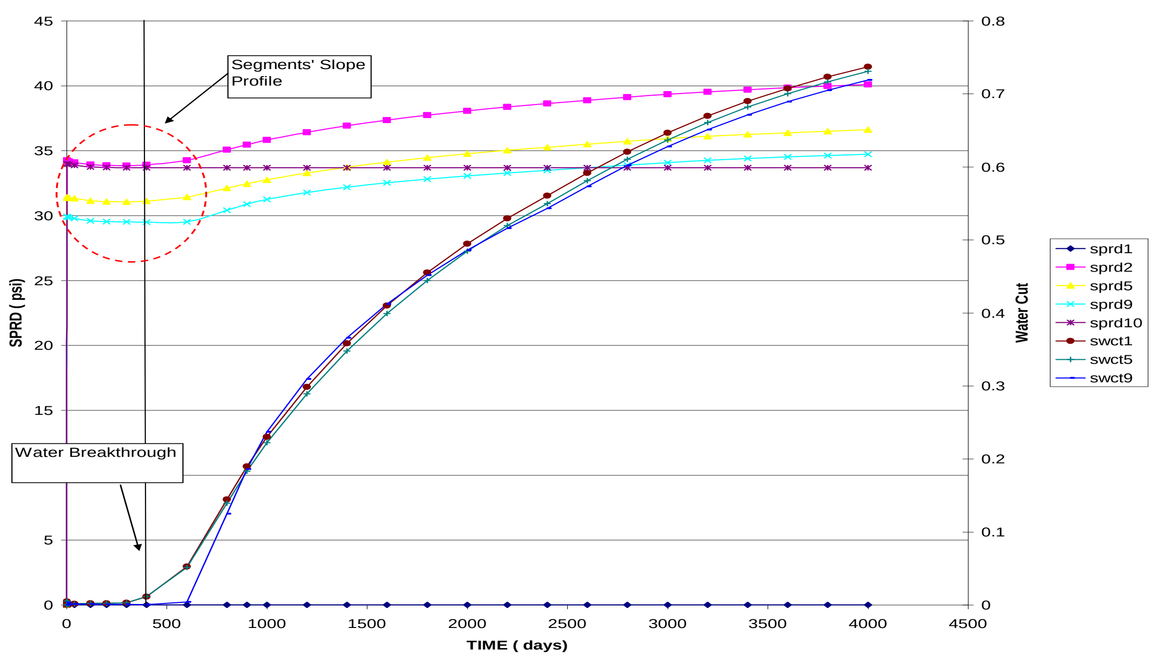


Figure 4.6: Water Breakthrough at Segment 2 and 9

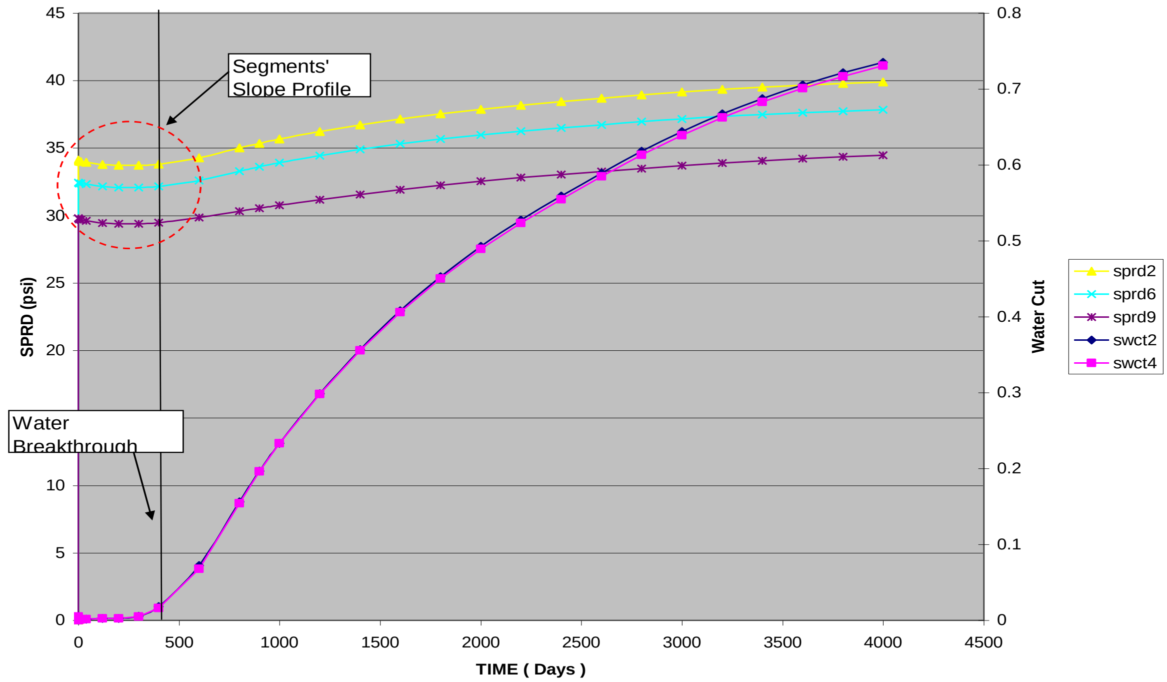


Figure 4.7: Water Breakthrough at Segment 6

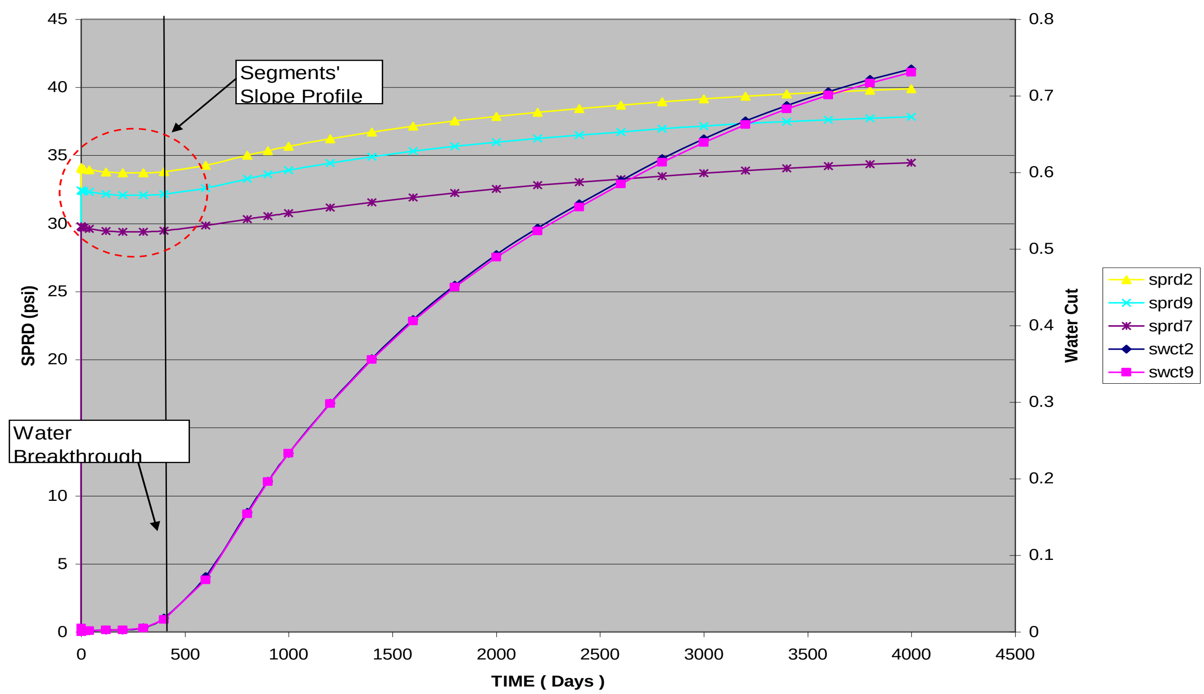


Figure 4.8: Water Breakthrough at Segment 9

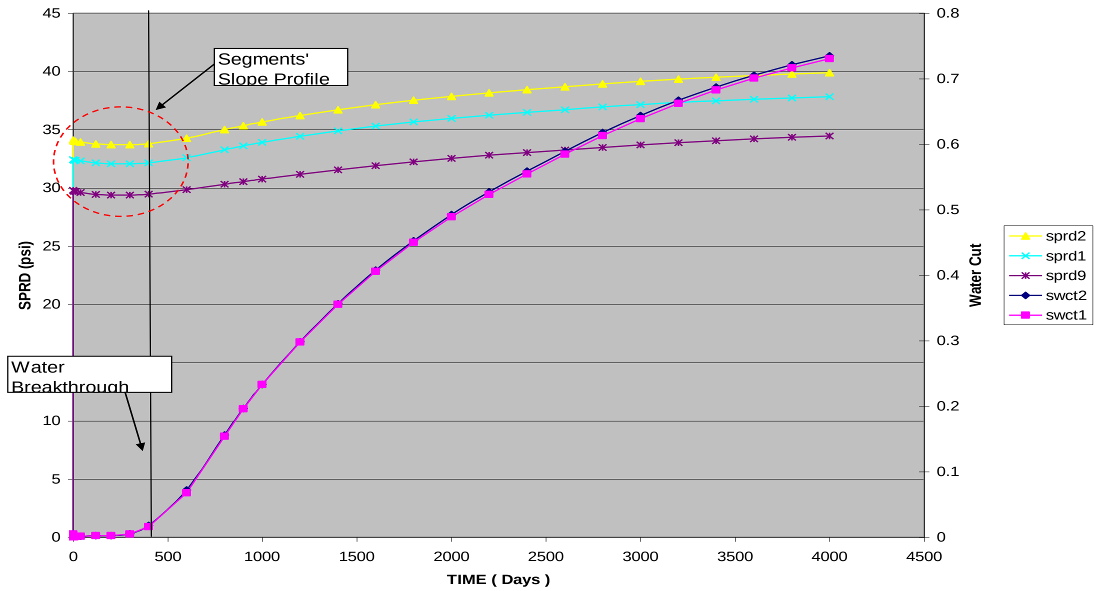


Figure 4.9: Water Breakthrough at Segment 1

So form the above analysis it can be conclude that SPRD profile of a segment moves down if water breakthrough at that segment and moving up if don't have any water breakthrough at that segment.

Table 4.1: Segment Slope Profile When Water Breakthrough Occur At Segment

	Segment Slope Profile When Water Breakthrough Occur At Segment						
Segment	1	4	5	6	7	9	1 & 9
1	↘	↗	↗	↗	↗	↗	↗
2	↗	↗	↗	↗	↗	↗	↗
3	↗	↗	↗	↗	↗	↗	↗
4	↗	↘	↗	↗	↗	↗	↗
5	↗	↗	↘	↗	↗	↗	↗
6	↗	↗	↗	↘	↗	↗	↗
7	↗	↗	↗	↗	↘	↗	↗
8	↗	↗	↗	↗	↗	↗	↗
9	↗	↗	↗	↗	↗	↘	↘

4.2 Technical reason of SPRD profile behaviour

Total pressure drop in the well is a summation of frictional, acceleration and hydrostatic pressure drop.

SPRD = SPRDF + SPRDA + SPRDH

Where

- SPRDA = Pressure drop due to acceleration
- SPRDA in this case is equal to zero as there is no gas and fluids in the well are assumed to be properly mixed
- SPRDH = Hydrostatic pressure drop
- SPRDH in this case is also zero as well is perfectly horizontal

That means frictional pressure drop over a length has significant effect on the total pressure drop in a perfectly horizontal well. The frictional pressure drop over length L of well is given by

$$\delta P_f = \frac{C_f . f . L . w^2}{A^2 . D . \rho}$$

c_f. unit's conversion constant (2.956E-12 in filed units)

δP_f is the frictional pressure drop

f is the Fanning friction factor

D is the segment diameter

ρ is the in-situ density of the fluid mixture

w is the mass flow rate of the fluid mixture through the segment

A is the segment area of cross section for flow

The fanning friction factor (f) depends upon the Reynolds number Re. For laminar flow (Re < 2000)

$$f = \frac{16}{Re}$$

For RE > 4000

$$\sqrt{\frac{1}{f}} = -3.6\ log_{10}\left(\frac{6.9}{Re} + \left(\frac{e}{3.7D}\right)^{10/9}\right)$$

In the region (2000 < Re < 4000) we use linear interpolation between value at Re=2000 and Re=4000

Reynolds number can be given as:

$$Re = \frac{C_r . D . w}{A\mu}$$

Where:

C_r = unit's conversion constant

Fluids the above frictional pressure drop definition it is conclude that

$$\delta P_f \propto \frac{\mu}{\rho}$$

As density of water is more than oil and viscosity is less than oil, frictional pressure drop goes down with the increase of water cut. This can explain by plotting pressure drop in segment 5 vs. Water cut in segment 9. As shown in the result, the increased in water cut in segment 5, SPRD of segment 9 moves down because segment 9 is after 5 and it can see the water.

CHAPTER 5
CONCLUSION AND RECOMMENDATION

In summary, the studies of pressure for horizontal well are very importance in order to enhance the oil production and to reduce the water production. This project is to developing intelligent oil wells that could spot advancing water from up to several hundred meters away and react before it contaminates production. The simulation that has been done must right to make sure the oil production increase and can give big effect for oil and Gas Company. However, the accuracy of the result can be improved by providing values that are nearer to the exact situation in the real reservoir. The calculation should be determined from the local fluid mixture properties and flow rate in each segment. This differs from the usual practice of using their average values within the well. Additionally, slippage between the phases may have an important effect on the mixture density, so a multiphase flow model that includes the effects of slip is an advantage.

A built-in drift flux model is available in the ECLIPSE Multi-Segment Well model to account for slippage. The pressure gradient should also include friction, which can be an important contribution in long horizontal wells or branches. Ideally, the acceleration component of the pressure drop should also be included. This may be significant in the parts of the well where the flow velocity increases due to the inflow of additional fluid, such as along the perforated lengths of the well or at branch junctions. After the simulation, pressure can be assume as an indicator for water breakthrough and recommendation after that like install water sensor or choke the segment where the water coming in can be done to make sure the production of oil can be maintained without any shutdown. Recommendation apply the same principle in full scale actual reservoir model can be made and this project also can study on the effect of well orientation. Since this project is can be consider the first non-commercial project in this area, the basic standard that being use will be the normal standard for testing.

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