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Sensitivity Analysis Over Injection Fluid Concentration of ASP Flooding to Enhance the Oil Recovery from Depleted Oil Reservoirs

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Abstract

Chemical methods have been growing with day-by-day modification since their invention but still, something is missing. As a matter of fact, chemical concentration plays important role either chemicals injected individually or combined thus, to find out best concentration and proportion is necessary. This study presents different models were generated from given data with appropriate properties for enhancing oil production starting Alkaline, Polymer, Surfactant, Alkaline Polymer, Alkaline Surfactant, Surfactant Polymer and Alkaline Polymer Surfactant. In this study, simple black oil simulator is used to avoid complication of chemical reactivity and just observed the influence of injection fluid on overall productivity from reservoir by chemical enhanced oil recovery technique. The models revealed capabilities of original field scenario as sensitivity analysis over injection fluid concentration was conducted and reservoir simulator gives accurate result and number of options. The result from simulation shows higher concentration drives more oil but to avoid cost issues productivity time can be elevated and equivalent recovery can be observed. Additionally, it was revealed that ASP has given ultimately good performance with concentration of 30% Alkaline, 35% Polymer, 35% Surfactant. Further, to justify the results, Response Surface Methodology (RSM) technique was used for performing accurate analysis over results with help of software.

Keywords: Enhanced Oil Recovery; ASP flooding; Chemical Injection; Depleted oil reservoir; Response Surface Methodology.

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1. Introduction

The demand of oil is increasing day by day in various industries and to meet its need we have to invent different technologies for recovering the residual oil and after the primary and secondary recovery a large amount of oil remains in the reservoir and these methods can only recover 20-30% OIIP (original oil in place), to recover remain oil tertiary recovery method should be applied which is also known as Enhanced oil recovery [16]. The enhanced oil recovery has been utilized since 1960 from thermal method to chemical method to gas injection method and every tertiary method has uniqueness and application for different reservoir to drive more and more oil from reservoir to well and also has some limitations [5].

1.2 Chemical flooding

The chemical method is highly potential recovery method of enhanced oil recovery and this very effective large reservoir and thin pay zone and this method gives best result than other methods of enhanced oil recovery methods, chemical method is comprised of polymer which increase density of water and alkaline and surfactant which decrease the interfacial tension between fluids or by changing wettability of rock from oil wet to water or mixed wet and these chemicals can increase both displacing efficiency and sweep efficiency [15]. Some researcher has combined these chemicals like alkaline surfactant (AS), surfactant polymer (SP), alkaline polymer (AP) and alkaline surfactant polymer (ASP) which has given better result in recovery and economic point view [4]. To find out the best of them, the simulation can play important role that can be run many times until we satisfy with result, it will be unwise to use directly on field due to high cast of chemical and also the waste of time which can cause millions of dollars, ECLIPSE SIMULATOR can be used for every reservoir type and can be used for black oil, compositional and thermal oil model and in our case, we will use ECLIPSE100 for determining the best method among them.

All the chemical injection techniques are either expensive by default or less effective, therefore (It is necessary to find out perfect EOR injection fluid in form of individual slug injection or mixed with specific chemical quantity. Subsequently, the foremost challenge in mixed chemical EOR is to select the required effective concentration of alkaline, surfactant and polymer.

For this reason, this study is proposed for observing comparative simulation study by using alkaline, surfactant and polymer separately and combined in order to know which combination results maximum productivity of oil.

To study the effect of alkaline polymer (AP), alkaline surfactant (AS), surfactant polymer (SP), and alkaline surfactant polymer (ASP) on depleted reservoir performance using ECLIPSE (E-100).

The most effective chemical injection method is not profitable at all, as it is expensive than produced oil. The cheap injection chemical is not capable of mobilizing the residual oil. In order to produce residual oil by chemical injection method an optimum strategy is required. The number of methods has been applied that showed effective recovery some of them and others are limited to particular formation and properties, it's important to find out common one that give good production and can be used more commonly rather than particular.

To evaluate the impact of formation pressure incline on all the developed models of chemical flooding using Response Surface Methodology (RSM).

Scope of study will achieve conditions which will increase recovery of residual oil after primary and secondary recovery by injecting Alkaline, Surfactant and Polymer with different concentration Indeed, the previously conducted studies as mentioned in literature review has focused on compositional modifications of chemical injection fluid or reactivity of reservoir fluid with injection fluid. Subsequently, most of the studies did not consider the reservoir engineering for recovery improvisation.

1.2.1 Alkaline flooding

Alkaline is a basic that contains pH greater than 7 possessing the qualities of alkali or alkali metal. In such flooding water is injected along with NaOH or Na_2CO_3 which assists increasing lost potential of the reservoir to push oil out up to surface. Surfactant is formed inside the reservoir when these alkaline chemicals react with certain types of oils. As a result, the surfactant proves enhancement in recovery by reducing IFT (Interfacial tension) between water and crude. Moreover, the crude oil is displaced by the alkaline agents maximizing the pH of injected water. It can also be done with the inclusion of polymer as well as surfactant to alkali. An ASP production technique is engendered which is particularly cheaper form of micelles polymer injection.

1.2.2. Surfactant flooding

In order to enhance oil recouping, surfactant injection lowers the IFT (interfacial tension) between water and oil. The merging of droplets brings about a change in the saturation of oil. Thus, the reservoir oil begins to move; eventually the impotent crude rushes up to the surface. Moreover, the optimum leftover crude is calculated by IFT between surfactant oil mixture after oil collection and the oil.

1.2.3. Polymer flooding

It is an EOR process that utilizes solution of the polymer to recoup oil by raising the viscosity of the water injected. This technique reduces the water or oil mobility ratio. Water viscosity is increased by flushing water soluble into water. Water permeability can be decreased in swept zones in changed degrees. Thus, S_{or} is unchangeable by polymer flooding. Yet this is very potent way to gain the S_{or} rapidly and inexpensively. The additional amount of oil recovery can be made possible by putting water soluble polymer to water-flood. High permeability zones are closed by polymer gel. In this process, oil is effectively produced by improving the volumetric sweep. The fluid's viscosity minimizes with maximizing the shear rate so that's why polymer solution must be non-Newtonian and shear thinning fluid.

1.2.4. Limitations of study

Every method has some limitation and chemical flooding cannot be used in every formation but particular that is suitable for chemical flooding due to problems encounter using it, like Chromatographic segregation of chemicals in non-uniform thickness, Dilution of chemical in a water drive reservoir which means more water

present in reservoir will be problem, in case of carbonate and sandstone formations rock surfaces hinder chemical adsorption, presence of high bivalent cations make it incompatible with formation fluids, chemical processes are not suitable for high salinity and high temperature, it can be applicable in carbonate and sandstone formations but mostly sandstone is suitable formation and also chemicals flooding cannot be used for very deep wells but for suitable condition perfect combination of chemical system can increase recovery factor by 15-20%.

2. Methodology

In recent years, Enhanced oil recovery projects has been increased since its invention and became only way of oil to displace from formation to well after primary and secondary recovery which only can recover 20-30% OIIP (original oil in place) and left large portion of oil in the reservoir. Now days, Chemical method of enhanced oil recovery is used and being discussed to explore new techniques and ASP (alkaline surfactant polymer) has become hot topic along with SP (surfactant polymer).

It is important to find out best among them (AS, SP, AP, ASP) in volumetric sweep efficiency, relative permeability, interfacial tension and of course in productivity, recovery and economic point of view, simulation is the best way to do it which can save both time and money. In our research ECLIPSE will be used that can simulate every reservoir and we will use ECLIPSE 100 to make models of them.

To make models of them we have to make data file each of them, for alkaline, polymer, surfactant, AP, AS, SP and ASP with suitable properties. In eclipse 100 we do not go in detail as we have required eclipse 300 or compositional simulator. And in this we consider injection as water then we will add chemical properties to it behave like it.

First, we will make data file by putting given data then run-in eclipse 100 and get result with different concentrations in each case after that we will choose best among with respect to recovery of oil and cost of chemical. we will take best case model from each model then compare between them like best model in alkaline, polymer, ASP and so on, until we find best from all methods.

Table 1: reservoir characteristics

Parameters	**Value**	**Unit**
Temperaturee	98.3	Celsius
Thickness	110	m
Porosity	25-30	%
Permeability	20-2500	md
Formation Type	Sandstone	

Table 2: oil properties

Parameters	Value	Unit
Gravity	32.7	API
Viscosity	<1.2	CP
Density	859.5	Kg/m3

Table 3: other input data

Parameters	Value	Unit
Oil Viscosity	0.318	CP
Oil FVF	1.038	Rm3/Sm3
Bubble point	251	bar
Water Density	1033	Kg/m3
Initial Pressure	277	bar

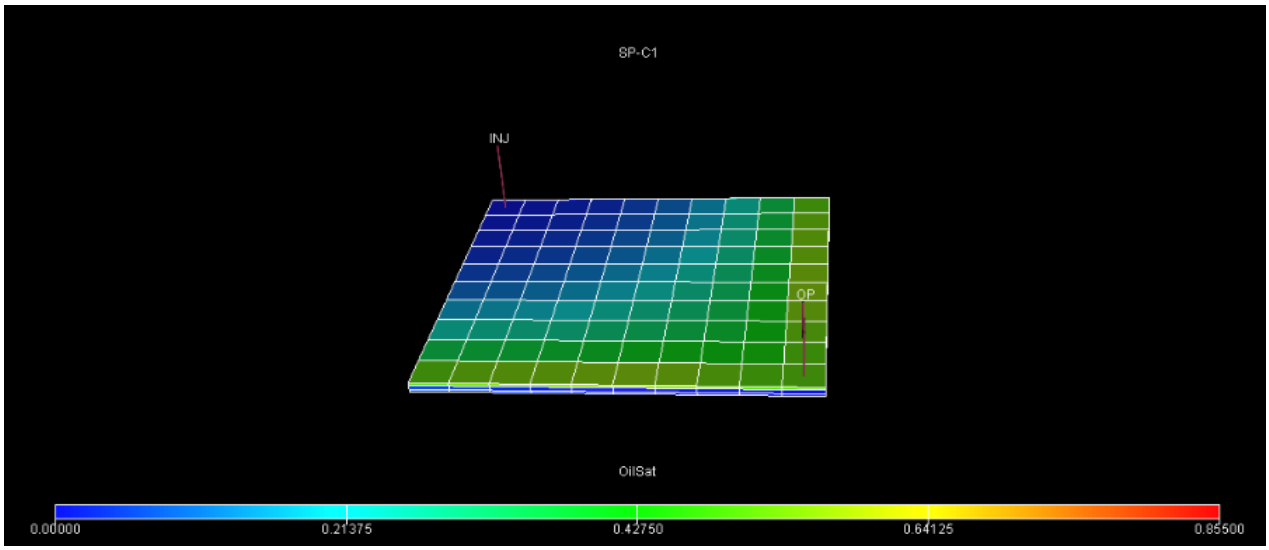

Figure 1: chemical flooding model

Model was made with help of ECLIPSE100 by putting data, dimension of model is 10×10×3 with two wells at the corner in which one is injection well and second is production well and other data is given below in tables and one of example is shown above in picture.

3. Simulation Results

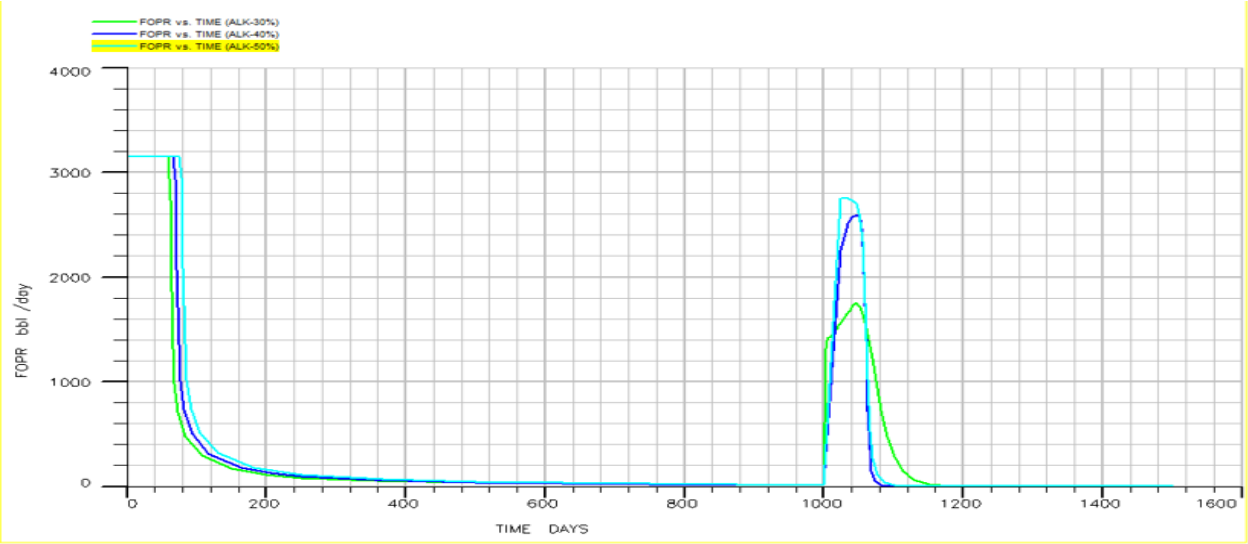

Figure 2: Effect of alkaline model with different concentrations on depleted reservoir flow rate

As shown in figure, different graphs representing different concentrations of Alkaline, green graph represent 30%, blue graph represent 40% and sky blue graph represent 50% concentration, green graph was stable initially at 3190bbl/day after some time, it fell very low and at 560 days became zero and during falling Alkaline flooding was carried out which showed effects from 1000 days that takes all graph higher according to their capabilities and it is quite interesting that alkaline goes to that higher production rate, first green graph goes perpendicularly up to 1400bbl/day then from which a curve was formed that reach 1770bbl/day then decline also curve shape can be shown up to 1160 days, flow was stable during rising and falling and graph does not drop directly but with curve that shows good sign overall.

Blue graph of Alkaline shows more positive result because it reaches higher than previous graph 2600bbl/day straight word with stable flow rate, no sign of irregularity was seen during whole process and also fell at same speed as rise which save time and money, well is completed at 1080 days which is quite good candidate for common use.

And last one is sky blue which has reached 2780bbl/day due to higher concentration which is 180bbl/day is better than blue graph in terms of production and well completed late than blue graph which means more flow but also takes more time which means more expenditure but higher production rate can cover those expenses, also we can notice that if we increase more concentration would not do better so this is perfect concentration of Alkaline that drive oil from reservoir to well.

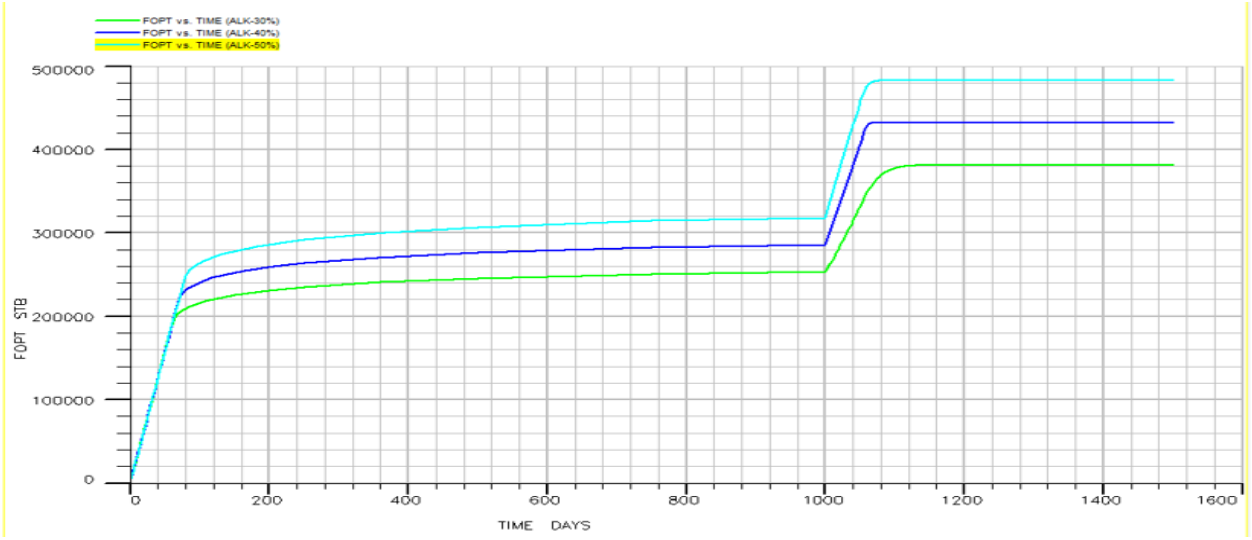

Figure 3: Effect of Alkaline flooding on overall oil production with different concentration

There are three graphs shown in figure that represent different concentration as defined in the above figure, first few days production remains same as shown in figure as all graphs are merged and later separated from each other to their way according capability given by different concentration of Alkaline, green graph remain low but steady and curve can be seen during rising of overall production, production increase from 1000 days and stabilized within days to reach 380000 STB oil production which was favorable according to given concentration of Alkaline.

Blue graph gives higher production due to higher concentration that drives more oil, it rises with stable condition and graph was angle wise which shows promising result, graph stabilized at 437000 STB production of oil which is 57000bbl/day oil production higher than green graph. Sky blue line reaches higher and stabilized at 480000 STB oil production which is highest overall production and stable in respect of cost of chemical and it can be concluded that concentration of alkaline with 50% in solutions is best choice according to the above figure among three model of alkaline flooding.

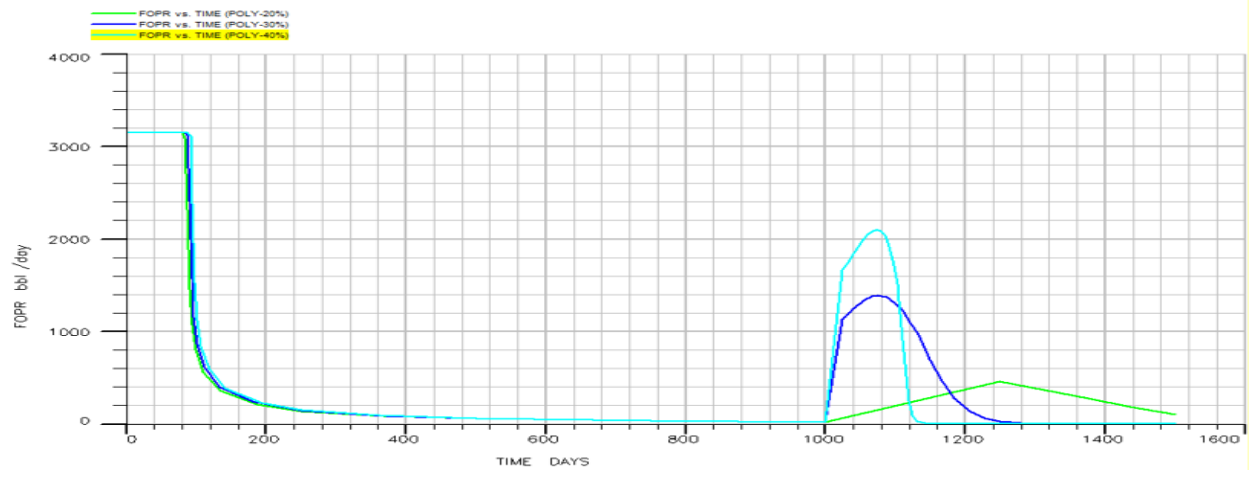

Figure 4: Impact of polymer on production rates with different concentrations

Different models have been made with different concentrations green graph stands for 20% concentration of polymer, blue graph stands for 30% concentration of polymer and sky blue graph stands for 40% concentrations of polymer, if go through figure we can see production rate was 3190bbl/day, was stable for 98 days then declining towards 30bbl/day and in the meanwhile polymer flooding was planned and carried out which showed effect on 1000 day because it took time to replicate initial condition with different concentration to check best among them. Green graph increased from 30 to 480bbl/day with steady effect then decline towards low and at last 1500 days it shows straight decline which prolong flow up to 1500 days and flow ended.

Concentration with 30% of polymer showed more promising result as oil well was opened to flow, it reaches 1100bbl/day with perpendicular shape then made some curve but again approaches forward 1400bbl/day at its highest value of producing rate after that graph returned toward downward and finally well stopped producing at 1220 days.

Concentrations with 40% polymer with starting production oil and it reaches at 2100bbl/day which is largest flow among them and we can see sky blue graph take few days longer than blue to reach its peak point of flow then graph shows declination and well finished at 1180 days which is earlier than blue graph which means overall time is same but flow rate of sky blue is highest.

Green graph is taking more time and gave least production rate, concentration with 30% completed early which saves time and money, concentration with 40% takes almost same time to complete but gave highest production rate among them.

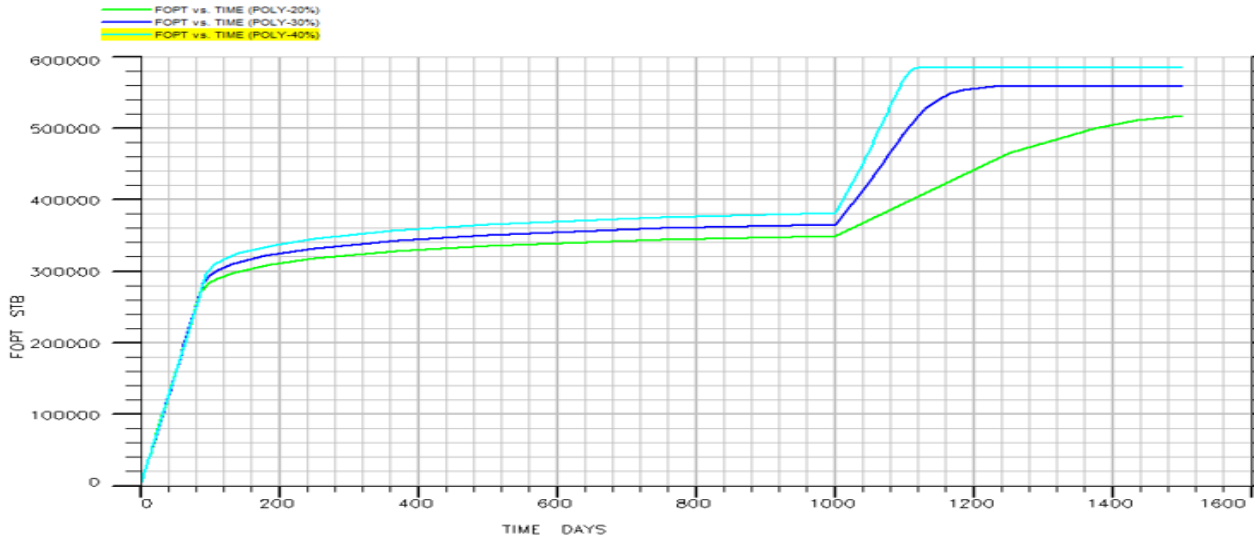

Figure 5: Different concentrations of polymer effects on depleted reservoir performance

As shown in figure that different concentrations of polymer which 20%, 30% and 40% affect reservoir performance and at start production was rising but after 100 days, it does not show much improvement then decision was made to inject polymer to improvise overall production and with different concentration of polymer to find most suitable for future use. Polymer injection was carried out, and as can be seen green graph

with 20% Concentration rise slowly with other graphs and separate from them at 100 days with production 300000 STB where it stabilizes with little improvement after some time as chemical approaches to ward production well, at 1000 days' sharp increment was seen which reach up to 520000 STB at 1440 days stabilized up to 1500 days.

Blue graph revealed better result than green graph because of concentration, from separation point it remains upward and to the last with higher overall production of oil which is 560000 STB.

Sky blue (40%) concentration of polymer that is far from both graph in performance, this graph rises upward which remain higher from both graphs and production stabilizes at 585000 STB of oil, benefit of more concentration means more production of oil.

If it compares Overall production of every model with different concentrations, then concentration with 40% polymer in to solution is the best choice in sweep efficiency and cost effective among others.

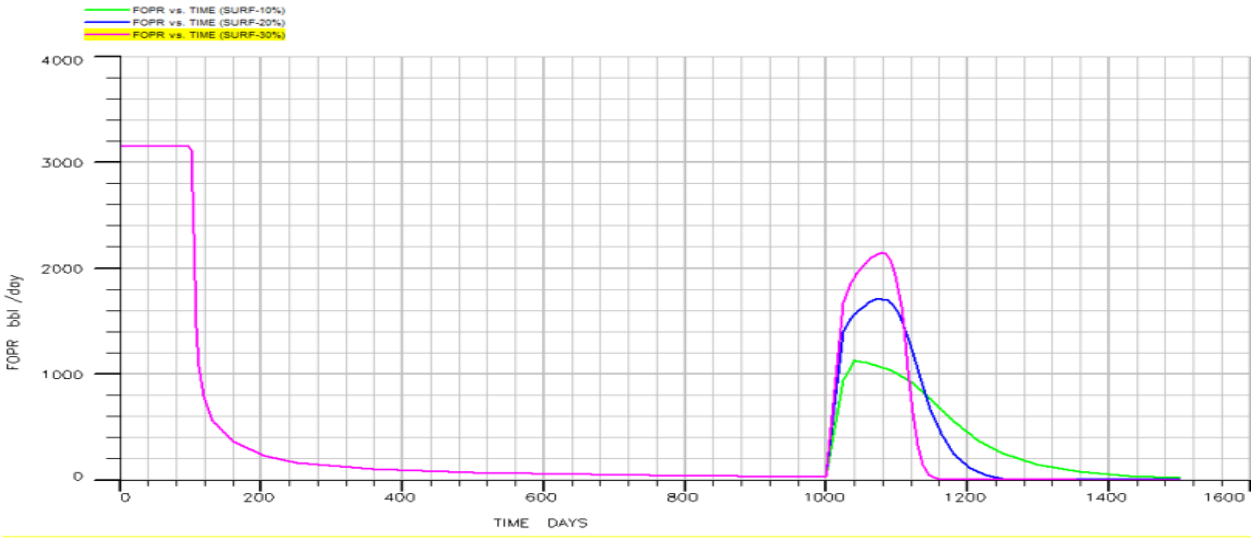

Figure 6: Comparison between three concentrations on production rates

In this figure, there are three concentrations green graph stand for 10% concentration of surfactant in to water solution and blue graph for 20% and pink graph for 30% follows, production rates remain stable for 100 days with rate of 3190bbl/day then drops to 20bbl/day, effects of surfactant flooding can be shown where all graphs increment of production green graph shows rise up to 1130bbl/day which is good production rate and remain stable there, rate started falling down and reached to 0bbl/day in 1440 days.

Blue graph revealed flow rate reaches up to 1700bbl/day with steady rate and well stopped at 1240 days with good production rate. This concentration has given higher flow rate with less time because of surfactant flooding that drives oil with decreasing interfacial tension between oil and water also changes wettability.

Pink graph with highest concentration and its production rate went to highest point with flow rate of 2150bbl/day, obviously surfactant concentration was higher than others and was within range in terms cost, also

reached completion within 160 days which ultimately save time of rig and crew and can be describe as best among them.

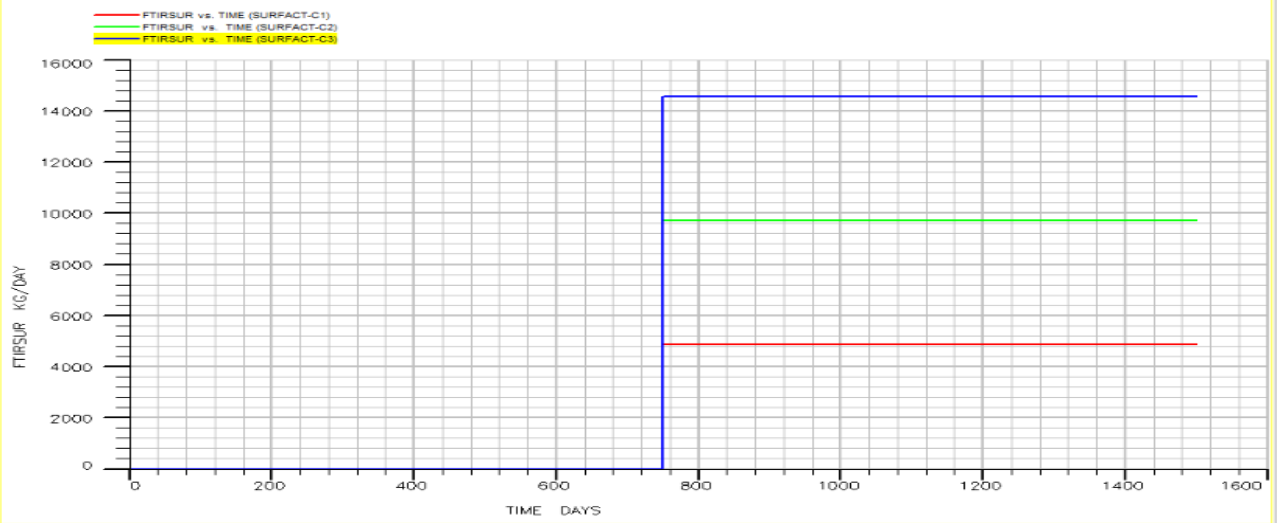

Figure 7: Surfactant injection with different concentrations

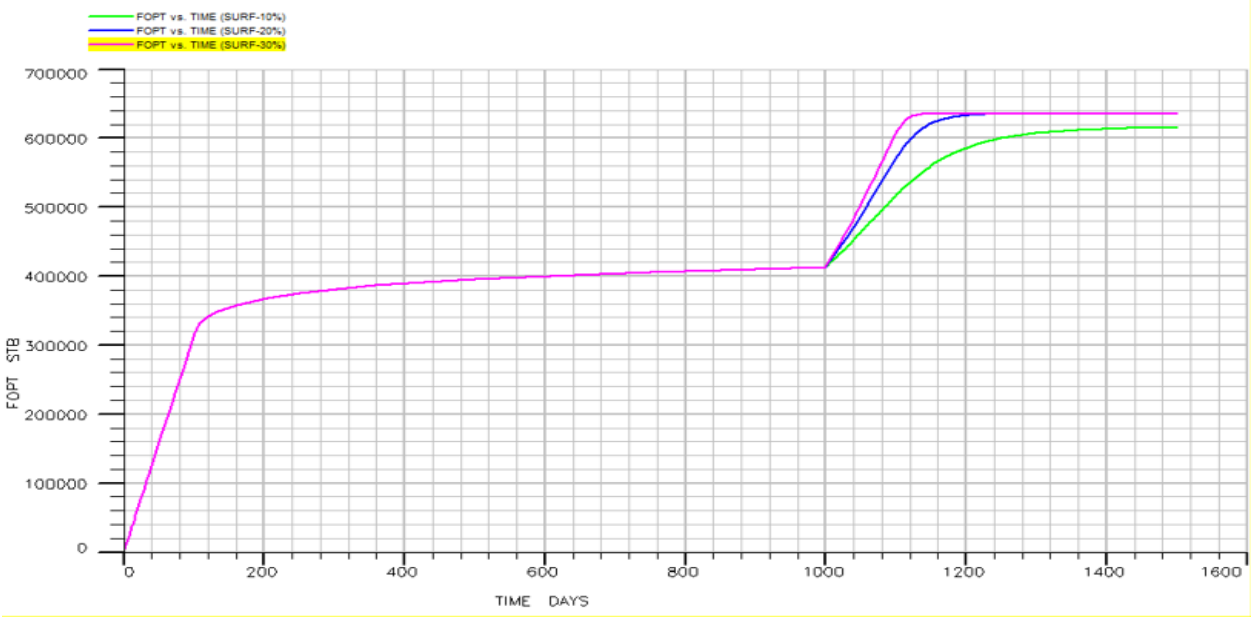

Figure 8: Total production with surfactant injection with different concentrations

In the above figure of production rate with different concentrations, here it will be more clear which concentration gives more production overall, if see through figure was on rise from day first and stable with giving 400000 STB of production with very little increment and to save cost and time which lead to drive more oil from reservoir to well and flooded surfactant with different concentration to find out favorable one, green graph has reached up to 620000 STB according to capability of driving oil from reservoir to well and blue graph has given 640000 STB production.

Pink graph 30% showed highest production of oil with starting 400000 STB to the end with 640000 STB of oil

production and as it can be seen through figure graph remain far better than others and became stable at 1080 days whereas others 1200 days and 1400 days project stopped at 1500 days, it is concluded that if we increase concentration of surfactant then it can increase the overall production of oil, with 30% concentration of surfactant will be appropriate concentration regarding cost and driving capability of oil and other main benefit is saving of time as we see through graph pink saves more time and gives more production.

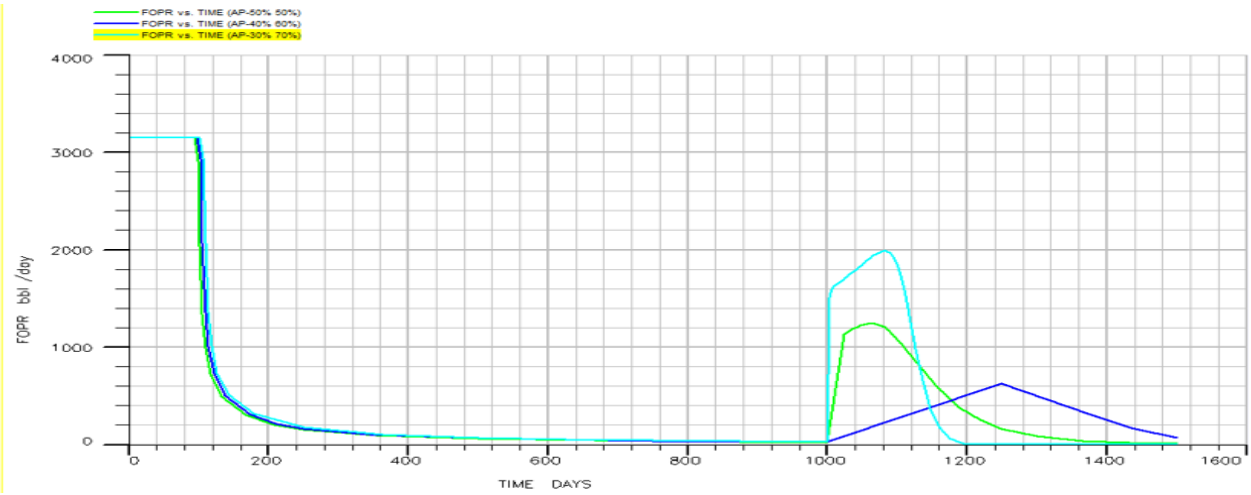

Figure 9: Alkaline and Polymer model with different concentration

As shown in figure, different concentration of Alkaline Polymer is compared to find suitable one, in this figure green graph represent alkaline polymer concentration (50%, 50%), blue graph represents concentration (40%, 60%) and sky-blue graph represent concentration (30%, 70%).

All graphs were stable with rate 3190bbl/day for 98 days then fell to 0 and at 1000 days' flow rate started increasing where all graphs revealed different position according to concentration, green graph goes straight up to 1220bbl/day where little slope developed, can be seen flow remain smooth from below to upward and from upward to down ward and finally finished at 1360 day.

Blue graph goes upward but with smooth flow, reached to 600bbl/day where does not stay there fell again to 0 in 1500 days which is longer than green graph and fluctuations was not seen at any point during whole process which was good sign.

Graph with higher concentration of Polymer and less concentration of Alkaline goes highest flow rate 2000bbl/day and does not merge with either during falling, where green and blue graphs continued flow for more time and but sky-blue fell straight in 1200 days.

As can be seen through figure there is very large difference in flow rate also time is quite different, also we have to consider flow rate because both of chemicals are not expensive and with higher concentration of polymer and less concentration of Alkaline is favorable among others according to figure.

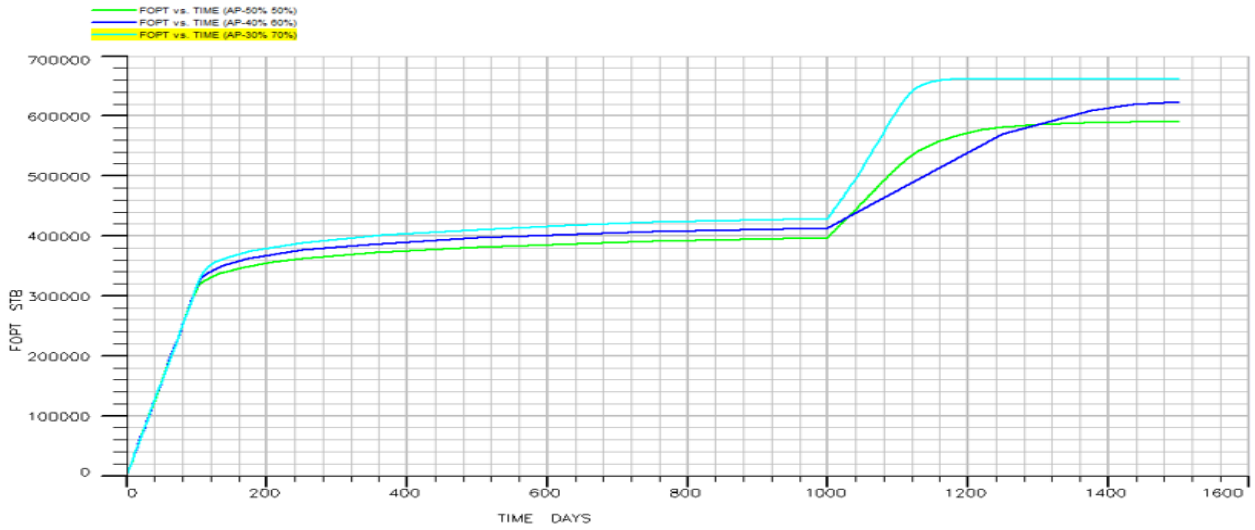

Figure 10: Different formulas of Alkaline Polymer effect on total productions

Alkaline Polymer has been used in different quantities to find in best proportions (50%, 50%), (40%, 60%) and (30%, 70%) which will be further elaborated, in this figure we can see that all graphs are merged from beginning but at 100 days and at 400000 STB are deviated little from each other to concentrations, usually chemical takes time to reveal effect on subjects as we see through figure for days oil production remain stabilized but after giving time effect was shown from 1000 day to 1500, as green graph at the lowest among them reach up to 590000 STB of oil and blue graph forwarding upward from start and reach up to 620000 STB with clear difference and last one with 30% concentration polymer and 70% alkaline gives highest production with 660000 STB up to 1500 days also which remain in range affordable cost. Alkaline Polymer concentration (30%, 70%) save time according to production rate figure and gives more production overall.

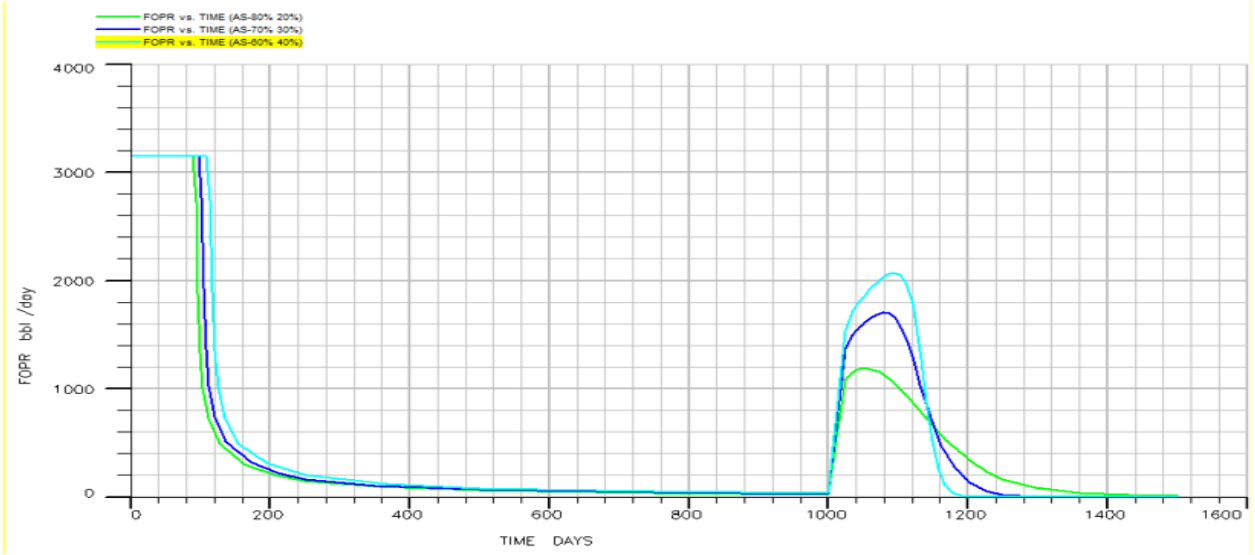

Figure 11: Impact of different formulas of Alkaline Surfactant on depleted reservoir flow rate

Three graphs have been shown here with different quantities of Alkaline and Surfactant in Alkaline Surfactant

flooding (AS) as (80%, 20%) represented by green graph (70%, 30%) represented by blue graph and (60%, 40%) represented by Sky blue graph for comparison to find most driving force of oil from reservoir to well.

All graphs were stable for different days at flow rate of 3180bbl/day then fell to downward but curve is seen at 120 days with rate 800bbl/day which prolong the flow with steady drop and led to 20bb/day, during this alkaline Surfactant injection were carried out which showed effect on 1000 days, as we can see green graph has been mingled up to 1100bbl/day where all shows directions with their capabilities. Green graph separated with circular curve to down ward with highest point which is 1200bbl/day, during falling a parabolic shape formed which prolong flow up to 1360 days.

Then comes blue line with 70% and 30% concentration of AS which separate from Sky blue line with straight line which shows stabilization with flow rate of 1700bbl/day which quite high, flow was still there up to 1240 days, one can sight that this graph falls earlier than green line.

And in last Sky-blue graph with higher concentrations of surfactant which increase cost of it and also the flow rate can be seen 2050bbl/day at its peak point, fall earlier than others because oil production taken earlier also which save time and money, and well completed at 1180 days. According to given graphs model with higher concentrations of surfactant gives higher flow rate of oil.

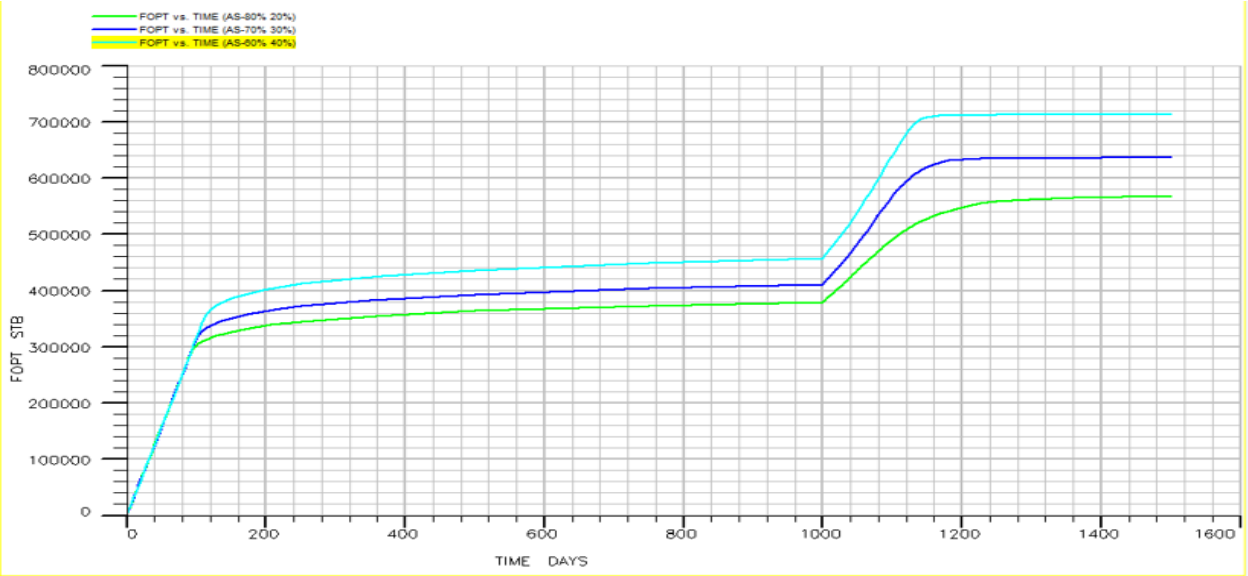

Figure 12: Impact of different schemes of Alkaline Surfactant on overall production of oil

If we see the above figure all graphs are merged then separate according their properties changed by concentrations, green line remains low and a straight line was formed until 1000 days where changes revealed first try to increase up to 1280 days then stabilization achieved 565000 STB of oil production at its peak point up to 1500 days if someone observe the graph showing good result but not require able because surfactant is low.

Blue graph with 70% Alkaline and 30% surfactant in figure green shows early curve but blue graph goes more

upward and graph shows very little curve which led to more production in same time, overall oil production up to 640000 STB.

Last with higher concentration of surfactant has given more production also, if we follow sky blue graph during rising to stabilization graph shows deflection last among them and remain at higher position which ultimately more production up to 720000 STB and save money by saving time.

After analyzing figure of oil production of depleted reservoir, graph with 60% Alkaline and 40% Surfactant concentration in AS flooding remains high during flow rate and overall production and also with this combination of AS cost is normal according to given production of oil.

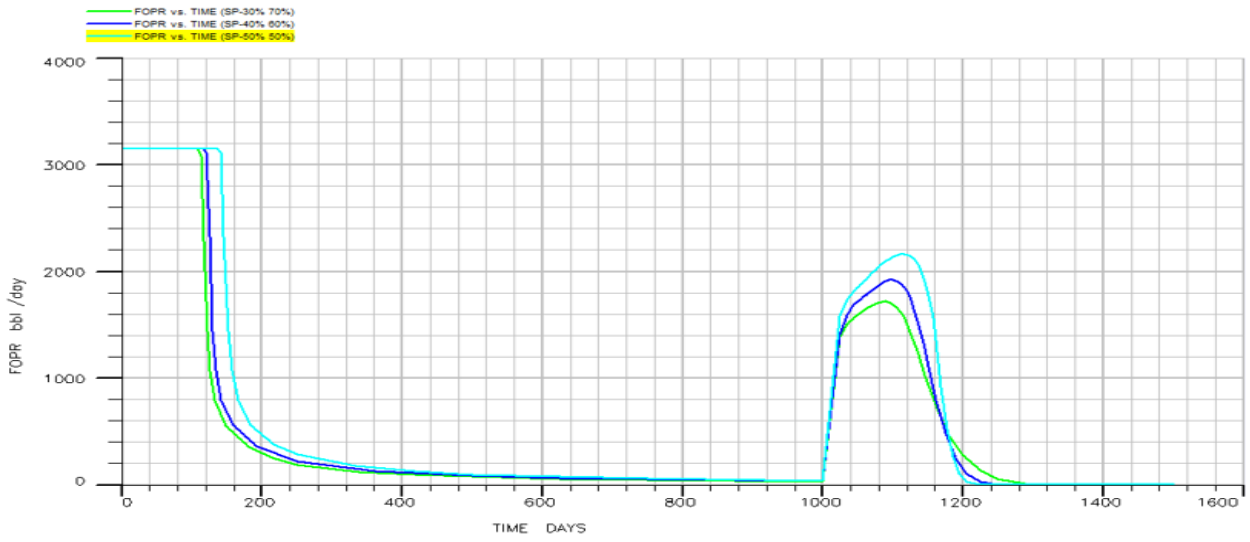

Figure 13: Impact of different of proportions of surfactant Polymer on flow rate of well.

As shown in figure, different graphs represent different proportions of Surfactant Polymer green graph represent (70%,30%), blue graph (60%, 40%) and sky-blue graph (50%, 50%), green graph shows improvement with straight line to upward reach desirable point 1730bbl/day then start reducing finally stop at 1280 day, also green graph takes longer time to reach to peak point with lowest rate among them.

Blue graph with 60% and 40% percentage SP reacts faster than green graph and also someone notice that it rises with sky blue line which has higher concentration of surfactant, blue graph rises perpendicularly up to 1400bbl/day and making bent at 1920bbl/day afterward flow rate was continue but negative rate and finally stops at 1240 days.

Sky blue highest rate with 50% and 50% proportions of SP which also increase cost with it because surfactant is expensive, sky blue goes along with blue graph up to 1400bbl/day where blue bent but sky blue goes higher and reach rate of 2200bbl/day and during falling clear difference can catch eye which sky falls slowly in respect blue graph which means production of oil and again well completed 20 days earlier than blue graph.

By comparing oil production rate sky blue which gives more flow rate among them and takes less time but it is

costly so concentrations with 60% polymer and 40% surfactant will be suitable one for common use.

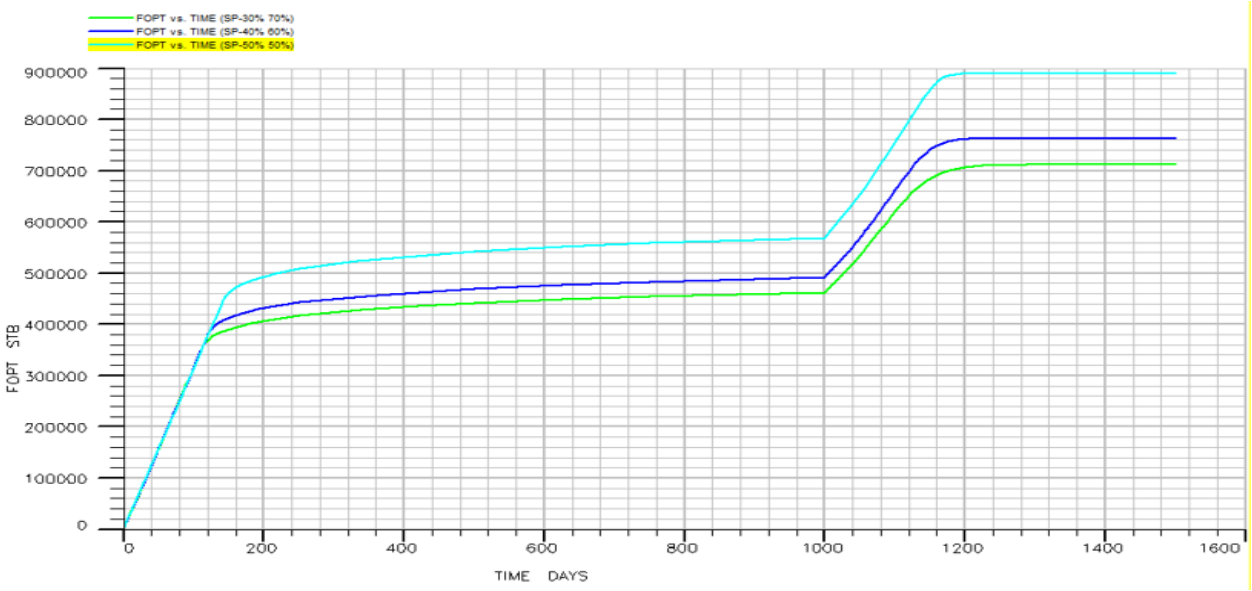

Figure 14: Impact of surfactant polymer with different proportions on total production of oil

In above figure we compared different concentrations of SP impact on flow rate and now we compared how it impacts on overall production, green graph reaches 720000 STB of oil production but remain lowest among them it goes straight from 1000 day to 1200 then show little curve but still forward and finally completed at 1500 days. Blue line with 60% and 40% of SP showing more positive result by making 60 degrees from 1000 day to 1200 then stabilization with production 763000 STB of oil and can be seen that in green graph stabilization was not achieved but very little time.

Sky blue with 50 50 percentage remain higher than both with more promising result with 880000 STB of oil which is quite high and graph in the figure more like perpendicular which means production of oil but surfactant cost can create problem to use in field because low price of oil will be real problem.

After figuring above figure with different of surfactant and polymer conclusion can be made based on cost of surfactant and polymer with respect oil prices that 60% polymer and 40% surfactant in SP flooding will be best choice because too much surfactant can be loss in reservoir.

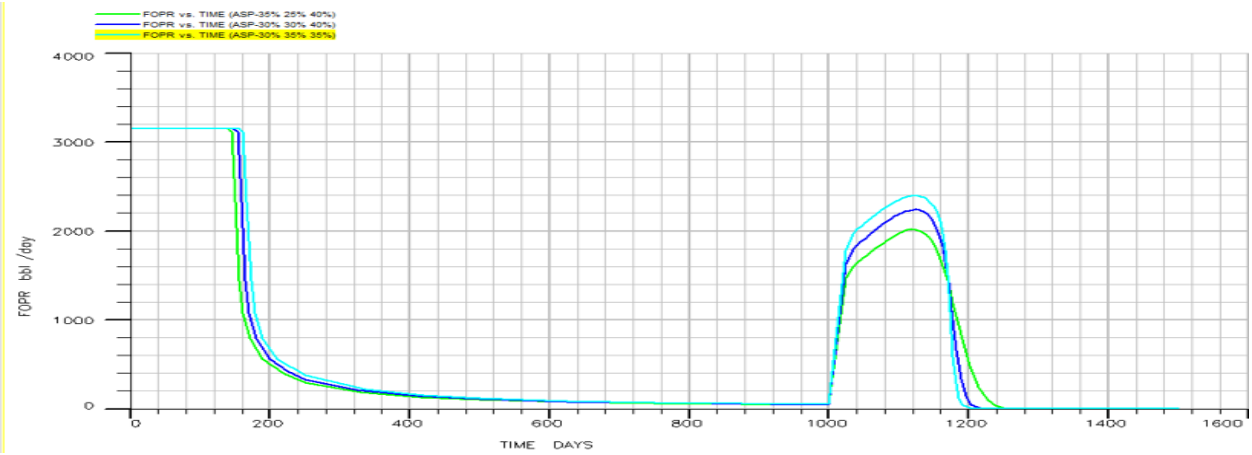

Figure 15: Impact of different proportions of ASP on depleted model production rate

Different proportions ASP is used to find most effective one, as we see through figure green line representing 35%, 25% and 40% of ASP fall on 120 days from 3190bbl/day to downward and reaches 40bbl/day meanwhile flooding was carried to push oil from reservoir to well, green graph moves vertical until reaches 1700bbl/day where it moved forward with curve shape and finally reaches at 2000bbl/day which its highest rate possible then declining and completed at 1240 days.

Blue graph represents 30%, 30% and 40% proportions of ASP flooding in the reservoir, blue graph was merged with green graph during rise of flow rate but it goes higher than green graph, highest flow rate of blue graph was 2220bbl/day and well completed at 1220 days.

Sky blue graph represents 30%, 35% and 35% proportions of ASP flooding in the reservoir, sky blue was also merged with others during rise but it goes highest flow rate and that flow rate was 2400bbl/day and it can be guessed that flow rate is rising because we are increasing concentration of surfactant in it and in this model well completed ten days later which pro long flow.

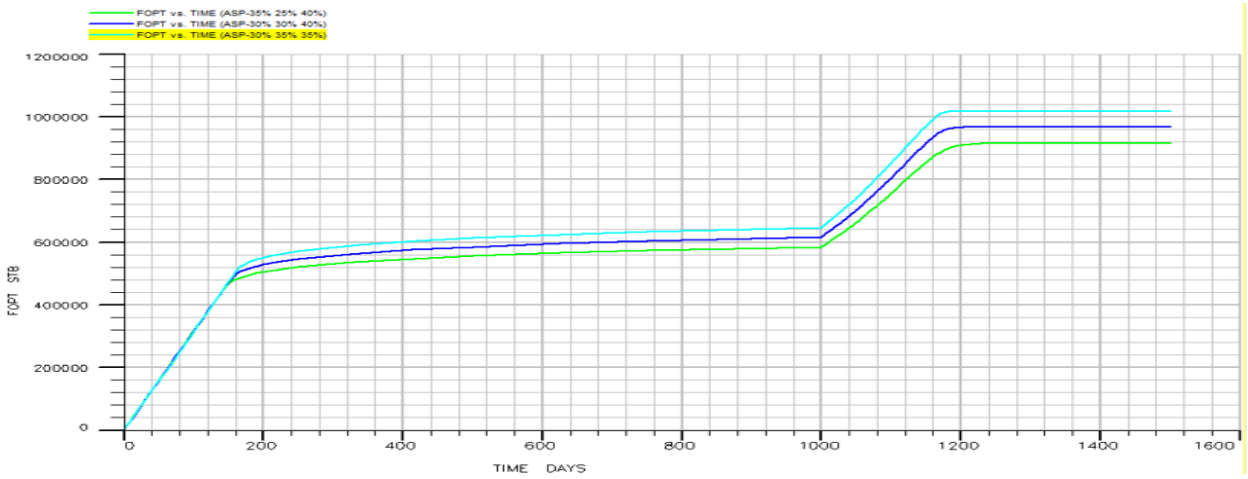

Figure 16: Effect of different formulas of ASP on overall oil production of reservoir

Green graph rising slowly can be seen from figure but after 1000 days' sharp increment was encountered which reach up to 920000 STB of oil production where it stabilized up to 1500 days which is good production and production was smooth there was no fluctuations during flowing. Blue graph is above than green graph, blue graph represents more surfactant injection than green graph and polymer remain same and blue graph has reached 960000 STB of oil production, sky blue graph which represent 30%, 35% and 35% of ASP concentration, has given highest overall production and stabilized at 1020000 STB oil production and this increment can be reason of adding more surfactant and minimizing polymer to make them equal quantity of them while quantity of alkaline remain same.

Summary of this procedure is ratio of 30% alkaline, 35% surfactant and 35% polymer are best choice in terms of recovery and cost of chemicals.

4. Response Surface Methodology

Table 4: input data

NUMBER	CHEMICAL METHOD	PRODUCTION
1	ALAKLINE	480000 STB
2	POLYMER	585000 STB
3	SURFACTANT	640000 STB
4	AP	660000 STB
5	AS	720000 STB
6	SP	763000 STB
7	ASP	1020000 STB

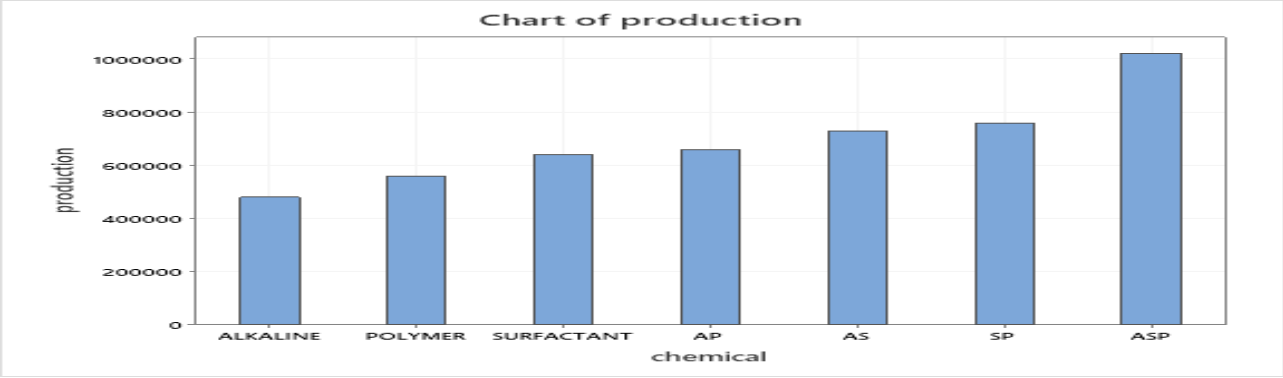

Figure 17: Comparative analysis of all methods based on RESPONSE SURFACE METHODOLGY

After generating models from ECLIPSE100 by putting data, result was compared with help of RESPONSE SURFACE METHODOLGY which is shown in above picture where different result of chemical flooding present that clarify individual chemical has given less production than mixed flooding and in mixed flooding

ASP has remain top with SP at second position.

5. Conclusion

ASP flooding was found to be the best injection mixture among all the adopted options moreover, Chemical flooding was found beneficial after conducting research on depleted reservoir with various concentrations. After performing sensitivity analysis over Alkaline model with different quantities and quantity with higher value which is 50% of solution is found to be best. Sensitivity of polymer flooding model with different concentrations have found best model in polymer which is model with 40% concentration Higher concentration drives more oil. Sensitivity of surfactant flooding model with different concentration and found best from them as concentration with 30% surfactant in water solution which is effective to drive oil from reservoir and cost saving one. After sensitivity analysis of Alkaline Polymer flooding model with concentration and the best choice of model in terms of concentration is 30% alkaline and 70% polymer concentration. In the end of sensitivity analysis of Alkaline Surfactant with concentration, 40% surfactant and 60% Alkaline has showed best result. Surfactant Polymer method with 40% surfactant and 60% polymer is best choice. Sensitivity analysis has revealed that concentration of ASP flooding that concentration 30% Alkaline, 35% Surfactant and 35% Polymer is effective formula to consider. SP has given second large production of up to 765000 STB and ASP remain best due presence of Alkaline that ultimately affect oil production of 1020000 STB. To make it more accurate RESPONSE SURFACE METHODLOGY was used which is shown in last figure that made it clear about best method, the data was put in to software obtained from these methods.

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