

An integrated water injection solution for Southern oilfields of Iraq

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Introduction

After two bid rounds of oilfields, moo has planned a plateau oil production of 12mmbblsd in 2017. in order to reach the plateau production, most of the oilfields require water injection to maintain the reservoirs' pressure. there are three main challenges in water injection. firstly, where could the urgent water resource be available in the rehabilitation phase of the brown oilfields? secondly, how could the high amount of produced water be handled at the late stage of the oilfields? thirdly, what kind of sweeping efficiency could the reservoirs be developed by water flooding?

Dump flood, produced water treatment and reinjection, combined with separate layers' water injection could be an integrated solution for southern oilfields of iraq.

The Feasibility Of Dump Flood

From regional geology, in the southern west of iraq, zubair and nar umr are two main continental clastics sediment by a shoal water delta that prograded from the wsw to the ene. there are huge infinite aquifers in these two reservoirs with a high potential of producing water with very little or no effect on its original reservoir pressure. as a

water source, nar umr reservoir is only with an oil cap at the crest of structure and with a strong bottom & lateral water thus the permeability and the productivity index is relatively high. this will allow the water to flow from nar umr into the wellbore with no reservoir restriction or drop in flowing bottom hole pressure. The chemical composition of the nar umr water is similar to that of the zubair and mishrif formation water which is a good compatibility between the reservoirs. main pay, mishrif and upper shale are the three main producers in southern oilfields of iraq where water flood will be required to enhance the reservoirs pressure and oil sweeping.

After more than 40 years the production of AB and DJ layers on top of main pay is at low pressure of 4000 psi. mishrif and upper shale reservoirs are also show a rapid pressure decline. nar umr reservoir is almost with the initial pressure about 5000psi. with a nodal analysis

on the pressure difference, a natural dump flood could be achieved from nar umr to top main pay and upper shale, even to mishrif.

Produced Water Treatment & Reinjection

Since starting development in 1960s, daqing oilfield has experienced more than 50 years development. currently, the comprehensive water cut of whole oilfield has exceeded more than 90%. by the end of 2010, there are totally 192 treatment stations for various kinds of produced water, and nearly $200 \times 10^4 \text{m}^3/\text{d}$ of various kinds of produced water repeated the circulation of “production → treatment → rejection” daily, which give great arbitration to high and stable production of the oilfield. at present, most of the brown oilfields in iraq such as rumaila oilfield mainly adopts depletion production method, but actually

water flood will be required to increase production in the future.

once large scale water dump development with esps is realized, the water cut of the oilfield will increase continuously and the produced water output will increase correspondingly year-by-year, so how to treat and utilize the produced water is a problem we have to solve.

The best solution is to treat the produced water to satisfy the quality for injected water and re-inject it into oil reservoir for water flooding. firstly, the produced water comes from the oil reservoir, so it has the best compatibility with the reservoir which is incomparable by other sources; secondly, the utilization of produced water as a source replacing other injected water sources can save surface water and ground water sources, which is the most useful for the areas where water source are insufficient; and the last one is that it is not only prevents from polluting the

environment by the discharge of produced water, but also avoids the high cost caused by treating the produced water up to discharging standard or ineffective re-injection. it is suggested that desalting treatment should not be taken into consideration for the produced water. if the h₂s content in the water is high in particular case, gas-lifting, oxidation and other method can be used for its removal.

Separate Layers' Water Injection

Separate layer water injection is applicable to the development of multi-layer reservoirs where the reservoir rock properties are varying, mainly the porosity and permeability amongst layers/sands. the sweeping efficiency of water flooding will be low if water injection is in commingled way for this type of reservoirs. consequently, a relatively low recovery factor is expected. in this case, the separate

layer water injection has been proven to be a more effective way of improving the efficiency of oil displacing and enhancing of recovery factor by the practices both in china and around the world.

geological characteristics of the southern oilfield in iraq show heterogeneity vertically in different layers/sands, primary barriers in between the net pay layers/sands. the characteristics are good for application of the separate layer water injection.

Conclusion

Nahr umr sandstone reservoir is only with an oil cap at the crest of structure and with a strong bottom & lateral water which could be as a water source. with a nodal analysis on the pressure difference, a natural dump flood could be achieved from nar umr to top main pay and upper shale, even to mishrif.

by utilizing the produced water, the circulation of “production

→treatment → rejection” daily could give great arbitration to high and stable production of the oilfield. it is suggested that desalting treatment should not be taken into consideration for the produced water. if the h₂s content in the water is high in particular case, gas-lifting, oxidation and other method can be used for its removal.

for the separate layers’ water injection , a in-depth petrophysics study and geological modeling will be required to characterize the barriers inside of those formations, either non-permeable or low-permeable, where core data analysis here is extremely important.

Recommendations

A dump flood pilot from nahr umr to top mainpay is recommended. a separate layers’ water injection pilot in upper shale is recommended.