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Flow Assurance Improvement by Injecting Pour Point Depressant Chemical through Permanent Coiled Tubing Gas Lift to Heavy Oil at MM-1 Well at MPA Field

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ABSTRACT

The majority artificial lift used in MPA Field use PCTGL (Permanent coil tubing gas lift). PCTGL is installed on several monobore well or dual monobore well. Some wells in the MPA Field have waxy HPPO oil character with pour point between 85-100°F with API between 30-35. The well "MM-1" has a HPPO character with pour point 95°F. The character high Pour point oil of the well will be problem to be solved. The MM-1 well is produced with PCTGL. From the simulation, a PCTGL design was obtained at a depth of 2250 ft. With the character of HPPO oil, pour point depressant injection optimization is also carried out along with the injection of gas lift so that the chemical can work from the downhole. The results of the bottle test of pour point depressant use concentration of 1000 ppm to reach the target. The results of the field test showed that the concentration of Pour Point Depressant of 1026 ppm was able to change the pour point up to 65°F. The results of optimization production showed that the production of MM-1 wells was able to increase with production of 290 bopd.

Keywords: gas lift; hppo; pctgl; pour point depressant

I. INTRODUCTION

The majority of oil-producing wells in the MPA Field are produced using artificial lifts. The majority artificial lift in MPA Field use PCTGL (Permanent coil tubing gas lift). PCTGL is installed on several monobore well or dual monobore well. PCTGL has been implemented by running 1.5" coil tubing into a well through a special tubing hanger attached to the top of Christmas tree. PCTGL application allows gas lift to an oil reservoir in monobore well completion without requiring rig for recompletion. This application use slickline unit to set PCTGL into the monobore well completion. Some wells in the MPA Field have waxy HPPO oil character with pour point between 85-100°F with API between 30-35. The contribution of HPPO oil to the MPA Field reaches 62.4% of the total production of the MPA Field. MM-1 well is one of the wells that has HPPO character with pour point 95°F. With the character of HPPO, oil and wax, it can cause a tendency to form plugging in the injection nozzle in the PCTGL well so that optimization and injection of pour point depressants are needed.

Pour point depressant (PPD) has been widely employed to improve the low-temperature flowability of crude oil. The polar moiety can decrease wax crystal size and provide electrostatic repulsion force to wax crystals, whereas the nonpolar main chain is responsible for adsorbing and co-crystallizing with wax molecules. In conventional wells with an ESP artificial lift, chemical can be injected continuously through chemical line that is inserted into the power cable so that chemicals can be injected starting from the subsurface. In conventional wells with gas lift system, chemical injection can be injected together with gas through the casing to form a multiphase mixture. Casing pressure can be increased to reduce chemical instability that enter the gas lift valve. Permanent Coil Tubing Gas Lift is one of the developments of artificial gas lifts that can be used in monobore wells where gas can be inserted into the downhole through coil tubing. PCTGL consists of coil tubing, nozzle, nipple, centralizer and check valve.

Pour point depressant can be injected simultaneously with gas to MM-1 well through coil tubing. This method can be applied to solve problem of HPPO oil in MPA Field especially for MM-1 well. The purpose of the research is improving flow assurance and production improvement. The results of the bottle test pour point depressant showed concentration of 1000 ppm to reach the target. The field test results showed that the optimum concentration of pour point depressant to achieve the target 65°F was 1026 ppm. By injecting pour point depressant from subsurface through gas lift line cause plugging problem can be prevented. From the simulation, PCTGL design was obtained at a depth of 2250 ft. The results of optimization production showed that the production of MM-1 well was able to increase with production of 290 bopd.

II. METHODS

Method in this study is intended to optimize the production of PCTGL "MM-1" well that has HPPO character through several methods: well data collection, PCTGL analysis and evaluation, Pour Point Depressant chemical bottle test and field test chemical.

Well data collection is carried out such as depth, layer, flow rate, pressure, temperature and oil characteristic (pour point data, wax content, specific gravity, API). Next method is intended to analyze and evaluate PCTGL so PCTGL can be optimized. Evaluation can be done by using petrel software to run simulation. Next method is bottle test chemical. Bottle test is used to predict and optimize pour point depressant concentration to HPPO oil in MM-1. The last step is field test method.

III. RESULTS AND DISCUSSION

MM-1 well has the HPPO character. Pour point crude in this well is 95°F. Well MM-1 is converted first time to PCTGL at November 10, 2017. In order to make MM-1 well flow again, it must be optimized and evaluated again. Crude oil MM-1 has wax content 72.3%. Data Properties crude MM-1 can be seen in table 1.

Table 1. Properties Crude MM-1

Component		Mole (%)	Component		Mole - %
Benzena		0.387	n-Octadecane	C_{18}	3.867
Toluene		1.095	Nonadecane	C_{19}	4.448
Xylene		1.174	Eicosane	C_{20}	4.650
Ethane	C_2	0.002	Heneicosane	C_{21}	5.172
Propane	C_3	0.011	Docosane	C_{22}	5.372
Iso butane	iC_4	0.011	Tricosane	C_{23}	5.692
n-butane	nC_4	0.022	Tetracosane	C_{24}	5.871
Iso-Pentane	iC_5	0.034	Pentacosane	C_{25}	6.174
n-Pentane	nC_5	0.029	Hexacosane	C_{26}	6.171
n-Hexane	C_6	0.037	Heptacosane	C_{27}	6.364
n-Heptane	C_7	0.057	Octacosane	C_{28}	5.798
n-Octane	C_8	0.099	Nonacosane	C_{29}	5.150
n-Nonane	C_9	0.166	Triacontane	C_{30}	4.309
n-Decane	C_{10}	0.335	Untriacontane	C_{31}	3.933
n-Undecane	C_{11}	0.553	Dotricontane	C_{32}	2.489
n-Dodecane	C_{12}	0.853	Tritiacontane	C_{33}	2.497
n-Tridecane	C_{13}	2.140	Tetratriacontane	C_{34}	1.282
n-Tetradecane	C_{14}	2.690	Pentatricontane	C_{35}	0.902
n-Pentadecane	C_{15}	2.664	Hexatriacontane	C_{36}	0.418
n-Hexadecane	C_{16}	3.295	Heptatricontane	C_{37}	0.128
n-Heptadecane	C_{17}	3.662	Total		100

In collecting data, it is necessary to conduct a BHP survey to determine the gradient pressure from the well. Bottom Hole Pressure (BHP) Survey are carried out in wells to obtain pressure data to define local and average reservoir pressures. Pressure and temperature reservoir in MM-1 well can be seen in table 2

Table 2. Reservoir MM-1 Data

Parameter	Value	Units
Reservoir Pressure	1777.29	Psi
Reservoir Temperature	181.896	F
Productivity Index	0.3	stb/ day/psi
Water Cut	0	%
Permeability (mD)	37	(mD)
Porositas	18.5	%
Saturasi	0.502	

After the data collection stage, it is necessary to analyze and evaluate the MM-1 well so that it can flow and the HPPO problem can be resolved. In this stage, PCTGL optimization and redesign are carried out in order to get optimal production. PCTGL design uses prosper software to determine the optimum depth and the most optimal gas injection rate. From the simulation results, it was found that the depth of PCTGL will be set at a depth of 2250 ft. From the sensitivity analysis, it was also found that the most optimal gas lift rate was 1.2 mmscfd.

Table 3. PCTGL MM-1 Data

Parameter	Value	Units
Max Gas Avalaible	1.2	MMscfd
Maximum Gas During Unloading	1.2	MMscfd
Flowing Top Node Pressure	163	Psig
Unloading Top Note Pressure	-562	Psig
Operating Inject Presssure	700	Psig
Kick Off Pressure	700	Psig
Max Depth of Injection	2250	Feet
Water Cut	0	%
Statik Grad of load fluid	0.346	psi/ft
Total GOR	300	scf/stb
Max Liquid Rate	100000	stb/day
CT Inside Diameter	1.25	Inch
CT Thickness	0.125	Inch
CT Maximum Depth	2250	Feet
Gas Injection	650	Psig
DP Across Valve	100	Psi

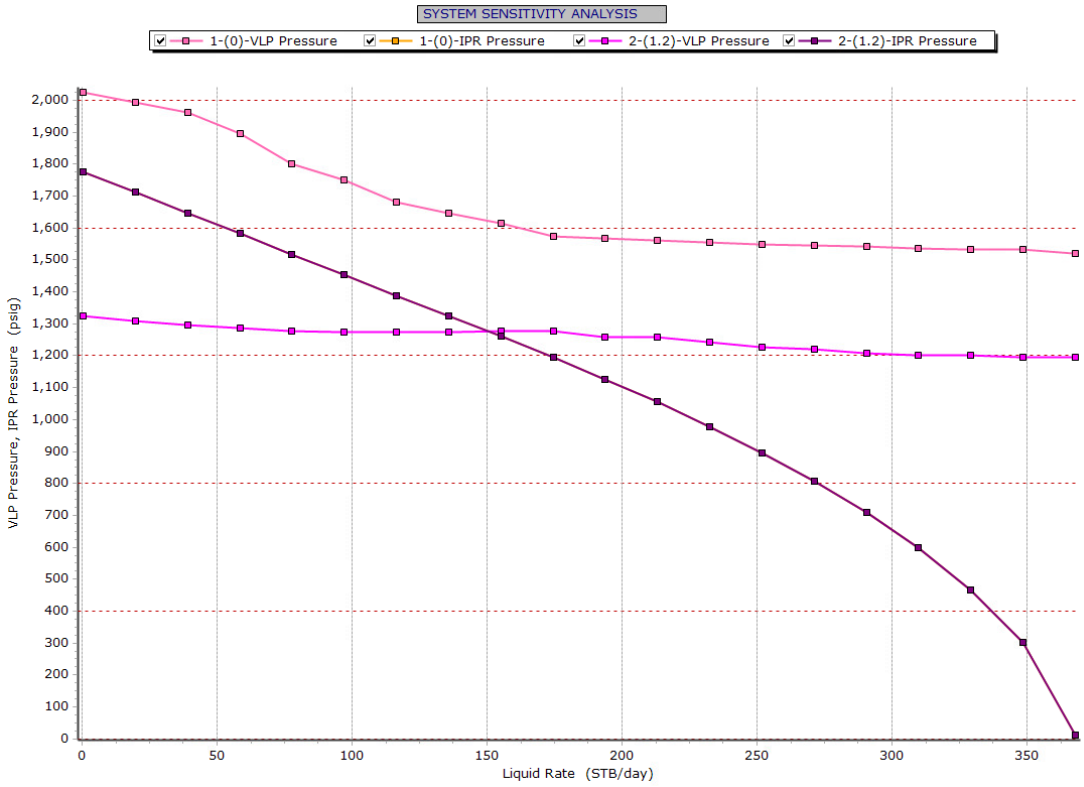

Figure 1. Design PCTGL MM-1

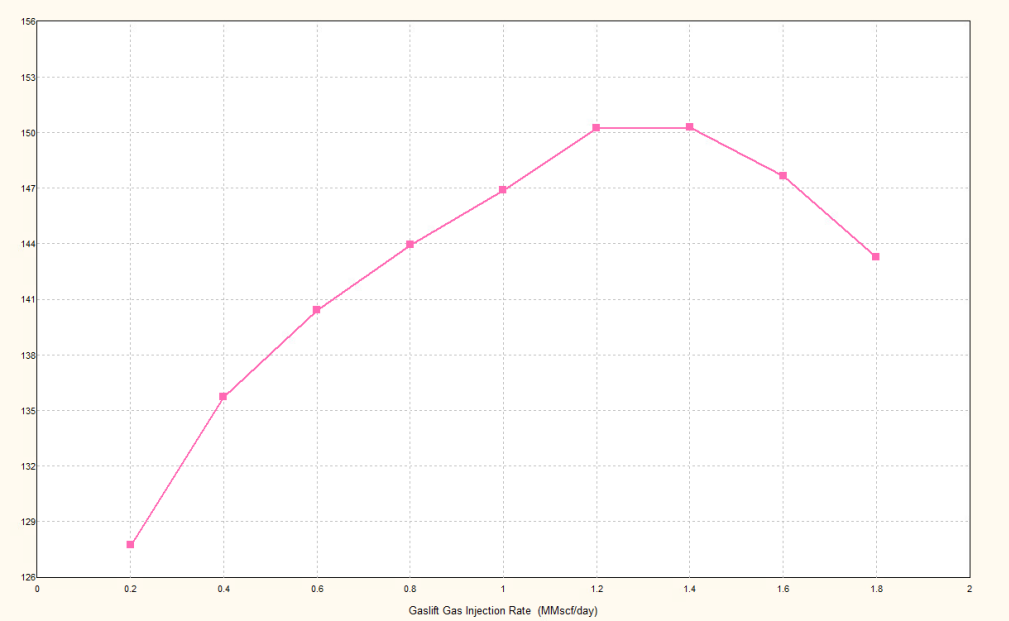

Figure 2. Sensitivity Analysis Rate Gas Lift

The pour point depressant injection process also needs to be changed by changing the chemical injection point so that the effect injection can work from subsurface. The process of changing this injection method can be seen in the following simple illustration in figure 3. On January 26, 2022, PCTGL was installed at a depth of 2250 ft. The PCTGL design is accompanied by Pour Point Depressant injection through coiled tubing along with gas lift injection

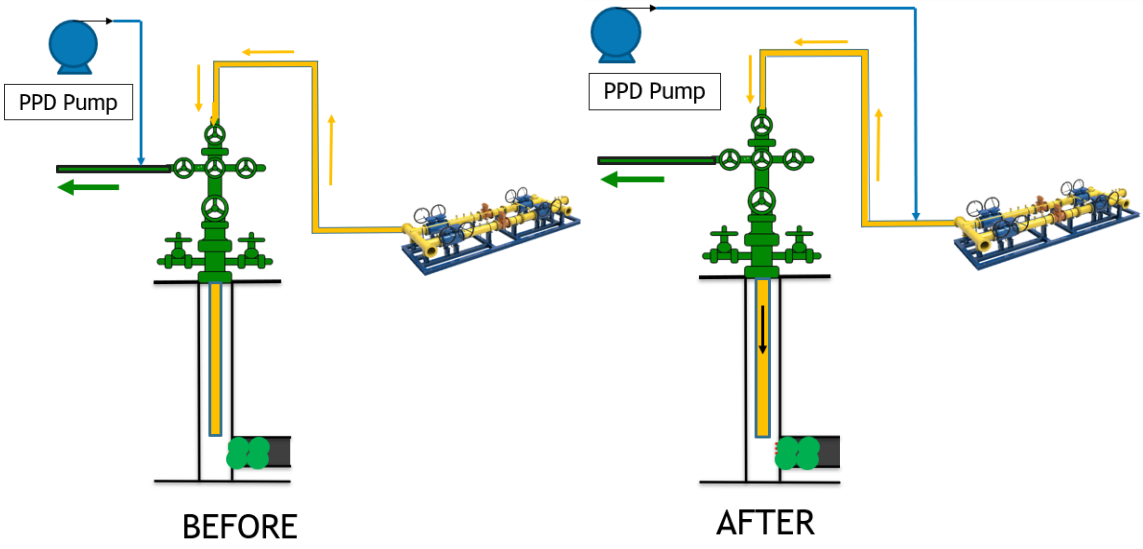

Figure 3. Illustration Pour Point Depressant Injection

After the design stage, it is necessary to analyze the bottle test of oil samples from the MM-1 well which has the HPPO character. From several types of chemicals, chemical XX600 is the best chemical for solving problem HPPO in MM-1 Well.

Table 4. Bottle Test Chemical Pour Point Depressant with Several Type of Chemicals

	PPM	97°F	91 °F	86 °F	81 °F	75 °F	70 °F	65 °F
BLANKO	3000	Flow	Flow	Solid	Solid	Solid	Solid	Solid
XX600	3000	Flow	Flow	Flow	Flow	Flow	Flow	Flow
XX34226PAO	3000	Flow	Flow	Flow	Flow	Solid	Solid	Solid
XX34228PAO	3000	Flow	Flow	Flow	Flow	Solid	Solid	Solid
XX34374PAO	3000	Flow	Flow	Solid	Solid	Solid	Solid	Solid

XXO8584A	3000	Flow	Flow	Solid	Solid	Solid	Solid	Solid
XXO2028A	3000	Flow	Flow	Flow	Flow	Solid	Solid	Solid
XXO3051	3000	Flow	Flow	Flow	Flow	Flow	Solid	Solid

From the chemical selection step, it will be continued with the bottle test using chemical XX600 by testing with various variations of PPD concentration. From table 5, chemical PPD XX600 can use 1000 ppm concentration to change pour point from 95ºF to 65ºF

Table 5. Bottle Test Chemical Pour Point Depressant MM-1 Crude Oil by using XX600

MM-1	Concentration PPD (ppm)	BLANKO	200	500	1000
	Pout point (ºF)	95	80	70	65

After the bottle test, the next step is field test. In the field test step, PCTGL is kicked off with a pressure of 700 psi and injected with pour point depressant (PPD) with concentration of 1000 ppm. From the results of the field test, the optimum concentration was 1061 ppm. The pour point depressant injection is equivalent to 14 gallons per day.

After collecting data, analyzing PCTGL design, bottle test, field tests, the next step is production monitoring. From the simulation, it is expected that a production of 150 bopd will be obtained. From the test results, MM-1 well can produce up to 300 bopd.

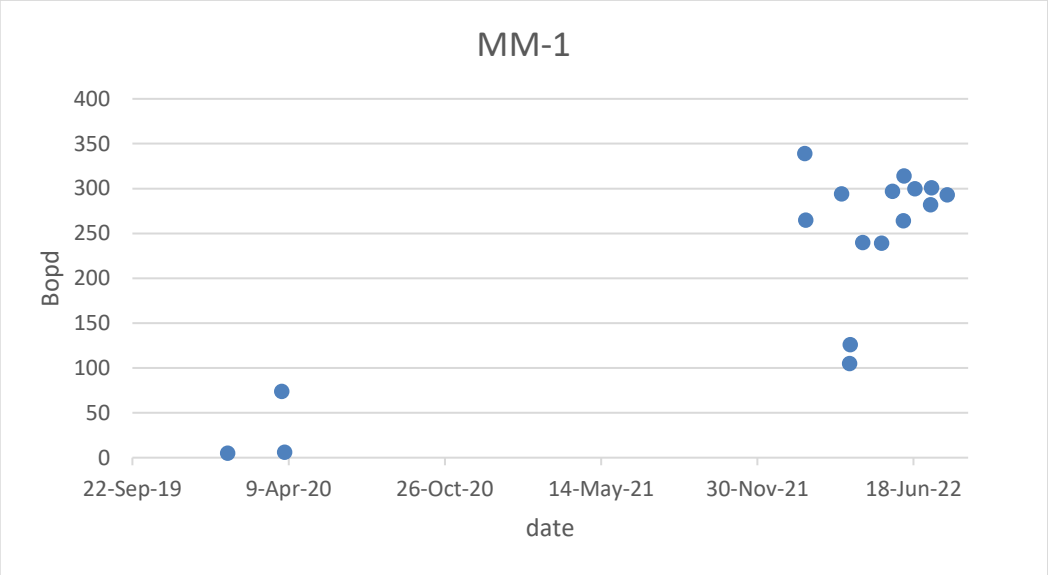

Figure 4. Data Test Production MM-1 well

IV. CONCLUSION

Based on the results of the Optimization and evaluation in MM-1 it can be concluded that:

1. The production of the MM-1 Well can be increased by evaluating PCTGL design and optimizing pour point depressant injection through coiled tubing along with gas lift injection because the effect of chemical pour point depressant has been carried out starting from subsurface.
2. The MM-1 well pour point of 95ºF can be lowered to 65ºF by injecting 1061 ppm using pour point depressant XX600 chemical which has been selected based on the results of chemical selection, bottle tests and field tests.

REFERENCES

Alade, O.S., Shehri, D.A., Mahmoud, M., Olusegun, S., Lawal, L.O. Kamal, M.S., Al-Nakhli, A. 2021. Viscosity Model for Bitumen-Solvent Mixtures. Journal of Petroleum Exploration and Production. 11:1505-1520

Al-Hashmi, A.R., Al-Wahaibi, T.K., Al-Wahaibi, Y.M., Mjalli, F., Al-Omairi, R. 2017. Transportation of heavy oils using polymer-stabilizied oil in water emulsions. 7. 881-890

Hart, A. 2014. A review of technologies for transporting heavy crude oil and bitumen via pipelines. 4:327-336

Hart., A., 2014. The novel THAI-CAPRI technology and its comparison to other thermal methods for heavy oil recovery and upgrading. 4:427-437

Kahfie, R.M., Kurniawan, F., Yahya, M., Edy, I.K.O., Iswardy, S. 2017. Integrated Work to Deliver 4,000 BPD Oil from Gas Dominant Field: A Case History from Rejuvenated Brown Filed Gas Lft Development.SPE-186933-MS. https://doi.org/10.2118/186933-MS

Kramadibrata, A.T., Sumaryanto, Panjaitan, P. 2011. Developing Oil in Well Completion Using Permanent Coil Tubing Gas Lift Application. SPE-147903-MS. https://doi.org/10.2118/147903-MS

Ren, Y., Fang, L., Chen, Z., Du, H., Zhang, X. 2018. Synthesis and Evaluation of Grafted EVAL as Pour point Depressant for Waxy Crude Oil. 57: 8612-8618

Sivakumar, P., Sircar, A., Deka, B., Anumegalai, A.S., Moorthi, S., Yasvanthrajan, N. 2018. Flow Improvers for Assured Flow of Crude Oil in Midstream Pipeline - A Review. Journal of Petroleum Science and Engineering. 164: 24-30