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Problem Solving of Flow Assurance due to Viscosities Issue in the Oil Well Flowline of Field-X Using Surface Chemical Injection

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Abstract.
Several wells in X Field have problems related to high pressure in the flowline due to high viscosities which are related with X-crude pour point properties. Current practice to solve the problem is by chemical stimulation to the wellbore using solvent. The chemical is proposed since it can create oil water emulsion, which hypothetically may have lower viscosity than the crude oil itself.

Historically, opportunity to utilize viscosity reducing chemical agent already identified and laboratory tested in 2017 and 2018 from two company providers. The Operation Laboratory conducted rheology tests at various chemical concentrations to determine whether chemical injection will give better flowability of the crude oil. One of the recommendations from the laboratory test is to conduct a field trial to see the real effectiveness and also compatibility with field operation. Project team decided to implement a different methodology to reduce viscosity through surface chemical injection.

This pilot project started with selection candidates in which congeal wells are mostly located in Area A, B, C, and D in X field. After candidates are fixed, the project team measures the oil properties (viscosity, water cut, pour point, and oil well test) for each well (before chemical injection). Parallel with candidate selection, the project team also executed a procurement process to purchase chemical and injection equipments.

After preparation completes, continuous chemical injection takes place in the surface pipeline. So, the producer well is still ON while the chemical pump keeps injecting solvent chemicals. During continuous chemical injection, the project team measures the oil properties and well tests to see the impact from solvent chemicals. This pilot project took two weeks of continuous injection for each well and after that injection stopped and the project team evaluated the result.

After doing surface chemical injection for 5 wells, it is concluded that chemical X gives a positive impact to oil viscosity that flows in the surface pipeline. Oil viscosity is reduced 30 – 50% after injecting solvent chemicals (4 out of 5 wells). This ultimately will increase oil production. Viscosity reductions happen effectively at 3-5 days after injection starting and higher injection rate from chemicals will result in larger viscosity reduction. Viscosity reduction result also varied by well depending on initial oil production, water cut, congeal severity, and wellhead temperature.

Keyword(s): Congeal; Viscosity Reducer; Chemical; Pipeline; Flow Assurance

1 Introduction

Field X has a massive operation area with a total more than ~6,000 producer wells running every day. With the nature from heavy oil, produced oil has higher viscosity compared to Sumatra Light Oil. Some of the producer wells even have significantly high oil viscosity. Congeal well population in Field X is 113 wells. Mostly coming from area A, B, C, and D. Congeal wells are marked as "oil congeal" in the database. Although in actual there are several wells that show congeal problems, but not identified as congeal wells.

Average performance of congeal wells is hanging around 10 BOPD. Furthermore, proactive stimulation jobs in congeal wells since 2015 is only 1% compared to the whole Field X area stimulation activities. Given that condition, congeal wells give a good opportunity to execute chemical stimulation.

Aside from congeal wells from the database, the project team also includes congeal wells that are found from Field Operation Team assessment but not captured in the database as candidates to do pilot project surface chemical injection.

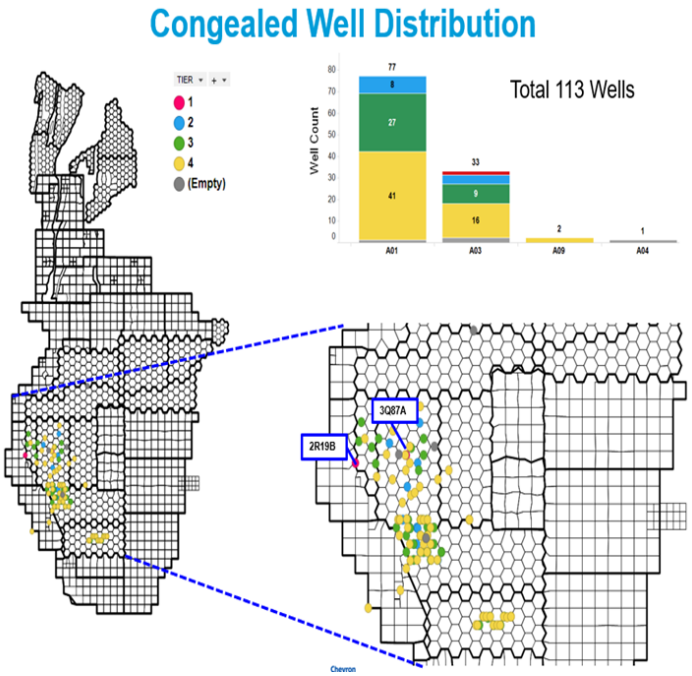

Figure 1. Congealed Wells Distribution (IODSC SA&I team, 2021)

2 Methodology

Prior to surface chemical injection execution, the project team selects chemicals to be used as viscosity reducers from various vendors. Chemical selection is based on laboratory tests conducted earlier from three chemical providers. All chemicals show viscosity reduction but one chemical performs better over the other. Chemical waxtreat from vendor 3 reduces ~40 - 50% viscosity while chemical from other vendors reduce ~30-45% with higher concentration. Figure 2 below showing the summary of chemical vendors comparison

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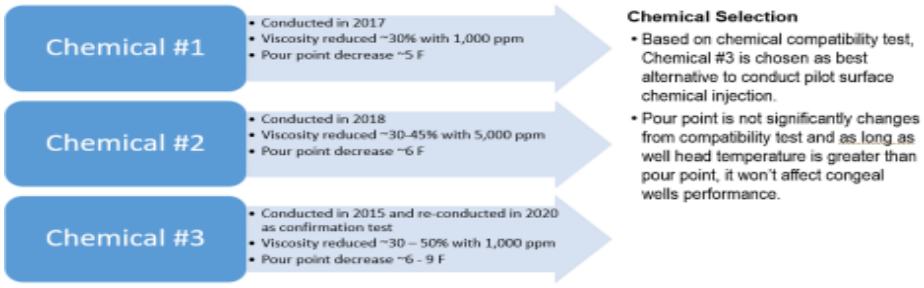

Figure 2. Chemical Vendors Comparison

To achieve success in pilot chemical injection, project team determine several screening criteria for candidates as follows:

- Congeal wells that are captured from a database or based on Field Operation Team assessment. Usually, Field Operation Team reports there are some wells that have congeal issues and oil sample is very viscous.
- There is a good test result at least after 2020: This pilot project needs justification whether chemical injection is working properly or not. One of the methods to measure it is from a well test. If congeal wells that have no test in 5 years due to severe congeal issues, then it would be difficult to measure the impact.
- Low water cut wells (<= 90%): This is a requirement from Clariant that chemicals will work moderately at the well with maximum water cut 95%.
- Wells should have a dedicated sampling point: Because this pilot injection is dedicated to one well, the sampling point should take place from that well only. The well with Automatic Well Test is an ideal candidate for this pilot injection. But since the congeal wells are mostly using Manual Well Test, the project team need to add hot tap along the flow line in the future when this project implements to full field scale.
- Wellhead Temperature should be >= 80 F as the requirements from Clariant that Viscosity Reducer will work at optimum performance if the Wellhead temperature is more than 80 F.

After the chemical is purchased, the project team works together to make injection configuration in the surface pipeline. Chemical drums will be put into a chemical rack and will be connected to wellhead using injection tubing.

Figure 3. Chemical Rack

To have excellent project monitoring, project team also create surveillance monitoring plan to measure the result of surface chemical injection as follow:

Table-1 Surveillance Monitoring Plan

Type	Data taken	Tools	Timing & frequency	PIC	Note
Well test	BFPD WC BOPD	AWT or MWT with adjustment	1. Before injection: 2-3 times 2. While injecting: 2-3 times per injection rate 3. After injection: Following well test schedule	Mohammad Aria Yudha Prawira (SFO Measurement Team)	Preferred AWT well but MWT well also executable if there is dedicated sampling point in the flow line
Fluid Properties & Rheology Test	Viscosity Pour point Water Cut	Fluid sampling from TS Lab	1. Before injection: 1 time 2. While injecting: 2-3 times per injection rate in weekdays 3. After injection: 1 time in 1 month after injection	Rene Pratamora (TS Lab)	Oil sampling is taken from well test station for AWT wells. If well test type is MWT, oil sampling uses additional spot along the flow line

Results

Waxtreat chemical showing viscosity reduction in 3 wells. Well 2 and 5 didn't show any reduction in oil viscosity but still showed response in terms of oil gain. Injection sustainability average is about 28.8 days with well 5 has the shortest duration of injection sustainability. It is mostly due to well 5 oil properties and is the most congeal among all well candidates. Therefore, it needs a higher dosage of injection to increase injection sustainability.

Viscosity reduction is measured during the first three days of chemical injection. Increased injection rate of chemical injection also has a tendency to larger viscosity reduction. In terms of oil gain, the combination between oil production initial, water cut, and Wellhead temperature will give optimum oil gain. If this project will continue with full field implementation, the project team needs to find congeal wells like well 3 that have high oil production rate, moderate water cut, and high wellhead temperature to achieve optimum result.

Table 2. Treatment Result

Well Name	Area	BOPD	Water Cut (%)	WHT (Deg F)	Average Oil Gain	Viscosity Reduction	Injection Sustainability, Days
1	A	6.87	35	110	2.54	-54%	42
2	B	2.315	67.1	196	2.68	88%	21
3	B	20.63	90.4	165	12.42	-45%	26
4	B	3.22	97.2	107	3.04	-48%	43
5	B	1.71	97.3	119	4.28	N/A	12

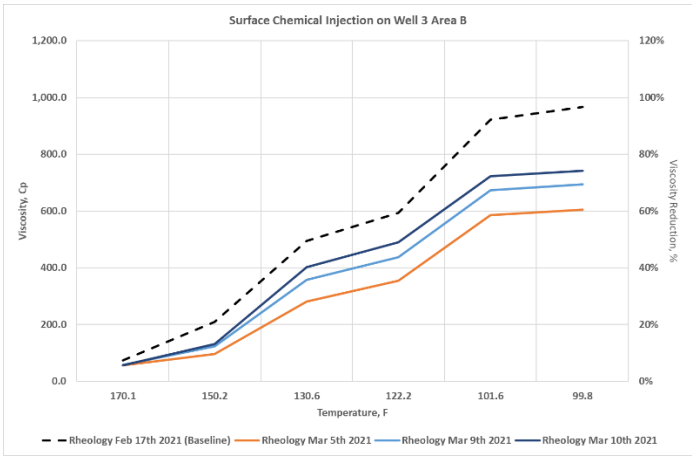

Figure 4. Viscosity Monitoring Result Example

Conclusions

Viscosity reductions happen effective at day 3-5 days and higher injection rate from chemicals will result in larger viscosity reduction. Result is varied by well depending on initial oil production, Water Cut, and wellhead temperature.

Following are recommendations from project team before full field implementation:

- Injection candidates should be wells with an Automatic Well Test that has a dedicated flow line. If the injection candidate is using Manual Well Test, then there should be additional work to provide hot tap along the flow line.
- Sampling point should be at least +/- 50 m from point of injection (recommendation from TS Lab Team and vendors) to be more representative.
- Sampling point when injection started should be 2 points to accommodate oil properties change that coming from reservoir:

  - Before point of injection
  - +/- 50 m from point of injection

- Post injection surveillance needs to be conducted once in 2 weeks to see the lasting impact for many viscous wells such as well 5.
- Consider using other chemicals to compare the effect with Waxtreat.
- Include Online Pressure Monitoring devices installation to the candidates wells to get more sources of surveillance data beside rheology test & well test.
- Injection rate adjustment should be applied if the current injection rate shows small impact based on a well test.
- Chemical injection candidates shouldn't base on the database only but also accommodate Field Operation Team assessment for the repetitive high-pressure wells.

Reference

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