PROCEEDINGS
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The Effect Of Regular And Long Cyclic Steam Stimulation Method On Oil Production Performance In X Field

Intan Permatasari, T. Mhd. Sofyan Astsauri, Tomi Erfando, Universitas Islam Riau.

Abstract

Cyclic Steam Stimulation (CSS) is the process of a single production well which is consisted of three phases: injection phase, soaking phase and the production phase. This analysis was performed only for regular cyclic and long cyclic stimulation. It can be performed more than one stimulation in a single production well which is called cyclic stimulation. It is because of the temperature reservoir is higher that the reservoir temperature base line in a short of time. Although the stimulation has been performed repeatedly, there is still decreasing of production oil. The variative of reservoir peak temperature and the existence of the possibility of damage on the pump after stimulation drive to do analyzing for these issues.

The analysis was performed by looking at the historical data of production, the reservoir temperature history data and the pump production job data for all the wells in the X field. By analyzing the production history data, it was found that there are increasing and decreasing of production oil after stimulation. It is because the production stages, ramp up and ramp down stage. At the ramp up stage, the production after stimulation will be higher than the previous stimulation.

Based on the production analysis, 53.24% production wells in the X field are already at the ramp down stage and 46.75% are already at the rump up stage. Based on the analysis of the reservoir temperature, it was known that 3rd to 4th months are the majority of the Heat Endurance Time (HET) for the regular cyclic stimulation and 5th-6th months are the majority of the HET for long cyclic stimulation in X field. Based on the pump job data, there are only three wells were damaged. It showed the cyclic stimulation is really safe to be performed in this field.

Introduction

X field was found in 1941 with the large of area 34730 hectars. The oil was found at the depth 300 – 700 ft when the first well was drilled in 1941. The Oil reserves which are found in the X field Indonesia is around 5.7 MBBL. Due to the characteristic of the oil in this field, there are only 7.5% of total oil reserve which could be produced at the primary recovery (Fuaadi, I M & et al 1991). The type of reserve in this field is classified into Heavy Oil reservoir. It is different from conventional petroleum insofar as it is much more difficult to recover from the subsurface reservoir. It has a much higher viscosity (and lower API gravity) than conventional petroleum, and recovery of this petroleum type usually requires thermal stimulation of the reservoir (Speight, 2009). The density of the oil in this field is 22.4 °API with 118 cp viscosity of oil.

It is required an advance method to increase the production oil in this field. One of the method that implemented to reducing the oil viscousity in this field is Cyclic Steam Stimulation (CSS). According to (Sheng J. J., 2013), CSS is an effective method can be implemented to reduce the oil at this range of viscosity due to the heavy component. There are three type of CSS, short CSS, regular CSS and Long CSS. The concern in this study is regular CSS and long CSS which is required long priode in implementation and affect the viscousity of oil in X field.

Data and Method

Cyclic steam stimulation (CSS), commonly referred to as "Huff n Puff", involve steam injection into a reservoir during some weeks (injection stage), allowing the reservoir to undergo short period of "soaking" where the well is closing during a few days (Trigos & Lozano, 2018). When the oil rate decline to a low level, the whole cycle – injection, soak and production – is repeated, and this may be continued as many times as is economical. The main purpose of implementation CSS in X field is to reduce the viscousity of the oil, drive the oil easier to flow and produced. Figure below presents the process of CSS.

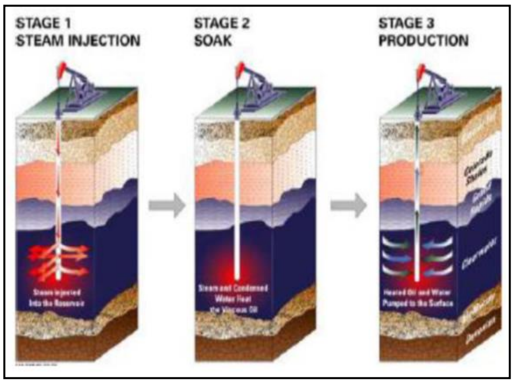

Figure 1. Stage of CSS Process (Stark 2011)

Results and Discussion

The study was conducted on field X which has 122 production wells that have been carried out regular cyclic and long cyclic jobs. Regular cyclic were carried out on 116 production wells in field X and long cyclics carried out on 6 production wells.

a. Temperature analysis of the reservoir after regular cyclic and long cyclic

From the temperature analysis performed on the X field, different temperature peaks were obtained for each cyclic job performed. Reservoir temperature data taken on field X uses Well head temperature (WHT) data. Because the WHT data is considered to represent reservoir temperature data on the well. Analysis carried out on one of the wells carried out by regular cyclic and long cyclic jobs on field X shows an increase in each cyclic job performed.

The following is an example of a well done regular cyclic job on the X field, namely YA22 wells, and long cyclic jobs, namely YA23 wells.

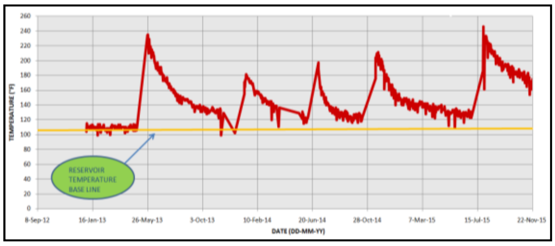

Figure 2. Graph YA22 well reservoir temperature data at regular cyclic job

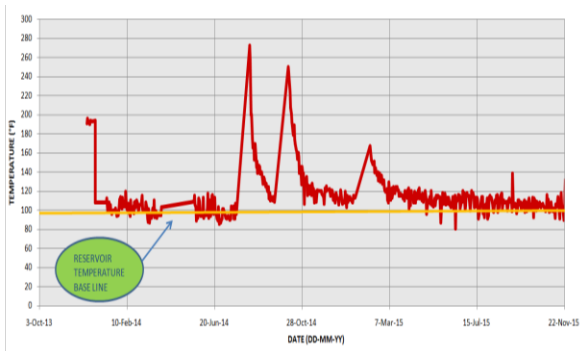

Figure 3. Graph YA23 well reservoir temperature data at long cyclic job

Figure 1. and Figure 2. explain that after cyclic job, there is an increase in reservoir temperature, where at each temperature increase has a different temperature peak. This occurs due to the injection of steam which is carried out on different reservoirs and heat distributions. Judging from the high-temperature reservoir after cyclic, the distribution of injected steam is very good, above 200 °F.

The influence of the distribution also not only had an impact on the peak temperature obtained but also on the time needed for the temperature reservoir to return to the temperature baseline reservoir after cyclic, called the Heat Endurance Time (HET). The time the temperature reservoir needed to return to the temperature reservoir baseline varies greatly depending on the distribution or distribution of heat given to the reservoir. If the heat given is well distributed, the reservoir temperature will last longer. Thus, the viscosity of oil in the reservoir will last longer. (Carcoana, 1992)

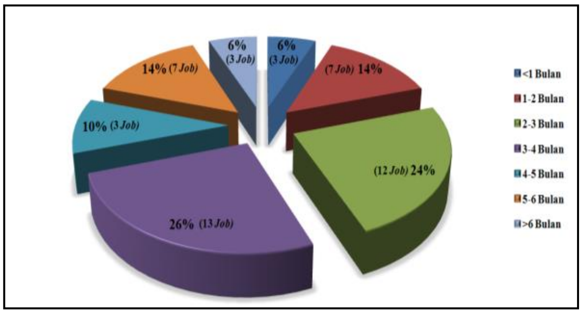

Figure 4. Regular Cyclic Heat Endurance Time (HET) (Januari 2013 - Oktober 2016)

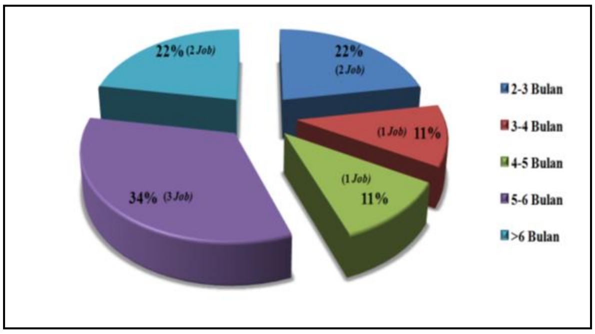

Figure 5. Long Cyclic Heat Endurance Time (HET) (Januari 2013 - Oktober 2016)

Figures 3 and 4. show the percentage of HET obtained after regular cyclic and long cyclic jobs on the X field. Of the 50 regular cyclic workshops, the highest percentage was 26% at 3-4 months which required the reservoir temperature to return to normal after cyclic job. . Meanwhile, 34% of the 9 long cyclic work on the X field took 5-6 months for the reservoir temperature to return to normal after the cyclic job was done.

b. Analyze oil production after regular cyclic and cyclic long

The following is the trend of heavy oil flow for the field with steam injection:

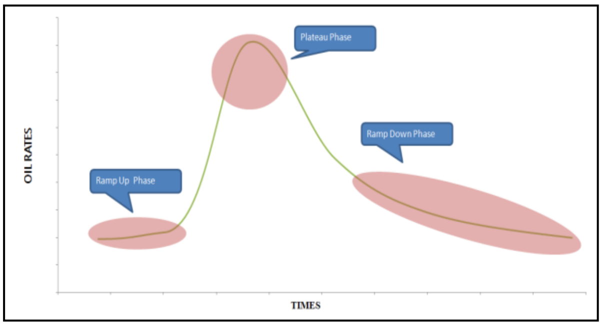

Figure 6. The trend of heavy oil flow rate for the field with steam injection

Figure 6. shows the 3 stages of oil flow in the field by steam injection. The first stage is ramp-up, the first time the oil is produced, at this stage the rate of production can continue to increase after cyclic jobs are carried out. Then the plateau stage, which is the peak stage of oil production in the well that has been done by the cyclic job. And the last is the ramp-down stage, that is if a cyclic job is carried out, the increase in production after cyclic jobs tends to continue to decline.

Typically, the total oil produced declines from cycle to cycle, whereas the volume of water increases, as if the volume affected is only the original hot zone. (Ali, 1994). In field X there are 2 different trends in oil production after cyclic jobs. In figure 7., it can be seen that the trend shown by the increase in production after the cyclic job has continued to decline. So, based on an analysis of the trend of heavy oil flow rates for the steam injection field, the YA01 well in Figure 7. has entered the ramp-down stage. At this stage, the highest production peak has been reached, so that when the well is carried out repeatedly cyclic jobs, increased production will tend to continue to produce a declining trend. While the analysis for YA03 wells in Figure 8. is still at the ramp-up stage. When a well is still in the ramp-up stage, the well will have a production trend several times increased when the cyclic repeats which later will produce the highest peak production (peak production).

Figure 7. Graph of YA01 well oil production data on field X

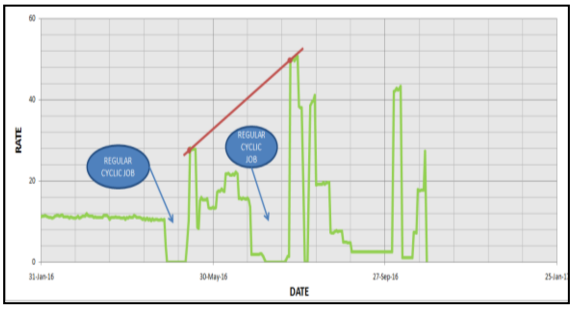

Figure 8. Graph of YA03 well oil production data on field X

The majority of production wells found in field X have entered the ramp-down stage. This is seen from 122 wells in field X, only 77 wells that provide representative data. Where can be seen in figure 9. there are 53.24% have entered the ramp-down stage and

46.75% of the 77 wells analyzed are still at the ramp-up stage.

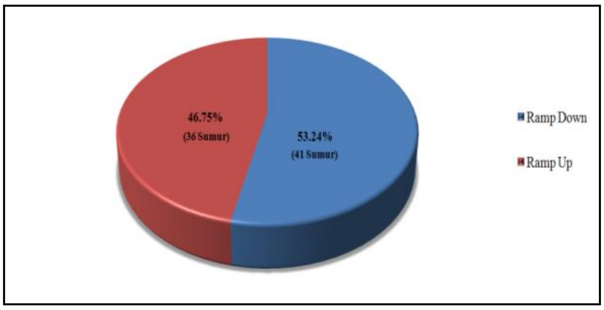

Figure 9. Percentage of well production stage on field X

From the differences in the trend of the oil production curve after cyclic jobs, it was analyzed that the trend of oil gain that is always obtained is not always decreasing. The oil gain trend that is generated from regular and repeated long cyclic jobs can also increase. this depends on the stage of production where the well is located. So it is necessary to pay attention to the 3 stages of heavy oil production in the field with steam injection in order to know and predict the increase in oil production in the well.

c. Analysis of pump damage after regular cyclic and long cyclic job

Field X is a field that has a very high level of acidity, therefore the artificial lift used in this field is an Sucker Rod Pump (SRP). An analysis is done on the pump after the cyclic job is done by looking at the pump work data.

Of the 122 wells that have been repeated by cyclic, only 3 wells with pumpages have been damaged in less than 10 days after cyclic. Indications of damage are found in the replacement or repair of stuck rods and rod pumps that are stuck as shown in Figures 10., 11., and 12. In Figures 13, well YA06 undergoes the replacement /repair of polish rods that are carried out after 1 day of cyclic work. YA08 wells have a rod pump stuck after 6 days of cyclic work. As for YA12 wells, after 9 days of cyclic work, there will be replacement work/repair of polish rods.

WELL NAME	TIME		JOB
YA06	3-Aug-2013	8-Aug-2013	Drill Hole
	19-Mar-2014	19-Mar-2014	Rod Pump-Bump Down Job
	30-Apr-2014	18-May-2014	Cyclic Steam, Improve Heat & Drainage
	10-Oct-2014	27-Oct-2014	Cyclic Steam, Improve Heat & Drainage
	27-Sep-2015	15-Oct-2015	Cyclic Steam, Improve Heat & Drainage
	16-Oct-2015	16-Oct-2015	Repair/Change Polish. Rod
	29-Oct-2015	30-Oct-2015	Cyclic Steam, Near wellbore stimulation
	15-Sep-2016	28-Sep-2016	Cyclic Steam, Connect to Steam chest

Figure 10. Table of Data Pump Work at Well YA06

WELL NAME	TIME		JOB
YA08	30-Apr-2014	18-May-2014	Cyclic Steam, Improve Heat & Drainage
	12-Feb-2015	10-Mar-2015	Cyclic Steam, Improve Heat & Drainage
	17-Mar-2015	18-Mar-2015	Rod Pump Stuck Normal
	28-Jul-2015	28-Jul-2015	Rod Pump-Bump Down Job
	23-Dec-2015	18-Jan-2016	Cyclic Steam, Improve Heat & Drainage

Figure 11. Table of Data Pump Work at Well YA08

WELL NAME	TIME		JOB
YA12	22-Jan-2013	26-Jan-2013	Drill Hole
	12-Nov-2013	30-Nov-2013	Cyclic Steam, Improve Heat & Drainage
	14-Aug-2014	21-Aug-2014	Cyclic Steam, Improve Heat & Drainage
	30-Aug-2014	30-Aug-2014	Repair/Change Polish. Rod
	31-Aug-2014	31-Aug-2014	Rod Pump-Bump Down Job
	27-Nov-2014	28-Nov-2014	Rod Pump Stuck Normal
	18-Feb-2015	7-Mar-2015	Cyclic Steam, Improve Heat & Drainage
	26-Aug-2015	16-Sep-2015	Cyclic Steam, Improve Heat & Drainage

Figure 12. Table of Data Pump Work at Well YA12

NO.	WELL NAME	TIME (AFTER CYCLIC)	JOB
1	YA06	AFTER 1 DAY	*Repair/Change Polish Rod*
2	YA08	AFTER 6 DAYS	*Rod Pump Stuck Normal*
3	YA12	AFTER 9 DAYS	*Repair/Change Polish Rod*

Figure 13. Table of Data Production Pump Work at Field X

Conclusion

From the results of the analysis of well data, regular work data and long cyclic and pump work data on this X field, the following conclusions are obtained:

1. Temperature resistance above the baseline or heat endurance time in this field is the

majority of 3 to 4 months for regular cyclic and 5 to 6 months for cyclic longs.

2. Wells - wells on the X field, still provide increased production every time cyclic is carried out. Whether it's a well that has a historical trend of declining production (rump-down phase) or that has a historical trend of increased production (rump-up phase). The wells in the X field are already on the ramp-down phase, which is as much as 53.24% and while at the ramp-up stage it is 46.75%.

3. Regular work and repeated long cyclic carried out on production wells did not significantly influence the production pump. Of the 122 wells analyzed, only 3 wells were damaged after less than 10 cyclic days. So that this work is very safe to do repeatedly to increase production.

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