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# Wax Problem Management in Sucker Rod Pump Wells with Rig-less Hot Water through Annulus Method in Tanjung Field, South Kalimantan

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**Abstract.** Tanjung Field is located in South Kalimantan province and was discovered in 1898. Currently operated by PT Pertamina EP since 2004. The production wells in the Tanjung Field have various reservoir problems, including scale, wax or paraffin, sand, and depleted reservoir. Wax problem is the one that has the most dominant influence on the lost production opportunity. The average pour point of the Tanjung crude is between 39-42°C. Reservoir fluids that have paraffinic characteristics experience a decrease in pressure and temperature during the production process from the reservoir to the oil storage tank. This change in conditions causes the formation of wax deposits at several points such as around the perforation or pump intake holes, in the tubing, and in the well flowline. This wax deposits cause resistance to fluid flow, causing a decrease in production in sucker rod pump wells. In addition, the negative impact of this problem is that it can increase the frequency of well services job and chemical costs for well stimulation work.

One of the efforts that can be done to overcome the problem of wax is the thermal method. Hot water is injected using a hot watering unit into the annular casing of sucker rod pump wells. Hot water injected with a temperature above the pour point is expected to clean the wax that forms around the perforation holes, pump intakes, downhole pumps, and tubing. During the work, the pumping unit continues to operate normally so that hot water can flow from the subsurface to the surface, and there is no loss of production time. This method is proved to reduce low production and even can provide a production gain compared to the potential of the well with minimum cost dan faster work duration.

**Keyword(s):** Hot Water, Wax, Sucker Rod Pump.



## 1 Introduction

Tanjung Field, located in South Kalimantan Province, Indonesia, is an oil and gas field currently operated by PT. Pertamina EP Tanjung Field since 2004. There are 139 wells and 137 of them produce using artificial lift. Tanjung Field reached its peak production in 1963 with production of 50,000 BOPD, and by implementation of staggered line waterflood reached its second peak production in 1998 with production of 10,000 BOPD. But along with the natural production decline, the current average production of Tanjung Field is around 2023 BOPD.

Sucker Rod Pump is an artificial lift that commonly used in oil and gas field in the world, as well as in Tanjung Field, because of low maintenance cost, best understood by field personnel, readily accommodates volume changes, reliable diagnostic tool available, and can often pump below perforations. Sucker rod pump consists of surface components (Pumping Unit) and subsurface components (tubing, barrel, plunger, sucker rod, standing valve, and travelling valve). Pumping unit converts the rotational motion of the prime mover into a reciprocating vertical motion that lifts and lowers a rod string connected to a subsurface pump. When the pump achieves maximum downward reach, the beam begins its upward movement and the rods and plunger are pulled up, forcing the ball of the traveling valve on to its seat. This upward movement reduces the pressure in the pump chamber until it is less than the pressure at the pump intake point. The ball in the standing valve comes off its seat, allowing formation fluid to enter the pump chamber. The standing valve closes at the end of the upward stroke. As the plunger travels down, the pump chamber pressure increases, pushing the ball in the traveling valve off its seat. This action allows the formation fluid to flow from the pump chamber into the tubing (right) as the plunger continues to move down. This cycle is repeated thousands of times per day. The fluid displaced into the tubing is carried toward the surface on subsequent upward strokes of the plunger.

The characteristic of Tanjung crude is paraffinic and high pour point oil. According to laboratory test, the average pour point is between 39-42°C. In 2020, wax formation in production system causing cummulative loss production almost 10,000 bbls. Wax deposits can form along the production process line due to a decrease in temperature to below the pour point, starting from around the perforation zone, downhole pump, inside tubing and up to the surface through flowline until reached oil storage tank. This wax deposits cause resistance to fluid flow, causing a decrease in production in sucker rod pump wells. One example of a decrease in production due to wax problems occurred at well T-076R

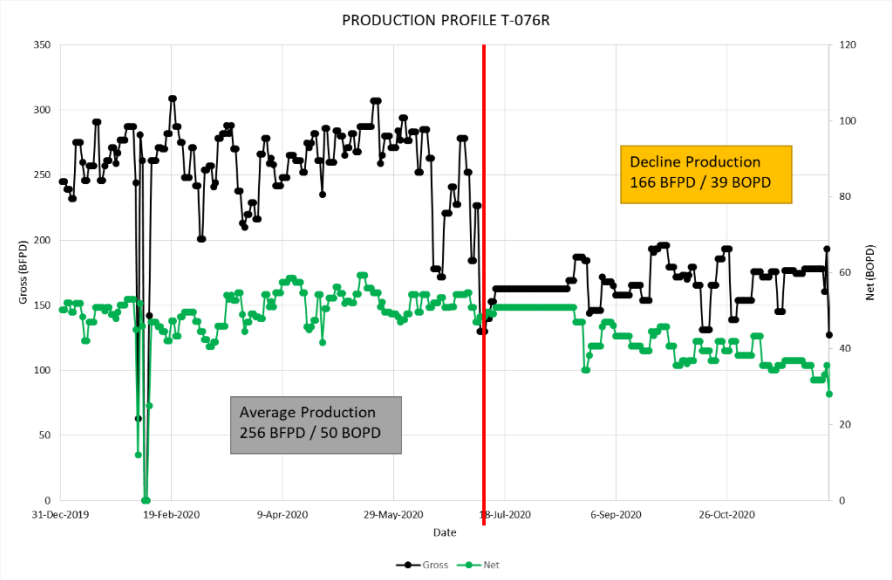


Figure 1 Oil Production Decrease due to Wax Problem

## 2 Methodology

One of the commonly used solutions to overcome wax problems is to inject chemical solvent into the reservoir. The purpose of this work is to remove the wax deposit in the reservoir so that the fluid flow into the wellbore becomes smoother and can increase production. However, this work requires an expensive cost because it uses rig, stimulation unit, and additional chemicals expenses. The well is shut down during the work, resulting in production loss. A more suitable solution but with maintained quality is by injecting hot water with a temperature above the pour point into the annular casing of sucker rod pump wells. This work is expected to clean the wax that forms around the perforation, pump intakes, downhole pumps, and tubing. During the work, the pumping unit continues to operate normally so that hot water can flow from the subsurface to the surface, and there is no loss of production time.

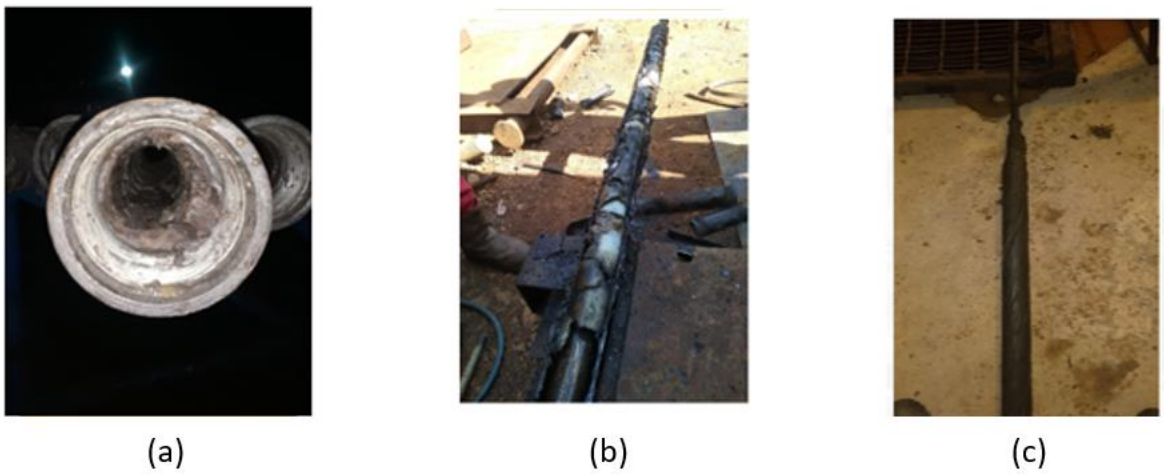


Figure 2 Wax deposits in (a) inside tubing, (b) rod guide, (c) plunger

However, hot water that is injected into annulus faster (about 60 bbls per hour) than the fluid pumped back by sucker rod pump (about 4-20 bbls per hour, depends on the pump capacity). This can cause some of the fluid to enter the reservoir (not stay in the annulus except in tight formation). If the fluid injected into the annulus contains contaminant, it may cause formation damage. Thus, the water used is clean water that has been treated and has been tested for quality. This test is very important to ensure the water does not carry impurities or solids that can cause damage in the reservoir. The advantages of using water as thermal conductor is it has a higher heat capacity, so its temperature can be more maintained and reducing temperature losses.

Some important things to consider in determining wells candidate and hot water work procedures are as follows:

1. Wells that are candidates for hot water jobs are wells that have a history of wax problems. Usually, the main characteristics are low gross production and low watercut because it potentially contains more concentration of paraffin.
2. Ensure the quality of the water used does not contains any contaminants to prevent formation damage in reservoir.

3. Hot water should be injected to annulus instead of tubing. In sucker rod pump wells, paraffin may be formed inside tubing or coat the sucker rod. When the paraffin is melted during the job, it can be produced out of well along with production fluid.
4. The frequency of work for each well needs to be carefully considered because paraffin deposition is a continuous process.
5. The volume of hot water required during the work must be calculated so that the work can be more efficient and reduce the potential for formation damage.

A detailed working procedure to perform this job as follows:

1. Measure the pressure in the annular casing. Bleed off pressure to 0 psi.
2. Turn on the generator of the hot watering unit. Turn on the fireplace and heat the water to 88 °C.
3. Install the treating line connection from the hot watering pump to the casing valve.
4. Pump hot water as needed using a hot watering pump. The pumping unit continues to operate normally during work and the production flowline remains open.
5. Perform a tubing pressure build up test after the work is completed as a quality check of the work.
6. Rigdown equipment, continue to monitor production.

## 3 Result

Rigless Hot Water through Annulus work was performed at well T-076R in December 2020. T-076R is one of the sucker rod pump wells in Area BS-I, Tanjung Structure. The potential of this well is 48 BOPD. The character of this well is low watercut and high wax content. T-076R has experienced low production since July 2020 as seen from a significant gross production decline. An indication of the cause is due to wax deposit factors that have formed around the perforation and pump intake which causes the influx to decrease.

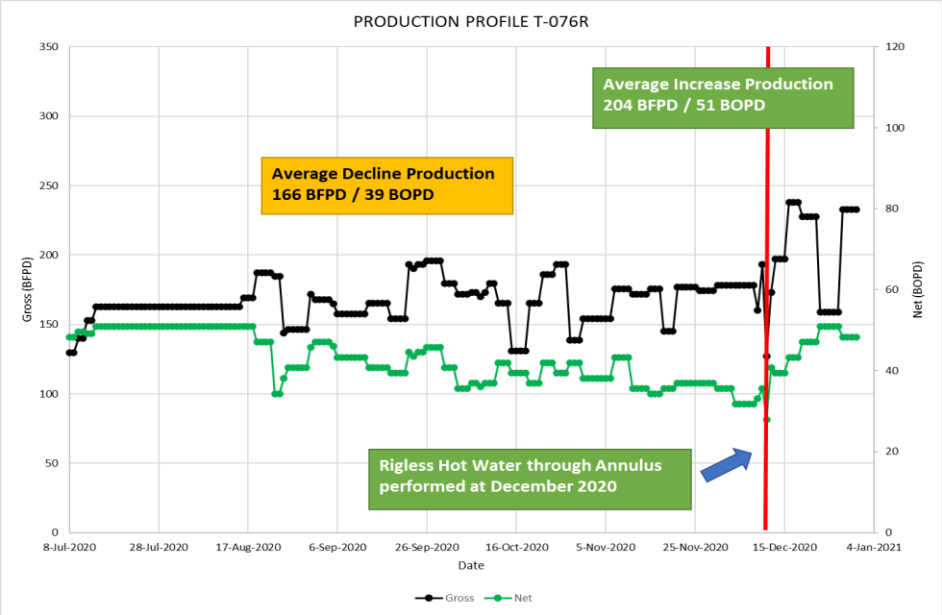


*Figure 3 Increase Production after hot watering*

After the Rigless Hot Water through Annulus work was carried out, well production increased and returned to its initial potential of around 51 BOPD and remained stable up to 1 month later. After carrying out the pilot project at the T-076R well, the team continued the work on Rigless Hot Water Through Annulus in 11 other wells in the Tanjung Structure, with a total of 12 works with details as follows:

Table 1 Hot Watering result in 12 wells

| Well | Potency (BOPD) | Hot Water Date | Before | | After | | Duration of Monitoring (days) | Gain/Low | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Gross (BFPD) | Net (BOPD) | Gross (BFPD) | Net (BOPD) | | Net (BOPD) | Cumm. Net (BO) | |
| T-076R | 43 | 10-Dec-2020 | 166 | 39 | 204 | 51 | 22 | 11,9 | 263 | Low Production |
| T-076R | 43 | 28-May-2021 | 136 | 23 | 210 | 41 | 60 | 17,8 | 1067 | Low Production |
| T-144 | 15 | 2-Jun-2021 | 39 | 7 | 60 | 15 | 120 | 8,2 | 982 | Low Production |
| T-076R | 43 | 28-Jul-2021 | 159 | 32 | 204 | 41 | 64 | 9,5 | 608 | Low Production |
| T-122 | 33 | 29-Jul-2021 | 20 | 13 | 49 | 22 | 22 | 8,9 | 197 | Low Production |
| T-014 | 2 | 29-Jul-2021 | 80 | 0 | 80 | 1 | 63 | 1,0 | 60 | Low Production |
| T-122 | 33 | 20-Aug-2021 | 35 | 22 | 54 | 22 | 41 | 0,0 | 0 | Low Production |
| T-185 | 10 | 24-Aug-2021 | 36 | 5 | 36 | 5 | 37 | -0,4 | -14 | Low Production |
| T-112 | 15 | 25-Aug-2021 | 121 | 11 | 164 | 14 | 36 | 3,4 | 121 | Low Production |
| T-153 | 13 | 25-Aug-2021 | 21 | 8 | 58 | 11 | 35 | 2,6 | 91 | Low Production |
| T-073 | 14 | 1-Sep-2021 | 51 | 6 | 86 | 12 | 29 | 6,2 | 179 | Low Production |
| T-164 | 15 | 2-Sep-2021 | 35 | 8 | 30 | 11 | 28 | 3,0 | 85 | Low Production |
| T-133 | 14 | 25-Sep-2021 | 75 | 11 | 97 | 12 | 5 | 1,0 | 5 | Low Production |
| **TOTAL** | | | | | | | | **5,6** | **3643** | |

In general, Rigless Hot Water Through Annulus work succeeded in reducing low production due to wax problems. In some wells such as T-076R, this work can even provide a production gain compared to the well's potential. Water required to perform this job is about 30-60 bbls, depends on length of perforation interval and well depth. Rigless Hot Water Through Annulus work will be carried out in other sucker rod pump wells in the Tanjung Structure that have a common fluid characteristic.

## 4 Conclusion

Rigless hot water can be an effective solution to overcome the problem of wax deposits in sucker rod pump wells, but careful calculations need to be made to reduce the potential for formation damage. Some key points to considered when performing this job are the selection of well candidates, the quality and quantity of water used, the frequency of the job, and the method to inject hot water through annulus.

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