

IDENTIFICATION AND MANAGEMENT OF PARAFFIN IN THE FM-20 WELL FROM THE WELL HEAD TO THE MANIFOLD OF DISTRICT I KAWENGAN

Kristofol Waas¹, Michelle Ivonie Letlora²

^{1,2}D4 Oil and Gas Production Engineering Study Program, Department of Mechanical Engineering, Ambon State Polytechnic

Email: kristwaas@gmail.com, michelleletlora1902@gmail.com

ABSTRACT

Indonesia is one of the oil and gas producing countries in the world. This natural wealth needs to be utilized as much as possible. The main objective to be achieved in the production operation of an oil and gas well, is to increase the rate of production until it reaches its peak. The sharp decline in production volumes and levels of oil production from oil wells is a production problem.

Paraffin is a raw material contained in crude oil and is a production problem. The paraffin deposition process can occur in perforations, tubing, flowlines, or surface facilities resulting in decreased production rates. In some cases, paraffin deposits may form at the bottom of the well and in the pore space in a radial direction several inches from the well wall, occurring as a result of the oil cooling below the cloud point.

Cloud point and pour point are two things that become certain factors in the characteristics of paraffin. The cloud point is the temperature where the paraffin first begins to precipitate from the crude oil mixture. When the temperature drops, the particles that form the paraffin precipitate attract and bind other paraffin particles into one group. At this point the crude oil will start to look hazy and then can't flow. The condition where crude oil cannot flow is called the pour point.

The results obtained by using the method. It can be seen that the Electric Heat Trace in the downstream area (variation 2) will be more effective because paraffin will no longer form in the flowline.

Keywords: Paraffin, Electric Heat Trace, Wellhead, Manifold

INTRODUCTION

Indonesia is one of the oil and gas producing countries in the world. This natural wealth needs to be utilized as much as possible. Therefore, it requires an exploration and exploitation of oil and gas. The main objective to be achieved in the production operation of an oil and gas well, is to increase the rate of production until it reaches its peak.

In producing reservoir fluids, the goal is always to maintain optimal well performance. The sharp decline in production volumes and levels of oil production from oil wells is a production problem. This problem must be analyzed in time so that it can be corrected before or after the problem occurs. Proper management of production problems results in wells returning to production at optimal capacity.

Paraffin is a raw material contained in crude oil and is a production problem. Damage to this type of organic deposit is usually caused by the composition of the hydrocarbons, the wax content of crude oil, the decrease in temperature and pressure so that the oil thickens (paraffin deposits) and closes the pores of the oil.

Paraffin deposits are caused by the tendency of hydrocarbon molecules to attract each other and form groups. Long carbon chain bonds with a number of carbon atoms ranging from 18 to 68 will have a high density, which can result in precipitates. A decrease in temperature and pressure or both will also contribute to the formation of paraffin deposits from crude oil.

Paraffin deposits can occur anywhere during the production process, from the bottom hole well to the holding tank. This deposit will lead to a narrowing of the diameter of the tubing or pipe (plugging) so that it can reduce oil production. Control can be done by several methods, either mechanically, thermally, chemically, and inducing electromagnetic. Based on the background above, the authors will identify the formation of paraffin and restore the production flow rate using heat trace and evaluate the installation method from the wellhead to the manifold.

METHODS

The type of research used in this paper is survey research, where there is no modification or special treatment of the variables studied.

The data obtained in this study are from PT. Pertamina EP Cepu Regional 4 Zone 11 Cepu Field District I Kawengan Field.

The data analysis method used in the identification and handling of paraffin in the FM-20 well from the well head to the Kawengan I district manifold uses the manual calculation method (excel). To find out the installation distance of the heat trace can be described as follows:

1. Identification of paraffin formation and how to overcome it using heat traces
2. Look for the temperature where paraffin is formed and the temperature when paraffin is not formed
3. Calculating the heat trace installation distance using the manual method (excel)
4. Done.

RESULTS AND DISCUSSION

To solve this paraffin deposition problem, it is necessary to identify the formation of paraffin deposits in the flow pipe, and then take preventive and countermeasures based on field conditions so that the process is smooth and effective. Analysis of the identification of paraffin is carried out in the following stages:

1. Production Data of Paraffin Wells (Reservoir Fluid, Flow Temperature, Flow Pressure and Topography)
2. Calculation of Flow Pipe Temperature Manually
3. Calculation of distance between pairs of Heat Trace using manual calculations (excel)

1. Identification of Formation of Paraffin Deposits in Flow Pipes

The results of fluid analysis in the laboratory state that the type of oil from this field is classified as intermediate-intermediate (according to the US Bureau of Mines), and according to the API Gravity this oil is classified as heavy oil.

Table 1
Fluid Components in the FM-20 well

Component	Amount (mol)	Component	Amount (mol)
Nitrogen	6,23E-30	137-40	0,013591021
CO2	6,21E-03	141-44	0,014291572
Methane	1,20E-02	145-48	0,013000999
Ethane	7,55E-03	149-54	0,010727975
Propane	7,05E-03	155-61	0,009447571
Isobutane	6,54E-03	162-71	0,010108837
N-butane	6,71E-03	172	0,009205496
Isopentane	6,61E-03	173+	6,98E-03
N-pentane	6,49E-03	N6-8	0,00940247
Methylcyclopentane	6,36E-03	N9-10	0,010531806
Benzene	6,54E-03	N-11	0,011373152
Cyclohexane	6,37E-03	N12-14	0,009240478
Methylcyclohexane	6,77E-03	N15-19	0,013714876
Toluene	6,91E-03	N20-23	0,087119509
Ethylbenzene	6,24E-03	N24-25	0,066434409
M-xylene	6,95E-03	N26-28	0,037031111
O-xylene	0,006533221	N29-30	0,009811592
I6-19	0,021322348	N31-33	0,0096615
I20-22	0,023029063	N34-36	0,006547268
I23-25	0,021359359	N37-40	0,006452858

I26-28	0,023472167	N41-46	0,006369532
I29-30	0,019829807	N47-55	0,006290871
I31-33	0,017333314	N56+	0,006206624
I34-36	0,015936189	WATER	0,06159221

Table 2
Oil Analysis on FM-20 well

No	Parameter	Method	Unit	Results
1	Density @ 15°C	ASTM-D.1298	gr/cc	0.8502
2	SG @ 60°F/60°F	ASTM-D.1298	-	0.8506
3	Viskositas Kinematik @ 100°F @ 122°F @ 140°F	ASTM-D. 445	cS cSt cSt	4.088 2.953 2.505
4	API @ 60°F	Dihitung	-	34.97
5	Sulphur point	ASTM D-4294	Weight %	0.196
6	Titik Tuang (Pour point)	ASTM-D.97	°F	89.0
7	Titik Sambar (Flash Point)	ASTM-D.93	°C	Below 0
8	Salt Content	IP 77	Weight %	0.0009
9	Water Content	ASTM D-95	Vol. %	0.05
10	Water and Sediment	ASTM D-1796	Vol. %	0.05
11	Wax Content	UOP A-46	Weight %	6.96
12	Asphaltene Content	IP 143	Weight %	0.12

Data taken from: Well Head
No. Well : "FM-20"
Well Status : Production

Table 3
Results of Analysis of Two-Phase Flow Pressure Drop "FM-20" Well

Login Data	Unit	Mark	Calculation	Unit	Mark
Prod rate		97,34	Velocity	Ft/sc	1,283
Camp	BLPD		Reynold Number		680,09
SG Oil		0,8506			
SG Water		1			
Long pipe	m	800	Analysis		
	ft	2624,6	Flow Type		Laminer
ID Pipe	Inch	3,285	Friction factor		0,094
	ft	0,27375	Pressure Drop	Psia/100 ft	0,2918

Table 4.4 is the result of the calculation analysis for the "FM-20" well. These results indicate that the fluid flow that occurs is laminar flow so that the production wells have a tendency for paraffin deposits to occur. Then fill in the parameters of the scheme such as pressure and temperature of the wellhead and flowline outlet, fluid flow rate, flowline profile such as length, roughness, type of material etc.

Table 5. Weather Recap of Kawengan, East Java

Month	temperature (C)	
	Lowest	Highest
July 2022	21	32
Agustus	21	32
September	23	34
Ocktober	22	34
November	22	35
Desember 2022	21	32

Room temperature uses 20°C data to accommodate the lowest temperature during the period July 2022 – December 2022 where the lowest room temperature reaches 21°C. After all the parameters are filled in which indicates Manual analysis and calculations (excel) are ready to be performed. Then determine the length of time the analysis will be carried out on the flowline pipe. And the last one is doing Analysis and Calculation. The time used is 30 days. The time of 30 days was chosen with the hope that after 30 days it could represent the state of the pipe when it was produced.

After the analysis is complete, we can draw conclusions. From the results of this analysis we can find out the temperature of the fluid in the pipe, the location and thickness of the paraffin in the flow pipe, as well as the cumulative production from this well. Then prevention and control methods will be carried out based on field analysis and manual calculations.

Fluid Temperature

From this analysis, it is possible to determine the profile of the fluid temperature drop along the flowline which can be seen in Figure 2. which is made in the diagram. From these results, the fluid temperature in the flowline is 21.35°C

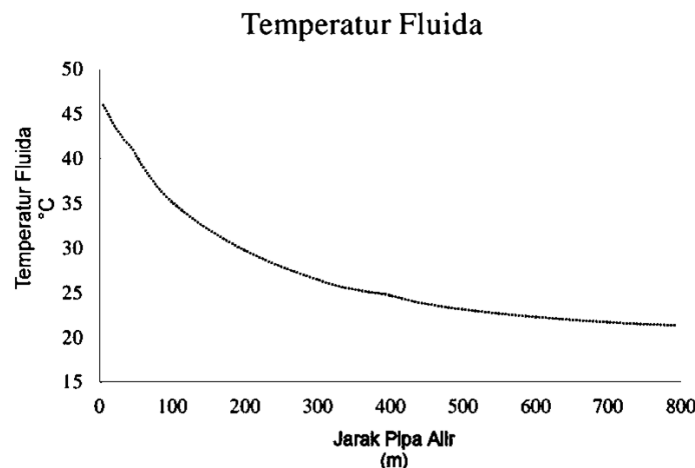


Figure 2
Fluid Temperature vs Pipeline Spacing

Sediment Thickness

The thickness of the precipitate formed in the flow pipe of this well can be seen in Figure 3 where paraffin has been formed from the inlet flowline, this is because this well is produced under the wax appearance temperature of the production fluid so that paraffin will form along the flowline and will continue to decrease as the distance increases. This is because the heavier hydrocarbon fractions have precipitated around the inlet, these hydrocarbon fractions cannot flow together with the fluid flow.

Whereas at a distance farther from the inlet, precipitate is formed from lighter hydrocarbon fractions which can still flow along with the fluid flow, which is 66% water.

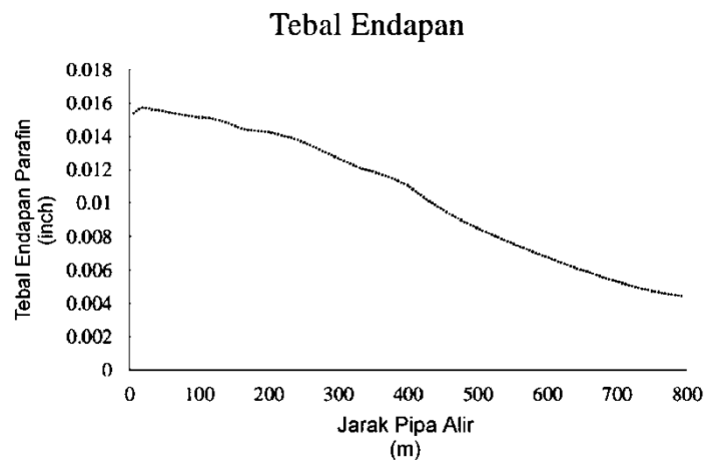


Figure 3
Paraffin Deposition Thickness vs Pipeline Distance

Cumulative Production

Cumulative production from the "FM-20" well for 30 days can be seen in Figure 4. with liquid of 2891 BLPD and oil of 984.398 BOPD. From these results it was found that as a result of the formation of this paraffin, production was reduced by 29 BLPD from the ideal production with liquid 2920 BLPD and oil by 972.358 BOPD.

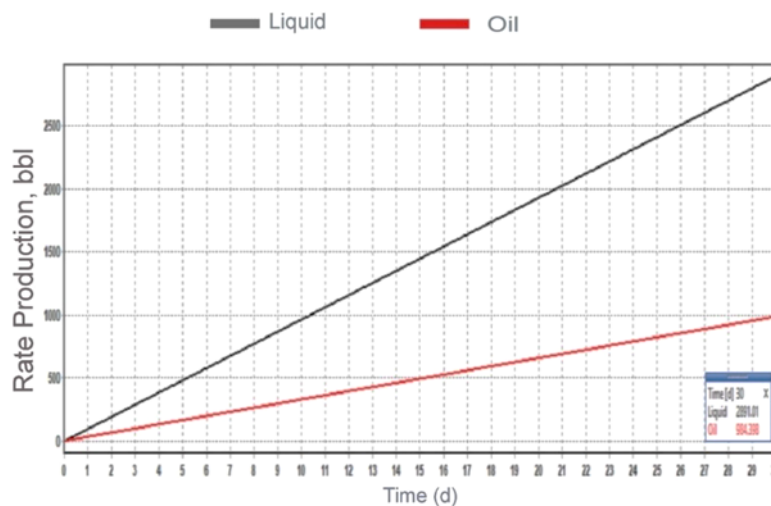


Figure 4.
Cumulative Production

2. Analysis of Calculation of Heat Trace Installation Distance

Judging from the location of the formation of paraffin deposits, namely at a very close distance to the well because the "FM-20" well was produced at a temperature below the wax appearance temperature. In an effort to overcome this problem, three variations of the calculation will be carried out to see the effect of installing the most effective heat traces as well as one variation, as a reference for ideal conditions if the use of heat traces is carried out optimally, namely by placing heat traces along the flowline which is also covered with insulation. In each of these variations, 50 meters of heat trace cable with a power of 20W/m will be used in several locations.

The variations in the installation of heat trace cable spacing to get efficient results for handling paraffin are as follows:

1. The first variation, the heat trace cable will be placed in the first 50 meters of the flowline.
2. The second variation uses a cable placed 50 meters at the end of the flowline.

3. The third variation, the cable is placed at the beginning and end of the flowline with a length of 25 meters each.

From the variations above, we will do manual calculations by entering all the data that has been collected and calculated manually using excel to get a definite and effective distance for installing heat trace distances.

a. Variation 1

In variation 1 which uses a 50 meter long heat trace cable at the beginning of the flowline or upstream (0 to 50 meters) as shown in Figure 5, it is successful in overcoming paraffin deposits at that point.

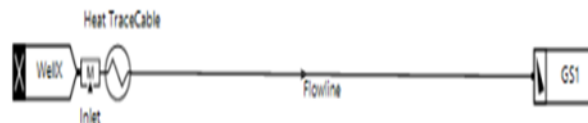


Figure 5.
Variation Production Scheme 1

From the results of this simulation, it can be seen that the use of a 50 meter long heat trace can overcome the formation of paraffin deposits in the flowline which is attached to the heat trace.

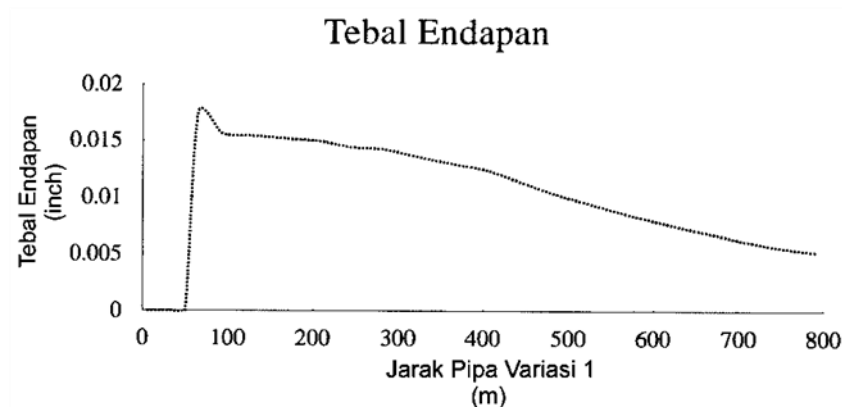


Figure 6
Sediment Thickness VS Distance Variation 1

However, paraffin will form again as soon as it passes through the flowline attached to the heat trace. This is because the flowline used has a very large heat loss because the flowline material is carbon steel. The maximum deposit thickness resulting from the use of this variation when compared to the existing conditions has increased to 0.017 inch. Then if you look at the cumulative production from variation 1, there is an increase in cumulative production from the existing conditions of 0.34 BLPD which can be seen in Figure 7

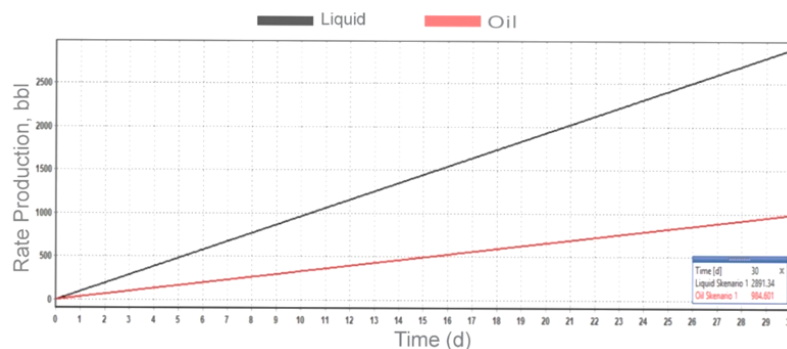


Figure 7.

Cumulative Production Variation 1

b. Variation 2

In this variation, the heat trace cable is placed at a distance of 50 meters at the end of the flowline (750 to 800 meters). The production scheme of this variation can be seen in Figure 8.



Figure 8.
Variation Production Scheme 2

The effect of using heat traces on this variation is quite good, although the thickness profile of the paraffin produced from this variation is not too different from the existing conditions, this variation is effective in dealing with paraffin. This is because the heat traces placed at the end of the flowline prevent the paraffin from settling back into the flowline.

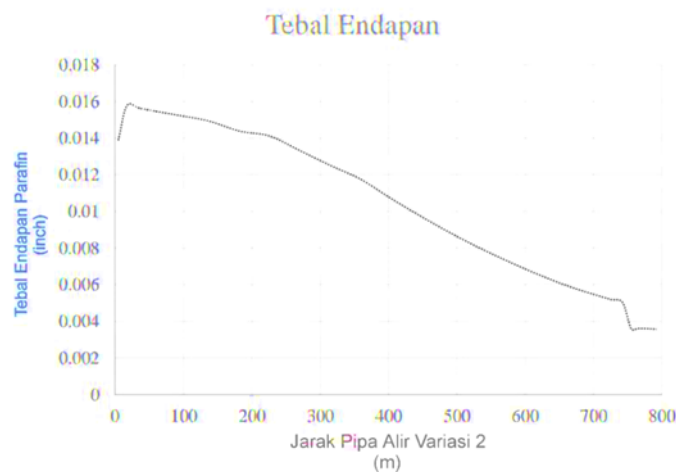


Figure 9.
Sediment Thickness VS Pipeline Distance Variation 2

This condition also resulted in the cumulative production obtained much better than the cumulative obtained by variation 1, which was 2896.15 BLPD.

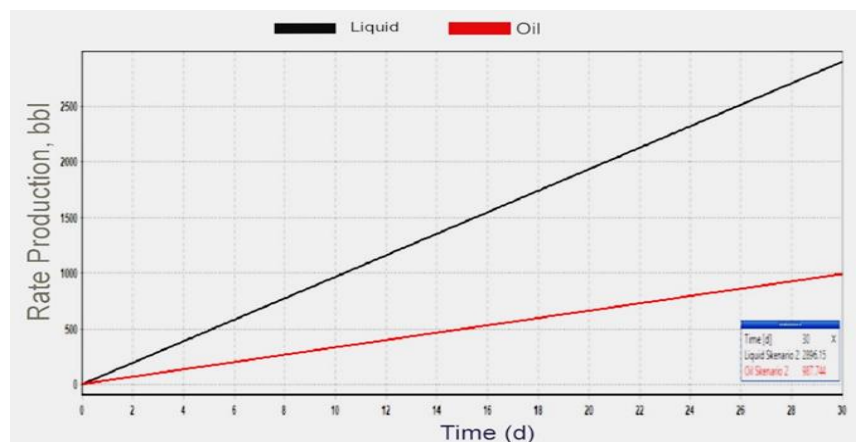


Figure 10.

Cumulative Variation Production 2

c. Variation 3

In this third variation, a combination of variations 1 and 2 will be used. With a heat trace cable length of 50 meters, the cable will be placed in two locations, namely upstream (10 to 35 meters) and downstream flowline (775 to 800 meters) with a length of 25 meters each.



Figure 11.
Variation Production Scheme 3

The performance of this 3 variation in overcoming the paraffin problem is quite good. At the points where the heat trace was installed, it was successful in preventing the formation of paraffin, besides that the thickness of the paraffin formed was not too different from the existing conditions, even though in the middle of the flowline the thickness of the paraffin was thicker than in the existing conditions, but the maximum thickness was not thicker than the existing conditions.

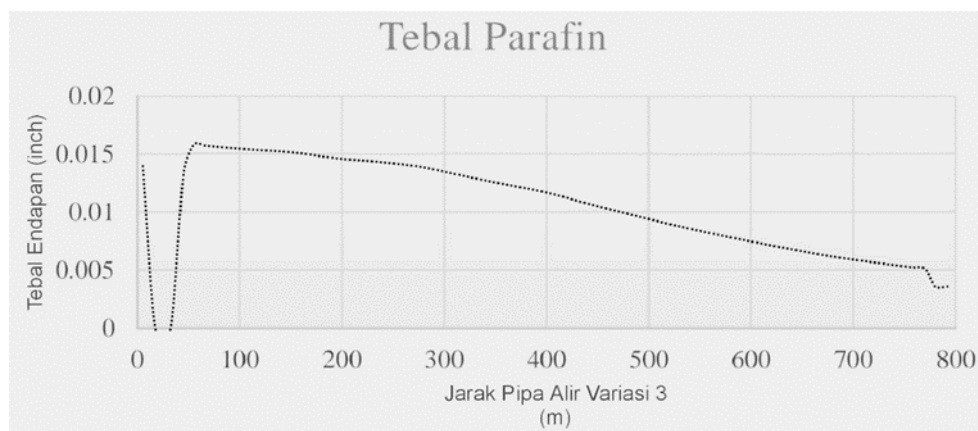


Figure 12
Sediment Thickness Vs Pipeline Distance Variation 3

When viewed from the cumulative production produced, this variation 3 managed to increase production although not better than variation 2. This is due to the use of heat traces around the downstream which is less than optimal.

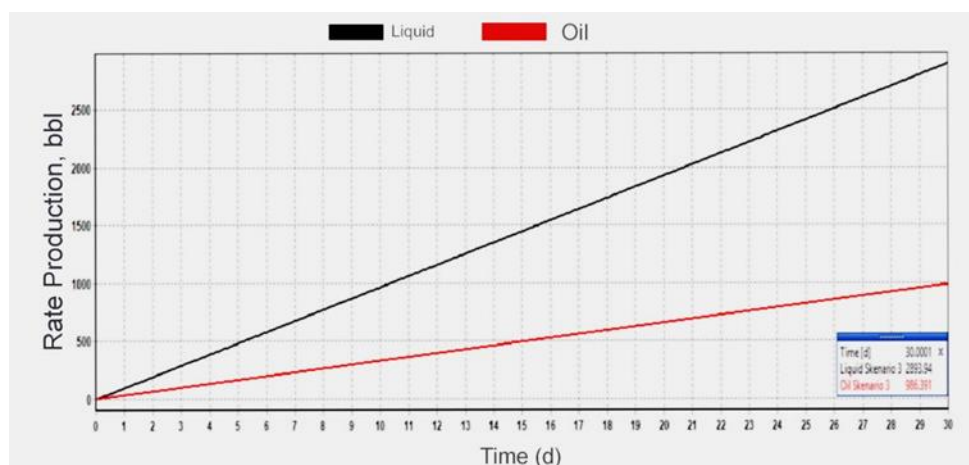


Figure 13
Cumulative Variation Production 3

3. Paraffin Countermeasures

From the simulation results that have been obtained, each variation is successful in reducing the formation of paraffin in the flowline. But there are differences in the effectiveness of using the heat traces from each variation. The use of heat traces that are placed upstream or in the middle of the flowline will be less effective because paraffin will re-form in the flowline. However, using a combination of the location of the heat traces will be more effective in maintaining and controlling the formation of deposits.

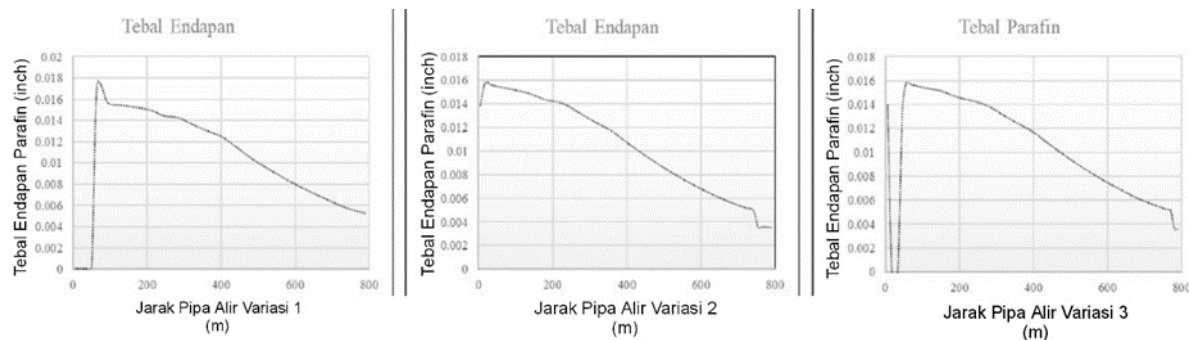


Figure 14.
Comparison Variation of Sediment Thickness

CONCLUSION

From the analysis that has been done before, the following conclusions are obtained:

1. The Wax Appearance Temperature of the "FM-20" Well oil is 58°C and with the production conditions of the "FM-20" Well which is below the wax appearance temperature it will result in the formation of paraffin deposits in the flowline with a thickness of up to 0.016 inches.
2. Cumulative production from the "FM-20" well for 30 days under existing conditions is 2891.01 BLPD; cumulative production with variation 1 is 2891.34 BLPD; cumulative production with Variation 2, namely 2896.94; cumulative production with variation 3 is 2893.94 BLPD.
3. From the results of these calculations it can be said that the installation of heat traces in each variation has succeeded in overcoming the formation of paraffin. But the use of heat traces in the downstream area (variation 2) will be more effective because paraffin will no longer form in the flowline. It is different from placing heat traces at the beginning or in the middle where paraffin will form again in the flowline.

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