CITIZEN: Jurnal Ilmiah Multidisiplin Indonesia
Vol 2, No. 4, 2022
ISSN: 2807-5994
https://journal.das-institute.com/index.php/citizen-journal

EVALUATION OF WELL PERFORMANCE "KD" IN FIELD X USING THE DECLINE CURVE ANALYSIS METHOD

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DOI: 10.53866/jimi.v2i4.151

Abstract

Accurate estimation of hydrocarbon reserves is critical in petroleum engineering, especially for the evaluation of well performance and optimization of production strategies. This research analyzes the production performance of "KD" both before and after completion operations using the Decline Curve Analysis (DCA) method. Estimated maximum recovery (EUR) and estimated remaining reserves (ERR) are calculated to evaluate the effectiveness of the completion process. The results show that the operating period significantly increases the EUR and extends the well life. This study emphasizes the importance of periodic evaluation of well performance to maximize hydrocarbon recovery. These findings contribute to the optimization of production strategies and the improvement of decision-making processes in reservoir management. It is recommended that future research include additional reservoir parameters and alternative recovery techniques to increase the accuracy of reserve estimates.

Keywords: *Decline Curve Analysis (DCA); Renew; Estimated Maximum Recovery (EUR); Estimated Remaining Reserves (ERR); Well performance*

1. Introduction

Estimating oil reserves is one of the most important things for a reservoir engineer because it can predict the remaining reserves and the production life of a well in the future. By knowing the amount of reserves can be used to calculate the economy of a well (Adha, 2021). Therefore, to find out the amount of oil reserves and the acquisition factor and the age of the well in a field must be done with the most accurate calculation possible (Anggaraini, D. F., 2021) .

In this Final Assignment will discuss the Performance Evaluation of "KD" Wells in field X using the Decline Curve Analysis method. This well is located in the basin area of South Sumatra which is included in the Jambi Sub-Cekungan, in Sarolangun Regency, Jambi Province and was first produced in January 2013 so it is necessary to recalculate the reserves in the well. It is known that the "KD" well has declined 2x, namely before the workover is done and After doing workover (Wiyono & Migas, 2024). This "KD" well has been in production since 2013 where the beginning of production produced 3,305 BOPM. However, as time went by until 2020, it experienced a decline caused by the turn reservoir pressure (Johanis, 2022). Therefore, a decline was carried out to find out the number of remaining reserves and the age at which the "KD" well can produce (Malrin, 2022). The selection uses the Decline Curve Analysis method, due to data limitations where only production data is available (Sirait, 2021).

This Decline Curve Analysis Method is a method used to predict residual reserves by analsing a decrease in the production rate until it reaches the q limit. This method is used in wells that have been producing for a long time until they reach optimal capacity (Megawati, 2019). There are 3 factors that

characterise this method, namely When the production rate starts or q at a certain time, Graphs that indicate a decrease in production, and a decrease in the rate of production (Ariyanto, 2021). Some of these factors are a combination of the influence of parameters in reservoirs, well holes, and equipment on the surface (Ariyanto, Y., 2011). From several methods that have been mentioned, one of the backup methods that will be used in this problem is using the Decline Curve Analysis method, because this method only requires historical production data for its calculation. The method that Cook sees as used to calculate the estimated reserve in this well is the decline curve method because of the very limited well data.

Decline curve is a method to predict the amount of oil reserves by analysing the decline in a production rate. In this method, it is used in wells that have been producing for a long time to reach optimal capacity. There are 3 factors in the use of the Decline Curve Analysis method, namely the beginning of the production rate or a certain time q, a graph that shows a decrease in production, and a decrease in the production rate. This method is often used to predict reserve estimates only by using historical production data. An important condition for the use of the Decline Curve method is when the production rate has decreased due to the state of the reservoir, not due to a decrease in the ability of a production tool (Imran, Rinalsi., 2021). The importance of this research is that there is a problem that is not yet known. Research is important to find answers to questions that have not yet been answered.

2. Methods

This study was conducted using the DCA method to analyze production data in the history before and after the workover. The steps taken in this section include; Production data was collected before and after the workover, The DCA method was applied to determine the downward trend in production value, Calculations for EUR and ERR were carried out using harmonic, hyperbolic, and exponential equations, Evaluation of the effectiveness of the workover was carried out based on the comparative values of EUR and ERR before and after the intervention.

The decline curve method is a method used to predict the amount of hydrocarbon reserves in a reservoir by using data on production following a certain time period. The first thing to use this method is that the production rate has decreased, which is caused by the condition of the reservoir, not because the performance of the production equipment has turned. The decrease in the rate of production is caused by factors such as the reservoir driving mechanism, pressure, and the physical properties of a rock and reservoir fluid. To predict the size of a hydrocarbon reserve by using the decline curve method, namely by predicting the line draw or the extrapolation result obtained based on the plot between the production data and the production time.

In this Decline Curve method, plotting the starting production rate with time (time) on semilog paper, log-log set paper with a certain scale used.

Semilogue is used more than others. In production, if the log rate is plotted against time, it will form a straight line, this is called exponential decline. Can be seen in figure 3.1 describing the basic type of Decline Curve. This method requires an estimate, where the longer a well production rate, the lower it decreases, this is because the decline curve analysis can be used in several conditions, namely during the mechanical state and the constant draining radius in a well that can produce according to its capacity.

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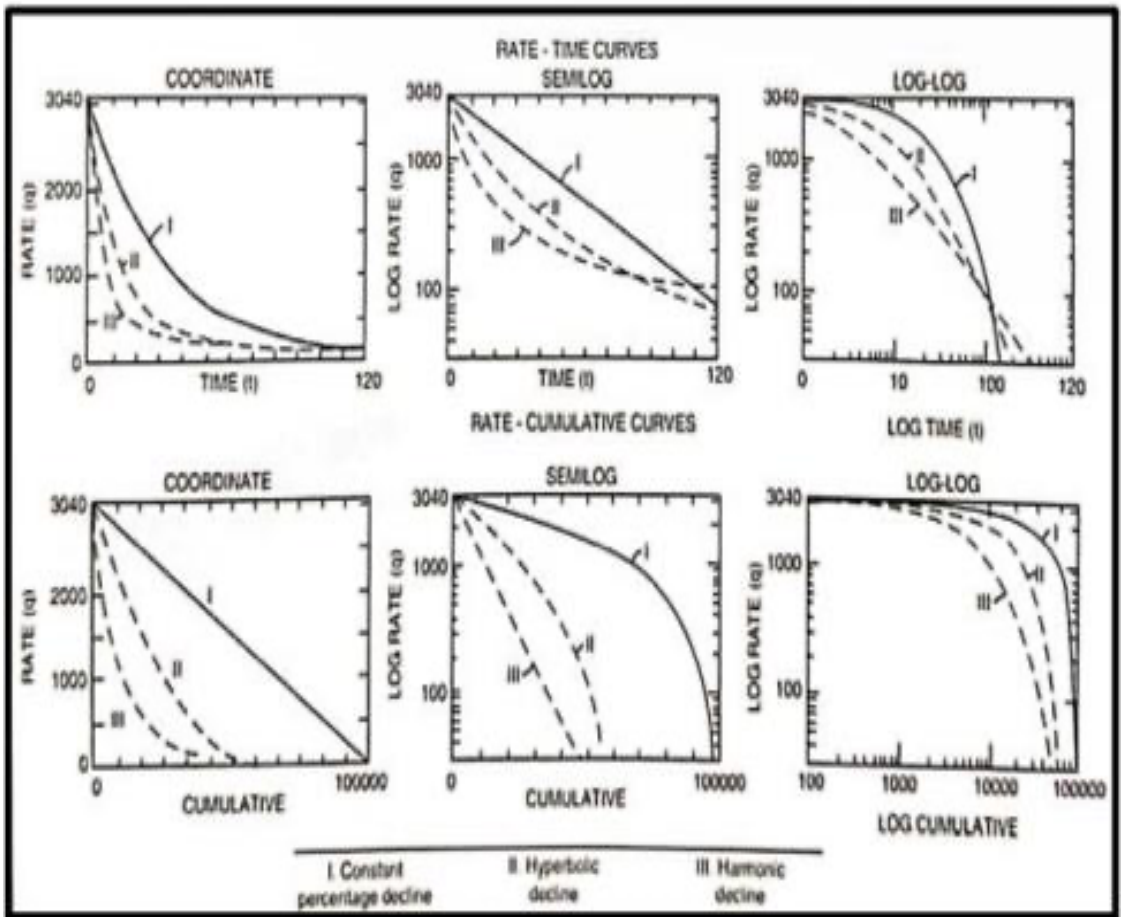

Figure 1. Basic type of Decline Curve
(After Arps, JJ. "Estimation of Primary Oil Res erves," Courtesy of Trans, AIME, vol. 207,1956)

In this Decline Curve method, plotting the starting production rate with time (time) on semilog paper, log-log set paper with a certain scale used. Semilogue is used more than others. In production, if the log rate is plotted against time, it will form a straight line, this is called exponential decline. Can be seen in figure 3.1 describing the basic type of Decline Curve. This method requires an estimate, where the longer a well production rate, the lower it decreases, this is because the decline curve analysis can be used in several conditions, namely during the mechanical state and the constant draining radius in a well that can produce according to its capacity.

3. Result and Discussion

Figure 2 is a flow diagram to find out the residual oil reserves at the "KD" well:

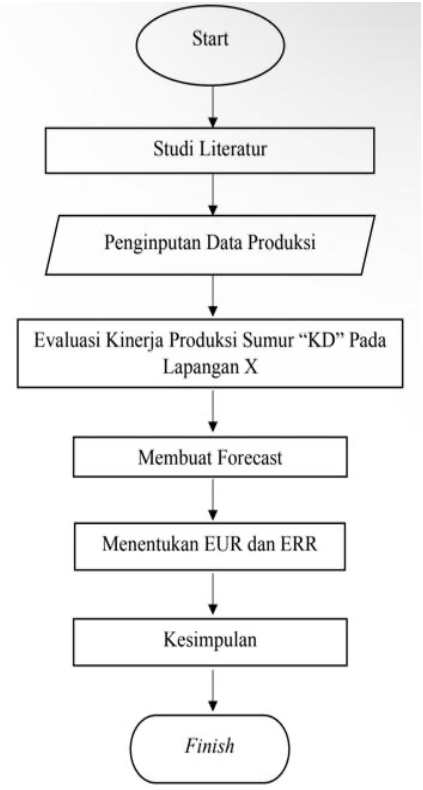

Figure 3. Flow Diagram

1. The results of the Analysis for this Production are: There is a change in the trend of the production "KD" before and after the rework.
2. Estimation EUR and ERR: In the calculation, reserves have increased that can be produced after the rework is performed.
3. Evaluation of Rework Effectiveness: Compare the calculation results with industry performance standards to determine if the rework has a significant impact on production.

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3.1. Plot the Production Rate against Time

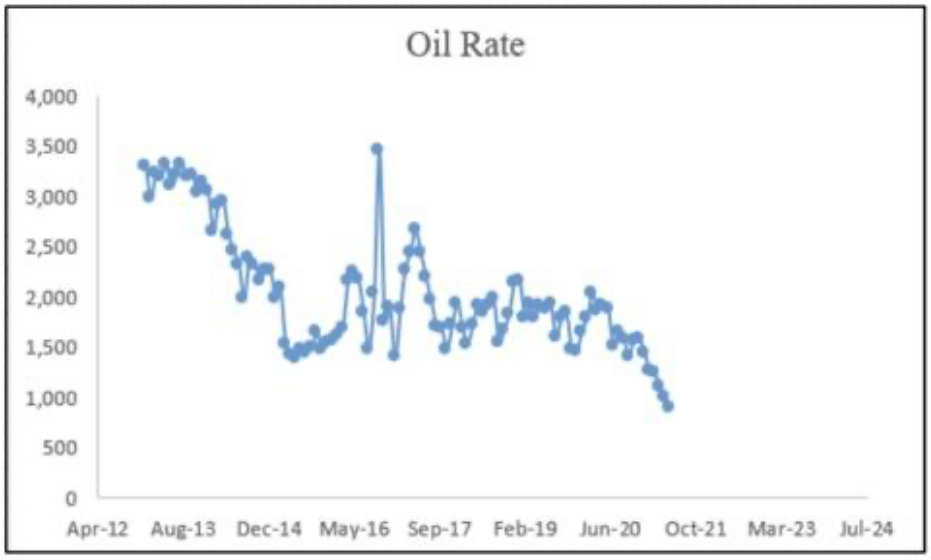

Figure 3.1.1 Qo vs Time Graph

The production rate and production time need to be recorded before determining the drop point. Making a graph of production rate (qo) vs time (t) aims to make it easier to calculate the production trend that will be analysed to estimate the future production rate.

3.2. *Determine The Type Of Decline Curve.*

Determining the type on the decline curve, is done by analysing a graph of production rate (go) vs time (t) before estimating the remaining reserve and age of the "KD" well calculated to Qlimit.

No	Time	Qo (BOPM)
1	Dec-20	1586
2	Jan-21	1448
3	Feb-21	1265
4	Mar-21	1246
5	Apr-21	1104
6	Mei-21	1000
7	Jun-21	902

Table 3.1.2 History Production Trend Decline

To determine hydrocarbon reserves, there are several methods, namely: Volumetric Method, Monte

Carlo Method, Material Balance Method, and Decline Curve Analysis Method. Each of these methods has its own advantages and disadvantages.

Decline Curve Analysis Method in is a method used to predict residual reserves by analysing the decline in the production rate until it reaches the q limit. There are 3 factors in the use of the Decline Curve Analysis method, namely the beginning of the production rate or a certain time q, a graph that shows a decrease in production, and a decrease in the production rate.

Reserve estimates will always be able to change at any time in line with the ongoing production operations that can reduce the reserves. Basically predicting the size of hydrocarbon reserves using the decline curve method is to predict the extrapolation hail or drawing lines obtained from the curve based on plotting between production data and production time. To predict the reserves and rate of hydrocarbon production used:

• Production rate with time (q vs 1).

Production rate with cumulative production (g vs Np).

Present oil with cumulative production (% oil vs Np).

• Cumulative production of gas with cumulative production of oil (Gp vs Np).

• Reserber pressure with time (P vs t)

• P/Z vs cumulative production for (reservoir).

In the decline curve, there is a decline curve formed due to a decrease in production caused by a static decrease in reservoir pressure in line with the hydrocarbon process. The reservoir experts try to draw a relationship between the rate of production with time and cumulative production that.

Aims to predict future production or future production and usa Reservoir (future life). Some characteristics of the decline curve of a production, namely: Early production lanue. Curve of a Decline curve, Decline Constant. The "KD" well is located in the basin area of South Sumatra, in the Regency Sarolangun, Jambi Province. The "KD" well started production in January Year 2013. Oil reserve estimation is done by using the method Decline curve to find out the amount of potential left from this well.

Before doing the workover, the point used is starting from December 2020 Until June 2021 and after workover which is in December 2021 until June 2022. After we determine the value of b on the curve b vs R? With the initial assumption of the value B=0, after comparing the value of R° from each assumption, the value b is obtained On the "KD" well before workover which is 0,I= 0,9879 and after Workover which is 0,1= 0,9181. After analysing, the results were obtained from the Ultimate Recovery Estimate (EUR), and Estimate Remaining Reserve (ERR) from the "KD" well before and After the workover.

3.3. Figures, Graphics content and Tables

Data and Calculations on the “KD” Well Before Workover The determination of oil reserves was carried out on the “KD” well using the decline curve analysis method and the available data, namely time data and production data. The following is the well data used:

Margin	Month	BOPM
1	Jan-13	3,305
2	Feb-13	2,976
3	Mar-13	3,223
4	Apr-13	3,191
5	May-13	3,31

6	Jun-13	3,104
7	Jul-13	3,216
8	Aug-13	3,312
9	Sep-13	3,201
10	Okt 13	3,219
11	Nov-13	3,029
12	Des 13	3,147
13	Jan-14	3,056
14	Feb-14	2,653
15	Mar-14	2,922
16	Apr-14	2,956
17	May-14	2,621
18	Jun-14	2,457
19	Jul-14	2,319
20	Aug-14	1,984
21	Sep-14	2,384
22	Okt 14	2,318
23	Nov-14	2,169
24	Des 14	2,258
25	Jan-15	2,268
26	Feb-15	1,983
27	Mar-15	2,084
28	Apr-15	1,527
29	May-15	1,426
30	Jun-15	1,383
31	Jul-15	1,471
32	Aug-15	1,45
33	Sep-15	1,49
34	Okt 15	1,646
35	Nov-15	1,469
36	Des 15	1,541
37	Jan-16	1,567
38	Feb-16	1,617
39	Mar-16	1,693
40	Apr-16	2,158
41	May-16	2,25
42	Jun-16	2,173
43	Jul-16	1,844

44	Aug-16	1,479
45	Sep-16	2,03
46	Okt 16	3,455
47	Nov-16	1,752
48	Des 16	1,899
49	Jan-17	1,404
50	Feb-17	1,877
	Mar-17	2,271
	Apr-17	2,443
	May-17	2,663

Table 3.3. KD Well Data
(Source: Tugas Akhir)

3.4. Harmonic Decline Curve

Harmonic decline curve on the decline of a production rate per unit time is directly proportional to the production rate itself. The shape of the harmonic curve is a special form of the hyperbolic form. There is a harmonic decline equation as follows:

Here is an of Harmonoc Decline Curve Formula:

$$\frac{qi}{1 + bDit} \quad \text{..... (1)}$$

Explanation of the formula:

Where:
q (t) = production rate against time t (BOPD).
qi = initial oil production rate when decline occurs (BOPD).
Di = initial exponential decline rate (1/time).
t = time (day).
b = hyperbolic decline price (b=1).

Source: Tugas Akhir

4. Conclusions

This study shows that repeated workovers performed on "KD" wells can increase the EUR and ERR values, and extend the production life of the well. DCA has been proven to be an effective tool in evaluating well performance and assisting in decision making related to production optimization.

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