Determination of the decline curve analysis type by using the loss ratio method on wells in the m field

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Abstract
One of the important things for petroleum engineers to do is evaluate the field to determine the number of reserves and characteristics contained in a reservoir, which is also useful for estimating the age of a reservoir based on production data. One way to estimate a reservoir is to use the decline curve analysis method which uses production rate and production time data. The total number of wells in the "M" field is 22 wells, but only six wells are producing and will be analyzed, namely wells M-1, M-10, M-13, M-15, M-16, and M- 22. In the decline curve analysis on the "M" field using the Loss Ratio method and OFM software. The results of the decline curve analysis calculation using the loss ratio method; in the M-1 well-obtained b = 0.6 (Hyperbolic decline), in the M-10 well-obtained b = 0.3 (Hyperbolic decline), the M-13 well-obtained b = 0.5 (Hyperbolic decline), the M-15 well-obtained b = 0 (Exponential decline), the M-16 well-obtained b = 0 (Exponential decline), and the M-22 well-obtained b = 0.2 (Hyperbolic decline).

Keywords: Decline curve analysis, reservoir, production, loss ratio

1. Introduction
Determining oil reserves is important to carrying out and evaluating for field development and increasing the productivity of a field. The decline curve analysis method is one of the most common approaches widely used to evaluate oil and gas reserves, as well as the properties of these hydrocarbons. The decline curve analysis method, which is a method of analyzing production decline curves using equations developed by Arps has been widely used to estimate reserves and predict future production times. Therefore, it can be used as a basis for estimating the amount of oil reserves that can be produced (Ultimate recovery) according to existing technology. The decline curve analysis method can be used to analyze the decline in production rates based on production rate data over a certain period. There are two types of decline curve analysis methods, namely the loss ratio method and the trial error-chi-square-test. The loss ratio method is the simplest decline curve analysis method and is the basic theory for more complex techniques.

2. Methodology
This research aims to determine the type of decline curve in wells in field M. The results of this research are types of decline curve analysis in each well in field M. This research uses existing secondary data such as well production data with a certain production time range. After having production data such as production rate at a certain time, a plot has been made between oil production rate vs time. After that, the trend line selection was carried out based on the conditions for selecting the trend line, such as the number of active wells must be constant, there are no changes in chokes or changes in capacity and oil lifting mechanisms in production wells, there are no problems or problems in the production wellbore, and there are no there are problems with production facilities at the surface of the production well. After determining the trend line on the production well, the production data and time that have been determined on the trend line have been analyzed. From this data, the value of the decline constant (b) has been obtained.

This decline constant value has been obtained using the Loss Ratio method. The loss ratio can be defined as the production rate at the end of the production time period divided by the production loss or loss during that period, which is the inverse of the decline rate and is presented in tabulated form for extrapolation and identification purposes of the type of decline curve. The steps for calculating the loss ratio are first to make a tabulation which includes number, time, time difference, flow rate, flow rate difference, loss ratio, and exponent. After all the tabulations have been searched by calculating the loss ratio, the exponent value has been obtained which determines the appropriate type of decline curve.

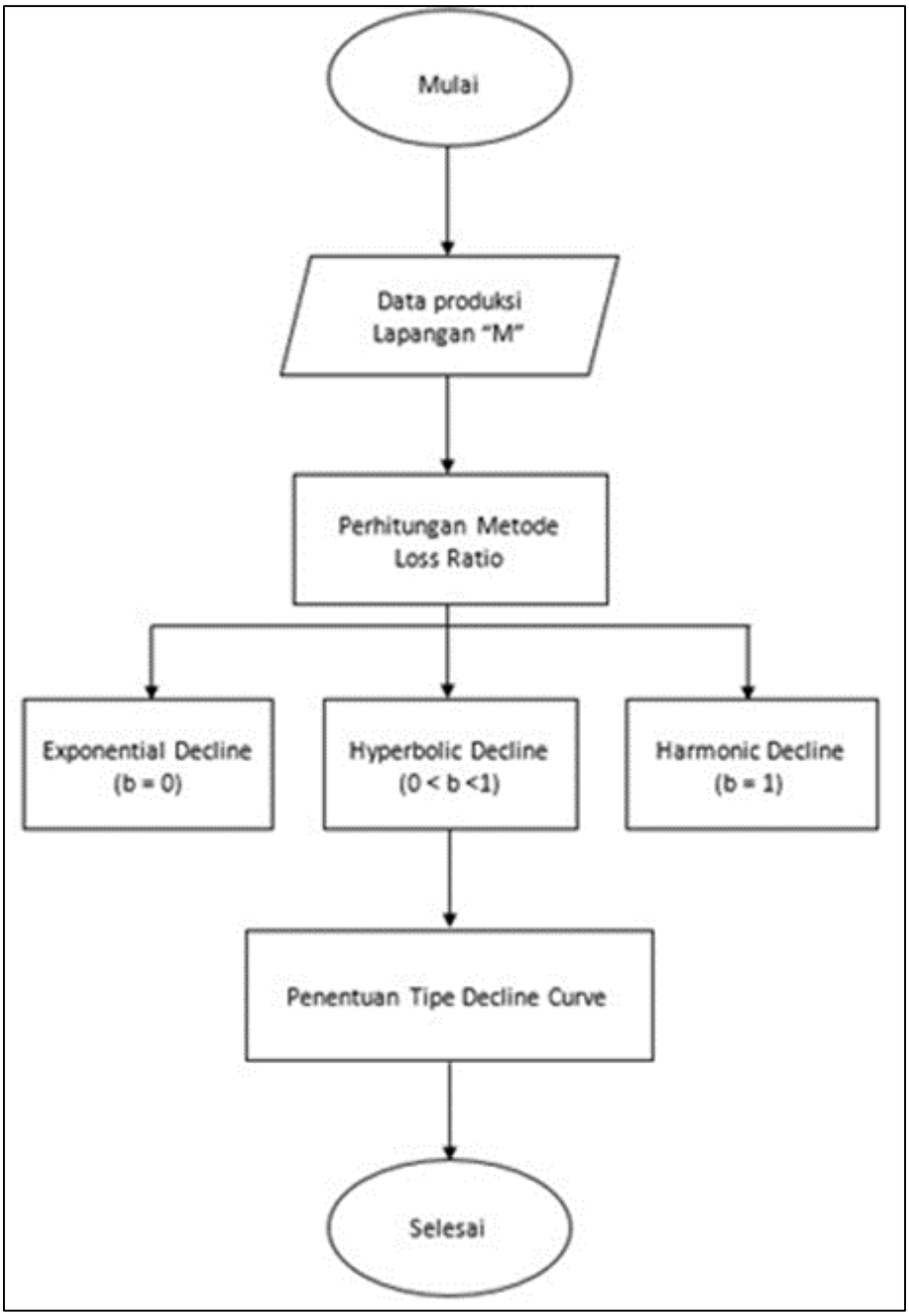

Fig 1: Flow chart

3. Results and Discussion

The "M" Field production data shown in Figure 2, shows a decrease in production rates from time to time, where this data is applicable to forecast future production up to its economic limit and can also be used to determine the number of residual reserves in the reservoir using the decline curve analysis method. The data required in the decline curve analysis method is the number of initial oil reserves in place (OOIP), oil production rate data (qo), and production time (t). The Original Oil in Place (OOIP) value, or the number of reserves in the reservoir in its initial condition before being produced to the surface in the "M" field well has been obtained from the data provided, namely 75,272 MMSTB.

The economic limit rate is the minimum production rate at which the amount of income received from the sale of production will be equal to the amount of costs required to produce that production. If the costs to produce are greater than the profits obtained, then the production well will be abandoned. The "M" field has seven active wells out of 22 total existing wells and the economic limit rate is assumed to

be 3 STB/d.

In decline curve analysis, the first thing to do is analyze production data to select a trend line that will be used in subsequent analysis. To make it easier to select a production trend line, a log graph of production rate (qo) vs time (t) has been made on semi log paper by plotting all production rate data from the beginning to the end of production on a log scale with a comparison of production time, which aims to make it easier to select a production trend line which will then be analyzed to forecast future production.

Fig 2: Production rate (qo) vs time (t) on M-1 well

Figure 2 shows that well M-1 had production data on the first day of 23,076 bbl/day and the last day of 17 bbl/day, and well M-1 produced its first production in September 1978 and its last production was in December 2020.

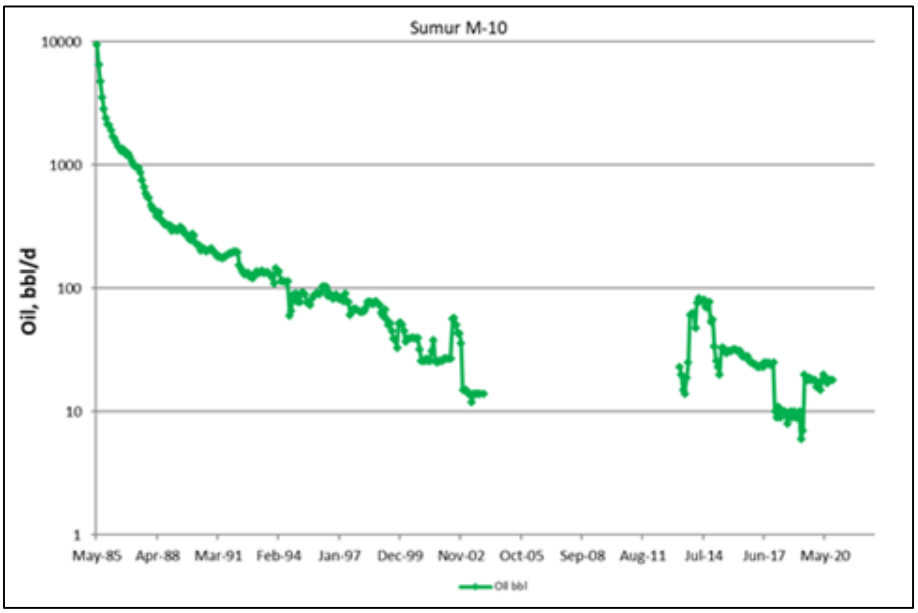

Fig 3: Production rate (qo) vs time (t) on M-10 well

Figure 3 shows that the M-10 well had production data on the first day of 9511 bbl/day and on the last day of 19 bbl/day, and the M-10 well was first produced in May 1985 and last produced in December 2020.

In Figures 2 and 3, an analysis of the production decline trend selection is carried out by the specified conditions to describe the reservoir production performance in the future.

Fig 4: The M-1 Well Production Trend Line Selection Chart

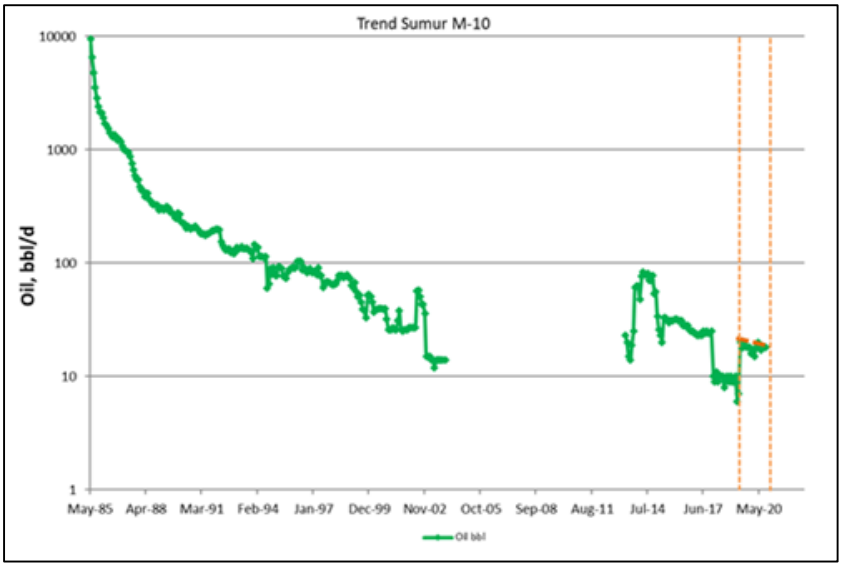

Fig 5: The M-10 Well Production Trend Line Selection Chart

The M-1 well production data graph shown in figure 4 shows a decrease in production rate which has then been analyzed by selecting the trend according to the figure below, namely from March 2020 to December 2020.
Then, the M-10 well production data graph in Figure 5 shows a decrease in production rate which has then been analyzed by selecting the trend according to the figure below, namely from May 2019 to December 2020.
After selecting the trend, proceed with calculating the loss ratio to determine the type of decline curve.

Table 1: Calculation Results of the Loss Ratio Method to Determine the Type of Decline Curve in the M-1 Well.

No	Date	Qo	dt	dq	a	da	b
0	01 March 2020	16					
1	02 March 2020	16	-1	0	0		
2	03 March 2020	16	-1	0	0	0	0
3	04 March 2020	16	-1	0	0	0	0
.....							
121	30 June 2020	16	-1	0	0	0	0
122	01 July 2020	15	-1	1	15	15	-15
123	02 July 2020	15	-1	0	0	-15	15
124	03 July 2020	15	-1	0	0	0	0
.....							
273	29 November 2020	18	-1	0	0	0	0
274	30 November 2020	18	-1	0	0	0	0
275	01 December 2020	17	-1	1	17	17	-17
						db	-17
						b	0,6

Table 2: Calculation Results of the Loss Ratio Method to Determine the Type of Decline Curve in the M-10 Well

No	Date	Qo	dt	dq	a	da	b
0	01 May 2019	20					
1	02 May 2019	20	-1	0	0		
2	03 May 2019	20	-1	0	0	0	0
3	04 May 2019	20	-1	0	0	0	0
…..							
335	31 March 2020	18	-1	0	0	0	0
336	01 April 2020	20	-1	-2	-10	-10	10
337	02 April 2020	20	-1	0	0	10	-10
338	03 April 2020	20	-1	0	0	0	0
…..							
578	29 November 2020	20	-1	0	0	0	0
579	30 November 2020	20	-1	0	0	0	0
580	01 December 2020	19	-1	1	19	19	-19
						db	-19
						b	0,3

In calculating each well, it can be seen that the b value obtained using the Loss Ratio method for each well in the field is; in well M-1, b = 0.6 (Hyperbolic decline); well M-10 obtained b = 0.3 (Hyperbolic decline).

4. Conclusions

Based on the results of the calculation analysis and discussion of this research, a conclusion was obtained, namely using the loss ratio method, the decline curve type was obtained for each well, and there was a hyperbolic decline type such as wells M-1 (b = 0.6) and M-10 (b = 0.3).

5. References

1. Fetkovich MJ, Fetkovich EJ, dan Fetkovich MD. Konsep yang Berguna Untuk Peramalan Kurva Penurunan dan Estimasi Cadangan, Onepetro; c1996.
2. Husla R, Mahadika A, dan Nugrahanti A. Penentuan Isi Awal Di Tempat Menggunakan Software IPM_MBAL pada Lapisan R25 Lapangan RFR, Jurnal Petro. 2020;9(3):140-145.
3. Rukmana D, Kristanto D, dan Cahyoko Aji VD. Teknik Reservoir: Teori dan Aplikasi, Percetakan Pohon Cahaya; c2011.
4. Saphiro Z. Peramalan Kinerja Produksi Minyak pada Lapangan "Z" dengan Menggunakan Decline Curve Analysis, PETRO: Jurnal Ilmiah Teknik Perminyakan. 2017;4(4):143-147.
5. SW YS, Ridaliani O, Lestari L. Evaluasi Isi Awal Gas Di Tempat Dan Analisis Decline Curve Pada Reservoir Ys. PETRO: Jurnal Ilmiah Teknik Perminyakan. 2019;8(4):135-41.