PROCEEDINGS
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Decline Curve Analysis in The Upper Kais and Middle Kais Layers, Kais Formation, "W" Field, West Papua

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Abstract

The "W" Field is an old oil field located in onshore of the Bintuni Basin, West Papua. The field was discovered by Nederlandsche Nieuw Guinee Petroleum Maatschappij (NNGPM) in 1941 and cumulative production are 2.1 MMBBL. The reservoirs were recognised as generally tight with fractures necessary for significant oil production from Limestones of Kais Formation. The field has 30 wells (12 production wells), which were produced in 1952-1961. The "W" field is devided into Compartment 1 (penetrates Upper Kais Layer) and Compartment 2 (penetrates Upper and Middle Kais Layer) by sealing faults. This study aims to determine the productive layers age, Estimate Ultimate Recovery (EUR), Recovery Factor (RF) and Estimate Remaining Reserves (ERR) in each layer and compartment. This research method first, calculates economic limit, secondly, observes a decrease in production curve and chooses a trend to calculate Decline Curve Analysis with loss ratio and trial error and x^2 chi square test methods. Next, choose the price of b and the corresponding terms, which are used to forecast reserves. The research results are obtained as follows; Decline Curve analysis on "W" Field Compartment 1 Upper Kais Layer with ERR of 4123.648 STB, obtained production age of 11.292 months, EUR of 306901 STB and RF of 6.936%, in Compartment 2 Upper Kais Layer with ERR of 24974.632 STB , obtained production age of 26.072 months, EUR of 434435.3647 STB and RF of 1.850%, in Compartment 2 Layer of Middle Kais with ERR of 3014779.202 STB, obtained production age of 1514.532 months, EUR of 4069146.767 STB and RF of 18.553%.
Keywords: Compartement, production age, ERR.

Introduction

One of the important problems in the petroleum industry is how to forecast remaining oil reserves. This problem may be solved by existing calculation methods (for example: material balance and reservoir simulation). These methods may not always be used because some of the required data is not available, calculations are limited by the time available, or the need for urgent information is desired.

Production with decline curve analysis (DCA) can solve this problem by using production data and analyzing the decrease in the production curve of a well. Decline curve analysis is one method to estimate the amount of oil reserves based on production data for a certain period of time and does not require enough data to be analyzed. Besides that, decline curve analysis is also an effective method to simultaneously analyzing production performance based on the production data produced, where reservoir behavior can be known by analyzing decreasing curve of the production rate.

Decline curve analysis applications can be used to optimize production in oil fields that have been producing for a long time using the decline curve analysis method, therefore the research was conducted on the "W" Field which has been produced for a long time.

The W oil field is located in a remote onshore part (north) of West Papua, (Figure 1). The location approximately 60 km north of the coastline of Bintuni Bay (Figure 1). Bintuni Basin is devided into offshore (Bintuni Bay), north onshore (Steenkool, Tembuni, Jagiro, Mogoi and surrounding area) and south onshore (Babo, Genting, Kasuri, Sumuri and surrounding area).

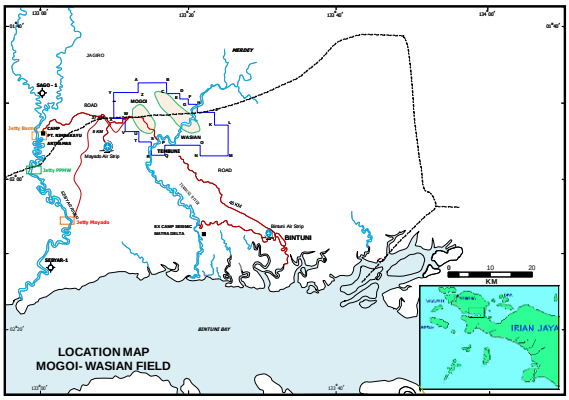


Figure 1: Location map of the study area (blue polygon). The location approximately 60 km north of the coastline of Bintuni Bay, (Utomo and Kaharyanto, 2015).

There are two productive layers penetrated by "W" Field, namely Upper and Middle Kais Layers. besides the availability of production data and some other data needed for decline curve analysis from the "W" Field.

This study aims to determine the production age of a layer those are; Estimated Ultimate Recovery (EUR), Recovery Factor (RF), and Estimated Remaining Reserves (ERR) to the economic limit.

Data and Method

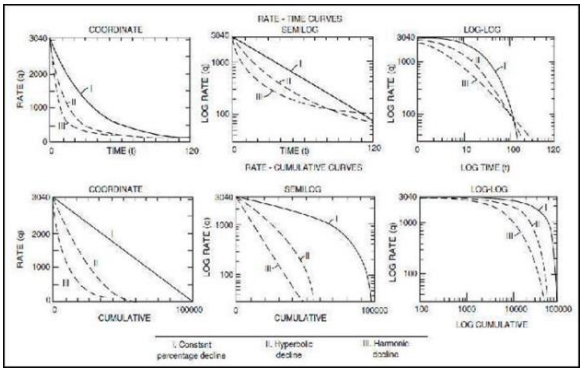
The data collection in this study is by obtained from the final assignment place, namely KSO Pertamina EP Petro Papua.

The available data is Data Production starting from December 1951 to March 1961 which includes data days on production, oil (m3 / month), water (m3 / month), gas (m3 / month), and well profile data. In addition, there are additional data such as geological data which includes thickness and reservoir area, reservoir data which includes porosity, permeability, water saturation, formation volume factors, and economic data which include Indonesian Crude Price (IPC), Total Production Cost, working interest, royalties interest, and tax.

Decline curve calculation uses the method of loss ratio and trial error and X2 chi square test with Ms.Excel as a given data processing tools.

The first step of this research is to calculate STOIIP which can be calculated from reservoir data, secondly to calculate the economic limit that can be calculated from the reservoir data, thirdly to observe the decrease in production curve after each layer penetrated. "W" Field has been allocated and plotted in an oil graph rate vs time, then choose the trend to do the Decline Curve Analysis calculation using the Loss Ratio and Trial Error and X2 Chi Square Test methods. Next, choose the price of b and the corresponding conditions, which are used to predict the production life of the layer, recovery factor and the amount of maximum hydrocarbon recovery (Estimate Ultimate Recovery) of remaining oil reserves. The explanation can be presented in graphical form.

The conditions for analyzing decline curves are:
1. The number of active wells must be constant.
2. There is no change in choke or change in capacity and method of appointment.
3. There are no well holes problems (production problems)
4. There are no problems with facilities or interference from the surface.



In 1935, S.J. Pirson classifies the production drop curve equation on the basis of 3 types, namely; exponential decline curve, hyperbolic decline curve, and harmonic decline curve. The commonly used graphs are first type (q vs t) and second (q vs. Np).
Figure 2. summarizing the development of relationships for the three types of decline curves that have been discussed.

Result and Discussion

The study area focused in Middle-Late Miocene time. Kais Formation consists of Mogoi (Upper Kais) and Wasian (Middle Kais) limestones. The Upper Kais is separated from the Middle Kais by the Sekau shale (shale break). The Upper and Middle Kais comprise sequences of interbedded marls and bioclastic limestones. The limestones are low relief carbonate build-ups or carbonate clastic material derived from nearby reefs.

Most of the NNGPM wells were logged with SP and Resistivity tools, (Figure 6). No other logs are available. The SP response is generally poor because of low salinity contrast between formation and drilling fluids. However, a marked resistivity log break occurs at the top of the Upper and Lower and a high resistivity response throughout the limestones is consistent between wells, (Utomo and Kaharyanto, 2015).

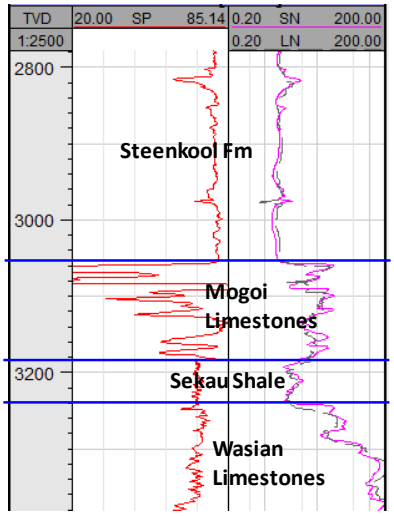


Figure 3: Logs (SP, Resistivity) of W field. Mogoi (Upper Kais) and Wasian (Middle Kais) limestones identified by electric log characters, (Utomo and Kaharyanto, 2015).

On the structure map, it can be seen mapping the location of the wells. According to data in 1961 the Field "W" had 30 wells with 29 wells around the structure, namely: W-01, W-02, W-03, W-04, W-05, W-06, W-07, W-08, W-09, W-10, W-11, W-12, W-13, W-14, W-15, W-16, W-17, W-18, W-19, W-20, W-21, W-22, W-23, W-24, W-26, W-27, W-28, W-29, W-30, and 1 other well namely W-25 well which is a delineation well and located outside the structure. According to production data from 1951-1960 wells that produce in the "W" field there are 12 wells, namely: W-01, W-02, W-03, W-04, W-07, W-12, W-13, W-17, W-18, W-19, W-20, W-21. In Compartment 1 there were wells W-02, W-04, W-08, W-13, W-23. In Compartment 2 there were W-01, W-03, W-07, W-09, W-10, W-11, W-12, W-14, W-15, W-16, W-17, W-18, W-19, W-20, W-21, W-22, W-24, W-26, W-27, W-28, W-29, W-30.

Since the Field "W" is divided into 2 compartments due to the presence of sealing faults. All production wells in Compartment 1

penetrate the Upper Kais Layer and in Compartment 2 there are two wells that penetrate the Upper Kais Layer and the Middle Kais Layer.

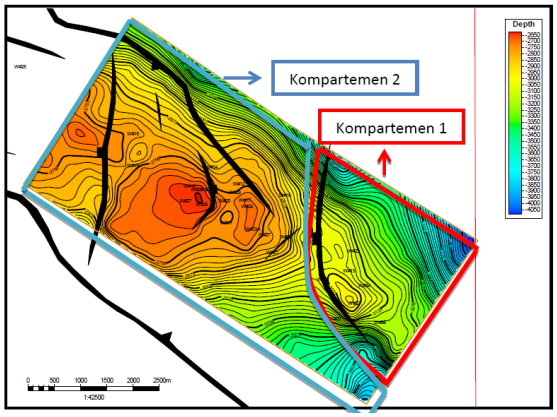


Figure 4. Figure of oil rate vs. time of Compartment 2 of the Middle Kais "W" Field.

Based on the data it is known that there are several faults in the "W" Field where the fault can divide the "W" Field into two compartments, namely Compartment 1 which penetrates the Upper Kais Layer called the Upper Kais Layer Compartment 1 and the second Compartment that penetrates the Upper and Middle Kais Layers, then for Compartment 2 was divided into Compartments 2 of the Upper Kais Layer and Compartment 2 of the Middle Kais Layer.

"W" Field in Compartment 1 of the Upper Kais Layer has STOIIP of 4424857 STB, in Compartment 2 of the Upper Kais Layer has STOIIP of 23484740 STB, Compartment 2 of the Kais Middle Layer has STOIIP of 21931998 STB. Then the number of STOIIP in the "W" Field is equal to 49841595 STB.

Cumulative production (Np) of oil until November 1957 in the Upper Kais Layer Compartment 1 was 302777.3524 STB. Cumulative production (Np) of oil until March 1961 in Compartment 2 of the Upper Kais Layer was 409460.7327 STB. Cumulative production (Np) of oil until March 1961 in Compartment 2 of the Middle Kais Layer was 1054367.565 STB.

Economic Limit determination for each layer is adjusted to the number of wells in the layer. The number of wells in the Upper Kais Layer Compartment 1 is 1 well so that the qLimit layer is 7.352 BOPSD (Barrell Oil per Stream Day). The number of wells in the Compartment 1 of the Upper Kais Layer contained 3 wells so that the qLimit layer was 22.056 BOPSD. The number of wells in the Compartment 1 of the Upper Kais Layer contained 4 wells so that the qLimit layer was 29.408 BOPSD.

Calculation method to determine production allocation from Upper Kais and Middle Kais Layers, as an example calculation using data rate of production well W7 with k = 1, h = 1. Using production rate data in April 1953. So that the results are as big as 33.51 m3 / month or 210.8 BOPM.

Plotting qo vs t is a plot of the entire data from the beginning to the end of production. The plotting results are actual graphs qo vs t per layer as shown in Figure 5, Figure 6 and Figure 7 aim to facilitate the selection of production trends which will then be analyzed into forecasting production rate and cumulative production of each well to the economic limit.

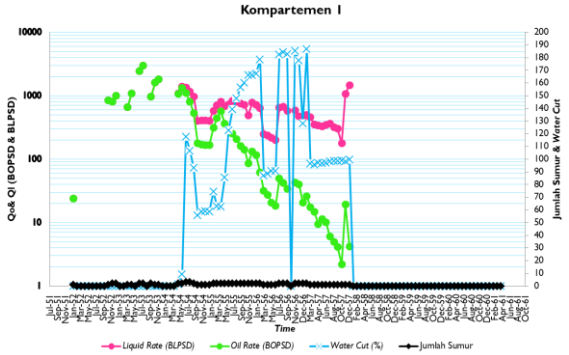


Figure 5. Figure of oil rate vs. time of Compartment 1 of the Upper Kais "W" Field.

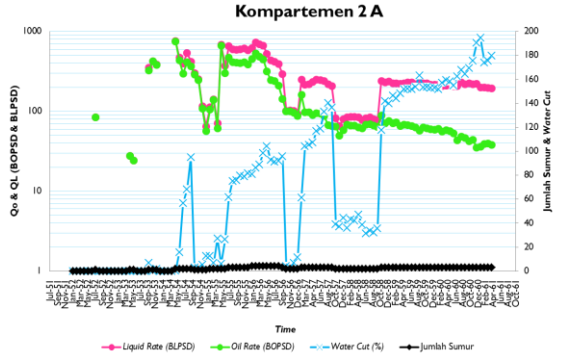


Figure 6. Figure of oil rate vs. time of Compartment 2 of the Upper Kais "W" Field.

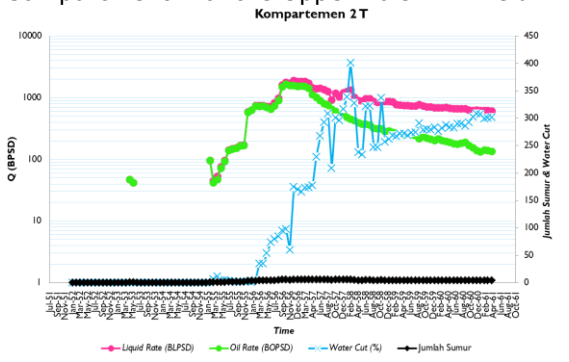


Figure 7. Figure of oil rate vs. time of Compartment 2 of the Middle Kais "W" Field.

The selection of the period (trend) for Decline analysis is done by analyzing the actual production rate graph (qo) vs. time (t) and the history of the well. The trends to be chosen must meet the following criteria:

1. There is no long closure of the well.
2. There is no replacement for production methods.
3. There is a graph of production decline.
4. The well produces in constant quantities.

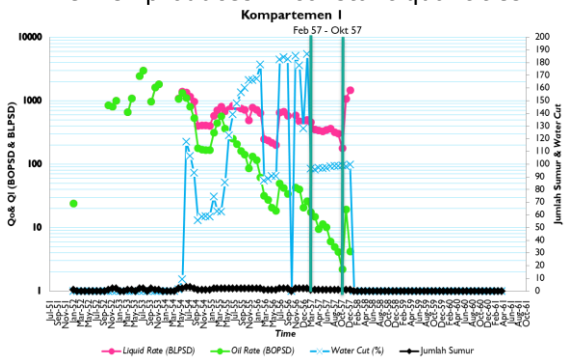


Figure 8. Figure of oil rate vs time for the Trend Selection of Compartment 1 of the Upper Kais "W" Field.

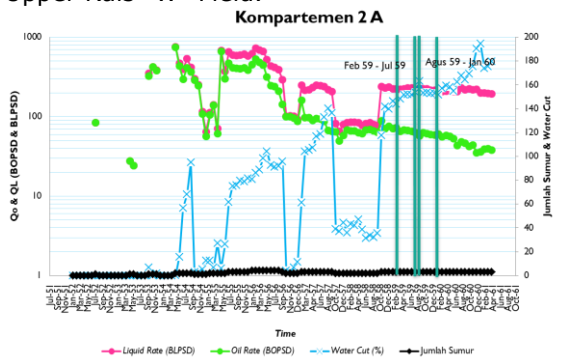


Figure 9. Figure of oil rate vs time for the Trend Selection of Compartment 2 of the Upper Kais "W" Field.

Based on the Decline trend selection criteria, in Compartment 1 of the Upper Kais Layer had the most possible production decline to be analyzed in February 1957 until October 1957 as shown in Figure 8, while Compartment 2 of Upper Kais Layer selected a decrease in production trend starting in February 1959 until July 1959, and August 1959 to January 1959 as shown in Figure 9, and Compartment 2 of the Kais Middle Layer selected a trend of decreasing production from November 1956 to April 1957, January 1959 to June 1959, August 1959 to January 1960, and March 1960 to September 1960 as shown in Figure 10.

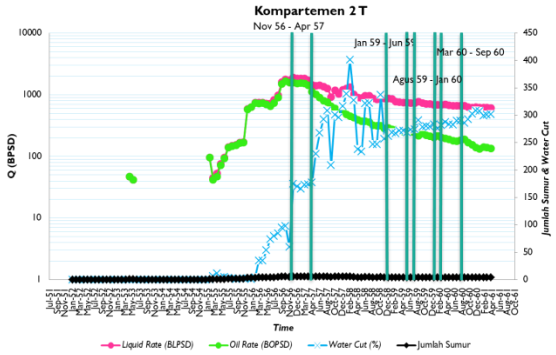


Figure 10. Figure of oil rate vs time for the Trend Selection of Compartment 2 of the Middle Kais "W" Field.

The steps for calculating decline exponents (b) with the Loss Ratio method. As an example of Trend I Compartment 1 of the Upper Kais Layer "W" Field. It can be seen in Table 1.

Trend I								
t	Waktu	q	dt	dq	D=-(dq/dt)/q	a=-(qo/(dq/dt))	da	b=-da/dt
	Bulan	BOPM	Bulan	BOPM				
1	Feb-57	17.4						
2	Mar-57	14.9	1	-2.53617	0.145348837	6.88		
3	Apr-57	9.5	1	-5.41523	0.310348837	3.222180592	-3.65782	3.657819
4	May-57	11.4	1	1.864592	-0.106860465	-9.357997824	-12.5802	12.58018
5	Jun-57	10.1	1	-1.27755	0.073217054	13.65802012	23.01602	-23.016
6	Jul-57	6.101009	1	-3.98348	0.228294574	4.380305603	-9.27771	9.277715
7	Aug-57	4.970892	1	-1.13012	0.064767442	15.43985637	11.05955	-11.0596
8	Sep-57	4.130236	1	-0.84066	0.048178295	20.75623492	5.316379	-5.31638
9	Oct-57	2.2154	1	-1.91484	0.109739981	9.112449219	-11.6438	11.64379
∑D					0.873034554	∑b		-2.23245
D					0.097003839	b		0.24805

Table 1. Determination the Type of Decline Curve with Loss Ratio Method Trend I of Compartment 1 of the Upper Kais "W" Field.

The steps for calculating decline exponents (b) with the Loss Ratio method. As an example of Trend I Compartment 2 Upper Kais Layer "W" Field. It can be seen in Table 2.

Trend I								
t	Waktu	q	dt	dq	D=-(dq/dt)/q	a=-(qo/(dq/dt))	da	b=-da/dt
	Bulan	BOPM	Bulan	BOPM				
1	Feb-59	81.7						
2	Mar-59	72.8	1	-8.97371	0.109792447	9.108094692		
3	Apr-59	75.3	1	2.524674	-0.03088914	-32.37383781	-41.4819	41.48193
4	May-59	75.1	1	-0.18003	0.002202686	453.9911349	486.365	-486.365
5	Jun-59	72.0	1	-3.07536	0.037626747	26.57683877	-427.414	427.4143
6	Jul-59	69.98552	1	-2.04345	0.025001374	39.99780212	13.42096	-13.421
∑D					0.143734114	∑b		-30.8897
D					0.023955686	b		5.148285

Table 2. Determination the Type of Decline Curve with Loss Ratio Method Trend I of Compartment 2 Upper Kais "W" Field.

The steps for calculating decline exponents (b) with the Loss Ratio method. As an example of Trend III Compartment 2 Middle Kais Layer "W" Field. It can be seen in Table 3.

Trend III								
t	Waktu	q	dt	dq	D=-(dq/dt)/q	a=-(qo/(dq/dt))	da	b=-da/dt
	Bulan	BOPM	Bulan	BOPM				
1	Aug-59	209.8						
2	Sep-59	228.4	1	18.58706	-0.088573305	-11.29008341		
3	Oct-59	212.8	1	-15.59967	0.074337427	13.45217404	24.74226	-24.7423
4	Nov-59	205.8	1	-7.00511	0.033381585	29.95663616	16.50446	-16.5045
5	Dec-59	195.8	1	-10.08136	0.04804093	20.81558381	-9.14105	9.141052
6	Jan-60	208.7452	1	12.99483	-0.061924534	-16.14868843	-36.9643	36.96427
∑D					0.005262103	∑b		4.858605
D					0.000877017	b		0.809768

Table 3. Determination the Type of Decline Curve with Loss Ratio Method Trend III of Compartment 2 of the Middle Kais of "W" Field.

The steps for calculating decline exponents (b) with the Trial Error dan X^2 Chi-Square Test method. As an example of Trend I Compartment 1 of the Upper Kais Layer of "W" Field. It can be seen in Table 4.

Trend I															
t	Bulan	Actual	b=0		b=0.1		b=0.2		b=0.3		b=0.4				
			Di	0.25798	Di	0.286531	Di	0.319372	Di	0.35723		0.40097			
		qo, BOPM	qo, BOPM	X2	qo, BOPM	X2	qo, BOPM	X2	qo, BOPM	X2	qo, BOPM	X2			
0	Feb-57	17.4	17.4	0	17.4	0	17.4	0	17.4	0	17.4	0			
1	Mar-57	14.9	13.48116	0.152007	13.15458	0.234967	12.8031	0.347597	12.42759	0.496931	12.0298	0.690863			
2	Apr-57	9.5	10.41569	0.080952	9.994441	0.024714	9.565444	0.000483	9.133444	0.014507	8.703495	0.072426			
3	May-57	11.4	8.047273	1.36539	7.649458	1.801861	7.26227	2.314442	6.88972	2.903112	6.535197	3.565065			
4	Jun-57	10.1	6.217409	2.405227	5.89559	2.976267	5.593554	3.605662	5.312765	4.285776	5.053938	5.007265			
5	Jul-57	6.101009	4.803636	0.350396	4.573986	0.509796	4.364465	0.69094	4.174538	0.88903	4.003278	1.099219			
6	Aug-57	4.970892	3.711341	0.427465	3.571011	0.548771	3.445639	0.675172	3.333973	0.803696	3.234726	0.931848			
7	Sep-57	4.130236	2.867421	0.556145	2.804688	0.62648	2.749436	0.693455	2.700773	0.756585	2.657888	0.815613			
8	Oct-57	2.2154	2.2154	3.76E-14	2.2154	3.2E-30	2.2154	3.56E-31	2.2154	0	2.2154	0			
∑				5.337583		6.722855		8.327751		10.14964		12.1823			

Trend I											
b=0.5		b=0.6		b=0.7		b=0.8		b=0.9		b=1	
Di	0.451612	Di	0.510366	Di	0.578666	Di	0.658213	Di	0.75103	Di	0.85952
qo, BOPM	X2	qo, BOPM	X2	qo, BOPM	X2	qo, BOPM	X2	qo, BOPM	X2	qo, BOPM	X2
17.4	0	17.4	0	17.4	0	17.4	0	17.4	0	17.4	0
11.61243	0.937929	11.17908	1.246945	10.73424	1.626509	10.28302	2.084383	9.830923	2.626834	9.383522	3.258003
8.280668	0.178796	7.86975	0.336656	7.474963	0.547219	7.099751	0.80974	6.746654	1.121572	6.417282	1.478416
6.201315	4.294745	5.889841	5.08417	5.601702	5.923464	5.337066	6.801544	5.095466	7.70684	4.875941	8.627968
4.81711	5.75973	4.601746	6.532398	4.406875	7.314769	4.231218	8.097134	4.073315	8.87095	3.931621	9.629043
3.849486	1.316892	3.711802	1.537881	3.588792	1.758597	3.479019	1.976083	3.381098	2.188021	3.293727	2.392679
3.146625	1.057626	3.068455	1.179507	2.999086	1.296401	2.937481	1.407586	2.882707	1.512646	2.83393	1.611404
2.620057	0.870455	2.586636	0.921158	2.557061	0.967861	2.530838	1.010762	2.507536	1.050097	2.486781	1.086121
2.2154	0	2.2154	0	2.2154	0	2.2154	0	2.2154	0	2.2154	0
	14.41617		16.83871		19.43482		22.18723		25.07696		28.08343

Table 4. Determination the Type of Decline Curve with Trial Error dan X^2 Chi-Square Test Method Trend I of Compartment 1 of the Upper Kais of "W" Field.

The steps for calculating decline exponents (b) with the Trial Error dan X^2 Chi-Square Test method. As an example of Trend I Compartment 2 of the Upper Kais Layer "W" Field. It can be seen in Table 5.

Trend I													
t	Bulan	Actual	b=0		b=0.1		b=0.2		b=0.3		b=0.4		
			Di	0.031035	Di	0.031277	Di	0.031521	Di	0.031769		0.032018	
		qo, BOPM	qo, BOPM	X2	qo, BOPM	X2	qo, BOPM	X2	qo, BOPM	X2	qo, BOPM	X2	
0	Feb-59	81.7	81.7	0	81.7	0	81.7	0	81.7	0	81.7	0	
1	Mar-59	72.8	79.23577	0.529302	79.22046	0.526904	79.20506	0.524497	79.18957	0.522081	79.17398	0.519655	
2	Apr-59	75.3	76.81446	0.030479	76.79225	0.029609	76.77	0.02875	76.74771	0.027901	76.72538	0.027064	
3	May-59	75.1	74.46715	0.005452	74.44566	0.005828	74.42422	0.006215	74.40283	0.006614	74.3815	0.007024	
4	Jun-59	72.0	72.19157	0.000366	72.1777	0.000307	72.16393	0.000252	72.15025	0.000204	72.13665	0.000161	
5	Jul-59	69.98552	69.98552	6.71E-15	69.98552	4.62E-29	69.98552	0	69.98552	2.89E-30	69.98552	2.89E-30	
				0.565599		0.562647		0.559714		0.5568		0.553995	

Trend I											
b=0.5		b=0.6		b=0.7		b=0.8		b=0.9		b=1	
Di	0.032271	Di	0.032526	Di	0.032783	Di	0.033043	Di	0.033306	Di	0.033572
qo, BOPM	X2	qo, BOPM	X2	qo, BOPM	X2	qo, BOPM	X2	qo, BOPM	X2	qo, BOPM	X2
81.7	0	81.7	0	81.7	0	81.7	0	81.7	0	81.7	0
79.15831	0.517221	79.14254	0.514777	79.12668	0.512325	79.11073	0.509864	79.09468	0.507394	79.07855	0.504916
76.70302	0.026239	76.68063	0.025424	76.6582	0.024621	76.63574	0.02383	76.61326	0.02305	76.59074	0.022282
74.36022	0.007446	74.339	0.007879	74.31784	0.008323	74.29673	0.008779	74.27568	0.009245	74.25469	0.009722
72.12314	0.000123	72.10973	9.04E-05	72.09639	6.31E-05	72.08315	4.07E-05	72.07	2.34E-05	72.05693	1.08E-05
69.98552	0	69.98552	2.89E-30	69.98552	0	69.98552	0	69.98552	0	69.98552	0
	0.551028		0.548171		0.545332		0.542513		0.539712		0.536931

Table 5. Determination the Type of Decline Curve with Trial Error dan X^2 Chi-Square Test Method Trend I of Compartment 2 of the Upper Kais Layer of "W" Field.

The steps for calculating decline exponents (b) with the Trial Error dan X^2 Chi-Square Test method. As an example of Trend I Compartment 2 Middle Kais Layer "W" Field. It can be seen in Table 6.

Trend I											
t	Bulan	Actual	b=0		b=0.1		b=0.2		b=0.3		b=0.4
			Di	0.068153	Di	0.069327	Di	0.070529	Di	0.071758	0.073016
		qo, BOPM	qo, BOPM	X2	qo, BOPM	X2	qo, BOPM	X2	qo, BOPM	X2	qo, BOPM	X2
0	Nov-56	1,557.1	1,557.1	0	1,557.1	0	1,557.1	0	1,557.1	0	1,557.1	0
1	Dec-56	1,505.5	1454.512	1.788788	1453.153	1.887193	1451.776	1.989623	1450.382	2.096186	1448.971	2.206992
2	Jan-57	1,524.9	1358.686	20.32907	1356.789	20.82466	1354.888	21.32839	1352.981	21.84021	1351.071	22.36005
3	Feb-57	1,491.8	1269.172	39.0473	1267.409	39.72347	1265.657	40.40219	1263.916	41.08322	1262.186	41.76628
4	Mar-57	1,411.0	1185.556	42.88683	1184.463	43.34369	1183.385	43.7967	1182.324	44.24576	1181.278	44.69079
5	Apr-57	1107.449	1107.449	5.12E-13	1107.449	1.17E-27	1107.449	0	1107.449	4.67E-29	1107.449	0
				104.052		105.779		107.5169		109.2654		111.0241

Trend I											
b=0.5		b=0.6		b=0.7		b=0.8		b=0.9		b=1	
Di	0.074303	Di	0.07562	Di	0.076968	Di	0.078347	Di	0.079759	Di	0.081204
qo, BOPM	X2	qo, BOPM	X2	qo, BOPM	X2	qo, BOPM	X2	qo, BOPM	X2	qo, BOPM	X2
1,557.1	0	1,557.1	0	1,557.1	0	1,557.1	0	1,557.1	0	1,557.1	0
1447.543	2.322153	1446.098	2.441779	1444.636	2.565981	1443.157	2.69487	1441.662	2.828557	1440.151	2.967152
1349.156	22.88785	1347.238	23.42351	1345.317	23.96695	1343.394	24.51806	1341.47	25.07675	1339.544	25.64288
1260.469	42.45114	1258.764	43.13754	1257.072	43.82522	1255.393	44.51393	1253.727	45.20342	1252.075	45.89344
1180.248	45.13172	1179.234	45.56849	1178.235	46.00104	1177.251	46.42932	1176.283	46.85326	1175.33	47.27283
1107.449	0	1107.449	0	1107.449	0	1107.449	0	1107.449	0	1107.449	0
	112.7929		114.5713		116.3592		118.1562		119.962		121.7763

Table 6. Determination the Type of Decline Curve with Trial Error dan X^2 Chi-Square Test Method Trend I of Compartment 2 Middle Kais "W" Field.

Prediction of oil production rate (qo) and cumulative production forecast (Npt → limit) for Compartment 1 of the Upper Kais Layer using hyperbolic decline curve type with the price of b = 0.248 and Di = 0.097 / day. Compartment 2 of the Upper Kais Layer uses curve type harmonic decline with the price of b = 1 and Di = 0.034 / day, while for Compartment 2 of the Layer Middle Kais uses the type of curve hyperbolic decline with the price of b = 0.1 and Di = 0.028 / day.

The results of the calculation of the production age needed to take the remaining oil reserves of Compartment 1 of the Upper Kais Layer to qlimit = 7.352 BOPSD ie 11.229 months or 11 months starting from November 1957 to October 1958. Compartment 2 Upper Kais Layer until qlimit = 22.056 BOPSD ie 26.072 months or 2 3 months starting from March 1961 to June 1963. Compartment 2 Kais Middle layer to qlimit = 29.408 BOPSD which is 3242.744 months or 126 years 2 months starting from March 1961 to May 2087. Judging from the analysis of the decline trend of both layers, Compartment 2 Kais Middle layer which has the longest production age.

EUR (Estimated Ultimate Recovery) is calculated from the total cumulative production (Np) of Compartment 1 oil in Upper Kais Layer in November 1957 until the prediction of total cumulative production forecast (Npt → limit).

Cumulative production (Np) of oil until November 1957 in the Compartment 1 of the Upper Kais Layer was 302777.3524 STB. Cumulative production (Np) of oil until March 1961 in Compartment 2 of the Upper Kais Layer was 409460.7327 STB. Cumulative production (Np) of oil until March 1961 in Compartment 2 of the Middle Kais layer was 1054367.565 STB. After Decline Curve analysis, the total cumulative production forecast (Npt → limit) of oil from the Compartment 1 of the Upper Kais Layer was obtained at 4123.3688 STB. Compartment 2 of the Upper Kais Layer was obtained at 24974.632 STB. Compartment 2 of the Middle Kais Layer was obtained at 3014779.202 STB. Then obtained EUR from Compartment 1 of the Upper Kais Layer was obtained at 306901 STB. Compartment 2 of the Upper Kais Layer was obtained at 434435.3647 STB. Compartment 2 of the Middle Kais layer was obtained at 4069146.767 STB.

So that obtained recovery factor in Compartment 1 of the Upper Kais Layer was 6.936%, in Compartment 2 of the Upper Kais Layer was 1.850%, and in Compartment 2 of the Middle Kais Layer was 18.553%.

Based on table 7 it can be seen that there is a significant difference in recovery factors from each layer, this is because the producing wells in Compartment 2 of the Upper Kais Layer are close to the barrier, the reservoir in "W" Field is heterogeneous, in addition there is one well in Compartment 2 of the Middle Kais layer which has a higher production rate compared to Compartment 1 of the Upper Kais Layer and Compartment 2 Upper Kais Layer so that it will affect reservoir drainage in the Compartment 2 Middle Kais Layer towards its Origial Oil In Place.

Sebelum di Lakukan *Decline Curve Analysis*			
Np (STB)	Hingga November 1957) 302777,352	Hingga Maret 1961) 369671,679	Hingga Maret 1961) 1094156,61
RF (%)	6,843	1,743	4,81
ERR (STB)	1113176,888	7105656,067	5963871,795
Setelah Decline Curve Analysis			
EUR (STB)	306901	434435,3647	4069146,767
RF (%)	6,936	1,85	18,553
ERR (STB)	4123,648	24974,632	3014779,202

Table 7. Observation Results Before Decline Curve Analysis and After Decline Curve Analysis.

After analyzing Decline Curve at Kais Upper Layer and Kais Middle of "W" Field, the remaining oil reserves (ERR) that can be produced up to qlimit = 7.352 BOPSD in the Compartment 1 of the Upper Kais Layer is 4123.648 STB with a production age of 11.292 months from November 1957 to November 1958. Residual oil reserves (ERR) that can be produced up to qlimit = 22.056 BOPSD in Compartment 2 of the Upper Kais Layer are 24974.632 STB with a production age of 26.072 months from March 1961 to June 1963. Reserves residual oil (ERR) which can be produced up to qlimit = 29.408 BOPSD in Compartment 2 of the Middle Kais layer is 3014779.202 STB with a production age of 1514.532 months from March 1961 to May 2087. So that the remaining oil reserves can be used as basis for field development.

Based on those discussion, the decline curve analysis method is used to estimate reserves in the future by using production data against time, and used when a field has been producing for a long time. Before calculating decline curve analysis is better if it is

calculated in advance how many hydrocarbons have been produced over a period of time certain, so that it can be known how much the increase in recovery factor in a layer or field, this is useful for field development.

in this study, the authors only tried to obtain a reserve value using the decline curve analysis method from a field with a large fault. whereas many other papers discuss the decline of Arps decline equation first, before determining the reserve value and additional modifications for research that are linked in reserve forecasting with decline curve analysis.

Conclusions

The conclutions of the decline curve analysis of the W field in Bintuni Basin are as follows:

1. The Upper Kais Layer Age in the first compartment to produce until qlimit is 11 months, the age of the kais layer for the second compartment is 2 years 3 months the age of the middle emperor layer of the second compartment was 126 years 2 months.
2. The amount of reserves that can be produced (EUR) for the Upper Kais Layer the first compartment is 0.306901 MMSTB, with RF of 6.936%. Kais layer The top 2 manufactured compartment (EUR) is 4344.354 MMSTB, with RF of 1.850%. Compartment 2 of the Middle Kais layer manufactured (EUR) was 4069.147 MMSTB, with RF of 18.553%.
3. Recovery Factor for Upper Kais Layer of the first compartment was 6.936%, Upper Kais Layer of the second compartment was 1.850%. Middle Kais Layer second compartment amounted to 18.553%.
4. Estimation of the amount of residual oil reserves (ERR) Upper Kais layer in the first compartment is 4.124 MMSTB, Upper Kais layer in the second compartment is 24.975 MMSTB, Upper Kais layer in the second compartment is 3.015 MMSTB, with retrieval time to the limit of qlimit or called Economic Recoverable Reserves.

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