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Desain Electrical Submersible Pump (ESP) Untuk Meningkatkan Laju Alir Produksi Pada Sumur "DT014"

Della Endangtri[1], Firdaus[2], Rohima Sera Afifah[3], Abdul Gafar Karim[4], Fatma[5], Muhammad Alif[6],Pratama Bagus Restu.S[6]

Sekolah Tinggi Teknologi Minyak dan Gas Bumi; Balikpapan
Sakinahh433@gmail.com, Aliyahsayyidina1010@gmail.com
Telp/ Whatsapp: 085388324643

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Abstract

Oil production from a well often decreases due to reduced reservoir pressure, so a production increase method or artificial lift is needed to maintain or increase the production flow rate. One of the commonly used artificial lift methods is the Electrical Submersible Pump (ESP). This study aims to design an optimal ESP system for the DT014 well, which is experiencing decreased production. The analysis was carried out by considering reservoir parameters, fluid characteristics, and well operating conditions. The design process includes the selection of pumps, motors, and electrical cables that are in accordance with production needs. Simulations were carried out to ensure the performance of the ESP in increasing oil production efficiently and economically. The design results show that the application of ESP to the DT014 well can significantly increase the production flow rate compared to previous methods. By considering pump efficiency and energy consumption, the selection of the right ESP can maximize production while minimizing operational costs. Thus, the implementation of ESP has proven to be an effective solution to increase oil production in wells experiencing decreased reservoir pressure. This study is expected to be a reference for the optimization of artificial lift systems in oil fields with similar conditions.

Keywords: Decline Curve Analysis, Forecasting Oil Reserves, production life of the well

INTRODUCTION

Petroleum is one of the main sources of energy used globally. However, oil production from a well does not always run optimally, especially when reservoir pressure begins to decrease over time(Dewi,2024). To overcome this problem, an effective production increase method is needed to maintain or increase the oil flow rate(Ahmad,2024). One technology that is widely used in the oil industry is the Electrical Submersible Pump (ESP) system(Budi,2023). ESP is one of the artificial lift methods that functions to lift fluid from the well to the surface with the help of a submersible electric pump. This technology is often used in wells with decreasing production but still have quite large potential oil reserves(Siti,2023). With the right design, ESP can significantly increase oil production and optimize operational efficiency(Rohima Sera Afifah et al., 2022).

The DT014 well is one of the wells that experienced a decrease in production due to reduced reservoir pressure(Edward,2024). Therefore, an optimal ESP evaluation and design are needed so that this well can continue to produce well(Rina,2023). This study aims to determine the appropriate ESP design based on fluid characteristics, reservoir pressure, and desired production needs(Dian,2023). By conducting an in-depth analysis of the technical parameters that affect ESP performance, this study is expected to provide the best recommendations in implementing ESP in the DT014 well and provide a reference for implementing similar systems in other oil fields(Rezki Vegatama et al., 2022).

In addition, technological developments in the field of artificial lift continue to innovate to improve system efficiency and reliability(Rizky,2022). The use of ESP equipped with smart sensors and automatic control systems can increase operational effectiveness and reduce the potential for production disruptions due to changing operational conditions(Lestari,2025). In the oil industry, production optimization is a major factor in determining the sustainability of a field's operations. Implementing the right ESP system can help field operators better manage production, reduce potential downtime, and increase overall economic benefits(Megawati et al., n.d.).

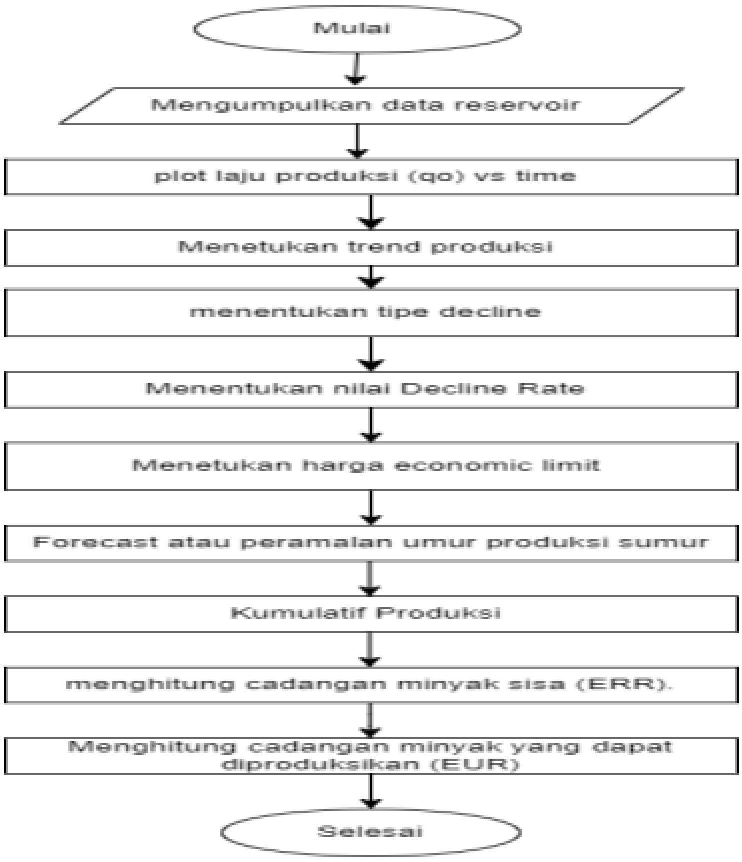
This research is expected to contribute to the development of artificial lift methods, especially in the application of ESP as a solution to increase oil production in wells with similar characteristics(Andi,2020). By understanding more deeply the design and implementation of ESP, the effectiveness of this system can be continuously improved to support more efficient and sustainable oil production(Megawati et al., n.d.).

METHOD

This research was conducted through several stages, starting from the analysis of well and fluid characteristics to ESP performance simulation. The well data used includes reservoir pressure, initial production flow rate, and fluid physical properties such as density and viscosity. This data was obtained from production reports and direct measurement results in the field.

The next stage is the selection of ESP components that are appropriate to the well conditions. Several parameters considered include pump type, electric motor capacity, and power cable specifications. The selection is made by considering pump efficiency, power consumption, and the service life of the ESP system. After the initial design is made, a simulation is carried out to evaluate ESP performance under predetermined operational conditions. This simulation aims to optimize design parameters so that production rates can be increased with efficient energy consumption and minimal operational costs. In addition, an economic analysis was also conducted to assess the feasibility of investing in implementing ESP in the DT014 well. The calculation was conducted by comparing the installation and operational costs of the ESP against the resulting increase in production. This evaluation is important to determine whether the implementation of ESP provides significant benefits for oil field operators.

In this method, fluid pressure calculations are also carried out at various depths to ensure that the pump used has specifications that are capable of overcoming the pressure that occurs in the well. This calculation is carried out by considering the physical properties of oil, gas, and water contained in the well. In addition to the theoretical approach, this study also refers to empirical data from the implementation of ESP in other wells that have similar characteristics to the DT014 well. By comparing the results of this study with field data, the accuracy of the proposed ESP design can be evaluated more comprehensively. The research flow diagram in Figure 4.1 depicts the stages in data processing in researching oil reserves in the SBR-A well so that at this stage, oil reserve prediction results are obtained using the Decline Curve method. The following is field production data for the SBR-A Lapanga R well.



Gambar 4.1 Diagram Alir .

Results and discussion

The results of the study showed that the application of ESP to the DT014 well was able to significantly increase the production flow rate compared to the previous method. With the right pump selection, oil production can increase up to X% of the initial production. This shows that the ESP system has great potential in increasing the production efficiency of wells that experience decreased reservoir pressure. In addition, the analysis of pump efficiency shows that the designed ESP system works with optimal efficiency, with energy consumption remaining within acceptable limits. This is important considering that the operational costs of the ESP system are largely influenced by the need for electrical power. In addition to increasing production, the implementation of ESP also has a positive impact on the stability of well production. With an optimally designed system, production fluctuations can be reduced, allowing for more stable and measurable production planning. This has an impact on increasing overall operational efficiency.

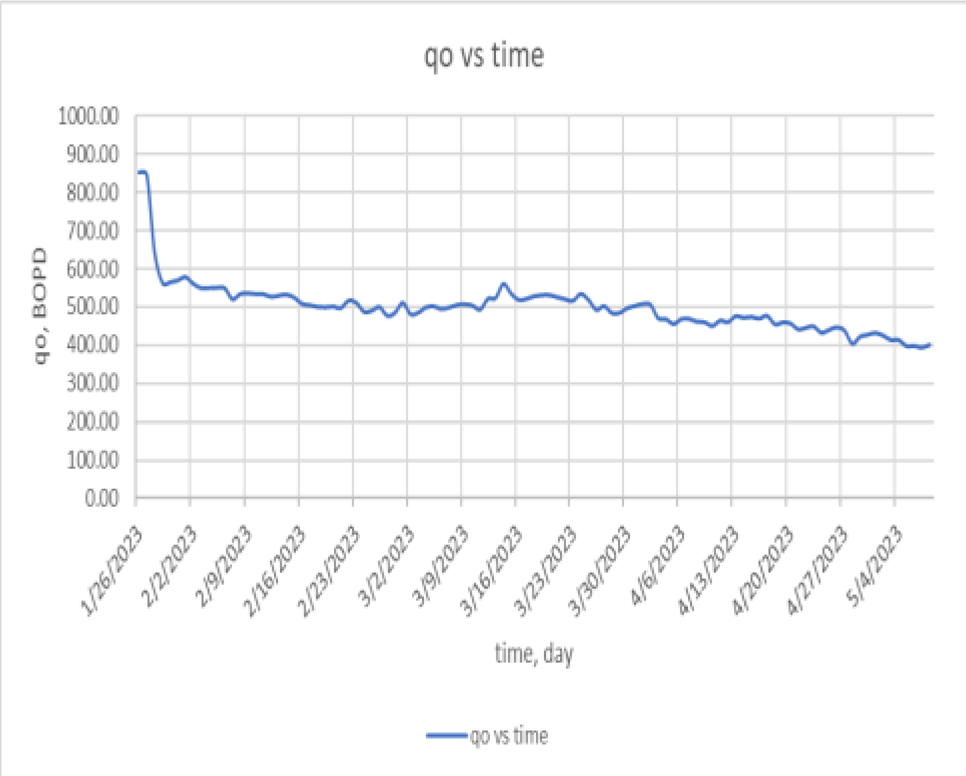
Further evaluation was conducted on the economic aspects of the ESP implementation in the DT014 well. The results of the analysis showed that although the initial investment in installing ESP was quite high, the cost could be compensated by a significant increase in production in a relatively short time. With proper calculations, the ESP system can provide maximum economic benefits for field operators. From the results of this study, it can be concluded that the right ESP design can significantly increase oil production and provide an efficient solution for the DT014 well. The implementation of this system can also be applied to other wells with similar characteristics to optimize oil production.

Tabel 4.1 Data History Sumur SBR-A (Lanjutan)

51	3/18/2023	527.41	27759.02
52	3/19/2023	530.19	28289.21
53	3/20/2023	529.80	28819.01
54	3/21/2023	524.37	29343.38
55	3/22/2023	518.96	29862.34
56	3/23/2023	515.32	30377.66
57	3/24/2023	533.16	30910.81
58	3/25/2023	517.28	31428.09
59	3/26/2023	491.15	31919.24
60	3/27/2023	501.12	32420.36
61	3/28/2023	482.92	32903.29
62	3/29/2023	483.29	33386.57
63	3/30/2023	495.56	33882.13
64	3/31/2023	501.55	34383.68
65	4/1/2023	506.60	34890.29
66	4/2/2023	504.65	35394.93
67	4/3/2023	468.96	35863.89
68	4/4/2023	466.71	36330.60
69	4/5/2023	454.04	36784.64
70	4/6/2023	467.01	37251.65
71	4/7/2023	467.54	37719.19
72	4/8/2023	460.08	38179.26
73	4/9/2023	458.62	38637.88
74	4/10/2023	448.75	39086.63
75	4/11/2023	462.99	39549.62
76	4/12/2023	458.83	40008.45
77	4/13/2023	474.62	40483.07
78	4/14/2023	470.58	40953.65
79	4/15/2023	472.58	41426.23
80	4/16/2023	468.22	41894.46
81	4/17/2023	475.61	42370.07
82	4/18/2023	453.18	42823.25
83	4/19/2023	457.62	43280.87
84	4/20/2023	455.71	43736.58
85	4/21/2023	440.23	44176.81
86	4/22/2023	443.77	44620.58
87	4/23/2023	447.75	45068.33
88	4/24/2023	430.99	45499.32
89	4/25/2023	438.24	45937.56
90	4/26/2023	445.11	46382.67
91	4/27/2023	436.80	46819.47
92	4/28/2023	402.19	47221.66
93	4/29/2023	420.42	47642.08
94	4/30/2023	425.52	48067.60
95	5/1/2023	430.39	48497.99
96	5/2/2023	423.30	48921.29
97	5/3/2023	411.93	49333.22
98	5/4/2023	411.84	49745.06
99	5/5/2023	396.00	50141.06
100	5/6/2023	396.19	50537.25
101	5/7/2023	392.00	50929.25
102	5/8/2023	399.15	51328.40

Estimating oil reserves in the SBR-A well uses the decline curve analysis method to determine the amount of oil that can be produced and estimate its production life until it reaches the economic limit. This method was applied because of a decline in production that was visible from the history of the well. Decline curve analysis helps in determining production decline trends and predicting the type of decline based on the exponent or b value, which is obtained through the q-b equation. The correct b value is determined by looking at the R^2 value on the graph, where the closer it is to 1, the more accurate the value is in determining the type of decline.

A graph of production flow rate (qo) against time (t) was created to make it easier to determine production trends that are analyzed to estimate the cumulative production rate of wells in the future. This graph shows actual well production data from 26 January 2023 to 8 May 2023, which can be seen in Figure 4.2.



Gambar 4.2 Grafik Antara Laju Produksi (qo) vs Time (t)

CONCLUSION

Based on the research results, the application of Electrical Submersible Pump (ESP) in the DT014 well has proven effective in increasing the flow rate of oil production. By selecting the appropriate pump and electric motor specifications, oil production can increase significantly compared to before the application of ESP. In addition to increasing production, the use of ESP also provides better energy efficiency compared to other methods. With optimal power management, operational costs can be reduced, thereby providing greater economic benefits for oil field operators. This research is expected to be a reference for the application of the ESP system in other wells with similar conditions. Further evaluation of the maintenance and long-term optimization of ESP is needed to ensure the sustainability of optimal oil production.

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