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Success of Acid Fracturing Job In Water Disposal Injection Well In "NJT-25" Well of "Subang" Field

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Abstract

Acid fracturing is one of the well stimulation methods that aims to restore or even increase the decline in well productivity caused by several factors, such as unstable production rates by giving a new way (bypass) to hydrocarbons. The NJT-25 well in the Subang Field is a well that was stimulated using acid fracturing on Friday, October 25, 2024. The NJT-25 well has a low permeability of Limestone rock mineralogy of about 2.2 mD with a porosity value of 12%. The mixing fluid used is Water Base Fluid, which is the water-based and acid-based mixing fluid used is 15% Hcl. The process of implementing acid fracturing begins with a step rate test, and immediately plays frac. The reason for acid fracturing in the NJT-25 well is that water injection wells as water disposal are less effective when injected with water because of the small rate of water injection, which is with a value of 365.49 BWPD. After acid fracturing, the NJT-25 well experienced an increase in permeability value of around 572.51 mD with an average permeability of around 9.2 mD followed by an increase in the productivity index (PI) with the Prats method of around 3.1 times and the Cinco-Ley method of around 3.3 times. The rate of water injection in the NJT-25 well is 1511.59 BWPD

Keywords: Water Injection Rate, Stimulation, Permeability, Productivity Index, Inflow Performance Relationship.

INTRODUCTION

In the oil and gas production process, formation water is usually produced along with reservoir fluids. Over time, the amount of water produced from a well tends to increase. This water can either be reused through injection to increase oil yield, or it can be managed by disposal. In the NJT-25 well, a no water disposal concept was implemented, where all produced water (100%) was injected back into the ground to reduce the impact on the environment. However, the water injection process often encounters problems, such as low permeability or damage to the formation. Therefore, stimulation is needed to improve so that these obstacles can be minimized. The NJT-25 well serves as a water injection well for water disposal and was stimulated using the acid fracturing method on Friday, October 25, 2024. The well is located in a limestone formation with a depth of 3398 m (11148.29 ft), and acid fracturing was performed in the interval 2515-2530 m. NJT-25 is characterized by low permeability of 2.2 mD and porosity of 12%, resulting in less efficient water injection flow rate.

Given these problems, researchers are interested in studying the changes in the parameters of the NJT-25 well in the Subang Field after acid fracturing. The results of this study are expected to be a reference in choosing the acid fracturing method as a solution for other wells with similar situations.

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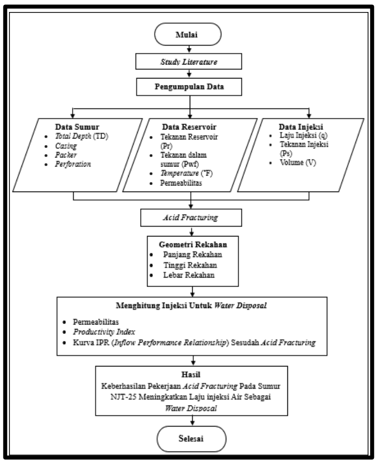
RESEARCH METHODS

In this research, the author examines the acid fracturing work at the NJT-25 well in the Subang Field. The methods used include literature study, data collection and processing. The literature study was conducted to strengthen the theoretical basis, while the data analyzed included stimulation proposals and post job reports containing well, reservoir, and injection information. The data was then used to calculate acid fracturing parameters, including formation average permeability, productivity index, IPR curve, and injection performance before and after stimulation.

Figure 1. Research Flowchart



RESULTS AND DISCUSSION

The discussion of this research starts from well data and fracture geometry in order to know the basic condition of the well.

Well Data

Table 1. NJT-25 Well Data

Well Name	**NJT-25**	
Field	**Subang**	
Layer	**Limestone**	
Well Data		
Data	**Value**	**Unit**
Total Depth	3998	mku
Casing 20”	350	m
Casing 13 3/8”	1348	mku
Casing 9 5/8”	2888	mku
Liner 7”	2808-3998	mku
Perforation	2515-2530	mku
Interval Perforation, h	59,970	ft
Packer 9 5/8”	2495	mku
Tubing 3 1/2”	2515	mku
Reservoir Data		
Reservoir Temperature	265	°F
Mineralogy	Limestone	-
Initial Permeability, k	2,2	mD
Thickness	15	m
Porosity, Ø	12,6	%
Drain Radius, re	820,25	ft
Static Pressure, Ps	1565	Psia
Well Radius, rw	0,292	ft

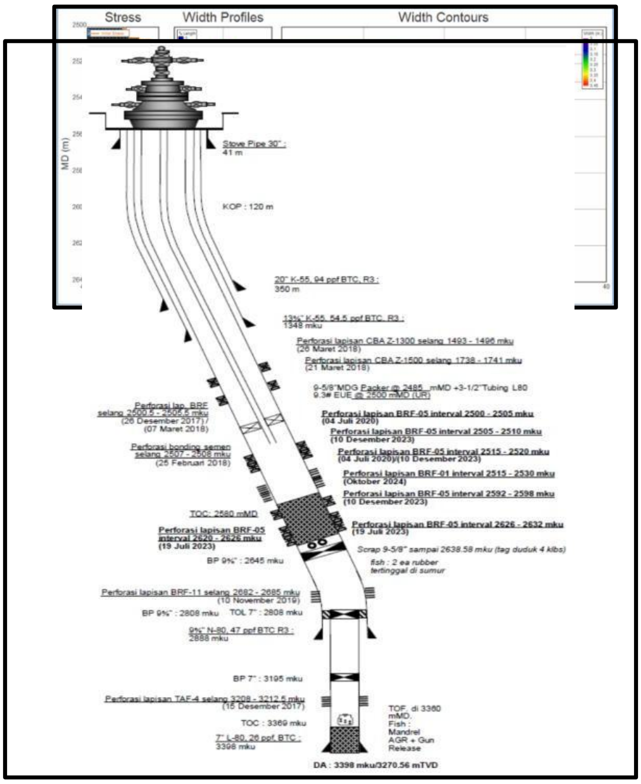


Figure 2. NJT-25 Well Profile

Fracture Geometry

This evaluation was conducted using the 2D PKN method. The selection of this method is due to the small permeability price so that the expected result is that the fracture length can be as long as possible. The calculation results are as follows.

Table 2. NJT-25 Well Fracture Geometry Results

The results of the final fracture geometry and post job fracture geometry calculations show differences in the fracture length and height parameters. In the geometry visualization, the red color indicates wider fractures due to a larger volume of acid entering the formation, while the blue color indicates narrower fractures due to less acid entering the formation. A comparison of the final and post job fracturing geometry is shown in Figure 3 and Figure 4.

Parameter	Unit	Initial Design	Final Design	Post Job Report
Etched Length	m	26	26	38
Frac Height	m	116	116	55
Frac Witdh	inch	0,16	0,16	0,18
FCD	-	22,4	81,7	27,7
Frac Conductivity	mD.ft	15962	15862	28068
Average Permeability	mD	8	2,2	8,2

Figure 3. Final Design Frac Geometry Well NJT-25

The final design frac geometry results show that in-situ stress variations of 4000-6000 psi influence fracture formation, where low stress zones open more easily than high stress zones. The fracture profile shows a symmetrical shape with a maximum width of about 0.3 inches (0.0076 m) around the well that thins towards the tip. The width contour shows a fracture length of ±40 m with a width of up to 0.45 m near the well. Overall, the fractures are forming on target and have the potential to increase the flow conductivity and injectivity values of the well.

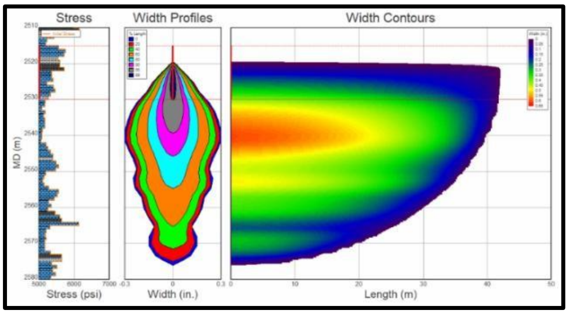


Figure 4. Post Job Frac Geometry Well NJT-25

The post job frac geometry results show a fracture with a length of 40-45 m and a maximum width of about 0.3 inch (0.0076 m) around the well that thins towards the tip. The stress variation of 5000-7000 psi affected the fracture opening, where the low stress zone developed more easily than the high stress zone. The fractures formed exhibited symmetrical, controlled geometry, and conformed to the design targets. Therefore, the acid fracturing job at the NJT-25 well can be declared successful because it has the potential to improve the injectivity and production performance of the well.

Acid fracturing Job Results

The ultimate goal of the acid fracturing operation is to increase the injection rate at the NJT-25 well. If the injection rate does not increase, it can be concluded that the acid fracturing operation was not successful. Therefore, the results of acid fracturing are analyzed, including the increase in average formation permeability, productivity index, IPR graph and injection performance after acid fracturing.

Average Permeability Increase of Formation

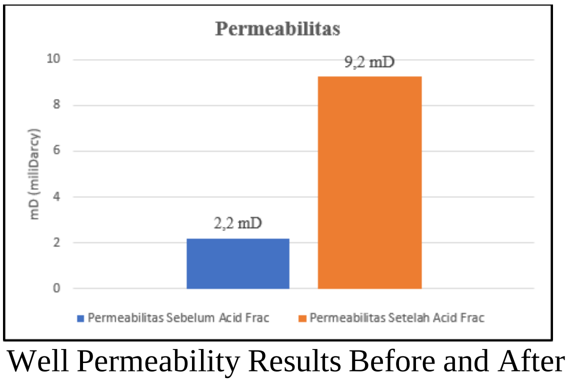


Figure 5. NJT-25 Well Permeability Results Before and After Acid fracturing

Based on the results of Figure 5, the permeability value before acid fracturing of 2.2 mD increased by 7 mD so that after acid fracturing the permeability value became 9.2 mD.

Productivity Index

The productivity index is an index that shows the ability of a well to produce. Calculation of productivity index using the Darcy method, Prats method, Cinco-Ley method, Samaniego and Dominique.

Table 2. Data for Evaluation of Productivity Index of Well NJT-25

Parameter	Value	Unit
Reservoir Static Pressure (Pr)	3370	psi
Bottom Hole Pressure (Pwf) After AF	1373	psi
Bottom Hole Pressure (Pwf) Before AF	1300	psi
Initial Permeability (k)	2,2	mD
Porosity (Ø)	12	%
Water Flow Rate (Qw) After AF	1511,59	BWPD
Water Flow Rate (Qw) Before AF	365,49	BWPD
Fracture Conductivity (WKf)	28068	mD.ft
Fracture Length (Xf)	126,73	ft
Drain Radius (re)	820,25	ft
Well Radius (rw)	0,29	ft

a. Darcy Method

Table 3. Productivity Index Darcy Method

Productivity Index	
Before Acid fracturing	0,18 bpd/psi
After Acid fracturing	0,76 bpd/psi

Before the acid fracturing method was carried out, calculations were carried out using the Darcy method where 0.18 bpd / Psi was obtained, while calculations after acid fracturing were obtained 0.76 bpd / Psi.

b. Prats Method

Tabel 4. Productivity Index Parts Method

Productivity Index After Acid fracturing	
Productivity Index	3,1 Times

Based on the results of the calculation of the increase in productivity index or multiple increases with the Prats method, the increase after acid fracturing at the NJT-25 well is 3.1 times.

c. Cinco-Ley, Samaniego and Dominique Method Table 5**.** Productivity Index Cinco-Ley, Samaniego and Dominique Method

Tabel 5. Productivity Index Cinco-Ley Method

Productivity Index After Acid fracturing	
FCD	100,7
rw'	74,8 ft
K2P	3,3 Times

Before acid fracturing the NJT-25 well had a productivity index based on the calculation of the Darcy method, the result was 0.18 bpd/Psi. After acid fracturing this well experienced an increase in productivity index with the Darcy method of 0.76 bpd / Psi, with the Prats method and the Cinco-Ley, Samaniego and Domonique methods, the results are not much different from the two methods, namely for the Prats method of 3.1 times and the Cinco-Ley, Samaniego and Domonique methods of 3.3 times.

IPR Curve

In the injection analysis using IPR, the NJT-25 well is said to be successfully acid fracturing, there is an increase in water injection after acid fracturing, the IPR curve is made using the Gilbert method which is a single-phase flow. The data required in the calculation of the IPR curve can be seen in Table 6.

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Table 6. NJT-25 Well Injection Data After Acid Fracturing

Parameter	Value	Unit
Reservoir Static Pressure (Pr)	3370	Psi
Bottom Hole Pressure (Pwf)	1373	Psi
Water Flow Rate (Qw)	1511,59	BWPD

Table 7. NJT-25 Well Flow Rate Calculation Result After Acid fracturing

Pwf (Psi)	QW (BWPD)
3370	0
3000	280,06
2500	658,53
2000	1036,99
1500	1415,46
1373	1511,59
1300	1566,85
1200	1642,54
0	2550,86

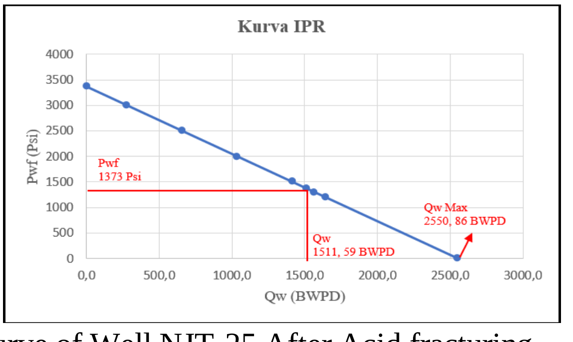

Figure 6. IPR Curve of Well NJT-25 After Acid fracturing

From the calculation of the IPR curve in Figure 6 carried out at the NJT-25 well, it is known that the water flow rate (Qw) is 1511.59 BWPD and the maximum water flow rate (Qw Max) is 2550.86 BWPD. So that the implementation of acid fracturing results in an increase in water injection. Judging from Table 2 before acid fracturing, the water flow rate (Qw) was 365.49 BWPD.

Injection Performance

Table 8. Actual Data Before and After Acid Fracturing

Parameter	PKN 2D Manual		Unit
	Before	After	
Permeability (k)	2,2	9,2	mD
Productivity Index (PI)	0,18	0,76	bpd/Psi
Water Flow Rate (Qw)	365,49	1511,59	BWPD
Maximum Water Flow Rate (Qw max)	595,02	2550,86	BWPD

Based on Table 8, before acid fracturing the well showed low permeability (2.2 mD, tight formation), productivity index 0.18 bpd/Psi, Qw 365.49 BWPD, and Qw Max 595.02 BWPD. After acid fracturing, all parameters increased significantly: permeability to 9.2 mD (fair formation), productivity index 0.76 bpd/Psi, Qw 1511.59 BWPD, and Qw Max 2550.86 BWPD. This proves that acid fracturing can optimally increase the water injection rate as water disposal.

CONCLUSION

The NJT-25 well in the Subang field had an initial permeability of 2.2 mD. After acid fracturing, the permeability increased by 7 mD, to a total of 9.2 mD. In addition, the productivity index was initially 0.18 bpd/psi, and after acid fracturing it rose to 0.76 bpd/psi indicating an increase of 0.66 bpd/psi. After treatment, the water injection rate (Qw) in this well reached 1511.59 BWPD and the maximum measured Qw was 2550.86 BWPD. Thus, this increase in water injection rate indicates that the use of water injection as a water disposal is optimized

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