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The Effect of Resin Injection on the Productivity of Shallow Sandstone Layer in Mawar Field

(Effect Injeksi Resin Pada Produktivitas Lapisan Batupasir Dangkal Di Lapangan Mawar)

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Abstract
Mawar Field is located in North Kalimantan Province. The field has an unconsolidated sandstone layer which is located in Tarakan formation. Porosity of the layer is more than 20%, while permeability of that is between 100 mD and 1000 mD. The zone which is poorly cemented is a source of sand problem. This sand production has an effect on the stability of oil and gas production. Sand production results in the formation of channeling around cement bonding. Sand production problem can be reduced. To overcome the acidity of the shallow formation, it can be done in two ways, that is Gravel pack using propan and stimulation using resin where the sand will be retained behind the formation. In research that has been done using core data and produced sand samples where the results obtained information about the characteristics of sand in shallow zones so that the appropriate treatment method can be recommended that is stimulation with resin. In the use of this resin there will be a permeability reduction of 15% -27% and a maximum fow rate reduction of 20%.

Keywords: Sand Problem, Permeability, Maximum Flow Rate

Sari
Lapangan mawar terletak di Provinsi Kalimantan Utara. Bidang ini memiliki lapisan batu pasir tidak terkonsolidasi yang terletak di formasi Tarakan. Porositas lapisan lebih dari 20%, sementara permeabilitas yang antara 100 mD dan 1000 mD. Zona yang buruk cemented adalah sumber masalah pasir. Produksi pasir ini memiliki efek pada stabilitas produksi minyak dan gas. Hasil produksi pasir dalam pembentukan penyaluran di sekitar ikatan semen. Masalah produksi pasir dapat dikurangi. Untuk mengatasi keasaman pembentukan dangkal, dapat dilakukan dengan dua cara, yaitu paket kerikil menggunakan Propan dan stimulasi menggunakan resin di mana pasir akan dipertahankan di belakang pembentukan. Dalam penelitian yang telah dilakukan dengan menggunakan data inti dan menghasilkan sampel pasir dimana hasil yang diperoleh informasi tentang karakteristik pasir di zona dangkal sehingga metode pengobatan yang tepat dapat direkomendasikan yaitu stimulasi dengan resin. Dalam penggunaan resin ini akan ada pengurangan permeabilitas 15%-30% dan pengurangan laju alir maksimum 20%.

Kata-kata kunci: Masalah Kepasiran, Permeabilitas, Laju Alir Maximum

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I. INTRODUCTION

As the production time increases, the production rate of an oil and gas reservoir will decrease due to the decline of reservoir pressure. Pressure drop in a shallow layer may lead to sand problem. A shallow layer (reservoir) usually has a low compressive strength and poorly cemented. Since it experiences low overburden pressure, both permeability and porosity of the layer are usually high. Sand problem may result in the damage of surface facilities. In addition, the damage of cement bonds around the wellbore due to sand production may cause the increase of water production rate significantly. Consequently, the production rate of oil is drop or even vanishes [1].

In order to handle the sand problem in shallow formation, two methods are usually applied, namely mechanical method and chemical method. The first method is performed by injecting propant into formation (gracvel pack) to restrain the sand and installing a screen to hold the proppant in the position [2, 3]. The second method is performed by injecting resin to attach the sand grains. Threfore the sand production can be prevented or reduced.

The methods should be designed according to the properties of formation to attain an optimal performance. In Mawar Field which has a layer with thickness of 6 – 8 meters with water zone in adjacent layers and fine sand grains, resin injection (chemical method) is believed as the most appropriate method.

II. METHOD

The procedure of the research is depicted in Figure 1. The research covered laboratory experiment of resin injection through three core samples. The cores were obtained fron two well (X-1 and X-2). Permeability reduction of the cores due to resin injection was analyzed. The research was then continued by the resin injection into the two wells. The reduction of productivity of the wells was observed by comparing the production data before and after resin treatment.

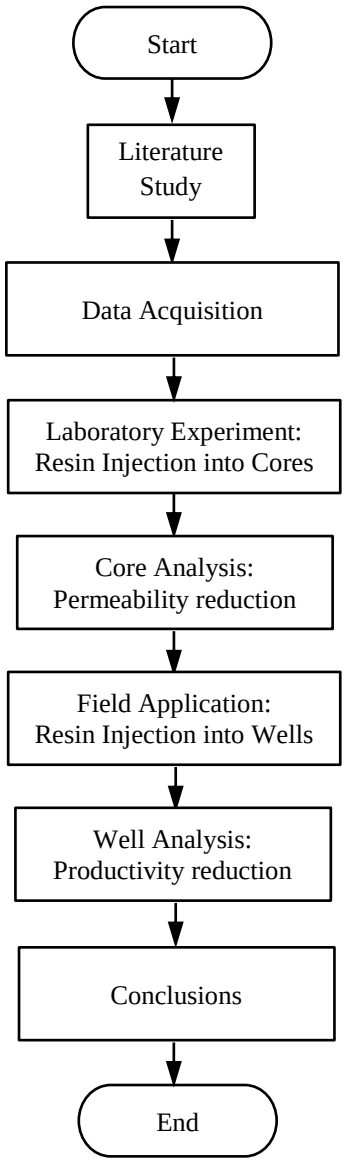

Figure 1. IPR curve of X-1 Well

Sand problems often occur in the old fields that have been depleted. The sand problem in a shallow zone in Tarakan Formation was resulted from the decline of reservoir pressure during oil production. A research is required for the treatment of such problems in Mawar Field. Based on the observation, two wells in the field were decided to get chemical treatment [4, 5]. The data of the wells are given in Table 1.

Table 1. Data of Well X-1 and X-2

Description	Unit	X-1	X-2
Formation		Sandstone	Sandstone
Layer		H-90	H-31
Interval	M	954-956	1045-1047
Permeability, k	mD	820.1	100.0
Porosity, ϕ	%	27	26
Thickness, h	M	8	6
Water Saturation, S_w	%	20	23
Static Pressure, P_{ws}	Psi	719	1067
Flowing Pressure, P_{wf}	Psi	318	528
Production rate, q	bpd	637	807
Reservoir Temp, T_r	^oF	165	173

Three core samples (one core sample is from Well X-1 and the rest is from Well X-2) were tested. 1 to 1.5 post volume (sand consolidation volume) of resin was injected. Permeability of the core samples was measured before and after resin treatment to regain permeability.

The research was continued after the resin treatment of Wells X-1 and X-2 to analysis the effect of resin injection on well productivity.

III. RESULTS AND DISCUSSION

Tables 2 and 3 shows the result of permeability measurement before and after resin injection into core samples of Wells X-1 and X-2 respectively. The tables indicate that permeability of the three cores after resin treatment is lower that that before resin treatment. The reduction of permeability due to resin injection ranged from 129 mD to 271mD or from 15% to 27%. In other word, the resin injection regains permeability as much as 72.93% to 84.22% from the intial permeability of the cores.

Table 2. Permeability Masurement of Well X-1

Test #	Post Volume based on ST volume	Permeability		
		Initial, mD	Final, mD	Regain, %
1	1.5	820.1	690.7	84.22

Table 3. Permeability Masurement of Well X-2

Test #	Post Volume based on ST volume	Permeability		
		Initial, mD	Final, mD	Regain, %
1	1.5	998.7	806.2	80.72
2	1	1001.2	730.2	72.93

In field work, resin injection was injected into Wells X-1 and X-2. It has been carried out by determining the volume of postflush to determine the optimal permeability and keeping draw down

pressure as small as possible can result in a longer well life time and sand production can be reduced from 15% to 0.05%. Success in sand consolidation work using resin provides benefits in the Mawar Field, which is to revive suspended wells, reduce the risk of channeling and increase the life time of the well. Maintaining drawdown pressure and postflush resin volume design is very important for the success of this stimulation work.

Based on the producton before and after resin injection, the change of well productivity was o served. Figures 1 and 2 shows the change of infow performance relationship (IPR) curves due to resin injection. The maximum flow rate (q_{max}) of X-1 and X-2 before resin injection is 845 bpd and 1067 bpd, respectively. The figures indicate that the maximum flow rate X-1 and X-2 after treatment is 675 bpd and 859 bpd. This means that the initial maximum flow rate is decreased by 20.13% and 19.48%, respectively for Wells X-1 and X-2.

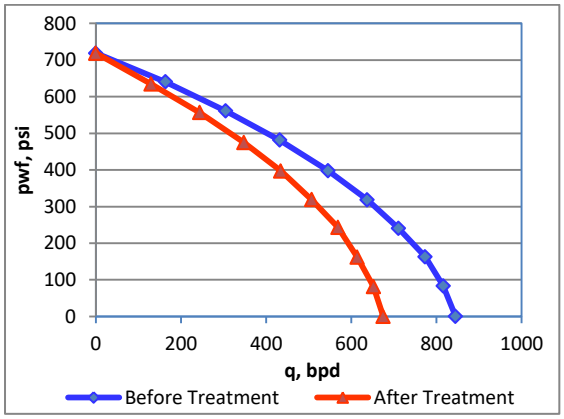

Figure 1. IPR curve of X-1 Well

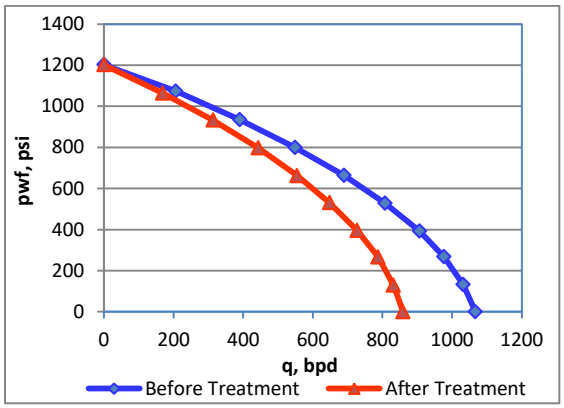

Figure 2. IPR curve of X-2 Well

Figures 3 and 4 show the production history of Wells X-1 and X-2 before and after resin treatment. The figures shows that the production rates after treatment are lower than those before treatment. The figures also indicate that the production rate of Well X-2 is more stable than that of Well X-1. The production time of Well X-2 is more than 14 months, while that of Well X-1 is only about 7.5 months.

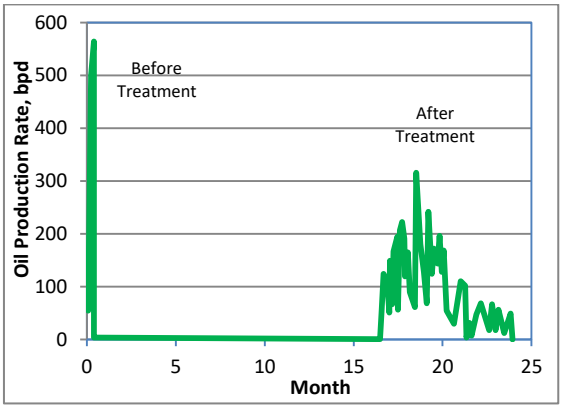

Figure 3. Production Rate of X-1

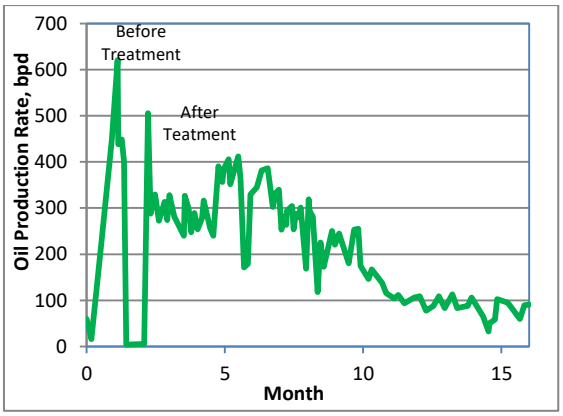

Figure 4. Production Rate of X-2

IV. CONCLUSIONS

Based on the experiments and analyses above, several conclusions are made as follows:

1. The reduction of permeability due to resin injection ranged from 129 mD to 271mD or from 15% to 27%.
2. The use of resin injection to prevent the production of sand grains reduced deliverability of production well, where the maximum flow rate after treatment reduced about 20%.
3. The production performance of Well X-2 is better than that of Well X-1, where Wells X-2 has higher maximum flow rate and longer production time than Well X-1.

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