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Acidizing Evaluation of Carbonate Rock in BDA-F Well, Jatibarang Field

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ABSTRACT

Acidizing is a dissolving activity, whether it is dissolving rock formations or other materials (natural or foreign) in reservoir of the rock. To maintain production in the Jatibarang field, especially in Bangodua (BDA) structure, there are 1 well that have experienced a short decline in production since drilling. The reservoir properties of that well is not good and there is impurity material (damage). Thus, requiring stimulation in the form of matrix acidizing. Evaluation of the matrix acid work in this well, is required for the same activities in other wells. To restore productivity this well, data were collected starting from production data, reservoir data, and well composition data. Then, candidate analysis and matrix acidizing job design are carried out. The design stage will be brought to the execution of matrix acidizing in the field. Then an evaluation was carried out after the presence of matrix acidizing in this well. This well carried out matrix acidizing activities, produced oil production gains. BDA-F well produced with artificial lift of Electrical submersible pump – ESP in C1 layer (1128 – 1130.5 mMD), experienced an increase in test production from 749 BLPD to 1865 BLPD with a decrease in skin factor from +32 to -1.

Keywords: acidizing; matrix acidizing; damage; skin; ESP

I. INTRODUCTION

Acidizing is a dissolving activity, whether it is dissolving rock formations or other materials (natural or foreign) in reservoir of the rock. To maintain production in the Jatibarang field, especially in Bangodua (BDA) structure, BDA-F well have experienced a short decline in production since drilling. BDA-F well start produced in July 29, 2021, only 1.5 month the production of this well get decline curve 20% from firstly.

From data collecting BDA-F well, the permeability of this well is 35 mD, mineralogy is carbonate, skin factor +32, differential pressure Skin 382 psi, and solubility test in the C1 layer at a depth of 1128 – 1130.5 meter Measured Depth (mMD), cutting sample can be dissolved carbonate is > 52%, and dissolve the scale around the formation. So the BDA-F well was stimulated by matrix acidizing treatment within the intention increasing the production.

Matrix acidizing is one of the stimulation techniques to increase the productivity / injectivity of wells with a large volume of acid and a high enough pump rate and addition of surfactants to dissolve impurities (asphalt etc.), before the acid reacts with the reservoir. [1]

There are four basic types of matrix acidizing treatment, Wellbore cleanout, which connect to the formation, acid volumes required range from 10 – 25 gal/ft. treated by spotting, soaking or circulating, or small bullhead treatment. Near Wellbore Stimulation treatments, which requires a volume of 25 – 50 gal/ft, and it improves the permeability within 2 – 3 ft of the wellbore. Intermediate matrix stimulation treatment, which use volume of 50 – 150 gal/ft and can reach 3 to 6 ft within the reservoir. Extended matrix stimulation treatment, which use acid volume of 150 – 500 gal/ft can result in production improvements comparable to hydraulic fracturing activities [2].

In the Carbonate Matrix Acidizing activity in the Majnoon Oilfield field, Al-Rekabi (2020), stated that skin factor trends and formation improvements can be modeled during acid matrix treatment. The skin factor trend monitoring model in real time is taken from wellhead pressure and flow rate values as the two main parameters for the formation of response interpretation during the acid injection phase and formation repair. [3]

From the literature review, it was found that near wellbore stimulation treatment and intermediate matrix stimulation treatment can be reduced skin and damage improvements, so it is expected to increase production in this well discussed.

II. METHODS

In carrying out matrix acidizing on carbonate rocks, several processes are carried out Selection candidate wells, in which wells were collected which experienced a significant decrease in production from the beginning of production. Data collection, after determining candidate wells with decreased production, data collection for each well is carried

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out, including Production data (Production rate, Qo), Reservoir data (Permeability, porosity, initial skin, impurities, and type of mineralogy), and Well completion data (thickness of perforation layer, casing, tubing, packer, and artificial lift).

Analysis of production decline rate data, after obtaining data on wells that experienced a decline in production, an analysis was carried out whether the wells could be used for matrix acid work or not. The analysis here is in the form of the layer whether it is a carbonate layer with properties that can be carried out by acid or not. Matrix acid design, at this stage volumetric calculations are carried out, in the form of bulk volume (initial and target), penetration length, acid volume, acid type, additive acid, and pumping pressure limits, to avoid fracture pressure. Implementation of matrix acid, this step is an execution in the field starting with the injectivity rate test (IRT), pumping pre-flush fluid, pumping main acidizing, and pumping post-flush fluid. Matrix evaluation, here we can see whether several parameters of production rate, Productivity Index, Skin, Skin permeability, damage ratio, flow efficiency, and Inflow Performance Relationship (IPR) have changed. Success or failure of the matrix acid work, from the changes in the parameters above, it can be seen whether the matrix acidizing is said to be successful or not.

Recommendations for the next acid work, with the results above, the design and implementation review become a reference for matrix acidizing work in the next well. It’s can be showed flow chart below:

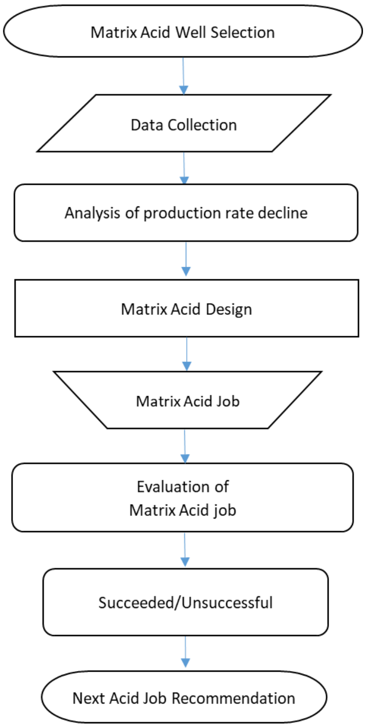

Figure 1. Flowchart of matrix acid methods

III. ACIDIZING EVALUATION OF CARBONATE ROCK IN BDA-F WELL

The BDA structure is located in Jatibarang Field. Geographically, it is located ± 32 km northwest of Cirebon City. Near with Jatibarang structure and the Randegan structure. BDA-F Well start produced in July 29, 2021, only 1.5 month the production of this well get decline curve 20% from firstly. The target zone is last opened during drilling which the production is under initial prediction. Current production is 855 barrel fluid per day (bfpd) with 93% water cut (WC). Based on PBU result, positive skin is observed. Larger production flow is expected from this well at 2500 bfpd by improving inflow (injection of small volume of acid and scale inhibitor for scale prevention) as well as outflow performance improvement (ESP large spec).

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Table 1. Properties Well BDA-F

Field	Jatibarang ; Structure Bangadua
Well	BDA-06
MD/TVD	1694 mMD / 1517 mTVD
Well type	Deviated , KOP at 100 mMD
Formation	Lapisan C1
Lower Zone Isolation	TOC at1663 mMD
Perforation	1128-1131 mMD
Porosity	15 % assumption general on BDA Field
Permeability	35 mD from PBU
Estimated Reservoir Pressure	950 psi
Estimated Reservoir Temperature	280 F
Mineralogy	Carbonate
Past injectivity reference	-

Casing Information

Depth	Size	Weight.	Grade	ID	Capacity	Collapse	Burst
1833 mMD	9 5/8 in	43.5 ppf	K-55	8.755 in	bbl/ft	3810 psi	6330 psi
993 mMD	7 in	26 ppf	K-55	6.276 in	bbl/ft	5410 psi	7240 psi

Production Tubing Information

Depth	Size	Weight.	Grade	ID	Capacity	Collapse	Burst
1131 mMD	2 7/8 in	6.4 ppf	L-80	2.441 in	0.00579 bbl/ft	11170 psi	10570 psi

Scale inhibition treatment has an objective to place a certain volume of neat scale inhibitor chemical to prevent fast deposition of scale potential mineral in this formation. Scale inhibitor is designed for 2500 bfpd 90% WC flow at medium strong concentration. Before desain pump acid in well BDA-F, we take solubility test for this formation :

Solubility BDA-F in HCl 15%

Interval	Weight Before Acid		Weight After Acid		Dissolve	Remark
meter	Gram		Gram		%	
1126-1128	2		1.63		18.5	Lowest Dissolve : - Transisi dari karbonat ke non karbonat - sandstone / shale
1128-1130	2		0.96		52	
1130-1132	2		0.78		61	
1132-1134	2		0.6		70	Highest Dissolve : - Carbonate atau Limestone

Figure 2. Solubility Test BDA-F

The results of solubility test in the C1 layer at a depth of 1128 – 1130.5 mMD, cutting sample can be dissolved carbonate is > 52%, and dissolve the scale around the formation. From solubility test, we can calculated fluid design :

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Table 2. Volume Pump Acid Matrix Job

Concentration		Material	Pump Vol	Mixing Vol	
BRINE INJECTIVITY KCl 2% and RIG fluid			**150**	**6,300**	**GAL**
990	GPT	FRESH WATER		6,237	GAL
167	PPT	POTASSIUM CHLORIDE		1,053	LB
The Following Fluid Is Pumped After Confirm Injectivity Test					
BRINE PREFLUSH			**5**	**210**	**GAL**
940	GPT	FRESH WATER		198	GAL
167	PPT	POTASSIUM CHLORIDE		36	LB
50	GPT	MUTUAL SOLVENT		11	GAL
HCL 15% MAIN ACID			**10**	**420**	**GAL**
476	GPT	FRESH WATER		200	GAL
15	GPT	CORROSION INHIBITOR		7	GAL
20	GPT	INHIBITOR AID		9	GAL
30	PPT	IRON CHELATING AGENT		13	LB
15	PPT	IRON CONTROL AGENT		7	LB
434	GPT	32% HCL		183	GAL
50	GPT	MUTUAL SOLVENT		21	GAL
5	GPT	NONEMULSIFYING AGENT		3	GAL
BRINE OVERFLUSH			**5**	**210**	**GAL**
940	GPT	FRESH WATER		198	GAL
167	PPT	POTASSIUM CHLORIDE		36	LB
50	GPT	MUTUAL SOLVENT		11	GAL
TUBING DISPLACEMENT			**70**	**2,940**	**GAL**
990	GPT	FRESH WATER		2,911	GAL
167	PPT	POTASSIUM CHLORIDE		491	LB
SCALE INHIBITOR			**45**	**1,890**	**GAL**
900	GPT	FRESH WATER		1,701	GAL
100	GPT	SCALE INHIBITOR		190	GAL
SCALE INHIBITOR OVERFLUSH			**45**	**1,890**	**GAL**
990	GPT	FRESH WATER		1,872	GAL
167	PPT	POTASSIUM CHLORIDE		316	LB

Job Summary

1. Run in hole (RIH) Coil Tubing (CT) to Target (1128-1130.5 mMD) while pumping KCL
2. Injectivity test at depth 1129-1130 mMD
3. Mixing Chemical for Acid
4. Start Pumping Treatment, Pre flush, Main Acid, Post flush
5. Pull Up CT to 1000 mMD, displace 1.5-2x volume tubing and soaking 30 minute acid, Mixing Scale inhibitor
6. Continue RIH CT to Target or 5 meter above perfo, and post flush as a spacer 5 bbl, continue with pumping scale inhibitor, (Pumping Schedule)

7. Displace CT, and Pull Out Of Hole (POOH) CT to surface
8. CT on surface, and close valve soaking until 12 hour-while waiting RIH Tubing production
9. Rig Down (R/D) CT
10. Continue RIH Tubing Production with ESP
11. Unloading until Well flowing via ESP

IV. RESULTS AND DISCUSSION

4.1. Treatment Report

Treatment Report performed during the job. Report export into Chart for detail information

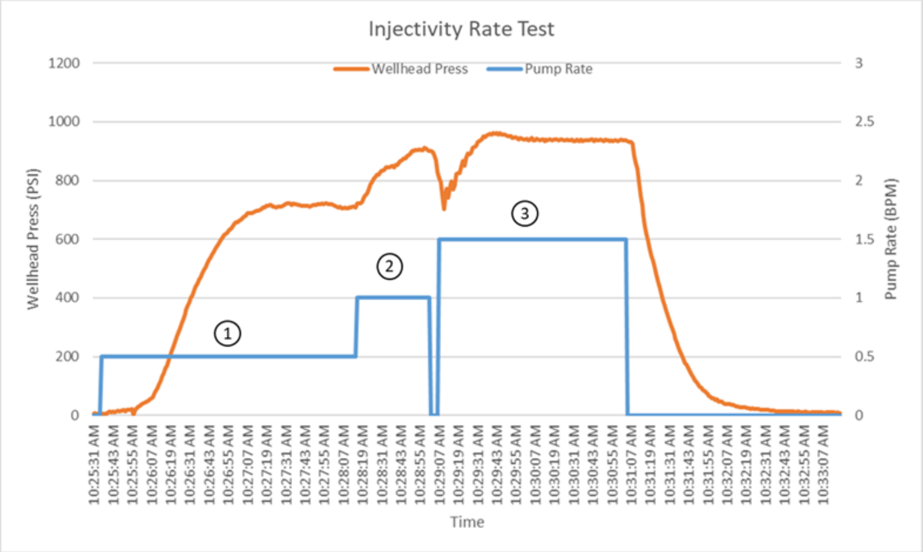

Figure 3. Injectivity Rate Test BDA-F

From injectivity rate test graph, it can be seen that the reservoir pressure responds when it is pressured or flows from outside, when the flow with 0.5 BPM pressure increases gradually from 0 psi to 750 psi (..1). Then the flow was increased to 1 BPM, the pressure response also increased from 750 psi to 925 psi then immediately the flow was stopped at 0 BPM, the pressure response also decreased, however, not significant (..2). Not long after the flow is at 0 BPM, the flow is increased immediately to 1.5 BPM, then the pressure also experiences the highest increase to 950 psi (not to fracture) where the pressure has not reached 0 psi when the flow is 0 BPM (..3). The pressure drop is slow when there is no flow from outside the reservoir.

The picture above shows that the reservoir response can still accept external action, the incoming flow is still in accordance with the acid matrix design. And when the flow is increased, the pressure also gives an increased response, which indicates that there is still skin or damage

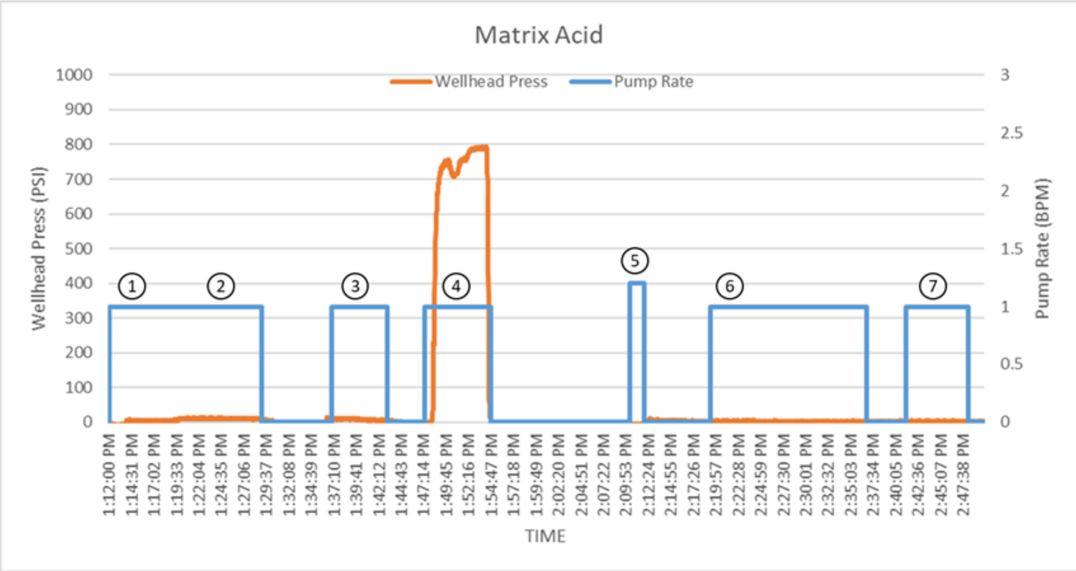

Figure 4. Press and Rate Matrix Acid BDA-F

The main acid pumping stages from the picture above are:

1. Preflush 5 bbl KCl, with flowrate 1 BPM and pressure 5 psi.
2. Main Acid 15% 10 bbl, with flowrate1 BPM and pressure 10 psi
3. Postflush 5 bbl KCl, with flowrate 1 BPM and pressure 10 psi
4. Postflush continued for 5 minutes with flowrate 1 BPM, the acid reached the formation (matrix body – near the perforation) and the tee flow (Surface) closed, the highest pressure increase was 795 psi. Then the wellhead pressure suddenly drops significantly from 795 psi to 0 psi (for 30 seconds). At this point there is an acid reaction to the reservoir and does not indicate a leak in the pump line on the surface.
5. To determine the effect of acid on the reservoir, a pump with a high flow of 1.2 BPM was tested for 1 minute, there was no increase in pressure (stayed at 0 psi).
6. To avoid scale formation in the reservoir, 45 bbl of scale inhibitor was pumped, with a flow of 1 BPM and a pressure of 3 psi (the pump pressure reads).
7. Overflush as much as 40 bbl, with 1 BPM and 3 psi pressure (reads pump pressure)

4.2. Discussion

After matrix acid treatment in BDA-F well, with artificial lift ESP, there're improvement from productivity, it's can be look at graph below:

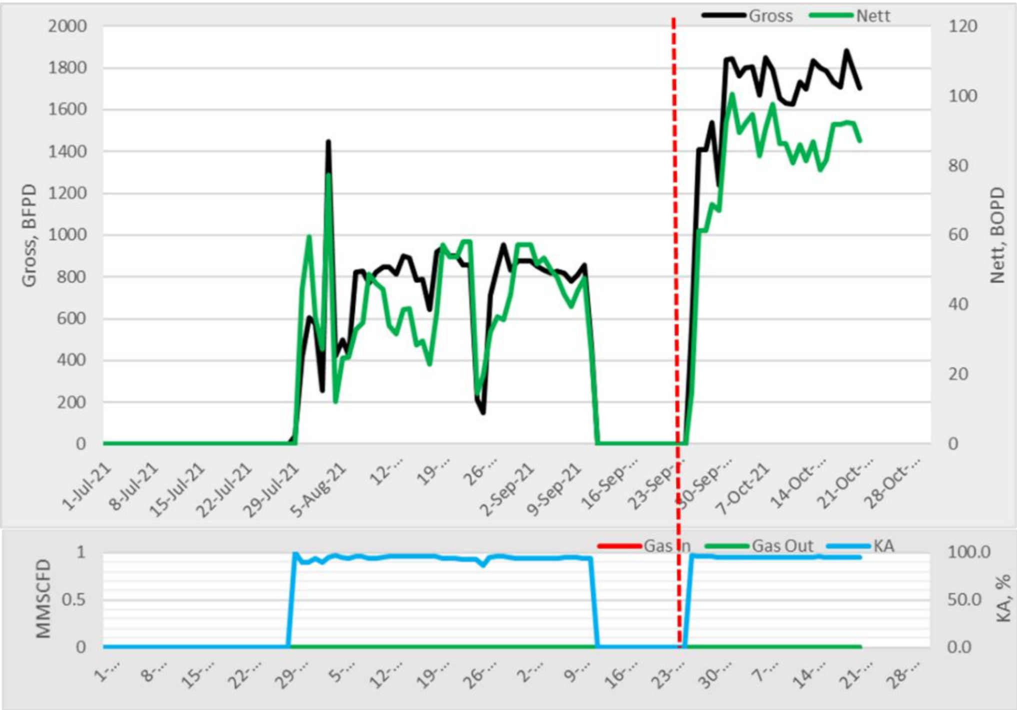

Figure 5. Production BDA-F After Matrix Acid Job

An evaluation of the production of the BDA-F well was carried out and a simulation of the skin changes before and after treatment was carried out. From the simulation results in PIPESIM, the matrix acid work also shows an increase in production and a decrease in the skin value from 32 to -1. With Skin +32 Production is 749.2 blpd, after Skin -1 production becomes 1865 blpd. This looks the same as the actual production test results (figure 5 versus figure 4)

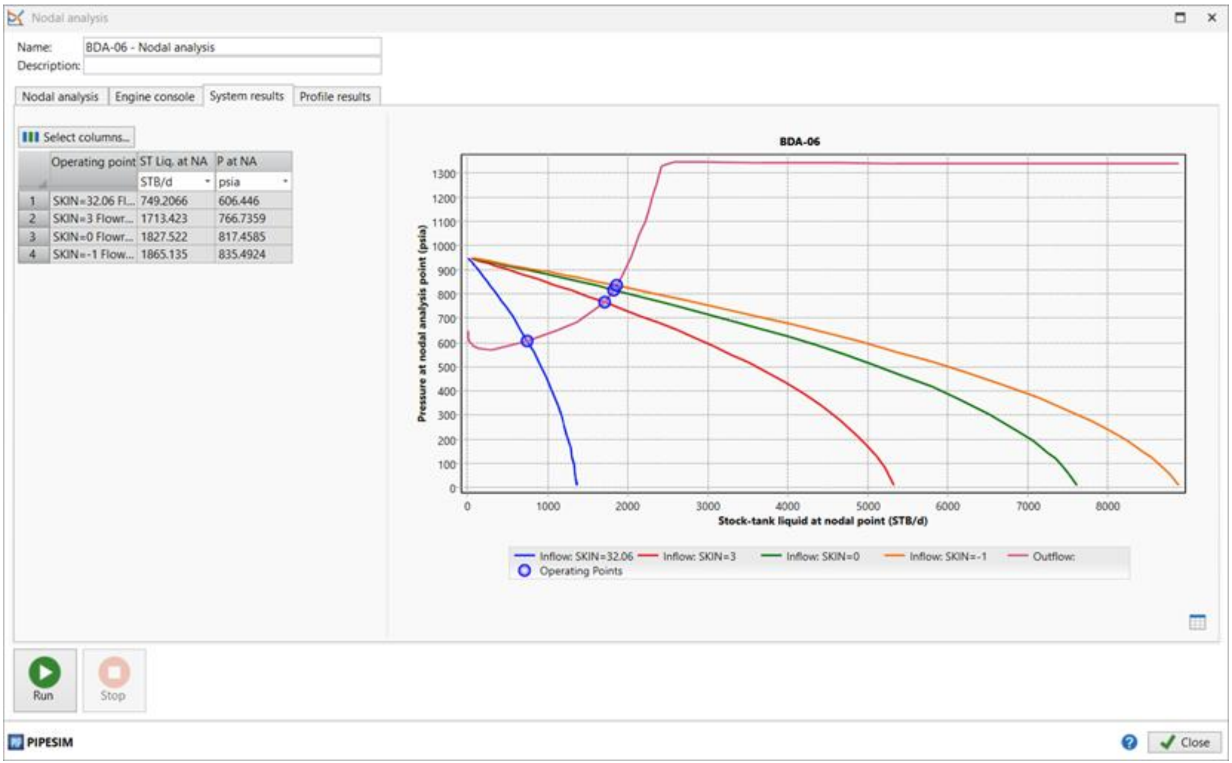

Figure 6. Nodal Analysis with Sensitivity Skin +32, 0, dan -1

V. CONCLUSION

The BDA-F well, with solubility test in the C1 layer at a depth of 1128 – 1130.5 mMD, dissolved carbonate cutting sample > 52 %, and scale around the formation. Matrix acidizing stimulation can be carried out with an acid pumping design of 10 bbl within 2.5 feet penetration. The implementation of matrix acid showed a decrease pump surface pressure from 900 psi to 10 psi (figure 4), so that the acid design was successful. By continue pumping scale inhibitor to prevent scale formation, the pump surface pressure does not increase. The results of the stimulation of the BDA-F well skin also decreased from +32 to -1, this can be seen from the IPR plot when +32 skin produced 749 BLPD to skin -1 production of 1865 BLPD.

REFERENCES

Al-Rekabi, M. A., Aktebanee, A., Al-Ghaffari, A. S., & Saleem, T. 2020. Carbonate Matrix Acidizing Efficiency from Acidizing Induced Skin Point of View: Case Study in Majnoon Oilfield. International Petroleum Technology Conference – 20006.

Amro, M. M. 2006. Extended Matrix Acidizing Using Polymer – Acid Solutions. SPE Technical Symposium of Saudi Arabia Section – 106360.

Lu, Yan., Wang D., Liang, J. Feng, P., Shao, S., & Wang, C. 2020. Porous Limestone Formation Stimulation Using Deep Penetrating Acidizing Technique for Both Injectors and Producers. International Petroleum Technology Conference – 20197.