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Pemex Increases Oil Production 162% More Than Predicted

SXE emulsified acid maximizes acid penetration in Samaria well

CHALLENGE
Optimize production from a well with formation damage caused by excessive oil-base drilling fluid losses in a naturally fractured reservoir.

SOLUTION
Use SXE* emulsified acid to maximize acid penetration and bypass the damaged zone in the critical matrix.

RESULTS
Achieved production 162% greater than predicted from offset wells and petrophysical analysis.

After an oil production increase 162% above its expectation for this well, Pemex will use the SXE acid treatment in wells with similar temperature conditions.

Excessive fluid loss in productive zones

Pemex's Samaria 6117 well in southern Mexico is in a naturally fractured reservoir with an average temperature of 279 degF [137 degC]. It was drilled to 15,150 ft [4,618 m] with oil-base mud as the drilling fluid.

Excessive drilling fluid losses were reported to be 440 bbl [70 m^3] in the productive zones. This fluid loss could cause formation damage from solids bridging and emulsions due to fluid incompatibilities. Pemex expected oil production in this area to be 800 bbl/d [27 m^3] based on offset well production and petrophysical property analysis.

Well Properties	
Perforated interval	14,810–14,910 ft [4,515–4,545 m]
Reservoir pressure	1,930 psi [13.3 Mpa]
Oil gravity	35 API
Temperature	279 degF [137 degC]
Porosity	8%
Permeability	30 mD
Water saturation	15%
Reservoir composition	97% limestone, 3% shale

Matrix stimulation proposal for well optimization

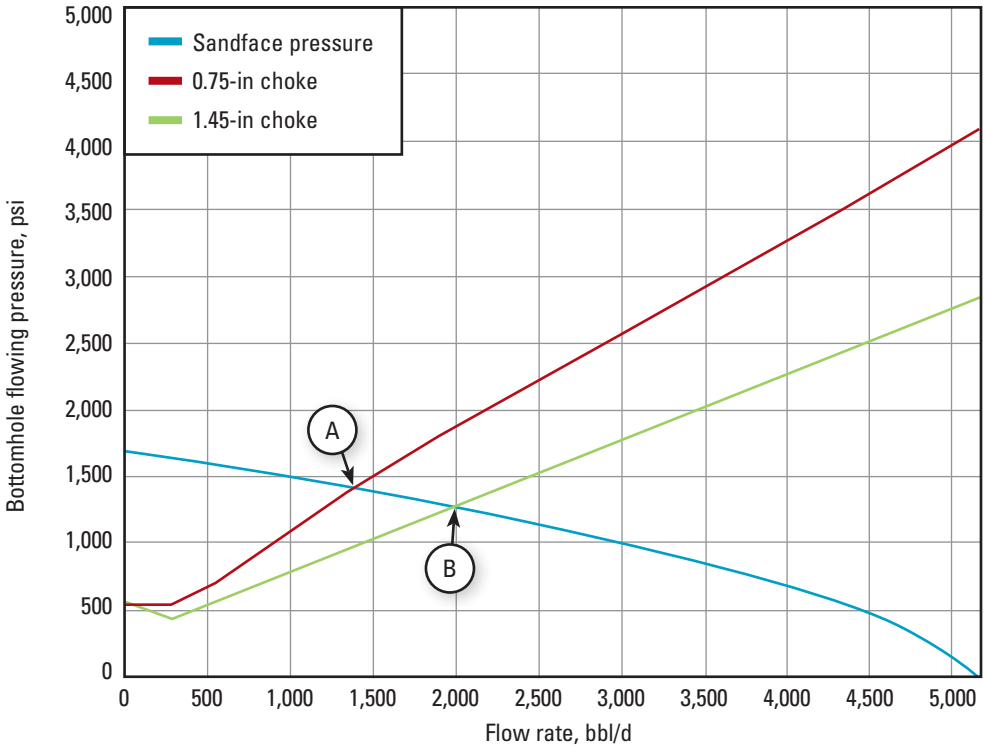
Schlumberger used the PowerSTIM* well optimization service to generate a stimulation proposal that considered reservoir knowledge, fluid selection, treatment design, execution, and evaluation. The model predicted that the lost drilling fluid had invaded the critical matrix and plugged the fracture system, reducing well productivity. This prediction was supported by a laboratory compatibility test for the drilling cuttings, oil sample, and stimulation fluids.

The proposal outlined two stages:

1. Nonreactive fluid CLEAN SWEEP* solvent systems for damage removal to disperse emulsions and clean drilling mud from the rock.

2. Reactive fluids including
   - retarded SXE acid to achieve greater penetration into the formation and to bypass the damage
   - MSR* 100 mud and silt remover (15%) to complement the retarded system
   - two SDA* self-diverting acid slugs to improve fluid placement along the entire perforated interval.

The SXE acid is a viscous, highly retarded, concentrated acid system (70% HCl, 30% oil), stabilized with an emulsifier. Because it can penetrate farther into the formation than any live acid, SXE acid was used for deep penetration. The dissolving power of the HCl-base SXE acid system, coupled with slower carbonate reaction time, creates deeper wormholes and makes the emulsion less corrosive to steel casing and tubing.



Nodal analysis at the sandface. Point A indicates actual conditions with 0.75-in choke: flow of 1,312 bbl/d, water cut of 0%, reservoir pressure of 1,930 psi [13.3 Mpa]. Point B indicates initial conditions immediately after stimulation: 1.45-in choke, flow of 2,077 bbl/d, water cut of 0%, and reservoir pressure of 1,930 psi [13.3 Mpa].

Production increased by 162%

The SXE acid treatment delivered a 162% production increase over expected production (2,100 bbl/d versus 800 bbl/d [334 m^3/d versus 127 m^3/d]). Pemex will use this treatment in wells with similar temperature conditions.

slb.com/SXEAcid

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