Marginal and Mature Field Development and Operation

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Enhancing Oil Production Sustainably through an Innovative Single-Stage Sandstone Acidizing Fluid: A Case Study from Offshore Malaysia

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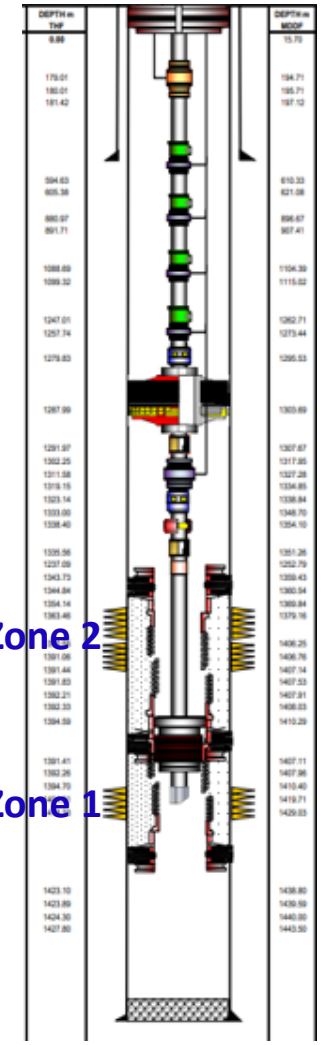
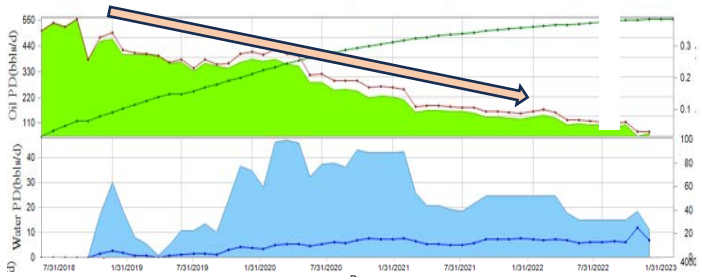
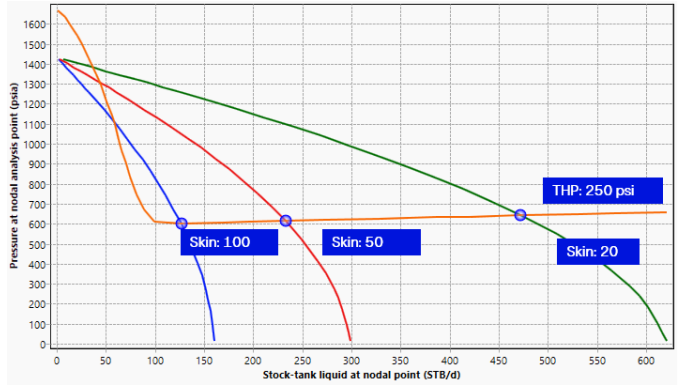
Offshore Malaysia Case Study- Well A

- Gradual decline in production with an increase in water cut.
- A well-performance analysis was conducted, and it showed high skin value.
- Reservoir contains a high percentage of migratory clays (Illite and Kaolinite).
- Suspected fines migration as a primary damage mechanism.
- A new Single-Stage Acidizing Fluid with fines migration control additives was proposed.
- Wax deposit in the wellbore as a secondary damage mechanism.
- Stimulation treatment was pumped into two separate zones.







XRD Mineralogical Composition

Minerals Detected			Composition Amount in % By Weight of	
Class	Group	Mineral		
Silicates	Quartz	Quartz	86.8	85.9
	Clay	Illite	5.6	4.7
		Kaolinite	2.4	3.1
	Feldspar	Orthoclase	0.3	-
		Microcline	-	6.2
Carbonates	Dolomite	Ankerite	4.9	-

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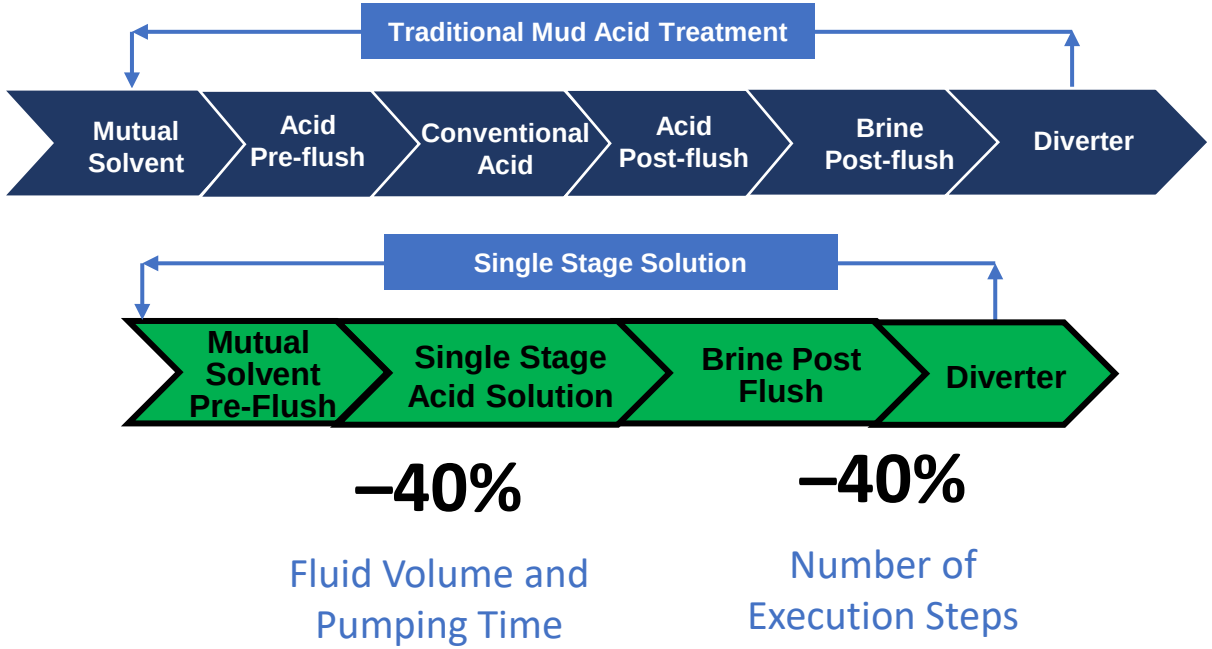
New Single-Stage Acidizing Solution

Efficient, Low-Risk Sandstone Stimulation Solution

Conventional Mud Acid Treatment

Single Stage Acid Solution



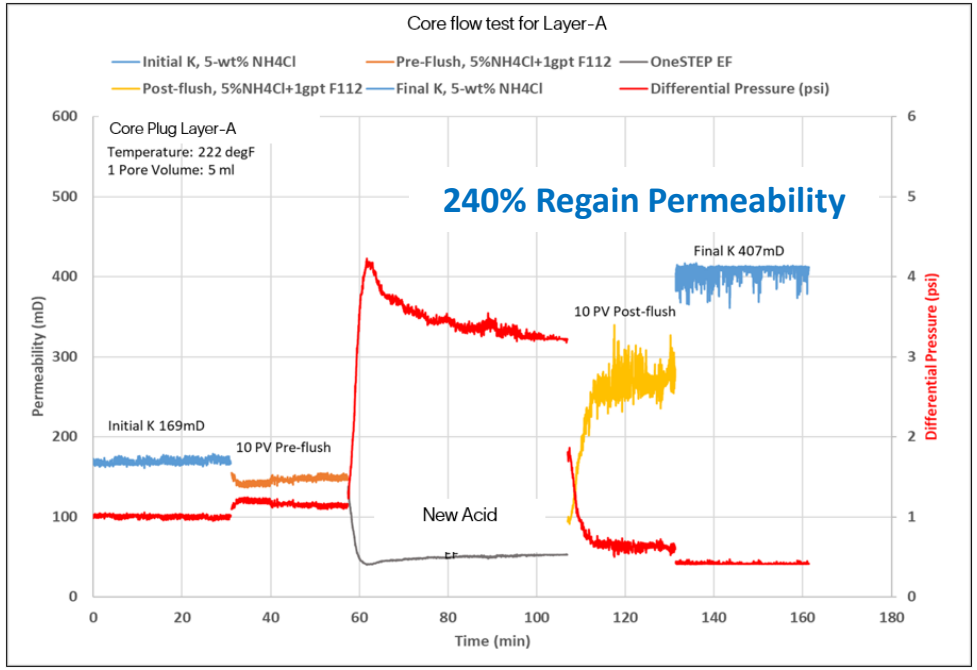
- Lower Risk Solution (low precipitation, low corrosive)
- Improve well performance (good damage removal, compatibility)
- High Operational Efficiency and Lower Cost (Single stage, low resources, less fluid and equipment, less logistic requirement)
- Better HSE Footprint (Less CO_2 emission, lower disposal requirement)

New Single-Stage Acid Vs Conventional Sandstone Acid

	New Single Stage Acid	Conventional Mud Acid
Fluid System	Proprietary blend of acids, which includes HCl, hydrofluoric acid and other additives, including inhibitors for temperature range 100-320degF	A blend of HCl/ organic acid and hydrofluoric/ fluoroboric acid system. Temperature range depends on acid type, mineralogy, and BH temperature.
Acid Pre-Flush/ Post-Flush Requirement	Contained inhibition mechanism to minimize precipitation. Therefore, it does not require acid pre-flush and post-flush.	Require acid pre-flush and post-flush to dissolve the CaCO3 and to keep a low pH environment (to prevent precipitations).
Operational	Lower total liquid volume compared to conventional mud acid system.	The fluid system requires a high volume of acid pre-flush and post-flush to prevent precipitation.
Mineralogy Data Requirement	It can work with limited mineralogy data and more tolerance with high calcite and dolomite content.	High risk of precipitation for the formations with sensitive clays and high calcite/ dolomite content.

Fluid Lab Testing

- Compatibility Tests between New Acid with Field Produced Water Sample & Crude Oil
  - ✓ **No compatibility issue was observed.**
- The corrosion test at BHST for 8 hrs duration
  - ✓ **Corrosion rate and pitting within the limit.**
- Core Flow Tests with Actual Core Sample
  - ✓ **Regained Permeability of 240% for Layer 1.**
  - ✓ **The core plug sample was intact, and no deconsolidation was observed.**



New Acid vs Crude Oil

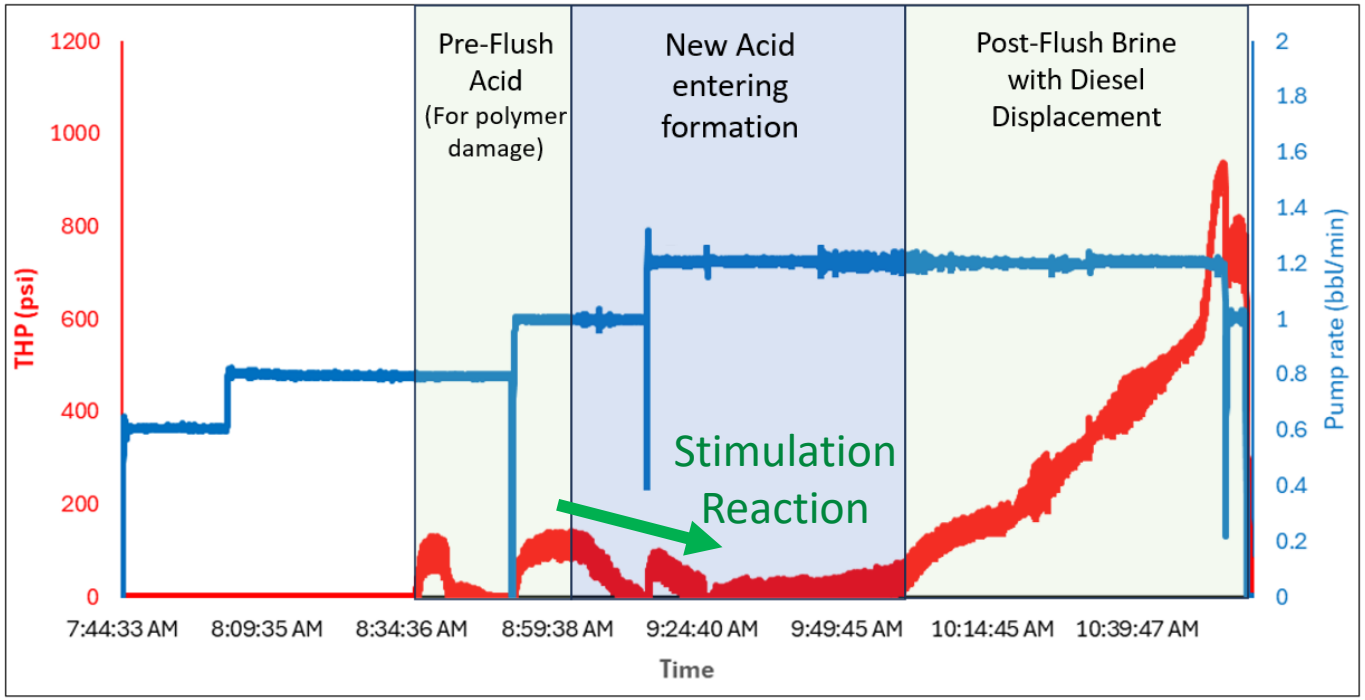
13Cr- L80 Coupon

Top Before

Top After

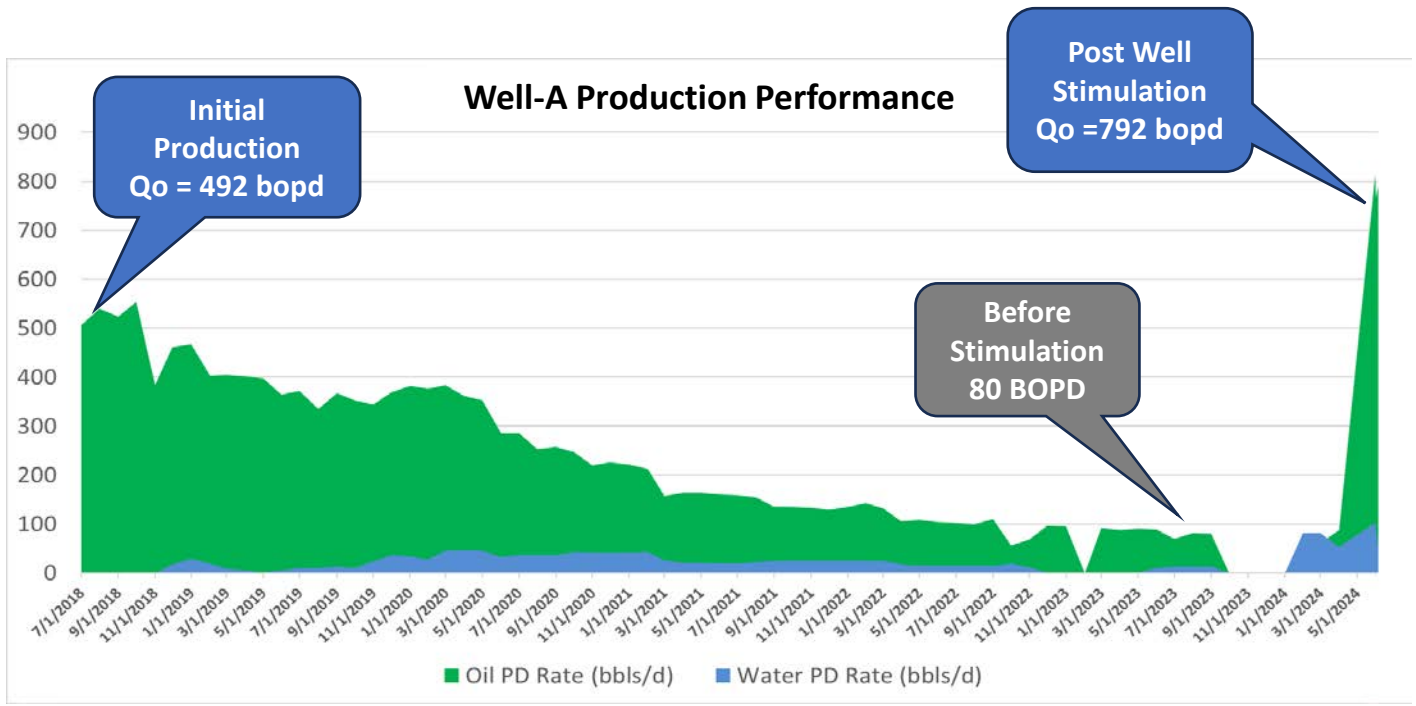
Job Execution (Zone-1)

	Stage	Fluid	Volume (bbl)
1	Polymer breaker/ Scale Dissolver	10% Acetic Acid	25
2	Main Acid	New Acid	62
3	Brine Post-Flush	5% NH4Cl+ Mutual Solvent	62
4	Tubing Displacement	Diesel	50



- A good stimulation reaction was observed during the New Acid stage entering formation.
- No plugging was observed during the main acid stage, showing no precipitation from the new acid.
- Pressure increases during diesel displacement due to hydrostatic change and increased friction.

Post-Stimulation Production Result



Post Stimulation Observations:

- Individual zonal was tested separately post stimulation:
  - Zone 1 = 500 BLPD (0% WC)
  - Zone 2= 400 BLPD (15% WC)
- After commingle:
  - Average 792 BOPD
- Water cut maintained (10-15%)

Conclusion

- The new single-stage acid system successfully **boosted well production by 400%.**
- **Simplified job execution**; i.e. no acid Pre-flush or Post-Flush.
- Surface pressure indication showed **good stimulation reaction** during the main acid stage.
- **Sustainable operations** with less fluid, less CO2 emission, fewer tanks/disposal required, and shorter overall job execution duration.
- **Lower overall cost (+/- 20%)** and **good HSE** practices.

Thank You!!!