Perforating with Propellants Increases Oil Production in Boa Esperança Field – Potiguar Basin, Brazil

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Initial Considerations

- Back in 2006, new wells drilled in Boa Esperança field had less favorable conditions when compared with others in terms of Gas Oil Ratio and Oil Water contacts.

- With this fact, new perforating alternatives in these conditions were studied.
Perforating with Propellants – Near Wellbore Stimulation

- Potassium Perchlorate in suspension by epoxy resin
- During perforating fragment into pieces
- Propellant pieces combust through heat and pressure of detonation
- Oxidizer material generates a rapid amount of CO2 during combustion
- Gas generated creates a pressure peak that exceeds the fracture gradient of formation
- High pressure injects fluid into fractures at extremely high rates for a few milliseconds
Perforating with Propellants – Near Wellbore Stimulation

- Propellant sleeve is installed over standard perforating gun
- Sleeve is ignited when guns fire and produces a rapid, large pressure peak at perforations
- Modeling is performed to determine the appropriate propellant volume, avoiding damage to the wellbore hardware and also to determine if the treatment will be effective
- Excellent pre-hydraulic fracture treatment to reduce HP requirements
- Larger, cleaner perforations when compared with conventional gun systems
Case History 1 – Potiguar Basin

**Considerations**
- Pendencia Formation
- Zone 1 is the main responsible for field production (85% of total)
- Frac Costs
- GOR and water contact issues
- Initially perforated with no expected results

**Solution**
- Perforate with propellant assisted guns
Case History 1 – Potiguar Basin

- **Results**
  - Well production improvement
  - Modeling software was able to estimate fracture length in the wellbore (4.22 ft)
  - 4 5/8” 5SPF 60deg phase guns were used

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Daily flow rate (Q in m3/d) conventional perforating vs propellant perforating comparison – Case 1
Case History 2 – Potiguar Basin

- **Considerations**
  - Pendencia Formation
  - Well was producing through 2 zones (Zones 1 & 2)
  - Production and flow rate were decreasing after a fracturing treatment

- **Solution**
  - Re-perforate with propellant assisted guns
Case History 2 – Potiguar Basin

**Results**

- Well production improvement
- Modeling software was able to estimate fracture length in the wellbore (9.78 ft)
- 4 5/8” 5SPF 60deg phase guns were used

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Daily flow rate (Q in m3/d) comparison after fracturing and propellant perforating
After November 2006

Table below shows the average oil production per day on the field from Jan 2005 until Jul 2007.

![Bar chart showing oil production from Jan 2005 to Jul 2007 on the field.](image-url)
Conclusions

- Achieved results were above expectations in terms of productivity at low cost
- Propellant perforating was effective as a near wellbore stimulation treatment, bypassing the damaged zone on the perforating tunnel in damaged or low permeability reservoirs
- Propellant perforating allows a uniform stimulation treatment on the perforated interval
- Can be used in zones where traditional fracturing treatment is not an option
- Another 3 wells were perforated in the same field with good results
- After these experiences, the technique is still used today (+250 jobs)
Questions?