Controlled Implosions to cleanup perforations improve gravel pack placement

SLAP-02
Simposio Latinoamericano de Perforating
Bogota, May 28th – 30th, 2013

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Dorotea and Leona fields

- Operated by New Granada Energy Corporation (Sinopec)
- Eastern Llanos Basin of Colombia
- C5 and C7 units of the Carbonera formation are the main reservoirs
- Currently there are 16 producing wells in Dorotea and 8 producing wells in Leona
- The current production is 10,800 BOPD
- 18 wells completed with cased hole gravel pack
Perforation Damage in Gravel Pack Completions

- Unconsolidated formation → No open perforation cavities
- Multiple perforations exhibit different levels of damage
- Bigger charges produce more damage
- Weak formations are more susceptible to perforating damage

Gravel Pack Impairment: Damage to the gravel in the formation portion of the perforation tunnel due to perforation generated rock debris. Traditional clean up techniques:

- Underbalance / Drawdown → Risk of sanding
- Swabbing → Additional time / costs
- Acidizing → Additional time / costs
Different Perforating Techniques

- **Overbalance**
- **Static Underbalance**
- **Dynamic Underbalance**

Stand alone DUB: Applied to existing perforations, documented successes in consolidated formations
Case Study 1

- Well completed in C-7
- 6 ft open @ 22 spf
- Cased hole Gravel Pack
- 3rd Workover to recover the screens, clean-up the perforations, pump clay stabilizer and rerun the gravel pack completion
- Stand alone DUB proposed to clean-up the existing perforations without re-perforating and facilitate subsequent operations

**Job Design and Execution**

A Standalone DUB chamber was designed to generate a pressure drop of 500 psi to mitigate any potential sanding risk. Injectivity tests were performed after each phase of the WO to evaluate the effectiveness of the proposed treatment:

![Injectivity Test Graph](image-url)
Case Study 1 – Production History

1. Initial completion, rapid decline

2. First workover, screens recovered, well re-perforated, re-packed

3. Second workover, clay stabilizer pumped through the screens

4. Third workover, perforations cleanup with DUB chambers, clay stabilizer
Case Study 2

- New well, initial completion
- 11 ft opened in C-7
- Perforating Strategy:
  - 1st run: Big Hole charges @ 12 spf
  - 2nd run: Stand alone DUB chambers to create at least 800 psi of DUB
- The initial production was 1,050 bopd, these fluids were above average; currently the well produces with a rate of 860 BOPD

Job Design and Execution

1,000 psi of DUB was generated without sanding

![Graph showing measured dynamic underbalance over time](image)
Case Study 2 – Production History

1. Very low decline since initial completion

2. Production is above average as compared with neighbor wells
Case Study 3

- Zone change from C-7 to C-3
- 23’ perforated
- Perforating Strategy:
  - 1st run: Big Hole charges @ 15 spf
  - 2nd run: DUB guns with Deep Penetrating charges @ 6 spf
  - Maximum dynamic underbalance ≈ -1,500 psi
- The production results were 132 bopd, currently the well produces at a rate of 57 BOPD.

Job Design and Execution

1,400 psi of DUB was generated without sanding

![Graph of Expected Dynamic Underbalance](image-url)
Summary and Conclusions

- 1st worldwide application of stand alone DUB to clean up perforations before gravel pack
- Safe, simple and effective methodology to cleanup perforations, with minimal risk of sanding
- Modeling is important to evaluate the magnitude of DUB to apply
- Dynamic underbalance magnitude before sanding is much higher than critical drawdown, due to its short duration nature
- In the first well the injectivity was improved by 70% and the productivity index increased by a factor of 4. In new completions the production results were above average