Thoughts on laboratory sand retention testing for water injection wells

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Sand control in water injectors

- Historically less focus on injectors compared to producers?
- Injectors are becoming more fashionable
  - SPE ATW every 2 yrs in nice places
Screen sizing

- We have rough guidelines for producers
  - D10 for metal mesh
  - D30-ish for wire wraps

- but are often asked about injectors

- Seems to be 2 schools of thought:
  - Size bigger than equivalent producer
  - Size smaller than equivalent producer
Difference between producers and injectors

- **Producers:**
  - Failing sand will tend to pack off around the screen.
  - Less susceptible to resorting though cross flow

- **Injectors:**
  - Potentially more aggressive environment for sand control
  - Flow in the injection direction will push failed sand against the formation.
  - Stopping and restarting injection causes water hammer and backflow into the well bore.
  - This flow in both directions means the sand is susceptible to resort as it is alternately flowed in both directions.
Possible test protocols for injectors

• Throbber
  – Slurry test incorporating strong pulsing allowing some re-sorting of the sand

• Pressuriser
  – Sandpack test where water is injected through the pack in the injection direction pressurising a reservoir behind the pack
  – When injection is stopped the pressure release from the reservoir allows fluid to flow through the screen.
  – Mimics a water injector?
Throbbing tests

- Not a direct simulation of what happens in the field but a way of incorporating an aspect of sand re-sorting in a test.

- A “normal” slurry test using a pulsing pump. The flow pulses (is not constant).

- The idea to be more aggressive than standard retention tests to mimic potential resorting of sands in water injectors.
Throbbing tests – test set-up

- Looks like one of normal slurry tests with the usual peristaltic pump replaced by a single piston positive displacement pump.
Test sand

Cumulative % vs. Diameter (microns)

- sample 1 run 1 (no sonication)
The Throbber

- Extreme pulsing lifts the sands grains allowing resorting ........until sufficient sand has built up on the screen.
  - 8ga wws sand produced: 0.621g

- Throbbing tests are surprisingly reproducible

- Slightly more difficult to seal the screen

- Conventional test
  - 8ga wws sand produced: 0.124g
Throbbing Slurry tests

- When the sand is retained there is not much variability in the amount of sand passing the screen with increases in screen aperture until the screen aperture is too big for the sand to be retained
  - Basically there is not a linear relationship between sand passing and screen aperture in retention tests.

- Want to find out if throbbing just moves the baseline of the amount of sand passing for good retention or actually changes screen sizing.

More sand passing in throbbing test but same screen selection

More sand passing in throbbing test and different screen selection
Results

- In the standard test good retention was achieved up to 200um, but decent retention in the throbbing tests was achieved up to 175um, though there was evidence of plugging in this test – without plugging 150um?
  - Looks like the screen selection would be 1-2 gauges smaller in a throbbing test compared to a std test.

![Graph showing sand produced vs. wire wrap slot size](image)
The pressuriser

- Simulates injection followed by a sudden stop
Sand produced during initial pressuriser test

<table>
<thead>
<tr>
<th>Parameter</th>
<th>S2858 no sonication</th>
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<tbody>
<tr>
<td>D5</td>
<td>665</td>
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<tr>
<td>D10</td>
<td>591</td>
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<tr>
<td>D40</td>
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<tr>
<td>Sc</td>
<td>4.0</td>
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<td>Fines %</td>
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</table>
commissioning tests

• Tried a more poorly sorted sand (fines 20%) ........loads of trouble
  – leaks around piston ..... etc....etc..

• Eventually set-up a working leak free system. But in the initial tests the piston was not moving – though we thought it was. This caused a number of effects - all getting worse as the tests progress
  – Moving the sandpack up and down
  – Partial fluidisation of the sandpack
  – Release of fines in the upward direction
  – Formation of holes in the pack

• Finally managed to get enough pressure on the piston to prevent the pack moving ......or so we thought. But the video shows some movement. Though test results are reproducible.
commissioning tests

- Injection rate doesn’t appear to affect sand production if the sandpack is fully constrained.

- If the pack moves allowing re-sorting loads more sand is produced.

- Have run initial tests varying the injection flow rate as the rate increases and the pressure increases the pressure on the piston is not sufficient and the pack can move.
PC-14 (8ga wws)

- a test where the piston did not move, pack movement increased as the test progressed
PC-17 and 18 duplicate tests where pack was better constrained

- a test where the piston moved to take up any gaps. There was still some gap but minimal movement of the pack until injection rate was inc to 100ml/min
PC-17 and 18 duplicate tests where pack was better constrained

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Sand produced: comparison
Summary

• Throbber
  – Nice reproducible results
  – But is it a better test for water injectors?
  – Need to re-inject the produced solids through the screen in the injection direction – check for plugging

• Pressuriser
  – What seems to be a straightforward test can be a nightmare in practice
  – Needs more work …..
Comments/ideas

...is this stuff any use ??