Best Practice for Stand-alone Screens

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Aberdeen
Stand-alone Screens
Best Practices

Industry Completion Failure Data
Data for OH Completions with StandAlone Screens

- Highest Failure Rate for Major Operator: 15 Failures/19 Wells
- Average Failure Rate from Industry Database: 39 Failures/110 Wells
- Lowest Failure Rate of Major Operators: 4 Failures/71 Wells
Field Case Causes of Production Decline/Disappointment

1. Sand control best practices for selection, design, manufacturing, installation & start-up mostly not followed
2. First wells had no sand control based on log-derived UCS
3. Short length screens and large annular gap have much bigger effect than other bad practices
4. Very short screens will plug or erode sooner due to higher rates/metre
5. Very short (e.g. < 10 metres) screen mesh intervals are extremely sensitive to anything less than ideal practice at every stage
6. Screen mesh size too small; very large $D_{10}$ sand size
7. Screens run in brine > 250 NTU picking up debris
8. Screens needed to be worked past shale picking up swelling shale
9. Lower post-acid loss rate 0.5 bpm - did not clean off all filter cake
10. Production declines are fines plugging formation or screen
11. Sudden changes in production are wellbore collapse onto screen, plugging the screen and reducing annulus permeability with re-sorted sand, shale and residual mud-cake
Sand Control Best Practices Outline

• Sand failure risk assessment
• Sand control strategy selection
• Sand screen selection method
• Sand screen manufacturing QA & QC
• Completion installation practices
• Production start-up
Sand Control Best Practice

- Sand failure risk assessment - risk of sand production
  - Strength characterisation
  - Stress characterisation
  - Formation failure modelling
Comparison of Log Predicted UCS with Core Measured UCS

Core Measured UCS, psi

Log Predicted UCS, psi

Field-1 Samples
Field-2 Samples
Field-3 Samples
Field-4 Samples
Unit Slope Line
Core Samples Used in UCS Testing
Formation Strength Characterization
Use of Core Data to Establish UCS Range

Example Formation Strength Characterization
Core Measured Unconfined Compressive Strength vs. Depth
Formation Stress Characterization

Principle Stresses = Vertical, Hz-max, Hz-min
Absolute Stress = Total Stress Acting at Depth
Net Stress = Absolute Stress - Pore Pressure
Depletion Forecast, so Net Stress increases over field life
Comparison of Field Sand Production Data with Model Prediction
Conventional Wells with Standard, Non-Stress Oriented, Perforations

- No Sand Production
- Failure Prediction
- Sand Production
- Unit Slope Line

Reservoir Pressure, psi vs. Bottomhole Pressure, psi
Sand Control Best Practice

• Select strategy for sand management
  - Produce sand to facilities, collect and dispose
  - Prevent formation failure (wellbore orientation, fracture and perforation tactics, resin stabilisation, increase pressure, choke back well, shut-in well, redrill well)
  - Screen out at sand face (stand-alone screen, gravel pack, frac-pack)
Sand Control Best Practices

• Select and design stand-alone sand control screen
  - Select most likely screen type
    • mesh sizes around $D_{10}$ from PSD
    • select maximum od screen size to minimise annulus (max 1” less than nominal hole size drilled)
  - Sand screen mesh sizing by proven lab testing methods
    • Plugging resistance test flow and return perms (screen & sand pack)
    • Sand retention
  - RDIF selection by testing
    • Drillability (inc. shale stability, loss control, rheology)
    • Completability (inc. formation damage, screen plugging)
  - Clean-up treatment by testing
    • Screen coupon from production line mesh
    • Sand as per PSD
    • RDIF with drill solids (including shale)
    • Clean-up fluid at representative volume
Formation Sand Variation
Sample Selection

Particle Size Distribution of Formation Sand Samples

- High Perm Sand
- Low Perm Sand
- Worse Case
Test Procedures for Screen Qualification

Gradual Formation Failure

- Flow at constant dP
- Produced solids conc. and particle size
- Initial / final sand pack, gravel and screen perms
Reservoir Drill-In Fluid Selection

Performance Test Criteria

**Fluid Loss Control**
- Bridging Agent PSD
- Bridging Agent Conc
- Polymer/Starch Conc

**Rheology**
- Polymer Conc

**Reactivity**
- Shale stability

**Formation Damage**
- Filtrate / Solids Invasion
- Filtercake Restriction
- Drill Solids Conc / Reactivity

**Screen Plugging**
- Filtercake Plugging
Clean-up System Testing

• Integrated test of:
  – RDIF (with drill solids inc shales)
  – Clean-up fluid volume, circulation, pressure and temperature, soak time
  – Flowback onto screen

• Screen plugging measurements:
  – flow initiation pressure
  – retained flow capacity
  – peak pressure
Screen Plugging Tests

12.2 ppg OBM w/ Super Pickle + Mark II

12.2 ppg NaBr/ KCL WB DIF #3 w/ EDTA

12.2 ppg OBM w/ 7.5% HCL +25% EGMBE

12.2 ppg NaCl/ KCl/ NaBr WB DIF w/ EDTA
Integrated System Testing

DIF/Screen/Clean-up Test Results

- OBM # 2 w/ SuperPickle + XYZ MarkII
- OBM # 2 w/ 7.5% HCL + 25% EGMBE
- WBM # 3 w/ EDTA

% Retained Flow Capacity vs. Peak dP (psi)
Sand Control Best Practices

• Procurement
  – Qualification testing (for specific screen design & manufacturing location supplying project)
    • Corrosion testing weave (completion & production fluids)
    • Bead testing mesh size
    • Burst & collapse full size joint
    • Assess assembly, inspection, repair and quality control procedures
  – Manufacturing quality control
    • Inspect records for satisfactory performance
    • Inspect screens for correct assembly and signs of repair
Sand Control Best Practices

• Field installation
  - Drill reservoir with RDIF MBT < 5 ppg (pit, not returns), drilled solids < 50% and < 30 ppb
  - Avoid too much steering which leaves ledges
  - Clean boats, rig piping, pumps, shakers and pits
  - Pickle running string and washpipe
  - Minimise time between TD and screens on bottom for shale clock (3-4 days to do all the stiff wiper trip, casing clean-up and RIH practices)
  - Circulate open hole to RDIF with zero solids (i.e. same shale stabilisers, same viscosity, same weight to keep hole diameter)
  - Clean casing to < 0.01% solids in brine returns (not just NTU)
  - Make-up all screen using dope-free ideally, or 1” paint brush doping pin-end only (screen, wash-pipe, work-string)
  - Hold acid treatment against sand face to soak filter-cake by holding wellbore static with seals in sealbores
DIF Quality Control

Solids Conc in Active System
(Initial CaCO₃ = 52 ppb; Dilution Rate = 0 bbl/ft)
Impact of DIF Quality on Filtercake Cleanup

![Graph showing the impact of DIF quality on filtercake cleanup. The x-axis represents MD (ft) ranging from 8000 to 12000, and the y-axis represents MBT or Drill Solids Conc. (lbs/bbl) ranging from 0 to 14. The graph compares MBT in Pit with Drill Solids @ Bit, showing good and poor removal scenarios.](image-url)

**Key Points:**
- Good Removal: MBT or Drill Solids Conc. at lower MD values.
- Poor Removal: MBT or Drill Solids Conc. at higher MD values.
Sand Control Best Practices

• Production Start-up
  - Limit drawdown
  - Gradual choke opening
  - Production or reservoir engineer witness offshore to influence, observe, record and react
  - Repeat for re-starts following first few production trips
Lessons Applied New Field

1. Sand control selection practices followed – ✓
2. Sand control design practices followed – ✓
3. Sand control manufacturing quality practices followed – ✓
4. Sand control installation practices followed in procedure, and in practice – ✓
5. 60 - 80 metre screens will avoid plugging and erosion due to lower rates/metre – ✓
6. 60 - 80 metre screen mesh intervals are less sensitive than last wells to anything less than ideal practice at every stage – ✓
7. Annular gap minimised, which has much bigger effect than good / bad practices – ✓
8. Screen mesh sized for very large D_{10} sand size – ✓
9. Run screens in clean brine < 0.01% solids – ✓
10. Avoid plugging screens by keeping shales from swelling – ✓
11. Ensure acid treatment effective by testing, uncontaminated filter-cake, good placement & exposure time to filter-cake – ✓
Sand Control Best Practices
Key Points Summary

• Core samples for sand strength
• Long screens, large OD screens
• $D_{10}$ particle size screen pre-selection & test
• Soluble filter cake by lab testing & QC during drilling & completion operations
• Prevent shales swelling (RDIF shale inhibitors, shale avoidance, exposure time)
• Clean pits, pumps, pipes, shakers, brine and pickle running string & wash-pipe
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SPE 73772 An Evaluation for Screen-Only and Gravel-Pack Completions
SPE 110082 Current State of the Premium Screen Industry: Buyer Beware ....
SPE 135294 Comparison of Inflow Performance and Reliability OHGP and OHSAS Completions

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