**Workover Approaches**

Workover methods seem to fall in one of three categories. An example of a ranking table is given for each of these three categories. Table two contains the "legends" for the ranking tables for the three examples.

**Remedies - Cleanouts**

Often determined by: geometry, reservoir pressure and characteristics, sweet/sour

- Circulating
- Perforation wash
- Bailing
  - Sand Line
  - Sand Pump/Tubing
- Pump to Surface (PTS)
  - Rig
  - Portable
  - Continuous
- Stable Foam Cleanouts
  - CTU (Coiled tubing unit)
- ...others?

**Remedies - “Quick Fix”**

Fluids are introduced into tubing or annulus to flush sand away from intake or perforations – **Be Very Selective in workover fluid choice!!!**

- Vary casing pressure, RPM or fluid level
- Flushby
  - "SUPER" Flush
  - CTU and Flushby
- Loading
  - Continuous annulus loading with fluid
- Swabbing
- ...others??

**Low/No Inflow Remedies**

Often determined by “proximity” of damage to well

- Reperforating
- Abrasi-Jet
- Proppant/Hydraulic Fracturing
- Chemical Stimulation
- Chemical Treatments
- Pressure Pulse Flow Enhancement
- ...others?
### Key - Describing Workover Methods

<table>
<thead>
<tr>
<th>Description: Functionality</th>
<th>Candidate Selection: Criteria for greatest chance of success</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Geometry (slant/vertical/deviated)</td>
</tr>
<tr>
<td></td>
<td>• Depth, pressure</td>
</tr>
<tr>
<td></td>
<td>• Sand outs/volumes, frequency</td>
</tr>
<tr>
<td></td>
<td>• Degrees of severity (decreased, lower, no oil)</td>
</tr>
<tr>
<td></td>
<td>• Frequency/past history/service success (episodic/frequent/continuous)</td>
</tr>
<tr>
<td></td>
<td>• Past workover history, successes, failures</td>
</tr>
<tr>
<td>Pros: Relative to similar methods/functions</td>
<td>Cons: Relative to similar methods/functions</td>
</tr>
<tr>
<td>Diagnostic Value: What the method tells about the well/reservoir during and after workover</td>
<td>Reservoir Effects: What/how the method affects the reservoir</td>
</tr>
<tr>
<td>• Inflow performance</td>
<td>• Best for: near-well, proximal zone, far-field</td>
</tr>
<tr>
<td>• Fluid/particle/debris sampling/diagnosis</td>
<td>• Does the method “surge” or “swab”</td>
</tr>
<tr>
<td>• Potential pressures</td>
<td>• Over- or underbalanced</td>
</tr>
</tbody>
</table>
| Equipment: What equipment is needed/required | Economics: Equipment/service cost, rig hours or total $\$

- Rig: XX hours @ XX $/hour
- PPT: XX hours @ XX $/hr or XX fixed price
- Downtime or lost production not considered (each company must address in-house)

**Comments:** The pros and cons are exhaustively listed for each method. Then, each method is ranked on whatever semi-quantitative scales can be developed. *Diagnostic Value* is part of being flexible in workover choice: as the workover is executed, different methods will provide it may provide valuable data as to what the dominant mechanism was for loss in production.

<table>
<thead>
<tr>
<th>Description:</th>
<th>Candidate Selection: (Frequency of Use)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pros:</td>
<td>Cons:</td>
</tr>
<tr>
<td>Diagnostic Value: (amount of info gathered or inferred)</td>
<td>Reservoir Effects: What/how the method affects the reservoir</td>
</tr>
<tr>
<td>What the method tells about the well/reservoir during and after workover</td>
<td>1 – Wellbore only</td>
</tr>
<tr>
<td>1 – Low</td>
<td>2 – Near wellbore region only</td>
</tr>
<tr>
<td>2 – Medium</td>
<td>3 – Far reaching, into the reservoir</td>
</tr>
<tr>
<td>3 – High</td>
<td></td>
</tr>
<tr>
<td>Equipment:</td>
<td>Economics: (relative to similar methods)</td>
</tr>
<tr>
<td>1 – Cheap $</td>
<td>Equipment or service cost, rig hours, $$, etc.</td>
</tr>
<tr>
<td>2 – Moderate $</td>
<td>1 – $</td>
</tr>
<tr>
<td>3 – Expensive $$</td>
<td>2 – $$</td>
</tr>
</tbody>
</table>

### Table 2: Descriptions of Methods and the Ranking Scheme Developed
### Table 3: Flushby (a “Quick-Fix” method)

<table>
<thead>
<tr>
<th>Description:</th>
<th>Candidate Selection:</th>
</tr>
</thead>
</table>
| Unseat the BHP and flush sand out of the tubing away from pump suction  
Type and volume of fluid varies  
How to do it – Pressure Test first? | Usually REACTIVE – for damage control or cure  
Can be PROACTIVE - for maintenance or if opportunity  
Primary response tool on ANY well  
Pressure Test BHP  
Prior to SI/PWOP |
| **Pros:** | **Cons:** |
| Turn/rotate tubing  
Cheap, quick  
Rigless  
Can PT BHP  
Can add heated fluid, chemicals, during Flushby  
Can lift and fix rods, turn/rotate tubg., proactive maintenance  
Pressure survey is straightforward | Can flush sand into perforations  
Can blow drain or shear rod boxes or couplings  
Usually unsupervised – no company supervision  
Have to SI well to flush versus loading the well |
| Diagnostic Value: | Reservoir Effects: |
| Tell if downhole/surface equipment failed (rods, pump...)  
Not a good job recording/trading flushby  
Injectivity  
Where fill is - on top of pump/intake  
Determines next step in problem solving process | Could possibly introduce fluid and sand back into reservoir  
Can cause surging or swabbing  
Overbalance reservoir |
| Equipment: | Economics: |
| Flushby unit | Flushby unit - 2-3 hrs @ $120/hr  
Load fluid |

### Table 4: Circulating (a “Sand Cleanout” method)

<table>
<thead>
<tr>
<th>Description:</th>
<th>Candidate Selection:</th>
</tr>
</thead>
</table>
| Unseat BHP and pump fluid down tubing, with returns up the annulus (forward method)  
Or, do it down the annulus and up tubing (reverse method) | Some reservoir pressure – or fluid lost to formation  
Good for any geometry  
New well completion choice  
Area specific |
| **Pros:** | **Cons:** |
| Good for fill above perfs, limited sump or fish downhole  
Reduces overall workover costs if able to do it  
Relatively fast and cheap | Seldom get returns  
Can lose fluids and sand through perforations to formation  
Only cleans out the tubing  
If well kicks, can get stuck in the well with the unit  
If the well has already exhibited large cumulative fluid and sand production – usually there are no returns |
| **Diagnostic Value:** | **Reservoir Effects:** |
| Where the plugging is occurring  
Similar to loading | Limited to the wellbore, no external effects  
Requires a reservoir pressure to balance hydrostatic, otherwise there are no returns |
| **Equipment:** | **Economics:** |
| Rig to unseat BHP  
Pressure truck  
Tank for returns | Rig time (depends on success achieved, how fast)  
Pressure Truck  
Tank  
Load fluid |
**Table 5: Reperforating (a “No/Low Flow” Remedy)**

<table>
<thead>
<tr>
<th>Description</th>
<th>Candidate Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perforating the well with different charges, phasing or spacing</td>
<td>Optimization of existing zone – older well was perforated conservatively or with small ports</td>
</tr>
<tr>
<td>Shoot additional pay or to destabilize near wellbore damage</td>
<td>Little to no inflow</td>
</tr>
<tr>
<td>Wellbore has to be free of sand above the perfs</td>
<td>Low cumulative oil production with low rates</td>
</tr>
<tr>
<td></td>
<td>High injection pressure+ skin/mud damage</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pros:</th>
<th>Cons:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lots of design parameters</td>
<td>Destructive to casing and cement</td>
</tr>
<tr>
<td>Under/overbalance</td>
<td>Conveyance complexity and floating of guns</td>
</tr>
<tr>
<td>“Traumatic” shake up</td>
<td>Orientation may be an issue</td>
</tr>
<tr>
<td>Cleans up old perfs</td>
<td>Safety with explosives</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diagnostic Value:</th>
<th>Reservoir Effects:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth of skin or damage</td>
<td>Traumatic shock – for short distance</td>
</tr>
<tr>
<td>Tag fluid level, pressure data as well</td>
<td>Overbalanced or underbalanced</td>
</tr>
<tr>
<td></td>
<td>Near wellbore– limited penetration</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Equipment:</th>
<th>Economics:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rig</td>
<td>Rig: rates fo $225-300/hour</td>
</tr>
<tr>
<td>Wireline truck</td>
<td>Wireline truck</td>
</tr>
<tr>
<td>Guns</td>
<td>Guns charge</td>
</tr>
</tbody>
</table>

1+
STEPS IN PROBLEM SOLVING

PROBLEM DEFINITION:
- NOT MAXIMIZING NETBACK
  - Lower Production and Higher OPEX

SYMPTOMS:
- PRODUCTION DROPS
- WELL DOWN FOR SERVICING

POTENTIAL ROOT CAUSES:
- MECHANICAL
- RESERVOIR

PARTICULAR ROOT CAUSES:
- SURFACE EQUIPMENT
  - High Torque
  - Prime Mover
  - Tankage
  - Weather
- DOWNHOLE EQUIPMENT
  - Tubing Holes
  - Pump Problems
  - Rod Breaks
  - Casing Damage
- WELLBORE BLOCKAGE
  - Settled Sand
  - Excessive Sand Production
- NEAR FIELD
  - Blocked Perfs
  - No Sand Production
  - Pore Throat Plugging
- FAR FIELD
  - Disconnected
  - Pressure
  - Depletion
  - Pilars

POSSIBLE REMEDIES:
(Problem Specific Workovers)
- REPLACE OR UPGRADE EQUIPMENT
  - Surface Equipment
  - Downhole Equipment or Configuration
- "QUICK" FIX
  - Vary Pumping Parameters
  - Flushing
  - Loading
  - SAND CLEANOUTS
    - Circulating
    - Perforation Wash
    - Bailing
    - Pump to Surface
    - Foam Cleanouts
- LOW/NO INFLOW
  - Reperforating
  - Abrasi-Jet
  - Fracturing
  - Chemical Stimulation
  - Chemical Treatments
  - Pulse Enhancement

CHOOSE SOLUTION:
- Technically
- Economically

EXECUTE:
- Staged approach
- Combined methods

MONITOR:
- Production Parameters
  - Fluid levels, rates, volumes, GOR, pressure
- Operating Parameters
  - Torque, pump eff., flowline pressure

EVALUATE:
- Technical success
- Economic success