Tejas

Technology for Water Injection Wells

Variable Orifice Injection Valve or VOi™

UNCONVENTIONAL
RESOURCES TECHNOLOGY CONFERENCE
FUELED BY SPE • AAPG • SEG

Patents Issued & Pending

Tom Hill – July 2019
• **Introduction**

• **What Tejas does**
  – Rapid Product Development
  – API Monogrammed Downhole Products
    • *Primarily “Flow Control”*
    • *Subsurface Safety Valves*
    • *Packers and Locks*
  – Testing – uHPHT up to 60,000 psi and 1,000°F

• **What will you see today?**
  – Wireline Retrievable - Variable Orifice Injection (VOi™) Valve for gas and liquid injection
  – Variable response to flow – it opens more with more flow!
  – Prevents backflow when injection is stopped – mitigates hammer
• Injector Wells are 25-33% of all completions world-wide
• Increasingly employed in “brown-field” applications

• Application:
  – Water Disposal
  – Water Flood / Pressure Maintenance

• Total DHSV market size for injector wells exceeds $250 million/ year
  – What does this mean for you?
Currently, Injection Wells use existing Production Well technology

The VOi is tailored *specifically* for injectors

Technical hurdles have been cleared

- Conception
- Design
- Qualification – API 14-A 12\textsuperscript{th} Edition, V3
- First Deployment – Tech is at TRL-6 (TRL-7 before years end)

So what is this thing?
Variable Orifice Insert or VOi™

Differential Pressure Force, Area is $f_3(x)$

VS.

Spring Force, $f_1(x)$
Spring Pre-Load Force
Magnetic Force, $f_2(x)$

$x$, Nozzle Displacement
Variable Orifice Insert, VOi

Variable vs. Fixed Orifice Insert Performance

Differential Pressure (psi)

Injection Flowrate

Fixed Orifice

Variable Orifice

Conventional Equipment Chatter Zone
VOi Insert Valve

- Replacement for Injection WL Flapper Safety Valves
- Wireline Retrievable with standard recovery tools
- High Efficiency alternative to conventional valves
- “Transparent” and robust well protection
- Low Differential “Surge Protection”
VOi Insert Valve

Operational Flow Cycles
Wireline Retrievable VOi™
Current VOi Multi-Zone Design & Testing

- Prevents “Back-Flow” during Multi-Zone Injection operations that could pull sand from one zone into another – killing the well
  
  - Low back-pressure
  - Highly reliable
  - Fully qualified
  - TRL-6 – Deep-Water, GOM
  - 42 Deployments
• Robust VOi Validation Testing Program – 30 Year Equivalent Life
  – Pressure Profile Testing
  – Erosional Endurance Test
  – Chatter Window Test
  – Pressure Integrity Test
  – Flow Surge Test
  – Thermal Cycle Test
  – Cycle Endurance Test
  – Cracking Pressure Test
  – System Debris & Solids Passage Test
  – Drogue Release Test
Technical Advantages – VOi

• Current Technical Benefits
  – Completely eliminates “Flow Back” when injection stops
    • Protects adjacent completion zones
    • Prevents sand incursion into wellbore
  – Unlimited setting depth
  – Eliminates “Water Hammer” effect
  – Higher injection efficiencies
  – Longer life by design
    • Ceramic wear components
    • Low velocities – below 100 fps @ 50,000 bbl/day
Financial Benefits

• Lower Operating Costs
  – Less injection horsepower needed
  – VOi is good for all injection rates → no adjustments for the life of the well

• Better Injection Strategy
  – Prevents formation pressure loss from back-flow
  – Safer well design
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