Well Stimulation

Exceptional Fluid Placement with Powerwave

Wavefront's Powerwave Odyssey Custom Stimulation (POCS) adds a dynamic dimension to well stimulation.

Powerwave creates high inertial fluid momentum which improves the flow efficiency of the near wellbore region and the reservoir. The nature of fluid displacement energy ensures that dynamically pulsed fluid will penetrate the matrix proximal to where the Odyssey tool is placed.

POCS is ideally suited to optimize the placement of chemical treatments, production solvents, water, and combinations thereof.

If you can intervene in a wellbore, you can benefit from Wavefront's POCS approach.

WAVEFRONT

FROM BIT TO LAST DROP™

POCS

Better Stimulation
Better Performance

OPTIMIZED MATRIX STIMULATION WITH POWERWAVE DYNAMIC FLUID PULSE TECHNOLOGY

Wavefronts Odyssey Tool

Optimized fluid placement with Wavefront's POCS approach is achieved by creating energy-packed fluid pulses that propel treatment fluids deep into the reservoir and more uniformly across the completed interval.

The dynamic fluid pulses associated with the Powerwave Odyssey tool allow injected fluids to be diverted away from established flow paths - typically not obtainable with other stimulation approaches.

The Powerwave Odyssey tool can be deployed on jointed pipe or coiled tubing requiring a constant stream of treatment fluid to be effective. No chemical or mechanical diversion methods need to be employed, as the Powerwave Odyssey tool will dynamically place the treatment fluid proximal to where it is landed, improving both zonal coverage and depth of fluid penetration.

Wavefront's Powerwave Odyssey Tool

Odyssey Applications and Benefits

- Oil, gas, water injection or water disposal wells
- Vertical, horizontal, or deviated well completions
- Thermal and non-thermal applications
- Computational model fully analyzes the completion to output a true selective injection program
- Minimizes chemical use and costs without jeopardizing post-stimulation outcomes

POCS Case History

Figures 1 and 2 depict a comparison of POCS versus a sonic stimulation tool from a leading service company performed by the same leading service company.

Stimulation of a Fractured Oil Shale Reservoir with an Uncemented Liner Completion

A client wanted to understand, on a comparative basis the effectiveness of dynamic fluid pulsing using the POCS approach against sonic well stimulation methods. Each technology was run independently with acid being displaced along a horizontal well. The well contained a fiber optic distributed temperature sensor (DTS), which provided the data necessary to understand where the stimulation fluids (acid) were going. DTS data showed that the sonic tool did not improve the placement of acid, with most of the fluid channeling down a high permeability streak located towards the toe of the well.

With POCS corresponding DTS data confirmed that the acid was placed throughout the horizontal interval with limited impact from the high permeability channel.

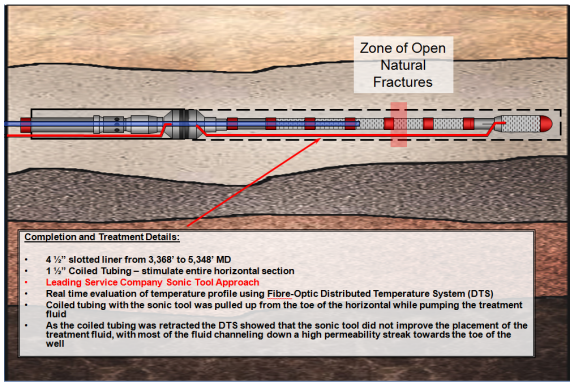


Figure 1: Horizontal Well Fluid Placement Comparison - Sonic Tool Outcome

POCS

Better Stimulation
Better Performance

WAVEFRONT
Exceptional Performance, Exceptional Technology

POWERWAVE ODYSSEY

OPTIMIZED MATRIX STIMULATION WITH POWERWAVE DYNAMIC FLUID PULSE TECHNOLOGY

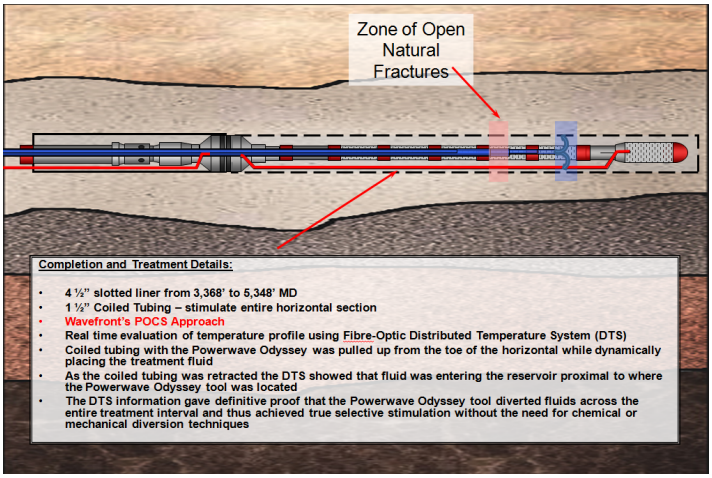


Figure 2: Horizontal Well Fluid Placement Comparison - POCS Outcome

POCS Modeling - Designing a Better Stimulation

To effectively plan a POCS program a mathematical model of dispersion is required to compute the saturation profile of the injected treatment fluid for a given injection volume. In addition, the mathematical model allows for a comparison of fluid dispersion by dynamic pulsing versus the saturation profile of a conventional well stimulation based on static flow parameters.

The table below shows the modeling input for a vertical water injector in a sandstone reservoir having a range of porosity from 9.79% to 24.58% and a permeability range from 0.96 mD to 2,787mD.

Well Information	
Well Type	Vertical Water Injector
Completion Type	Perforated Liner
Treatment Intervals:	9824 – 9838, 9843 – 9856, 9865 – 9879 9884 – 9937, 9940 – 9959, 9971 – 10050 ft MDKB
Treatment Interval TVD	9824 – 10050 ft TVDKB
Treatment Interval Length (net)	192 ft
Production Liner	5.5"
Prod. Tubing	4.5" & 3.5"
SIWHP	0
Reservoir Information	
Formation Type	Sandstone
SBHP	3,800 psi @midpoint of target zone
BHT	202°F (94.5°C)
Permeability	0.96 – 2787.3 mD
Porosity	9.79 – 24.58 %
Fracture pressure gradient	0.82 Psi/ft
Tool Information	
Cavitation-Based Cleaning Tool	2.0" Model 2
Dynamic Fluid Pulsing Tool	1,200 psi tool

The POCS model was used to evaluate both the Radius of Influence ["ROI"] (Figure 3) versus measured depth as well as the Extra Pore Volume ["EPV"] (Figure 4) of the rock matrix that is in contact with the stimulation fluid. In this example EPV occupied by dynamic fluid pulsing for a treatment volume of 19,200 gals of HCl/HF mud acid is 1,335.5 ft3 when compared with viscous fingering model associated with conventional steady-state injection through open coil. In the graph PW Overflow ("PWO") represents the volume of fluid that freely moves up or down the completion at the onset of a dynamic fluid pressure pulse initiated by a Powerwave Odyssey tool. PWO is pseudo-dynamic fluid dispersion.

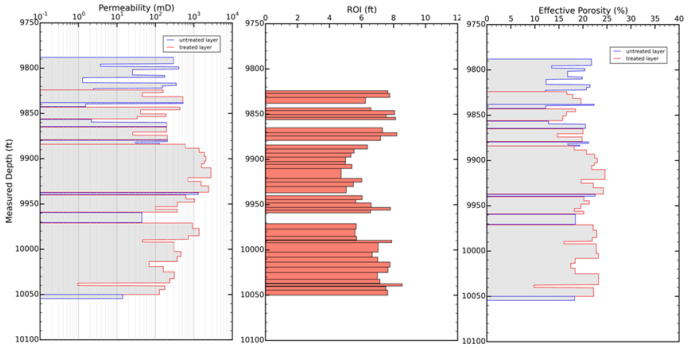


Figure 3: Radius of Influence versus Measured Depth

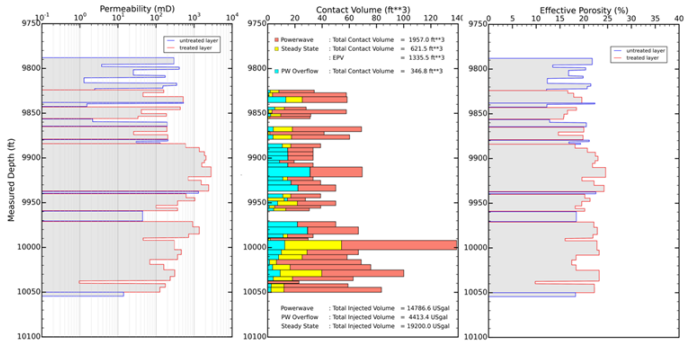
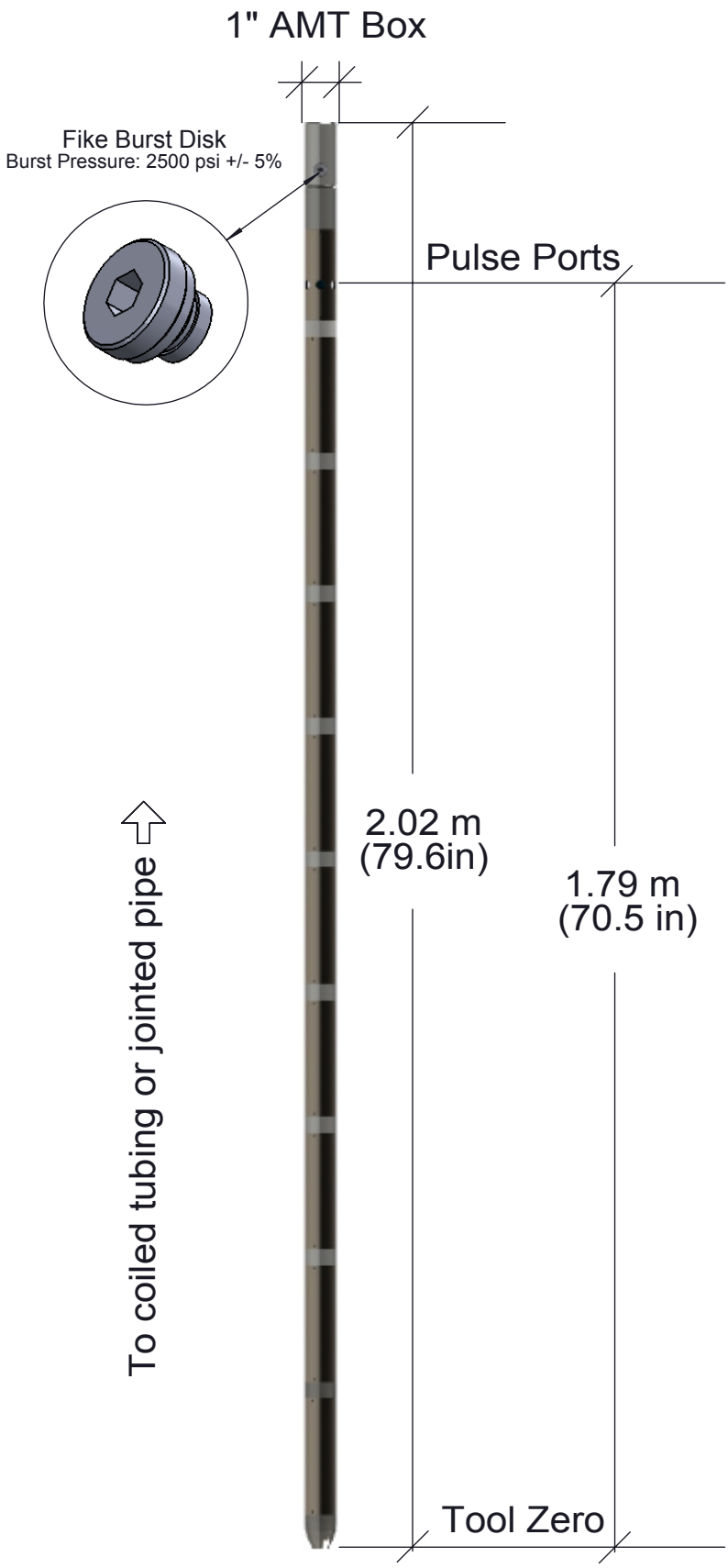


Figure 4: Contact Volume versus Measured Depth

WAVEFRONT
POWERWAVE

For further information please visit www.onthewavefront.com/contact



1" AMT Make up Torque: 350-400 ft.lbs

OD: 1.69 in

Weight: 40 lbs

Max Temp: 110°C (230°F)

Magnets degrade with time therefore this tool is not meant for permanent installations. The Odyssey is suitable for well stimulations where the maximum time in the well shall be no longer than 72 hours.

Fluid Pulse Amplitude: 1,200 psi

Δp Flow Rates: 0.5-2.0 BPM

Flow rate values depend on operating conditions and surface connections. Please consult Wavefront from appropriate flows rates for specific conditions.

Maximum Operating Pressure: 1,400 psi

Burst Pressure: 2,625 psi (differential)

Collapse Pressure: 1,750 psi (differential)

Max Operating Tensile Load: 5,000 lbs

Max Tensile Load Limit: 11,000 lbs

Max Compressive Load: 6,000 lbs

NACE Reference: MR-0175

Odyssey 1-11/16" 1,200 psi (Burst Disk Included)

Wavefront Reservoir Technologies Ltd.
5621 - 70 Street, T6B 3P6 Edmonton, Alberta, Canada

Drawn:	Approved:	Date:	Size:	Scale:	Sheet:	Drawing Name:	Rev.
SL	SB	Oct 28, 2014	A	NTS	1 OF 1	PWRWVE_Odyssey1200BS	6