



impaCT

Integrated wellbore preparation service



impaCT: Debris removal made easy - combining fluid, tools and equipment

Coiled tubing offers a host of economic and HSE advantages for post-stimulation cleanup of high-angle, multi-stage unconventional wells in which failure to remove even the smallest non-ferrous or ferrous debris particles can result in costly post-completion interventions. However, whether used to extract plugs, proppant, or remove formation dislodged when the well goes on line, conventional CT operations generally employ clear fluids that rely primarily on velocity for hole cleaning and frequently require viscous sweeps to assist.

The self-contained impaCT¹ integrated wellbore preparation service merges advanced fluid technology, a specially engineered downhole tool, and a mobile pressure and solids control system into the industry's only true circulating solution for coiled-tubing horizontal wellbore cleanouts.

Chemical and mechanical synergies deliver a clean pathway to production

Features

- Solids-free, elevated low shear rate viscosity (LSRV) fluid system
- Magnet specially designed for use with coiled tubing
- Automatic closed-loop fluid and pressure management system
- All operations under single umbrella
- Fluid easily mixed on location
- Compact, self-contained package
- Designed for simplified rig-up
- Low flow-rate cleaning capacity
- Fluid recycling capabilities

Benefits

- Reduces fluid consumption
- Decreases mobilization, clean-up time
- Extracts all large and small debris particles
- Reduces coil repairs, replacements
- Minimizes tank cleaning
- Promotes uninterrupted hole cleaning
- Reduces surface footprint
- Requires fewer personnel on-site
- Provides single-source accountability
- Enhances well productivity
- Reduces clean-up costs
- Enhances HSE profile

Recognizing that the unique requirements of coiled tubing call for equally unique chemical and mechanical components, M-I SWACO, a Schlumberger company, developed the impaCT integrated wellbore preparation service for coiled-tubing operations. The industry's only all-inclusive circulating system designed solely for coiled-tubing wellbore cleanups, impaCT service comprises a uniquely formulated fluid system, a coiled tubing-specific ferrous debris extraction magnet, and a mobile closed-loop pressure and solids control system. This high-performance trio is combined in a compact package that requires only a single mixing tank and uses a fraction of the fluid required of a conventional coiled-tubing cleanout operation.

Specifically, this truly seamless coiled-tubing wellbore cleanup service brings together:

- The specially formulated POWERPRO CT[†] fluid, offering superb suspension characteristics with demonstrated carrying capacity to remove large volumes of debris from the wellbore at low flow rates
- The versatile CT MAGNOSTAR[†] magnet tool, engineered specifically to remove the large ferrous debris particles generated during coiled-tubing cleanouts
- The compact PRESSURE & FLUID MANAGEMENT SYSTEM[†] (PFMS[†]), designed for the unique demands of coiled-tubing applications, where the utmost precision in pressure and solids control is paramount.

POWERPRO CT: The only fluid designed for the unique demands of coiled-tubing cleanups

In a conventional coiled-tubing cleanup, Newtonian fluids with zero suspension or carrying properties typically are employed as circulating fluids, with viscous sweeps often used in an attempt to improve hole cleaning. Add in the lack of workstring rotation and only a small portion of the

cumulative debris is extracted from the wellbore. The debris that remains usually accumulates in low places, restricting production and leading to costly problems when it comes time to re-enter the well.

The POWERPRO CT fluid, formulated with the uniquely engineered POWERVIS[†] biopolymer fluid additive, generates the rheological properties required to extract large volumes of debris in coiled-tubing clean-out applications. Along with superb fluid and debris separation, the POWERPRO CT fluid also reduces mechanical drag and pump pressure considerably, thereby extending coil fatigue life and allowing the operation to progress for longer periods without interruptions. Effective when formulated in a low-salinity system, the POWERPRO CT fluid also is tolerant of cement and other contaminants encountered during a coiled-tubing operation.

The foundation of POWERPRO CT fluid is the long-lasting POWERVIS additive that delivers the low shear rate viscosity (LSRV), which provides the excellent hole cleaning and suspension characteristics. The durable POWERVIS additive maintains its rheological profile longer than conventional xanthan biopolymers and at a lower concentration. Consequently, it not only provides more effective debris removal, but extends coil life, meaning operations can continue without having to stop for coil repairs or replacement. Compared to conventional xanthan biopolymers, the molecular structure of the POWERVIS additive also allows it to maintain rheological properties in downhole temperatures up to 325 degF (163 degC), even in freshwater, where standard xanthan biopolymers will fail at less than 300 degF (149 degC).

CT MAGNOSTAR: Versatile, high-capacity magnet for coiled-tubing operations

Operators worldwide have come to depend on our pacesetter and continually evolving MAGNOSTAR tool suite of ferrous debris extraction magnets to ensure their wells are free of obstructions that can increase non-productive time (NPT), while decreasing asset value. Our emphasis on fit-for-purpose designs is clearly reflected in the CT MAGNOSTAR magnet, the industry's only magnet engineered specifically to extract the large volume of ferrous debris often generated in horizontal coiled-tubing cleanout operations.

This unique high-strength rare earth magnet typically is fitted on the BHA atop the coiled-tubing motor where it attracts plug slips, metal swarf and other ferrous materials during milling and cleanout applications. The placement of the CT MAGNOSTAR magnet prevents debris from interfering with coiled-tubing operations, thus reducing both the risk of motor stalling and the time required to complete the cleanout operation. In addition, high temperatures do not diminish the effectiveness of the rare earth metal magnet.

The CT MAGNOSTAR magnet is designed with offset valleys that trap debris and cover 360° of the wellbore. Along with simple cleanout runs, the versatile CT MAGNOSTAR magnet can be used for cutting windows with coiled tubing, drilling out plugs, and milling stuck fluid loss

control devices. The through bore of the CT MAGNOSTAR magnet also is large enough to allow balls to be dropped to disconnect a sub below for high-rate circulation. The design allows for the addition of multiple CT MAGNOSTAR magnets as required to capture the larger volumes of ferrous debris expected during a milling operation.

PFMS: The CT-specific pressure, solids control solution

Conventional equipment configurations usually are not designed for the safest and most efficient execution of coiled-tubing applications. M-I SWACO addresses those

limitations with our compact and dual-function PFMS unit, which provides an automatic closed-loop solution for controlling pressure, while removing solids and gas from the fluid system. Though it arrives to your location as a single skid-mounted package, the modular PFMS provides compartmentalized pressure and solids control capabilities, incorporating the most advanced pressure and solids control technologies.

Basically, the PFMS consists of several pieces of new generation equipment segregated based upon their respective functions into two main sections.



A typical PFMS layout for impaCT includes:

- Dual AUTOCHOKE[†] drilling chokes for precise control of well pressure with improved wear and anti-plugging characteristics for severe-service applications
- The field-proven MUD/GAS SEPARATOR[†] unit for removing high volumes of free gas
- A dual-motion MONGOOSE PRO[†] shale shaker outfitted with pre-tensioned DURAFLO[†] composite screens
- One vacuum D-GASSER[†] unit for final removal of any gas still entrained in the fluid after solids-control processing

impaCT service: Seamlessly cleans your well, the first time

Our objective in developing impaCT service was ambitious: Engineer an all-inclusive circulating system, in a small footprint configuration, that will fully capitalize on the inherent advantages of coiled tubing to deliver a thoroughly clean unconventional well in a single run.

Starting with POWERPRO CT fluid, we eliminated the need for sweeps

by formulating a fluid system that effectively and quickly circulates debris out of the wellbore at the low flow rates intrinsic of coiled-tubing operations. The low circulating rates help extend the operational life of small diameter coils used frequently, while the liquid polymer is easily mixed on location using a single tank.

If during the cleanout, you expect ferrous debris, such as teeth or the small blocks left behind after milling up the packer slips, the simple attachment of one or more CT MAGNOSTAR magnets to the work string will do the trick.

Once debris is circulated to surface, the PFMS unit takes over, with the gas separation and shale shaker components removing any entrained gas and solids, respectively, while the dual AUTOCHOKE drilling chokes hold back-pressure.

And, with less fluids, too

The tremendous volumes of water and other fluids used in standard coiled-tubing cleanups of horizontal wells not only elevate costs considerably, but raise a number of environmental issues.

With impaCT service, we put many of those issues to rest. Unlike conventional systems that continually require significant volumes of newly sourced water, the capacity of impaCT service to remove solids and other contaminants allows for recycling of the circulating fluid. Rather than a system requiring 1,500 bbl of water, for instance, we work with a 200-bbl system with full recycling and reuse capabilities.

As an added bonus, with impaCT service you eliminate the numerous frac tanks where settlement requires continual cleaning, demanding even more water and increasing time and costs.

Put our impaCT service to work for you

To find out more about our impaCT service integrated coiled tubing-conveyed wellbore cleanup solution and how it's performing for our other customers, contact your local M-I SWACO representative.



impaCT service proves itself in the field

Arkansas: CT MAGNOSTAR magnet quickly recovers all plug slips in milling job

The Situation

The operator had to drill 10 composite plugs with metal slips during a coiled-tubing application on its 10,500 ft (3,200 m) well with 90° deviation. The primary concern was that the slips would not be circulated out with the fluid being used. Leaving slips in the highly deviated hole likely would cause debris to collect in the heel of the well and potentially choke the wellbore and reduce productivity. As the well likely would require an ESP later, any debris left in the hole could damage the stages of the pump within two to three years after being put on production.

The Solution

The operator decided to use a 2 7/8-in. CT MAGNOSTAR magnet tool on the BHA to recover the metallic slips of the 10 plugs to be drilled. The CT MAGNOSTAR magnet was positioned on top of the motor assembly to recover the debris while the milling operation was being carried out.

The Results

The CT MAGNOSTAR magnet recovered between 7-8 lbs (3 - 4 kg) of very fine metal shavings and pieces of the plug slips, some of which were longer than 1-in. Pieces of this length would have been difficult, if not impossible, to circulate out of the hole. Moreover, positioning the CT MAGNOSTAR magnet close to the motor kept the hard slips away from the milling face, thus speeding up the operation while reducing stalls. The average plug milling time was improved to 29.7 min.



South Texas: Formation solids identified as production barriers

The Situation

Debris of unknown origin was found to be blocking production of a previously fractured horizontal unconventional well. Coiled tubing was selected to remove what was suspected to be a significantly large amount of debris.

The Solution

A POWERPRO CT fluid was formulated with potassium chloride base brine. The fluid was designed for superior hole cleaning, to minimize circulating pressures and to withstand expected high downhole pressures. For this job, 1 ½-in. coiled tubing would be used to circulate debris from roughly 11,000 ft (3,353 m).

The Results

Only 100 ft (30 m) of hole was washed before the returning cuttings load plugged surface circulating lines, demonstrating the tremendous hole cleaning capabilities of the POWERPRO CT fluid. After more than 3 hr of attempting to unplug the lines while not circulating, it was decided to extract the coil and cease operations. The coil was slowly extracted over 9 hr without circulation or any over-pull from settling debris, which was later determined to be formation solids.

South Texas: Proppant extraction clears way for production of two wells

The Situation

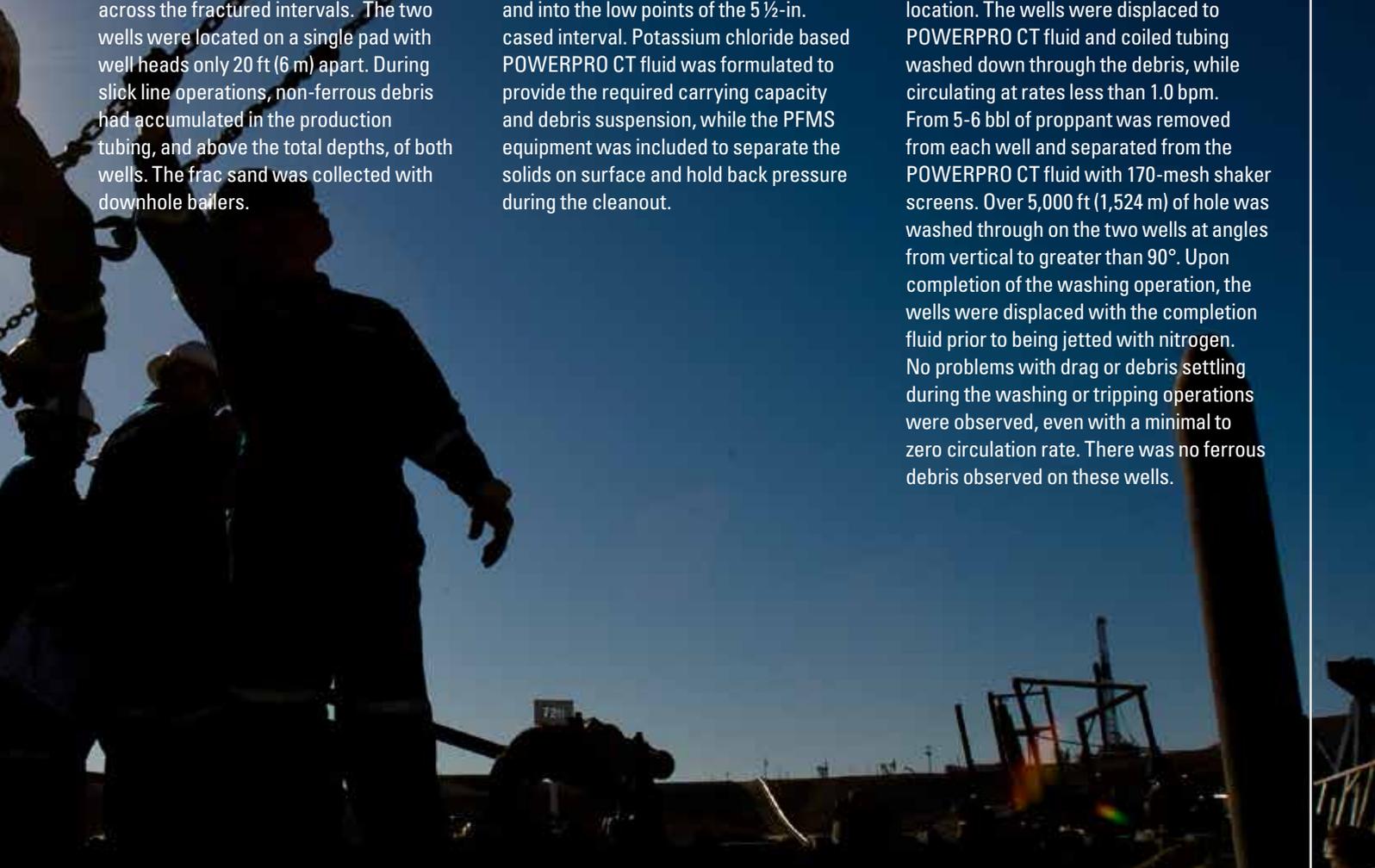
Proppant had to be removed from a pair of previously-fraced horizontal wells before production could be initiated across the fractured intervals. The two wells were located on a single pad with well heads only 20 ft (6 m) apart. During slick line operations, non-ferrous debris had accumulated in the production tubing, and above the total depths, of both wells. The frac sand was collected with downhole bailers.

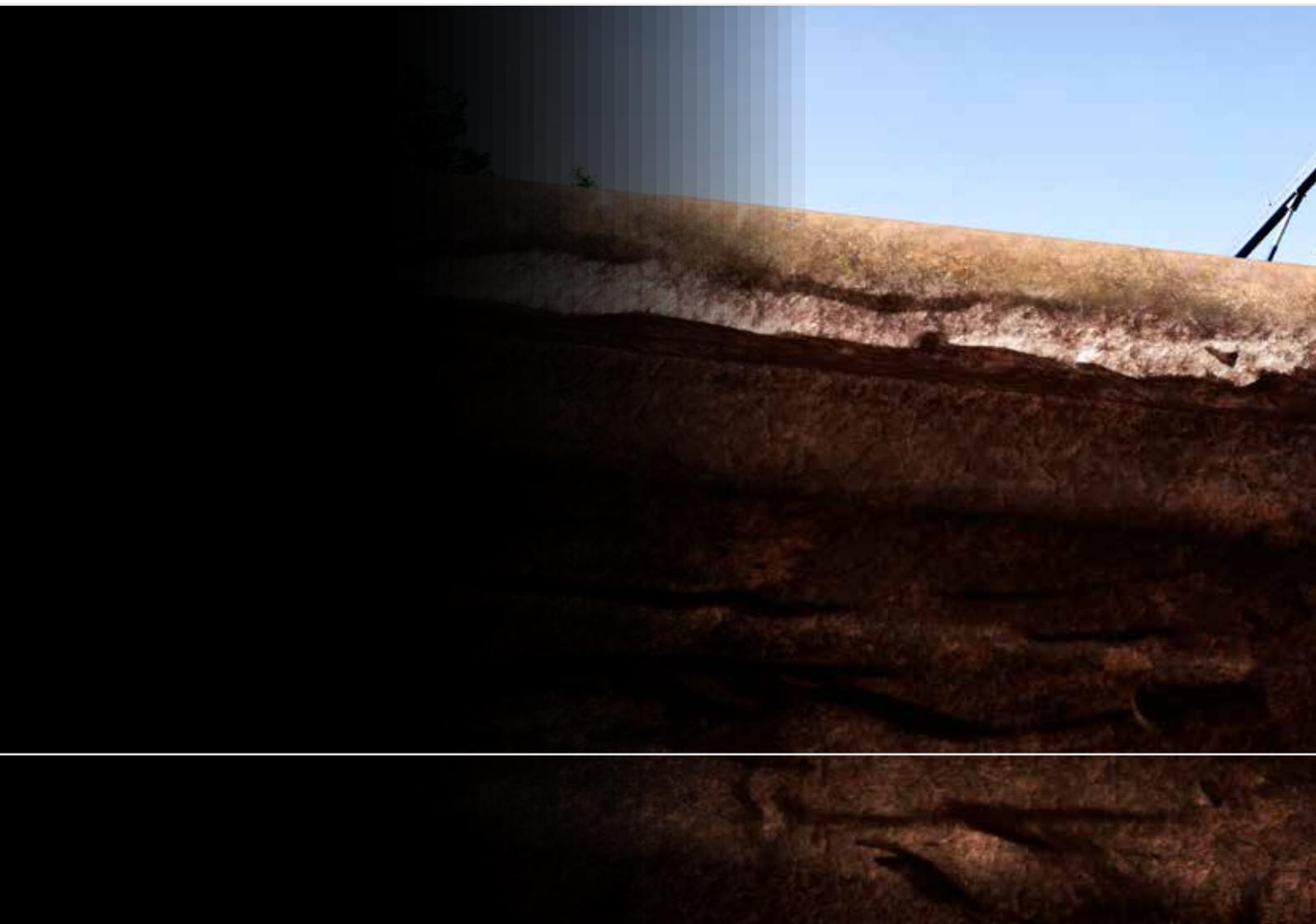
The Solution

Coiled tubing with 1 ¼-in. OD was required to circulate the debris from the wells, while washing through the 2 3/8-in. tubing and into the low points of the 5 ½-in. cased interval. Potassium chloride based POWERPRO CT fluid was formulated to provide the required carrying capacity and debris suspension, while the PFMS equipment was included to separate the solids on surface and hold back pressure during the cleanout.

The Results

After rigging up the coiled tubing and surface mixing/solids control equipment, the POWERPRO CT fluid was mixed on location. The wells were displaced to POWERPRO CT fluid and coiled tubing washed down through the debris, while circulating at rates less than 1.0 bpm. From 5-6 bbl of proppant was removed from each well and separated from the POWERPRO CT fluid with 170-mesh shaker screens. Over 5,000 ft (1,524 m) of hole was washed through on the two wells at angles from vertical to greater than 90°. Upon completion of the washing operation, the wells were displaced with the completion fluid prior to being jetted with nitrogen. No problems with drag or debris settling during the washing or tripping operations were observed, even with a minimal to zero circulation rate. There was no ferrous debris observed on these wells.





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