Schlumberger

P3

Postperforating treatment

APPLICATIONS

- Cleanup of existing perforations
- Low-pressure wells that cannot be perforated with dynamic underbalance
- Removal of hard scale, fines, and organic deposits

P3* postperforating treatment employs a patented dynamic underbalance technique to break up and remove flow impairment damage (typically called skin) from existing perforating tunnels. It can be used any time—from hours to years—after the initial perforating.

By creating a short-duration implosion in the wellbore, P3 treatment delivers a dynamic underbalance transient at the targeted treatment depth. When the implosion occurs adjacent to existing perforation tunnels, the pressure shock wave is transmitted via the well fluid into the perforation tunnel to break up the damaged material and then the underbalance strips material from the inside of the tunnel, leaving a clean tunnel wall. This clean tunnel improves communication between the reservoir and the wellbore, often with zero or slightly negative skin, which helps to optimize productivity and injectivity.

Similar to how the PURE* clean perforations system uses dynamic underbalance to deliver the cleanest perforations, the controlled implosions of a P3 treatment can help significantly improve productivity and injectivity. These implosions also aid the removal of hard scale, fines, and organic deposits.

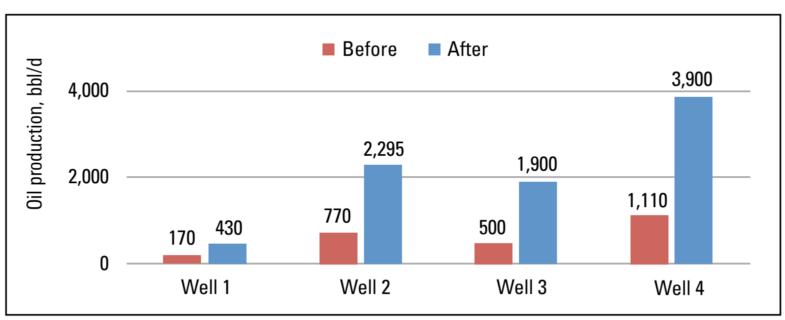
The magnitude and duration of the implosion are modeled using the PURE Planner* perforation job planning application, and downhole measurement using high-speed pressure gauges then verifies job execution as designed. The flow or injectivity improvements realized are also easily objectively measured with production logs and by monitoring surface flow rates and pressures.

The performance of P3 postperforating treatment has been proved in many environments, and the increases in produced or injected fluid can be substantial, often doubling or tripling flow rates. In older wells the technique has also been proved to remove flow-impairing deposits, such as hard scale (barium and strontium sulfite), fines, waxes, and asphaltenes, from perforation tunnels. In addition, the cleanup can be selective, enhancing production from specific production zones and leaving high skin at the perforations in zones producing unwanted water or gas. This is an effective way to increase flowing pressures and oil and gas production while reducing water production.

CASE STUDIES

Case study: Removing scale and crushed zone increases production up to 280%

In Libya, P3 postperforating treatment was used in a stimulation campaign for four wells plagued with hard scale deposits, high water-cut, and dwindling production. The reservoir layers varied in thickness from 50 ft to less than 10 ft and produced light oil (42 API). Reservoir porosity ranged from 15% to 25% and permeability from 50 to 300 mD. The carefully planned stimulations were all successful, removing hard scale along with the crushed zone of the perforation tunnels. Production logs run before and after the P3 treatment's implosions evidence significant improvement of up to 280%.

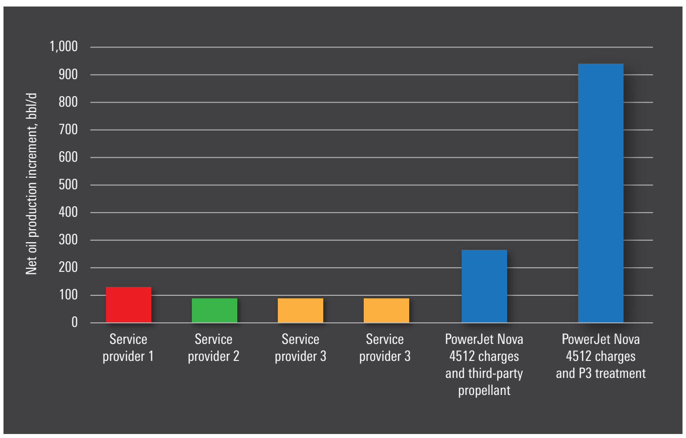


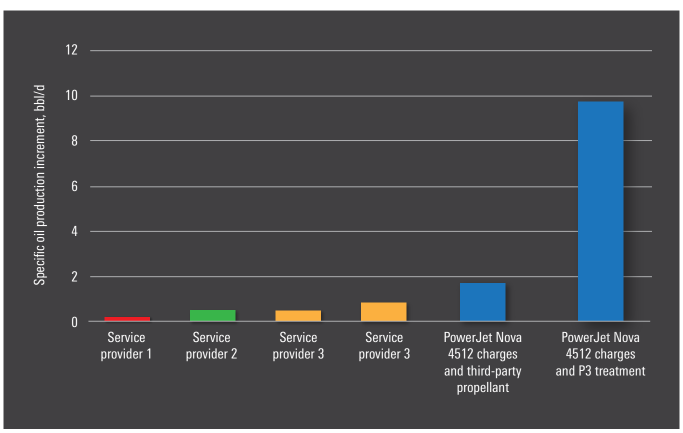
Stimulation conducted with P3 treatment increased production by 150% to 280% in the four wells.

P3

Case study: Perforating with PowerJet Nova charges followed by P3 treatment implosions outperforms other methods

In a two-month campaign in Colombia, Schlumberger and three other service providers each were assigned two or three wells to be perforated using each company's best perforating technology. All the wells had similar properties: high permeability (1–2 D), low pressure (2,500 psi), and heavy oil (200 cP). The perforating operations were performed on wireline with the well in overbalanced conditions. Schlumberger used several techniques including perforating followed by use of either P3 postperforating treatment or third-party propellants. PowerJet Nova* extradeep penetrating shaped charges used with a third-party propellant or in combination with P3 postperforating treatment delivered the best performance. The two-step process of perforating with PowerJet Nova 4512 charges followed by P3 treatment gave the best results from the combination of the highest shot density with maximum penetration and the cleanest perforation tunnels produced by the high dynamic underbalance created by P3 treatment.





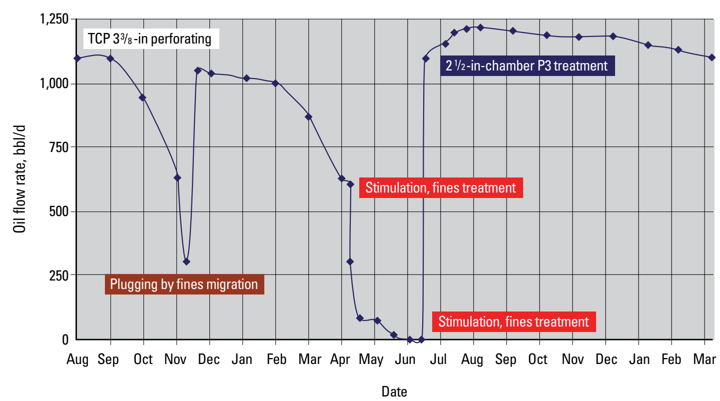
Perforating using PowerJet Nova extradeep penetrating charges followed by P3 postperforating treatment produced deepest, cleanest perforations that significantly increased production.

Case study: P3 treatment revives wells after formation damage from well kill fluid

In West Venezuela, a workover operation to replace damaged production tubing resulted in extensive formation damage from the well kill fluid used during the operation. Several interventions were attempted to clean up the well including on coiled tubing but without success. Production logs showed that only the bottom interval was producing. Nine of the 15 intervals in the well were selected for application of P3 treatment, and the Schlumberger and PDVSA team worked together to design a selective P3 treatment that used a 2⅞-in chamber for a 128-ft interval with focus on the zones that were not producing. The treatment was highly successful, completely eliminating the formation damage, and oil production increased by 250%, to 1,400 bbl/d from 400 bbl/d.

Case study: P3 treatment restores production after fines plugging

In East Venezuela, an operator perforated a well using tubing-conveyed perforating (TCP) with 3⅜-in HSD* high shot density perforating gun systems. The well was then completed with 3½-in tubing with a 2.75-in minimum restriction. Well production declined and then stopped as a result of fines migration and plugging. Reperforating with 2½-in HSD gun systems was attempted with partial success but fines migration subsequently reoccurred. A 2½-in-chamber P3 postperforating treatment was designed to maximize the dynamic underbalance and resulted in cleanup of the fines migration and bridging material. Production improved to 1,200-bbl/d oil and stabilized to the levels achieved prior to fines migration and bridging.



The production history shows that the P3 treatment both increased and stabilized production.

slb.com/perforating

Schlumberger

*Mark of Schlumberger