



# SEQUENCED STIMULATION DIVERSION SERVICE MAXIMISES RESERVOIR CONTACT TO IMPROVE WELL

Contributed by Schlumberger

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**A**cid stimulation remains the most efficient and cost-effective stimulation method for carbonate formations. However, issues regarding diversion of the fracturing fluid present several challenges. In wells with multiple clusters or perforation intervals, it is often difficult to divert stimulation fluid from one zone to another, and often the fluid stimulates the same interval.

Some conventional diversion techniques can deliver variable results. Rock salt and benzoic acid flakes can block the path of least resistance by diverting stimulation fluids to the perforation clusters identified as the best perforation targets. However, the permeability of those materials often results in fluid breakthrough.

In a move to address these limitations, Schlumberger has developed a system for more precisely diverting acid stimulation fluids into target zones, enhancing reservoir contact, and boosting well productivity. The OpenPath Sequence\* diversion stimulation service can be used for new completions and to re-stimulate mature wells in conventional and unconventional formations. It is especially suited to wells in the Middle East, where acid stimulation is very common due to mineralogy of carbonate formations. The OpenPath Sequence service enables sequential stimulation of multiple zones and intervals, in both cased and openhole completions using stimulation modeling, an acid system appropriate for reservoir conditions, and a proven near-wellbore diversion system.

Composite pills containing a blend of degradable fibers and multimodal particles effectively divert acid between clusters along the wellbore to temporarily plug a specific region, or can be used in a sequence for systematic uniform distribution of the fluid along the wellbore, maximising wellbore coverage and reservoir contact. Diversion occurs in the near-wellbore area of the formation with the large particles forming a bridge and the smaller particles filling the gaps to create a low-permeable seal.



**The OpenPath Sequence diversion stimulation service sequentially plugs perforations in the near-wellbore to maximise wellbore coverage, resulting in greater production and recovery when compared with conventional methods. (Image: Schlumberger)**

Following treatment, the fibres and particles fully degrade within hours or days at downhole temperatures ranging from 130-300°F (54-149°C), with no intervention required. The new service can be used with multiple acid systems and can withstand differential pressure up to 4,500psi for acid fracturing or matrix stimulations.

### **BOOSTING PRODUCTIVITY MORE THAN 300 PER CENT**

A Middle East operator applied OpenPath Sequence service to effectively increase productivity in a multilayer, heterogeneous limestone reservoir with natural fractures and multiple perforation intervals. To meet economic objectives, the operator needed to refracture a vertical well with a technology capable of achieving good fracture conductivity, an extended fracture length, and effective diversion in the near-wellbore. This required an acid treatment that would stimulate multiple perforation intervals in a continuous treatment in the upper and previously unattainable lower carbonate formation without mechanical isolation. Production would be enhanced by diverting some of the acid stimulation from the upper part of the reservoir to the lower reservoir section.

The new diversion service deployed the composite pills to provide consistent, effective isolation plugs. The treatment alternated

between three acid stimulation stages and two diversion stages. Following placement of the pills, diversion within the perforated intervals was indicated by pressures of 500 to 1600psi and instantaneous shut-in pressure changes. Injection log data, based on stationary spinner and temperature information, further confirmed the diversion was effective.

Injection logging performed after the pre-job injection and after each diversion stage verified coverage of all perforation intervals. The injection flow profile for the upper reservoir intervals improved an average 70 per cent for perforated cluster after the first diversion stage and more than 150 per cent after the second diversion stage. Injection logging also confirmed that fractures had been initiated and propagated in the lower reservoir section after the second diversion stage.

Following treatment, production improved to 1,200 bbls/d from 350 bbls/d prior to stimulation, with the productivity index increasing by more than 300 per cent. OpenPath Sequence service is the first release of a family of stimulation services aimed at maximising well productivity in conventional reservoirs.

*\*Mark of Schlumberger*