TECH REPORT

PRODUCTIVITY ENHANCEMENT RESEARCH FACILITY (PERF)
ROSHARON, TEXAS, US

Sample type	Carbonate cores

Background

Matrix acidizing experiments conducted with 15% HCl in 1- and 10-mD carbonate cores perforated with deep penetrating charges showed a change in wormhole patterns from conventional tip nucleation to a unique transverse pattern in which the dominant wormhole nucleated well behind the tunnel tip. Because understanding the basis for this pattern change is critical for optimizing acid stimulation operations, PERF researchers built a detailed computational fluid dynamics (CFD) model to directly simulate the prestimulation flow field and wormhole formation process.

Technologies

- PV-94 pressure vessel (API RP 19B Section IV testing)
- Computed tomography (CT) scanner
- Thin-section analysis
- Parallel acidizing simulations on high performance computing cluster

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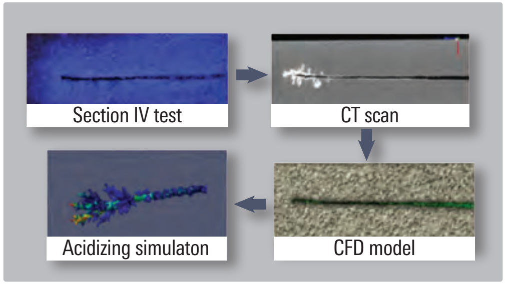
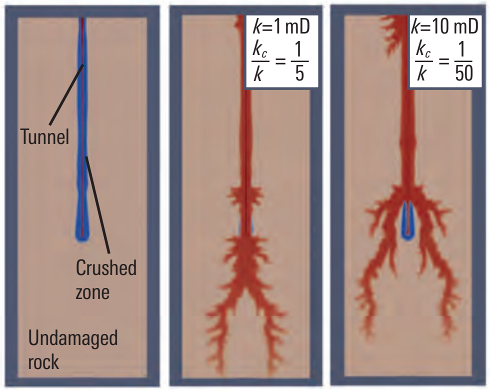
Pore Compaction Damage Mechanism Identified as Driver for Matrix Acidizing Performance in Carbonates

Computational fluid dynamics model integrates perforation CT scans and thin-section analysis to digitally reproduce wormholes





The digital workflow (left) developed to construct a CFD model of a perforated core directly from CT scan images explicitly resolves the tunnel and crushed zone and incorporates crushed zone properties extracted from thin sections. Simulations (right) with the core compaction damage account for the nonuniform profile of the crushed zone thickness and the ratio of crushed zone to initial permeability (k_c/k) to reproduce the experimental wormhole patterns for use in stimulation design.

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