THE UNIQUE CHARACTERISTICS OF NANOMITE™ C CERAMIC MICROPORPPANT REDUCE COMPLETION TIME, SCREEN-OUT RISKS, AND OVERALL COMPLETION COSTS WHILE IMPROVING THE PRODUCTION CONTRIBUTION FROM ALL CLUSTERS AND THE RESERVOIR MATRIX.

NANOMITE C MICROPORPPANT DELIVERS NUMEROUS BENEFITS DURING STIMULATION THAT INCREASE EFFICIENCY AND WELL PRODUCTIVITY:

- Overcomes fracture entry restrictions
- Lowers high surface treating pressures
- Improves cluster injection efficiency
- Increases propped reservoir contact area
- Increases production and recovery

REDUCE COMPLETION TIME, SCREEN-OUT RISKS, AND OVERALL COMPLETION COSTS

NANOMITE C MICROPORPPANT OVERCOMES FRACUTURE ENTRY RESTRICTIONS IN THE PERFORATIONS AND NEAR-WELLBORE AREA THROUGH EROSION OF RESTRICTIONS AND IMPROVES NEAR-WELLBORE DIVERSION RESULTING IN REDUCED SURFACE TREATING PRESSURES. AS A RESULT, REDUCED PUMPING PRESSURES CAN BE REALIZED, OR LOWER PUMPING TIMES ARE REQUIRED DUE TO INCREASED INJECTION RATES, THAT LOWER COMPLETION TIME AND OVERALL COMPLETION COSTS. THE REMOVAL OF ENTRY RESTRICTIONS LOWERS SCREEN-OUT RISKS.
NANOMITE C ceramic microproppant

**Improve production contribution from all clusters**

Cluster injection efficiency is increased due to the improved transport characteristics of NANOMITE microproppant in the wellbore, ensuring that proppant reaches the farthest clusters in a horizontal stage. As the microproppant enters the fractures, it conditions the clusters reducing fracture entry restrictions, so they more readily accept conventional sized proppant. The result is more uniform distribution across all clusters.

**Improved cluster injection efficiency and improve fracture coverage**

Fracture coverage using conventional sized proppant

Improved fracture coverage using micro sized NANOMITE proppant
NANOMITE C ceramic microproppant

Increase overall production contribution from the reservoir matrix

Increase propped contact in the reservoir by transporting further into fractures and microfractures, thus increasing overall production contribution from the reservoir matrix.

Outperform alternative products

NANOMITE C microproppant delivers, operational, performance, and cost benefits compared to alternative, along with minimized health concerns associated with exposure to dust.

NANOMITE C microproppant is easily incorporated in stimulation treatment designs. The microproppant is pumped as the first proppant in a thin fluid system at a low slurry concentration (0.10 to 0.25 lb/gal) to maximize the depth of the microproppant penetration into the fracture.

NANOMITE C vs. Competing products

<table>
<thead>
<tr>
<th></th>
<th>200 mesh silica sand</th>
<th>Amorphous silica</th>
<th>Ceramic spheres</th>
<th>NANOMITE C</th>
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</thead>
<tbody>
<tr>
<td>Dust exposure (health)</td>
<td>Must be slurried</td>
<td>Must be slurried</td>
<td>Safe</td>
<td>Safe</td>
</tr>
<tr>
<td>Delivery to blender</td>
<td>Slurried (dust exposure)</td>
<td>Slurried (dust exposure)</td>
<td>Slurried (dry packing)</td>
<td>Dry</td>
</tr>
<tr>
<td>Fracture conditioning</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Poor</td>
<td>Good</td>
</tr>
<tr>
<td>Durability</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Total cost (incl slurry cost)</td>
<td>$$</td>
<td>$$</td>
<td>$$$</td>
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</tbody>
</table>

NANOMITE C can be pumped dry with conventional proppant

**Dry method (preferred):**
- Delivered same as conventional proppant (rail, truck, box, bag)
- Pumped using conventional fracture pumping equipment

**Slurry method (optional):**
- Slurried in gel (typical 8.0 to 8.5 lb/gal)
- Delivered by transport or batch-mixed on location
- Add slurry to blender or downstream of the frac pumps (cement unit)
Durable to maintain long-term conductivity
NANOMITE C microproppant is a high-quality ceramic proppant that has the compressive strength and durability to maintain fracture conductivity and more space for hydrocarbon flow under closure stress.

Excellent proppant transport characteristics due to a wide range of settling velocities
NANOMITE C ceramic microproppant contains a broad range of particle sizes within the 150/635 mesh (100 μm to 20 μm) range. The smallest NANOMITE particles are over five times smaller than the smallest particles in 100 mesh frac sand.
NANOMITE microproppant has superior transport and settling characteristics in thin fluid systems (freshwater or slickwater) so travel farther into complex fracture networks to release production from otherwise untapped microfractures. The average settling rate of 100 mesh sand is over twice as fast as NANOMITE particles.

Mean size and settling rate in water of 100 mesh sand compared to 325 mesh NANOMITE C microproppant

Mean particle size 45 μm [-325 mesh]
Apparent specific gravity (g/cm³) 2.7–3.2
Absolute volume (gal/lb) 0.040–0.044
Bulk density (lb/ft³) 100-115
[gal/lb] 1.6-1.8

Features
- Extremely small microproppant particles
- Broad size range for optimum operational flow and reach
- Low settling velocity due to the wide range of particle sizes
- Strong and durable ceramic particles

Benefits
- Increased EUR and maximize production
- More erosive to fracture entry restrictions than 100 mesh sand
- Superior transport characteristics to travels further into complex fracture networks
- Props secondary and microfractures to increase long-term well productivity
- Survives impact forces during pumping and withstands high fracture closure stresses
- Can be added during pad stage without disrupting established routines

Physical and chemical properties

Talk to CARBO to find out how we can help you enhance your production.
carboceramics.com