

CARBONBOND[®] LITE[®]

Curable Resin-Coated Ceramic Proppant

FEATURES

- Formulated for maximum compatibility with complicated frac fluids
- Bonded proppant pack reduces effective stress on proppant
- Resin coating completely encapsulates substrate
- Bonds in the fracture with temperature and closure

BENEFITS

- Versatile – expands the usable application range (depth, temperature and stress)

- No proppant flowback – eliminates subsequent equipment damage, expense of cleanouts and disposal
- Maintains conductivity – resin coating prevents fines from being released
- Maintains particle integrity – prevents chemical attack on substrate
- No additional chemical costs – since no fluid chemistry change is required, the job can be pumped as designed



Physical and Chemical Properties

Typical Chemical Properties

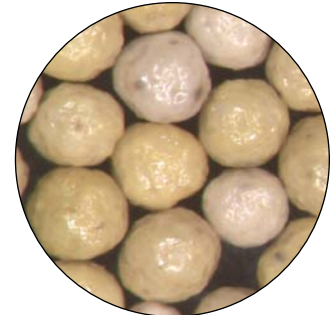
Resin Type	Phenolic, 3-4 weight %
Equilibrium pH	8.9-9.3
Residual Acidity, gal 50% NaOH/1000 gal 2% KCl	< 0.1
Solubility, ISO 13503-2, formerly API RP-56	Weight %
Water	< 0.2
Alkaline water* uncured	< 1.0
cured	< 0.2
Water with 2% by weight KCl	< 0.2
Light brine	< 0.3
12% HCl/3% HF Acid	< 1.0
Oil	< 1.0
Shelf-life (years)	> 3 (estimated)

Compatibility: Compatible with most commonly used fracturing fluids, both water and oil. Testing with fluids prior to pumping is advised. Some fluids may require adjustment of pH control, breaker or foamer loading. Avoid prolonged exposure to highly alkaline fluids, i.e., pH > 12 and > 2¼ gal 50% NaOH/1000 gal (2.2 L/m³).

*66°C, unbuffered 2% KCl, adjusted to pH = 11, 12 lb_m/gal (1.4 kg/L) proppant added

Typical Physical Properties

Particle size ISO 13503-2	20/40
Substrate	CARBOLITE
Physical State	Solid, particulate
Particle Density (g/cm ³)	2.60
Specific Volume (cm ³ /g)	0.385
Bulk Density (g/cm ³) [lb/ft ³]	1.54 ± 0.06 96 ± 4
Pipe-fill Factor (cm ³ /g)	0.625
Krumbein Shape Factors	
Roundness	0.9
Sphericity	0.9
Particle Size Distribution uncoated ceramic substrate	Meets or exceeds ISO 13503-2, (formerly API RP-60)
Turbidity (NTU) [FTU]	< 250
Coating Efficiency (weight %)	> 99.8
Clusters (weight %)	< 1
Bond Strength	See included chart
Long-term Conductivity	See included chart



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Long-Term Conductivity

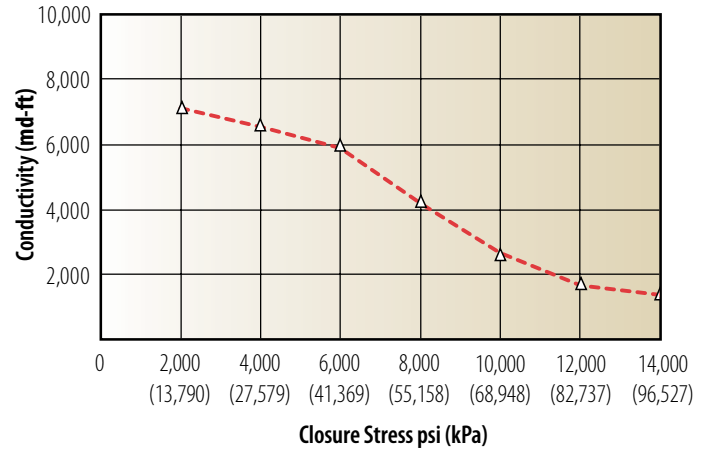
Reference Conductivity*, md-ft @ 300°F**

Closure Stress [psi]	Conductivity md · ft (md · m)
2,000	7023 (2141)
4,000	6441 (1963)
6,000	5860 (1786)
8,000	4170 (1271)
10,000	2599 (792)
12,000	1700 (518)
14,000	1432 (437)

Reference Permeability, Darcies @ 300°F

Closure Stress [psi]	Permeability (darcy)
2,000	369
4,000	343
6,000	318
8,000	233
10,000	154
12,000	107
14,000	94

2 lb/ft², 300°F, with 2% KCl | Between Ohio sandstone



* Reference conductivity and permeability are measured with a single phase fluid under laminar flow conditions in accordance with ISO 13503-5. In an actual fracture, the effective conductivity will be much lower due to non-Darcy and multiphase flow effects. For more information, please refer to SPE Paper #106301.

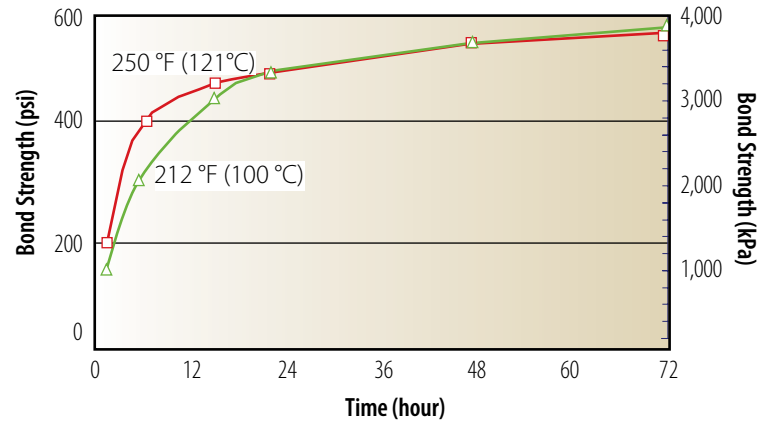
** StimLab report 8927 run on two separate production samples.

Bond Strength Performance

Unconfined Compressive Strength

Fluid Temperature °F (°C)	Closure Stress psi (kPa)	Time (hour)	Bond Strength psi (kPa)
212 (100)	0 (0)	24	< 50 (345)
		4	150 (1034)
	1,000 (6,895)	8	300 (2068)
		16	440 (3034)
		24	500 (3447)
		48	550 (3792)
		72	580 (3930)
250 (121)	0 (0)	24	< 50 (345)
		4	200 (1379)
	1,000 (6,895)	8	400 (2758)
		16	475 (3275)
		24	500 (3447)
		48	550 (3792)
		72	570 (3930)

Unconfined Compressive Strength



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