

Unconventional petroleum exploitation V: proppants and their properties

	River sand	Sand Well-sorted sand Usually a quartz sand, like that from the St. Peter Sandstone.	Resin-coated sand	Ceramic proppants Low-density	High-density
Properties related to behavior in fractures (to maintaining conductivity)	<i>Uniformity of particle size:</i>		In granular materials, more uniform particle size gives greater porosity and permeability, because smaller particles are not present to fill voids between larger ones.	✓	
	<i>Strength / resistance to crushing:</i>		Subsurface pressure can crush proppants, letting fractures close and generating smaller pieces that lessen permeability (see "Reduction to smaller pieces", below). 6000 psi is cited by some as the pressure for transition from natural sand to ceramic proppants.	?	✓
	<i>Reduction to smaller pieces</i>		Coatings hold together the fines/debris from crushing; Coatings also make sand more cohesive, so less proppant flows from fractures back into well.		✓
Properties related to behavior in fluid	<i>Sphericity / rounding of particles</i>		More spherical particles are less prone to crushing and move more freely with the fracking fluid.	✓	
	<i>Density</i>	✓ Quartz = 2.65 g.cm ³		Particles with density of the fracking fluid are at neutral buoyancy; more dense particles sink and therefore require gelling agents. CarboLite = 2.71 g.cm ³	CarboHSP = 3.56 g.cm ³
	<i>Cost</i>	✓ Local	Non-local	Non-local and coated	Non-local and manufactured

Sources include University of North Dakota Energy & Environmental Research Center (2014) Investigation of improved conductivity and proppant applications in the Bakken Formation; Beard (2011 - Chesapeake Energy Corp.) Fracture design in horizontal shale wells – data gathering to implementation (EPA Hydraulic Fracturing Workshop; Kullman (2011) The complicated world of proppant selection.