Mike O'Driscoll
Guest columnist

The changing sands of our time

How proppant demand has influenced ceramic mineral supply

Since the mid-2000s, three of the most important ceramic raw materials—silica, kaolin, and bauxite—have been in high demand as proppants from the North American oil and gas drilling industry as it develops unconventional resources, particularly shale gas and shale oil.

After a recent dip in demand, we are now witnessing another Mother of a Sandstorm of proppant demand. This time it's slightly different in that silica is totally dominant, but there is the same question of whether there will be enough material for its other markets, including ceramic, glass, and foundry applications. And what about the future of ceramic proppants?

Fracking takes off

In simple terms, the extraction process of hydraulic fracturing (fracking) requires vast amounts of water entrained with additives, including spherical grains of ceramic material, to be pumped under high pressure into shale formations to recover oil and gas finely disseminated in the rock's pores.

Drilling opens up fissures and fractures perpendicular to the main well bore, where the spherical grains function to "prop" open the fractures to maintain oil or gas flow (conductivity) into the main well bore for pumping to the surface.

Although this treatment for well stimulation has been around since 1949, it was only perfected in the late 1980s. Combined with advances in horizontal drilling techniques and a drive for cheaper gas from flat-lying shale gas formations, fracking really came to the fore in the early- to mid-2000s.

At the same time, proppant science evolved to meet demands for high crush resistance under pressure and, above all, induce high conductivity in application.

Seemingly almost overnight, humble silica sand became in high demand as American and Canadian exploration and production (E&P) companies started fracking in earnest. To gain some perspective, according to U.S. Geological Survey data, just 8% (2.3 million tons) of silica sand produced in the U.S. in 2005 was used as frac sand. In 2017, this share rose to 63%, or 66 million tons!

But silica sand is not the only proppant in town—deeper and higher-temperature wells require higher-strength grades that can only be manufactured mostly from sintering bauxite or kaolin, or blends of each. More recently, ultra-high-strength grades have been introduced based on high alumina materials.

Resin coating of silica sand introduced a third option in proppant selection by enhancing silica sand performance. However, silica sand still falls short in performance but is 4–6-times more expensive than ceramic proppant grades.

The upshot was an explosion of U.S. frac sand mine developments (then, mainly in the so-called Northern white sands of Wisconsin, Missouri, and Illinois), diversion of existing silica sand production to frac sand, and a lesser degree but nonetheless significant investment in more sophisticated ceramic proppant plants.

Chinese refractory and abrasive bauxite producers in particular lost no time in diversifying to supply the U.S. proppant market. They enjoyed high-volume penetration until around 2012, when U.S. plants started to catch up and the market was on the wane, albeit with a slight recovery in 2014.

The prevailing proppant share split hovered around 70%–80% frac sand for many years, with a mix of resin-coated and ceramic proppants accounting for the remaining shares.

Shifting sands

From 2014, overall proppant demand started to slacken and was compounded by falling oil prices in 2015. The same time saw the beginnings of a trend that has since become a stampede—to fracture using huge volumes of cheap silica sand, which has steadily eroded ceramic proppant's share of the market.

During 2015, this practice caught hold to the extent that most ceramic proppant producers either closed or mothballed most of their plants—including Carbo Ceramics, Saint-Gobain, and, unfortunate latecomers to the proppant party, Imerys—affecting ~80% of U.S. capacity. There has been little if any recovery of late, as silica sand remains king.

From mid-2017, proppant demand for silica sand started to pick up markedly and is now hitting stellar heights, with U.S. market demand for 2018 expected to increase by 45% to 100–110 million tons. This is a conservative estimate apparently—according to one consultant, the market "has yet to peak."

The proppant share split is now ~94% silica sand and 5% resin-coated, with ceramic capturing the remainder.

Recently announced 2017 results indicate that Hi-Crush Partners LP sold 8.9 million tons of frac sand, more than double 2016 volumes, while U.S. Silica sold a record 3.2 million tons in Q4 2017, an increase of 52% over Q4 2016.

Recovering oil prices into the $60/barrel range has helped, but the main driver has been E&Ps drilling longer lateral lengths and the rising intensity of proppant loading levels per frac stage. For example, the Delaware basin uses 1 ton of proppant per lateral foot, up 32% from 2016 levels; Bakken uses 70 tons per stage; Permian Basin wells consume 5,000 tons per well; and reports from elsewhere indicate 6,000–7,000 tons per well.

A second key trend is the shift to using mostly finer 100-mesh, in addition to 40/70-mesh sizes. This raises an interesting issue of how this may affect the balance of industrial sand supply.

While frac sand-only producers have tunnel vision, all-round producers (such as U.S. Silica and Unimin) need to maintain supply to industrial or speciality markets in glass and ceramics. Industrial sands can be "converted" to frac sand, but the reverse is not always true. The continued push for finer frac sands could impact certain industrial markets, such as fiber glass.

That said, what is often specified as 100-mesh for one proppant customer does not always match that of another. Currently there is much mixing of grades—but it still works!

Glass industry applications use 40/70-mesh and 100-mesh as well. But with spot prices exceeding $60/ton for frac sand (and expected to reach $75/ton in the Permian this year; Northern white sand is already >$100/ton), which requires minimal processing and quality control—compared to <$30/ton for glass sand grade, which requires strict chemical and physical specifications and treatments—it's little wonder that producers, especially those that are publicly traded, are leaning toward proppant markets.

Sure, 2–3-year frac contract prices are lower at around $30–$40/ton, but they remain lucrative deals—U.S. Silica recently announced it had more than 30 long-term contracts and is aiming for 70%–80% contracted output.

The third main trend making waves is the rush to develop in-basin sand sources in the Permian, using cheaper and what was initially considered inferior brown-colored sand in Texas.

Of course, with increased Permian fracturing activity combined with the high logistical cost of moving sand—which can account for up to 70% of delivered price—southern brown sand is suddenly in vogue, and end-users are desperate for it because supply is currently tight. Hence the latest sandstorm in the Permian is a raft of companies bringing on new mines and plants. For example, U.S. Silica alone is adding 6.6 million tons of new capacity there.

The good news is that increased availability of Permian sand towards the year-end—with estimates indicating 25–30 million tons per annum in total—will ease the tight supply situation for other industrial and speciality consumers of Northern sands.

About the author

Mike O'Driscoll is director of IMFORMED and has over 30 years of experience in the industrial minerals business. IMFORMED has conferences this year covering mineral recycling, magnesia, fluorspar, and China's abrasives and refractory minerals—see www.imformed.com for more information. Contact O'Driscoll at mike@imformed.com. ■