

Silica Sands of Minnesota

WHAT IS SILICA SAND (FRAC SAND)? Silica sand consists of well-rounded, sand composed of almost pure quartz grains. Quartz, or silicon dioxide (SiO₂), is the most common mineral found on the Earth's surface and is found in rocks like granite, gneiss, and sandstone. The value of silica sand can be significantly higher than sand and gravel used in the construction industry. Silica sand is processed into frac sand, a product used by the oil and gas industry.

WHERE IS SILICA SAND FOUND? Silica sand is mined from Paleozoic-aged sandstones occurring in portions of Minnesota, Wisconsin, Iowa, and Illinois. In Minnesota, glacial drift and other bedrock layers commonly exist on top of the sandstone. Three sandstone formations have potential for producing high quality silica sand. The Jordan and Wonewoc sandstones are the most sought after sources for frac sand, followed by the St. Peter sandstone. Natural aggregates mined from sand and gravel deposits do not meet the specification for frac sand.*

WHAT TYPES OF INDUSTRIES USE SILICA SAND? Silica sand has been mined in the Upper Midwest for over a century. Uses for this resource include a variety of products and applications like glass-making, abrasives, bedding for livestock, golf course sand traps, and frac sand. Over the past decade, a sharp increase in demand for silica sand corresponded with a rapid expansion of shale oil and gas development. An extraction method called hydraulic fracturing is used to access oil and gas from shale and limestone bedrock which can require approximately 10,000 tons of frac sand per well.



WHAT IS THE STATUS OF SILICA SAND MINING IN MINNESOTA? Silica sand is found in the southeastern portion of the state. Five mines are currently known to extract silica sand for industrial applications. An unknown number of silica sand mines produce silica sand for construction and agricultural uses. Silica sand mines producing frac sand may or may not process the sand on-site. Off-site processing plants that receive silica sand from various mining operations in Minnesota and Wisconsin are also found in Minnesota.

HOW IS IT MINED? In Minnesota, all silica sand mines that produce industrial and agricultural sand operate as surface quarries using similar equipment as aggregate mines. Both surface and underground mines exist in other states.

WHAT IS "FRACKING"? "Fracking" is slang for hydraulic fracturing. Developed in 1947, hydraulic fracturing is a method used to increase the production of a well. The hydraulic fracturing process for oil and gas uses a mixture of proppant (usually frac sand), water, and chemicals. The mixture is injected into a well under very high pressures. Small cracks form in the bedrock, frac sand "propp" open the fissures, and conduits form to allow the flow of fluids and gas within a well. The average depth of an hydraulically fractured oil/gas well is between 6000-9000 feet below the surface.

*Dustman, J.E., Gulbranson, B., Bell, P., Gregg, W., 2011: Characteristics of high quality frac sand, and where to find it in the upper Midwest., Geological Society of America Abstracts with Programs, Vol. 43, No 5.

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IS FRACKING FOR OIL AND GAS OCCURRING IN MINNESOTA? No. Sand used for hydraulic fracturing is mined and/or processed in Minnesota. The sand is then transported out of the state by rail or barge to oil and natural gas producing regions (e.g. Western North Dakota, Pennsylvania, and Texas). However, a method of hydraulic fracturing is used in Minnesota to increase production of water wells screened in certain types of bedrock.

WHY HERE? WHAT MAKES OUR SAND SO UNIQUE? Even though sand is found all over the world, the sandstones of the Upper Midwest have several unique physical properties (listed below). It is one of a few known places on Earth where this resource occurs, making it a globally desired commodity.

Composition: Sand usually contains many different rock types; however, silica sand consists of nearly 95% quartz.

Strength: Quartz is a very hard mineral and able to withstand high pressures produced during the hydraulic fracturing process without breaking.

Shape: The sand grains are shaped like little ball bearings allowing for oil and gas to flow between individual grains without clogging the fractured rock. It is very important that the round, unbroken grain shape is preserved throughout mining, processing, and transporting the sand to the market.

Size: The sand grains are fairly uniform in size. When washed and screened, the sands meet a precise grain-size distribution required for frac sand (specified by the American Petroleum Institute, Recommended Practice 56):

PRODUCT	8/12	10/20	20/40	70/140
RANGE OF GRAIN SIZE DIAMETERS	2.38 to 1.68 millimeter	2.00 to 0.84 millimeter	0.84 to 0.42 millimeter	210 to 105 microns
AGGREGATE NAME	Fine Gravel to Coarse Sand	Very Coarse Sand to Coarse Sand	Coarse Sand to Medium Sand	Fine Sand to Very Fine Sand

NOTE: Ninety percent (by weight) of the total product must fall within the specified range of grain sizes. Washing significantly reduces silt and clay sized particles (less than 62.5 microns in diameter) so to not exceed a turbidity threshold of 250 FTU (Formazin Turbidity Units).

WHO REGULATES SILICA SAND MINING? Counties, townships, or municipalities are the responsible governmental unit (RGU) for administering permits to mine for silica sand. The DNR administers an additional permit, Silica Sand Mining Trout Stream Setback Permit, for silica sand mines within one mile of a designated trout stream.

WHO ARE THE OTHER REGULATING AUTHORITIES? Depending on size and scope, the proposed mining operation may be subject to the following state and federal permits and regulations:

Department of Natural Resources (DNR)- Silica Sand Trout Stream Setback Permit, Water Appropriation Permit; Public Waters Work Permit; Burning Permit; and Endangered or Threatened Species Taking Permit.

US Army Corps of Engineers- Section 404 Permit (discharge of dredged or fill material or excavation within waters and wetlands may require approval of the US Army Corps of Engineers).

Environmental Quality Board (EQB)- Requires environmental reviews in the form of an Environmental Assessment Worksheet (EAW) for operations excavating 40 or more acres of land at a mean depth of 10 feet and Environmental Impact Statement (EIS) for operations exceeding 160 acres.

Board of Water and Soil Resources (BWSR)- Wetland Conservation Act.

Pollution Control Agency (MPCA)- Section 401 Certification; Water Quality, and Air Quality Regulations.

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