

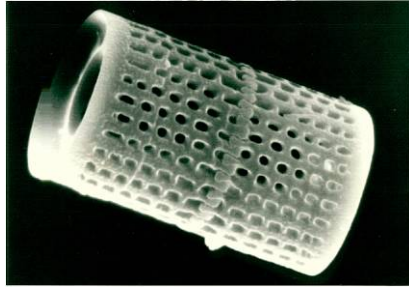
Definitions of Calcined Diatomaceous Earth, Calcined Clay, Zeolite & Sand

Sand is described as a specific grain size in the soil. Sand grains range in size .05 to 2.0 mm in diameter. Sand is also defined as a specific class of soil texture that has more than 90% sand content and almost no clay. USGA Sand is any sand that meets the recommended particle size distribution and particle integrity required by the USGA to be used in golf green construction.

Diatomaceous Earth is a form of sedimentary ore formed by fresh water planktonic species dying, settling to the bottom, and accumulating to form deposits. In life, as water moved through the plankton, they removed silicic acid and traces of iron from the water to form a nearly pure silica diatom structure. Calcining diatomaceous earth fuses the diatoms together for hardness and long term durability.

Clays are secondary materials created from granite, feldspar, and other materials that break apart, decompose or have undergone chemical changes to form clay. Common clay minerals are kaolinite, illite, and montmorillonite. Calcining clay creates indentations, fractures, and fissures in the particles, and holds those porous structures in place as they become ceramic.

Zeolites are crystallized minerals made up of chains of alumina and silica. The chains form an open structure with microscopic channelways in which water and other molecules may be readily housed. Zeolites are used in industrial applications as molecular sieves.



Calcined Diatomaceous Earth magnified 6,000X, photographed with electron microscope. Courtesy of EaglePicher Filtration & Minerals.

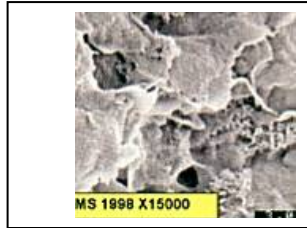
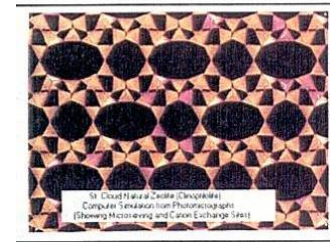


Photo of calcined clay magnified 15,000X, courtesy of Agronomic Systems Design Group.



Natural Zeolite courtesy of St. Cloud Mining Company. Computer Simulated Photomicrograph, shows Microsieves and C.E.C. Sites.

Internal Pore Size and Structure

One micron equals one thousandth of a millimeter.

	Source of Porosity	Pore Size	% Porosity
USGA Rootzone Mix	Space between particles	not available	35-55% (recommended)
Calcined D.E.	Natural Diatom	.1 to 1.0 microns	82%
Calcined Clay	Ceramic Processing	.01 to .1 microns	74%
Zeolites	Molecular Structure	.0001 microns	52%

Example: If we assigned a single pore of Zeolite a size of one square inch, then the following would be true:

Zeolite	single pore space	= 1 square inch
Calcined Clay	single pore space	= 100 square inches
Calcined Diatomaceous Earth	single pore space	= 70 square feet

Absorption, Bulk Density & Cation Exchange Capacity

	Absorption % wt. in H ₂ O	% of Absorp. Avail to Plant	Tapped Bulk Density lbs./c.f.	C.E.C. meq / 100 g
Sand	12	---	95	2
Zeolite	---	30	50	110
Calcined Clay	90	---	41	30
Calcined D.E.	142	94	26	27

Mineral Composition

	Sand	Calcined D.E.	Calcined Clay	Zeolite
SiO ₂	60-90%	90%	74%	64.7%
Al ₂ O ₃	varies	6.5%	12%	12.6%
Fe ₂ O ₃	varies	2.3%	5%	1.8%
K ₂ O			Trace	3.3%