

## Chemistry

# New properties from superficial changes 1 – mechanical properties

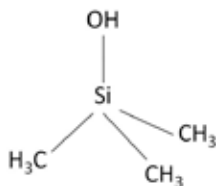
(Spain)

### Background:

Properties of so-called magical, kinetic sands compared with common sand are explored by performing simple experiments. The chemical composition of the sand does not vary, but by changing the chemical that the sand is coated with, it is possible to change its properties in a superficial way.

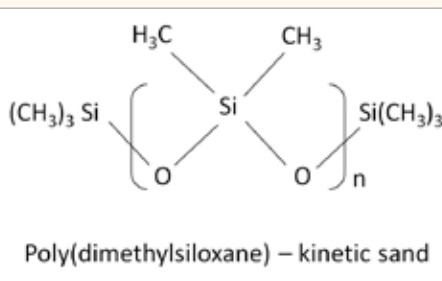
Various types of sand can be created for testing, using DIY instructions, details of which, including other areas of extension can be found here [bit.ly/SonS2019](http://bit.ly/SonS2019)

**MAGIC SAND:** The hair like molecules of trimethylhydroxysilane, repel water molecules. Submerged in water this creates a layer of air bubbles around the sand allowing water to run off the sand without wetting it. Magic sand was developed originally to use in oil spill clean-ups. It is known as Nano Sand outside of its use as a toy.



Trimethylhydroxysilane – magic sand

**KINETIC SAND:** Developed as a commercial sand moulding product, polydimethylsiloxane (PDMS) is the chemical coating that gives kinetic sand its superficial properties.



**PDMS** is a silicon-based organic polymer, known for its flow properties. The longer the polymer chain (the larger the n number), the greater its elasticity. PDMS is also present in shampoos (as dimethicone makes hair shiny and slippery), food (antifoaming agent), caulking, lubricants and heat-resistant tiles. Its food safety number is E900, and trace amounts can be found in fast food nuggets, as its antifoaming ability prevents oil spatter in cooking. It is also found in chips, milkshakes and smoothies.

### You will need:

- ✓ Dry sand
- ✓ Magic sand (or dry sand mixed with Scotchguard)
- ✓ Kinetic sand (or dry sand mixed with shaving foam)
- ✓ Water
- ✓ Four plastic plates (or large clock glasses)
- ✓ Knife

### Follow these steps:

1. Place roughly the same amount of dry sand onto two of the plastic plates.
2. Repeat for one plate each of magic sand and kinetic sand.
3. Add water to one plate of dry sand until soaked.
4. With your fingertips pinch the sand in each dish to test whether it holds its form when released.
5. Then test each sand sample by cutting a line through each.



### So what happened?

The elasticity or stickiness of the sands increases in the order dry sand, wet sand, magic sand, kinetic sand. The why of this is best demonstrated using a microscope camera, as hair like strands will be seen in increasing amounts. These binding strands occur because of the trimethylhydroxysilane and polydimethylsiloxane.

### What next?

- Dimethicone (a form of PDMS used in shampoo and skin moisturisers), or bees-wax spray can be used to form alternative water repellent sands, for comparison.
- Nature employs a number of hydrophilic compounds in a wide variety of situations: forest fires cause the rapid decomposition of organic material forming organic acids that coat soils, causing water to run off these soils rather than soak into them. As some plants require the intense heat of fires to cause germination, perhaps the prevention of water logging allows these plants to grow.

