CERAMIC AND GLASS INDUSTRY FOUNDATION

The Science of Silly Putty®

If you have played with Silly Putty®, you know how fun it can be! Silly Putty® can bounce like a rubber ball, break from a sharp blow, be stretched, and will flow into a puddle after a period of time. If you flatten it and press it over a comic or newspaper print, it will copy the image.

So how in the world can it do so many things? Is it a solid or is it a liquid? The most important compound in Silly Putty® is polydimethylsiloxane (PDMS). This is the simplest member of the polymer family known as the silicones.

PDMS is viscoelastic. This means that it acts like a viscous liquid and flows over long time scales. However, over short time scales (for example, being rolled into a ball and thrown at a hard surface), its behavior is elastic, and it will bounce back.

The presence of PDMS alone, and its viscoelasticity, doesn't fully explain how Silly Putty® behaves. Another ingredient, boric acid, also makes a telling contribution. The boric acid helps to create "crosslinks" between adjacent polymer chains. These help to give silly putty its putty-like nature, and also help explain its strange behavior.

The boric acid reversibly reacts with these to form short-lived crosslinks between polymer chains. Slow deformation gives these crosslinks time to break and reform, allowing viscous flow, but rapid, forceful deformation does not, so elastic behavior is instead seen.

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Let's experiment!

1. Remove your Silly Putty® from its package and form it into a nice round ball. Drop it onto a hard surface. What happens? It bounces back to you just like a rubber ball and demonstrates its elastic behavior.

2. Take that ball and stretch it. Does it bounce back to its original ball shape? No, it remains in its plastic deformed state and may even continue to slowly flow.

3. Roll the Silly Putty® back into a ball shape and flatten it. Securely grasp the putty in your two hands and quickly tear it apart by shearing. What happened? (Hopefully you tore it and not just stretched it--if not, move faster.) The Silly Putty® will fracture like a brittle material complete with fractured edges that look like broken glass.

4. Roll the Silly Putty® into a ball again and set it on the table top. What happens after several minutes? The Silly Putty® will flow like a very thick liquid.

You just experienced four major mechanical behavior types of Silly Putty®!

Learn more about ceramics, glass, and materials at ceramics.org/ceramicsarecool.

Demonstration originally developed by Missouri S&T, Materials Science & Engineering, http://mse.mst.edu

Source: www.compound.com