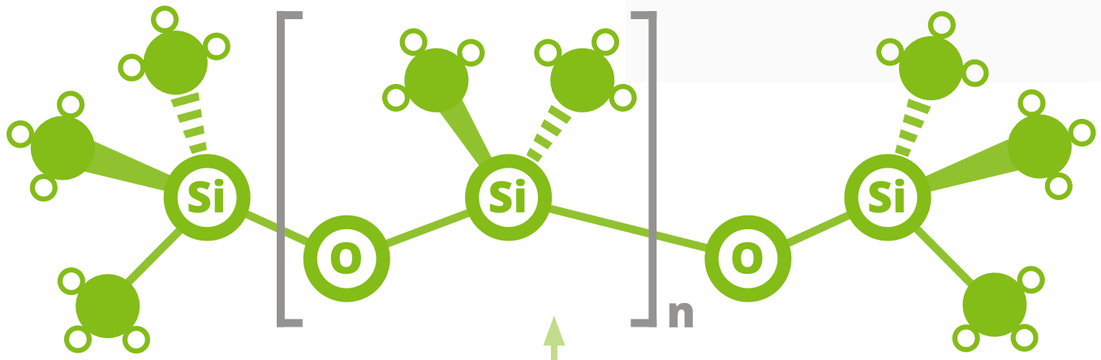
THE CHEMISTRY OF SILLY PUTTY

Silly putty is an odd substance – it can be slowly stretched out, but snaps if pulled apart with greater force. It can be molded into shape, but bounces if rolled into a ball. What's behind these strange properties? Here's a quick look at the chemical composition and explanation.

WHAT IS IT MADE OF?

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 behaviour is elastic, and it will bounce back.



A POLYDIMETHYLSILOXANE

(solid filled atoms represent carbon; smaller outlined atoms represent hydrogen)

At high molecular weights, the flexible polymer chains become loosely entangled, which contributes to PDMS's viscoelasticity.

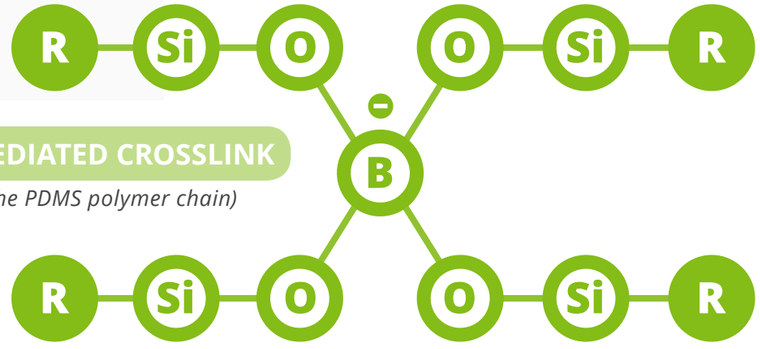
HOW DOES IT WORK?

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 behaviour.

EXAMPLE BORON-MEDIATED CROSSLINK

(R represents the rest of the PDMS polymer chain)



The polydimethylsiloxanes in silly putty end in Si-OH groups. 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 behaviour is instead seen.