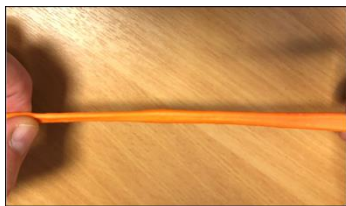


Discover Smart Materials



Shear thickening materials (D30)

Viscosity is a property of a fluid that describes how easily it flows. Low viscosity fluids (such as water) flow easily and higher fluids (such as honey) flow more slowly.



Stretch slowly



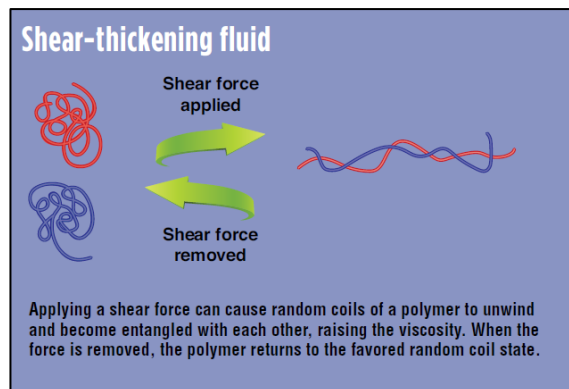
Stretch rapidly

D30 can flow easily (low viscosity) when stretched gently (low strain rate*) BUT get very stiff when suddenly stretched (a high strain rate*). This behaviour is known as a ‘non-Newtonian fluid’.

D30 is a polymer so is made of long, entangled molecules (a bit like spaghetti). When this material is stretched slowly, the polymer molecules slowly slide over each other and stretch. If they are stretched rapidly the polymer chains do not have time to disentangle and so they are more brittle and can snap.

This type of material is fantastic at absorbing shock and is used in **personal protective equipment**, such as elbow and knee protectors.

Shear thickening can be demonstrated by mixing corn flour (cornstarch) with water to make oobleck. Spoon can easily be drawn through this mixture slowly but gets stuck if you attempt to drag it through quickly.



<https://www.acs.org/content/acs/en/education/resources/highschool/chemmatters/past-issues/2016-2017/february-2017/no-hit-wonder-d30.html>

Curriculum Links

- ‘Core technical principles - Smart Materials’ (AQA GCSE Design and Technology, Section 3.1)

Learn more

- Find out more about Newtonian and non-Newtonian fluids: <https://tinyurl.com/5j4eju4a>
(<10 mins long)



- Find out how D30 can be used in crash helmets: <https://tinyurl.com/8f2a3w77>
(< 6mins long)

- D30 (the company website): <https://www.d3o.com/>

Try it in the classroom

You will need

- D30 protective armour ~£25 for a knee pad
- D30 phone case ~£23 per case



(e.g. <https://tinyurl.com/46h3mjoy4>)



(e.g. <https://tinyurl.com/wezeb287>)



- Science putty, ~£8 per pot
(e.g.: <https://tinyurl.com/38zbmja5>)



Please note we have not tested the brand of putty for which we have provided the link yet. The one we use (see the photo above) has been discontinued.

- Optional: Hammer



What to do

- Take the putty and gently stretch it – it will be very stringy and ductile
- Roll the putty back up
- Try to pull the putty apart as quickly as possible, it should snap
- Then take the D30 (phone case or knee pad) and show how flexible it is by gently bending it
- Hit the D30 onto the side of a table to show how rigid it is

'Show off' type demonstration (optional and perform with care!)

- If you like you can put an (old) mobile phone in the D30 phone case and throw it on the floor or hit it with a hammer.
- Make a bridge out of the putty and put your finger under it and then hit the bridge with the hammer – THIS IS DONE AT YOUR OWN RISK!

!!Risks – Impact injuries if using the demonstration with a hammer and your finger

Homework ideas

- In advance of this demonstration task the students with making a mixture of cornflour and water at home (e.g. <https://www.instructables.com/Oobleck/>) in order to lead into a discussion about shear thickening materials.

The future is what you make it, but it is also what you make it out of

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