Non-Newtonian fluid

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Non-Newtonian fluid

A **Non-Newtonian fluid** is a fluid whose flow (**viscosity**) properties differ from those of Newtonian fluids, described by Sir Isaac Newton.

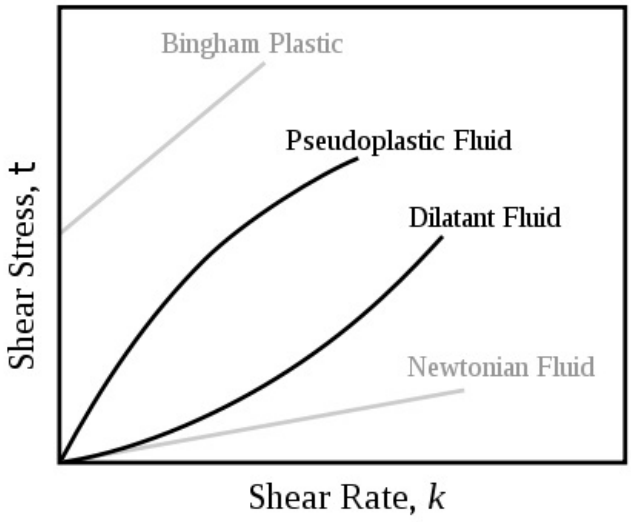
Newtonian fluid VS Non-Newtonian fluid

Two types of fluids exist: **Newtonian fluids** and **Non-Newtonian fluids**.

Newtonian fluids[1] (http://www.wikilectures.eu/index.php?title=Newtonian_fluid&action=edit&redlink=1)[2] (http://en.wikipedia.org/wiki/Newtonian_fluid) have a constant viscosity (flow). Viscosity, measures a fluids ability to resist gradual deformation by shear or tensile stresses, in other words, is a propriety that measures how easily a fluid move: if a fluid has high viscosity, then the fluid will move slower; if a fluid has low viscosity, then it will move faster. For example: fluids like water, have lower viscosity unlike fluids such as honey or syrup.

For *Newtonian fluids*, changing the force you apply to the fluid will not change their viscosity. The viscosity remains constant as the force applied changes.

Non-Newtonian fluids have viscosities that change according to the amount of force that is applied upon the fluid. The viscosity changes as the force applied changes.



Types of Non-Newtonian fluid behaviour

Usually, the viscosity of non-Newtonian fluids is dependent on shear rate or shear rate history, or their viscosity is shear independent but still exhibit normal stress-differences or other Non-Newtonian behavior.

In science, stress means that a force is applied to a body. The result of that stress is described as strain.

In a *Newtonian fluid* the relation between shear stress and the shear rate is linear, passing through the origin, the constant of proportionality being coefficient of viscosity.

In a *Non-Newtonian fluid* the relation between the shear stress and the shear rate is different and can even be time-dependent (Time Dependent Viscosity) - a constant coefficient of viscosity cannot be defined for Non-Newtonian fluids as its possible for Newtonian fluids.

In case of the Non-Newtonian fluids, the concept of vicosity usually used in fluid mechanics to characterize the shear proprieties of a fluid is not quite adequate. Instead, they are studied best through several other rheological proprieties that relate to stress and strain rate tensors under many different flow conditions which are measured using different devices or rheometers.

Comparating Viscoelastic, Non-Newtonian and Newtonian proprieties we can observe:

Viscoelastic	Kelvin material, Maxwell material	"Parallel" linearstic combination of elastic and viscous effects	Some lubricants, whipped cram, Silly Putty
Time Dependent Viscosity	Rheopecty	Aparrent viscosity increases with duration of stress	Printer ink, gypsum parte
	Thixotropic	Apparent viscosity decreases with duration of stress	Yogurt, xanthan gum solutions, aqueous iron oxide gels, gelatin gels, pectin gels, synovial fluid, hydrogenated castor oil, some clays, carbon black suspension in molten tire rubber, some drilling muds, many paints, many colloidal suspensions
Time-independent viscosity	Shear thickening (Dilantant)	Apparent viscosity increases with increased stress	Suspensions of corn starch in water (Oobleck), sand in water
	Shear thinning (Pseudoplastic)	Apparent viscosity decreses with increased stress	Nail polish, whipped cream, ketchup, syrups, paper pulp in water, latex paint, ice, blood, some sillicone oils and some sillicone coatings
	Generalized Newtonian fluids	**Viscosity is constant**. Stress depends on normal and shear strain rates and also the pressure applied on it	Blood plasma, custard, water

Understanding the behaviour of non-Newtonian fluids has important applications:

• Prevent disasters - planning the place to construct a house or building depending on the soil of the terrain

• Safety - creating body vest / armours that behave like non-Newtonian fluids for Police or Military uses

• Medicine - understand more about our body and improve health tecniques

Examples

- Foods: ketchup, mayonnaise, soup, butter, jam, yogurt
- Natural substances: magma, lava, extracts and gum
- Biological fluids: blood, saliva, semen, mucus, synovial fluid
- Slurries
- Emulsions
- Dispersions
- Oobleck
- Flubber

Links

Portal:Questions_for_final_examination_in_biophysics_(2._LF_UK,_GM)

Related Articles

Newtonian fluid

Viscosity

Blood flow

Bibliography

Amler E. et al. Chapters from Biophysics. Published by the Institute of Biophysics, Charles University in Prague, 2nd Faculty of Medicine, Praha, 2006 ISBN 80-239-8173-0 [1] [2] [3] [4] [5] [6] [7] [8] [9] [10] [11] [12]

1. http://commons.wikimedia.org/wiki/File:Non-Newtonian_fluid.svg?uselang=pt-br
2. http://www.wikilectures.eu/index.php/Newtonian_fluid
3. http://imaginationstationtoledo.org/content/2010/12/oobleck-a-non-newtonian-substance/
4. http://www.math.ubc.ca/~njb/Research/non-newtonian.htm
5. http://sciencelearn.org.nz/Science-Stories/Strange-Liquids/Non-Newtonian-fluids
6. http://antoine.frostburg.edu/chem/senese/101/liquids/faq/non-newtonian.shtml
7. http://www.ncbi.nlm.nih.gov/pubmed/22862282

7. http://www.ncbi.nlm.nih.gov/pubmed/23863283
8. https://www.youtube.com/watch?v=DQoelYi6qfw
9. https://www.youtube.com/watch?v=l2z3LKpMGo0
10. https://www.youtube.com/watch?v=bLiNHqwgWaQ
11. https://www.youtube.com/watch?v=D-wxnID2q4A
12. https://www.youtube.com/watch?v=D2aB3nCmIII

References

[1] [2] [3] [4] [5] [6] [7] [8] [9] [10] [11] [12]

1. http://commons.wikimedia.org/wiki/File:Non-Newtonian_fluid.svg?uselang=pt-br
2. http://www.wikilectures.eu/index.php/Newtonian_fluid
3. http://imaginationstationtoledo.org/content/2010/12/oobleck-a-non-newtonian-substance/
4. http://www.math.ubc.ca/~njb/Research/non-newtonian.htm
5. http://sciencelearn.org.nz/Science-Stories/Strange-Liquids/Non-Newtonian-fluids
6. http://antoine.frostburg.edu/chem/senese/101/liquids/faq/non-newtonian.shtml
7. http://www.ncbi.nlm.nih.gov/pubmed/23863283
8. https://www.youtube.com/watch?v=DQoelYi6qfw
9. https://www.youtube.com/watch?v=l2z3LKpMGo0
10. https://www.youtube.com/watch?v=bLiNHqwgWaQ
11. https://www.youtube.com/watch?v=D-wxnID2q4A
12. https://www.youtube.com/watch?v=D2aB3nCmIII