Rheology

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What is Rheology

- Rheology is the study of deformation and flow.
- Oil and water flow in familiar, normal ways, whereas mayonnaise, peanut butter, and chocolate flow in complex and unusual ways.

- In rheology, we study the flows of unusual materials.
- When you open a partly used jar of mayonnaise, the top surface retains the shape created by the last person who made a sandwich.

- Well, compare that observation with the behavior of honey. The top surface of honey in a jar is always smooth. Within a few seconds of serving yourself from a honey jar, the surface is flat again

Importance of Rheology in Pharmacy

- In preparation, development and evaluation of pharmaceutical dosage forms e.g., suspensions, emulsions, pastes, suppositories, tablets coating, …., etc.

- Mixing and Flow of materials, Packaging into containers and their removal prior to use in respect to Pouring from bottle, extrusion from tube, passage from syringe

FORMULA AND UNITS

- $\eta = F/G$

Where η is viscosity

F is shear stress

G is rate of shear

Unit in CGS dy.sec/cm2

Unit in SI Ns/m2

Generally used unit is poise

Classification of Materials according to the types of flow

1) Newtonian Systems

They obey Newton's law of flow.

Example: Water, Ethanol, Benzene.

2) Non-Newtonian Systems

They fail to follow Newton's law of flow.

Examples: Colloidal Solutions, Emulsions, Liquid Suspensions, Gels and Ointments.

Newtonian system

They have constant viscosity where

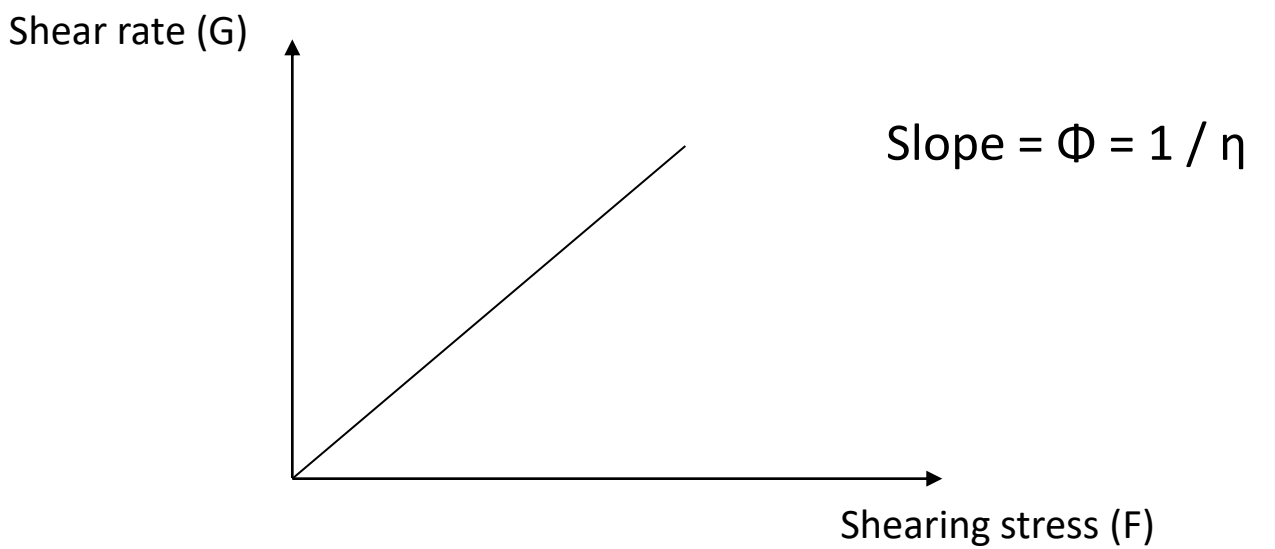
$$\eta = F / G.$$

- When we plot a rheogram of G against F, then a straight line is obtained passing through the origin, the slope of which is equal to the reciprocal of viscosity, a value referred to as **the fluidity Φ**,

$$\Phi = 1 / \eta$$

- Newtonian systems like water, simple organic liquids, true solutions and dilute suspensions and emulsions.

Rheogram of a Newtonian liquid



NON-NEWTONIAN SYSTEMS

- Do not follow the simple Newtonian relationship i.e., when F is plotted against G the rheogram is not a straight line passing through the origin i.e., viscosity is not a constant value.

- Such as colloidal dispersions, concentrated emulsions and suspensions, ointments, creams, gels, etc.

- These rheograms represents three types of flow:

1. Plastic
2. Pseudoplastic
3. Dilatant.