

METHODS FOR DETERMINATION OF VISCOSITY

DR. SHASHI KIRAN MISRA

Viscometer

Single/One point:

At a single rate of shear one point on the curve

Multipoint:

Several rates of shear many points on the curve

Equipment:

- 1) Ostwald viscometer
- 2) Falling sphere viscometer

Equipment:

- 1) Cup and bob
- 2) Cone and plate

Applications:

- Newtonian fluids

Applications:

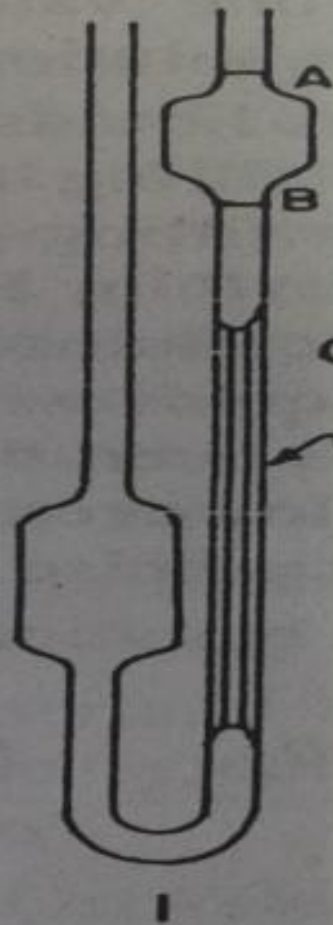
- Non-Newtonian fluids
- Newtonian fluids

“One point” instruments

- Provide a single point on the rheogram.
- Extrapolation of a line through this point to the origin will result in the complete rheogram.
- Used for Newtonian fluids.
- Since the rate of shear is directly proportional to the shearing stress.
- The capillary and falling sphere are for use only with Newtonian materials.

Ostwald Viscometer

Ostwald viscometer



Suspended level viscometer

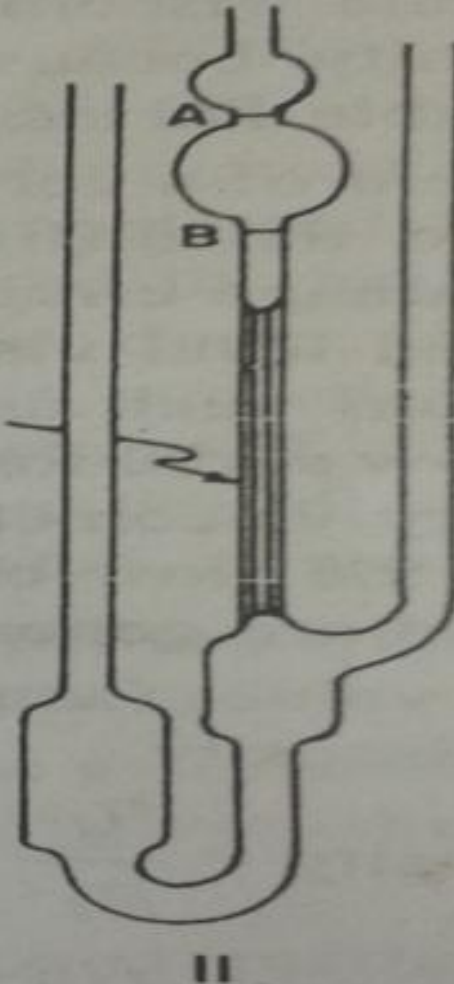
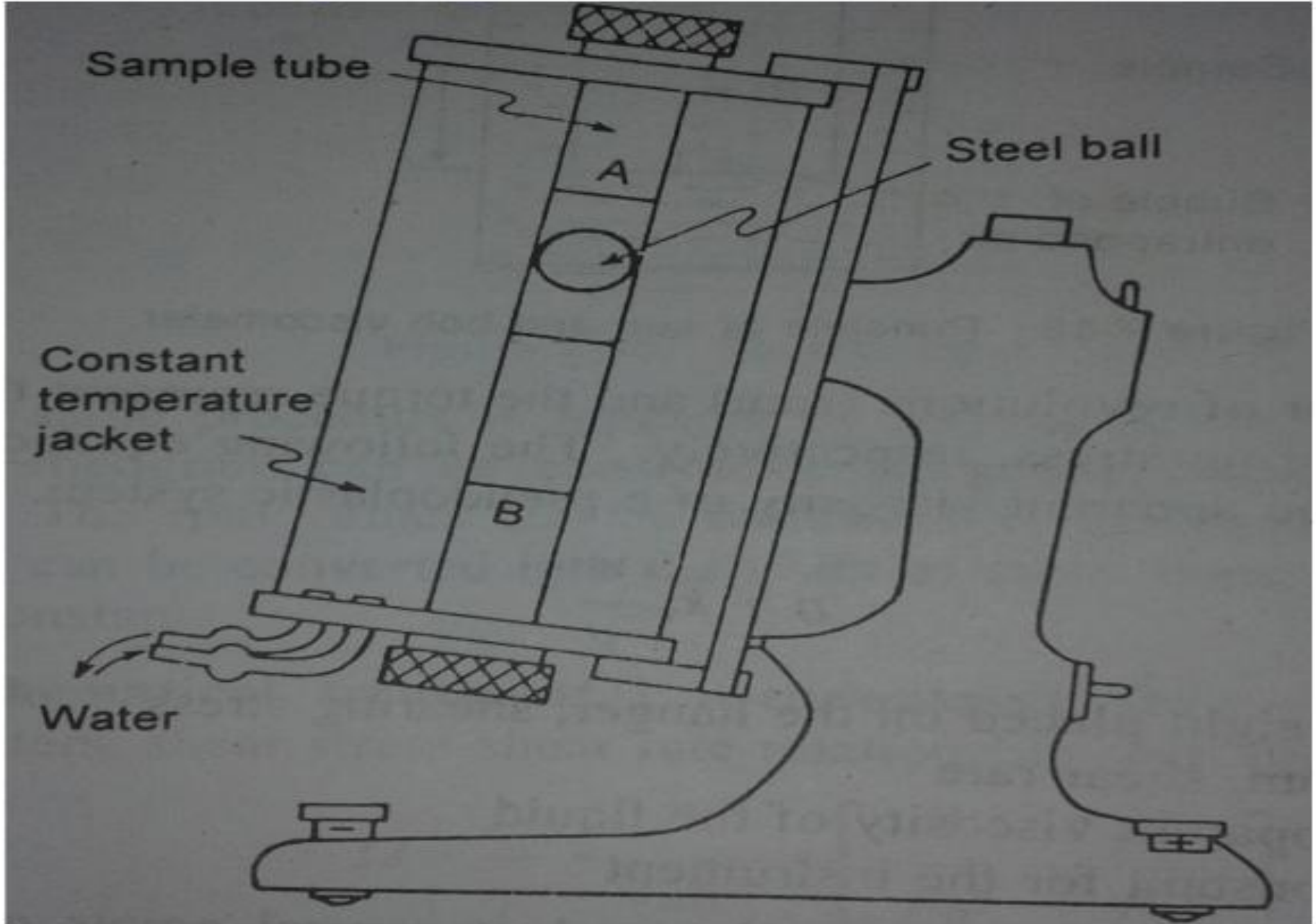


Figure 7-16. Capillary viscometers. Ostwald viscometer (I) and suspended level viscometer (II).

- Ostwald viscometer is used to determine the viscosity of a Newtonian liquid. Both dynamic and kinematic viscosities can be obtained.
- When a liquid flows by gravity, the time required for the liquid to pass between two marks (A and B shown in Figure) through a vertical capillary tube is determined.

Falling Sphere Viscometer



Falling Sphere Viscometer

The sample & ball are placed in the inner glass tube & allowed to reach temperature equilibrium with the water in the surrounding constant temperature jacket.

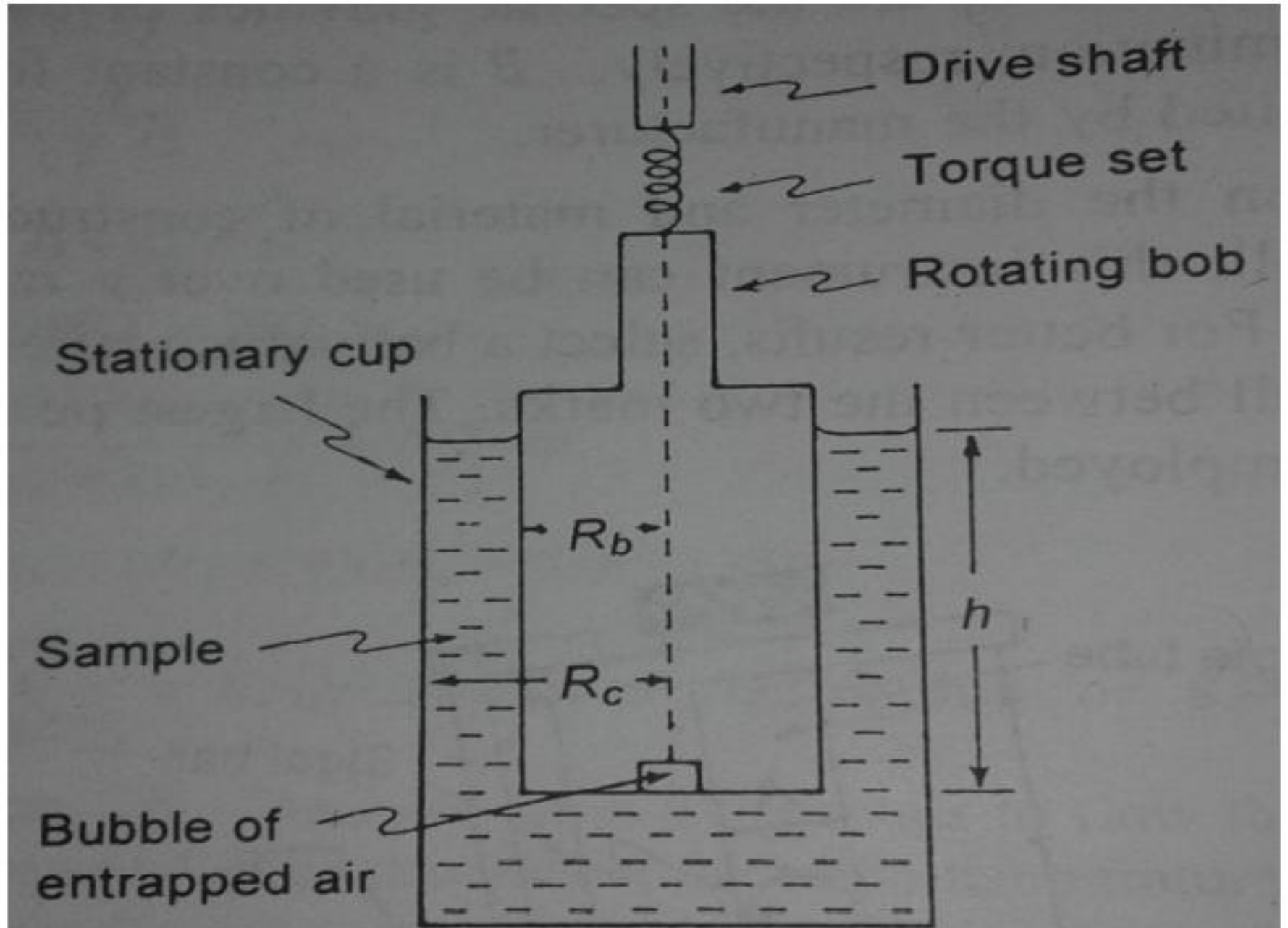
The tube & jacket are then inverted, which effectively places the ball at the top of the inner glass tube.

The time for the ball to fall between two marks is accurately measured & repeated several times.

“Multi-point” instruments

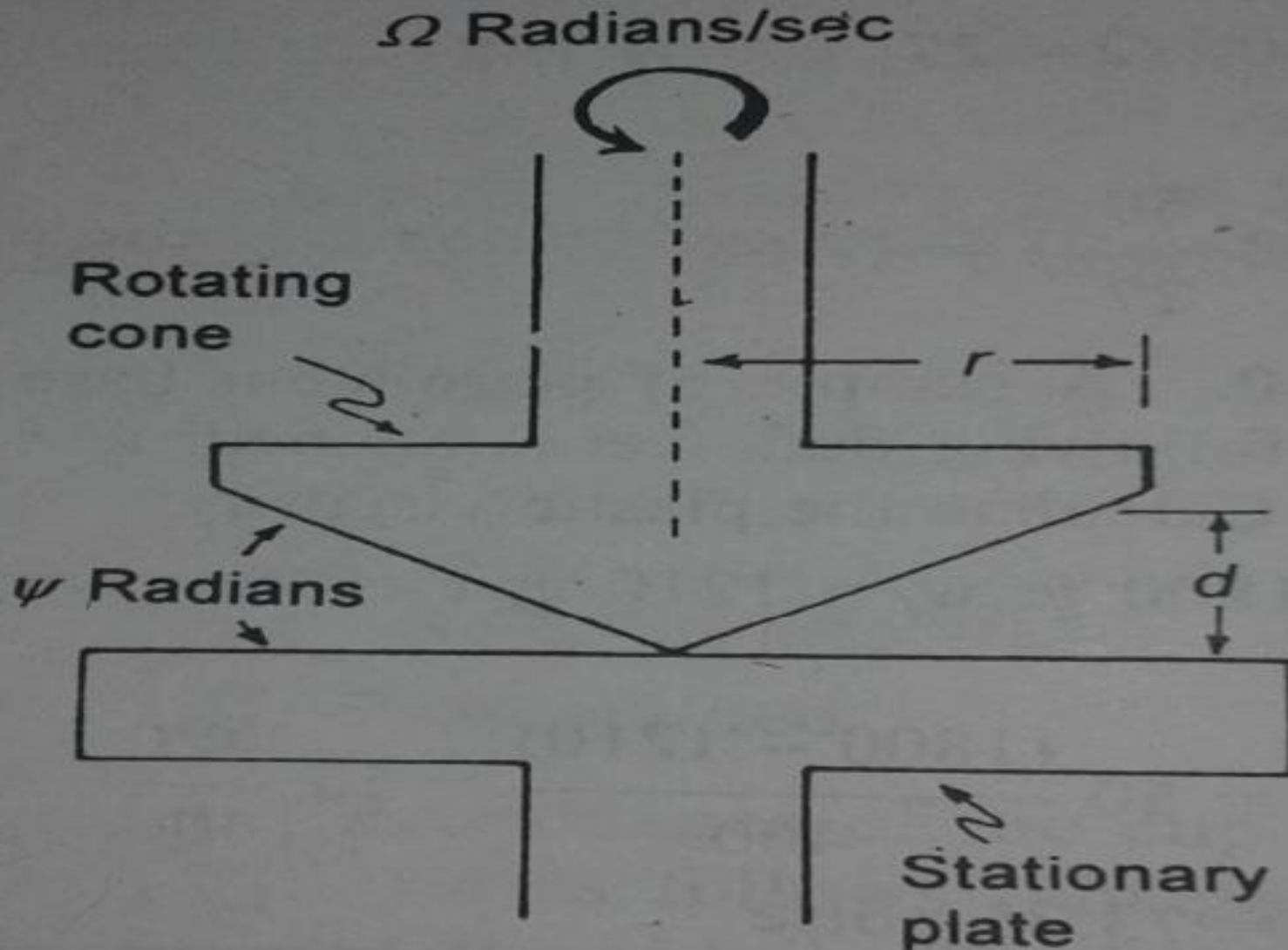
- Used with non-Newtonian systems.
- The instrumentation used must be able to operate at a variety of rates of shear.
- Cup and Bob , Cone and Plate viscometers may be used with both types of flow system.

Cup and Bob Viscometer



- This is a multipoint viscometer and belongs to the category of rotational viscometers.
- The sample is placed in the cup and the bob is placed in the cup up-to an appropriate height.
- The sample is accommodated between the gap of cup and bob.
- Cup or bob is made to rotate and the torque (shearing stress) from the viscous drag is measured by a spring or sensor in the drive of the bob.

Cone and Plate Viscometer



- The sample is placed at the center of the plate which is then raised into position under the cone.
- The cone is driven by a variable speed motor & the sample is sheared in the narrow gap between the stationary plate and the rotating cone.
- The rate of shear in rev./min. is increased & decreased by a selector dial & the torque (shearing stress) produced on the cone is read on the indicator scale.
- A plot of rpm or rate of shear versus scale reading (shearing stress) may be plotted.

Pharmaceutical Applications

1. The viscosity of creams and lotions may affect the rate of absorption of the products by the skin.
2. A greater release of active ingredients is generally possible from the softer, less viscous bases.
3. The viscosity of semi-solid products may affect absorption of these topical products due to the effect of viscosity on the rate of diffusion of the active ingredients.
4. The rate of absorption of an ordinary suspension differs from thixotropic suspension.
5. Thixotropy is useful in the formulation of pharmaceutical suspensions and emulsions. They must be poured easily from containers (low viscosity)

Viscoelasticity

- Viscoelasticity is the property of materials that exhibit both viscous and elastic characteristics when undergoing deformation. Viscous materials, like honey, resist shear flow and strain linearly with time when a stress is applied.