**SOME RHEOLOGICAL MODELS**











Generalized Model

****

* *For Power-law fluids*

****

**FLOW OF FLUIDS IN PIPES**

**Main Equation**



**Pressure loss in straight pipes for different fluids**

1. Newtonian Fluid()(Hagen-Poiseuille Equation)

****

1. Power Law Fluid ()



1. Bingham Fluid ()

**** If 

**** If 

**Shear stress and shear rate at the all for power-law fluids**

****



**Friction Factor Concept**

****

****

**** *Laminar Flow*

****

**Velocity Profiles**

* *Newtonian Fluids*

****

****

**

**

* *Power-law fluids*

****

****



****

**Balance of Mechanical Energy**



****

**Correlations useful to estimate kinetic energy changes**

|  |  |
| --- | --- |
| **Fluid** |  |
| **Newtonian** | 1 |
| **Power-Law** |  |
| **Bingham** |  |
| **Herschel-Bulkley** |  |
|  |

**ROTATIONAL VISCOMETRY**

**CONCENTRIC-CYLINDERS**

* **Newtonian/Non-Newtonian Fluids**











where m is the slop of a log  versus log M plot





* **Plastic Fluids (Bingham)**

If  and (all the sample in the gap is sheared)









If (sheared and non-sheared regions exist)







**CONE AND PLATE**

****

****

**PARALLEL PLATES**

* For any fluid

****

****

****

* For Power Law and Newtonian fluids







**VISCOELASTICITY**

* Dashpot (fluid element)



* Spring (elastic element)



* Maxwell element





* Kelvin-Voigt element



**TRANSIENT TESTING**

**Relaxation Test – Maxwell Model**

 Stress Relaxation

 Relaxation Modulus

**Relaxation Test – Generalized Maxwell Model**

 Stress Relaxation

 Relaxation Modulus

**Creep Test – Kelvin-Void Model**







**Creep Test – Burger Model**









**OSCILLATORY TESTING**

**** Strain

**** Stress

**** Phase Angle

**** Storage Modulus

**** Loss Modulus

**** Complex Modulus

**** Dynamic Viscosity

**** Out of phase **v**iscosity

**** Complex Viscosity

**** Complex Viscosity

**** Complex Compliance

**** Storage Compliance

**** Loss Compliance

**Maxwell Model under Oscillatory Testing**

Storage Modulus G’



Loss Modulus G”



**Generalized Maxwell with N elements under Oscillatory Testing**

Storage Modulus G’



Loss Modulus G”

