The Brookfield viscometer measures the torque required to rotate the selected spindle in a fluid. This torque value is directly related to the viscosity of a fluid. The viscosity of a fluid can be described as the internal friction of a fluid. This friction is apparent when a layer of fluid is made to move in relation to another layer. As this friction or torque value increases, the amount of force required to cause this movement also increases. This force is also known as “shear”. Shearing occurs when the fluid is moved. Examples of shearing occurring in fluids includes pouring, spreading, spraying, mixing, etc. Each of these are common practices used in industry, hence the importance of understanding the rheological properties of fluids. The equation below was developed by Newton and is used to calculate the viscosity of a fluid:

$$\eta = \frac{\tau}{\dot{\gamma}} = \frac{F/A}{\frac{dv}{dx}} = \frac{shear\ stress}{shear\ rate}$$

Where F/A is the force per unit area required to produce the shearing action and dv/dx is the measure of the change in speed at which the intermediate layers move in respect to each other.

Additionally, for the Brookfield rheometers, the following equations can be used to calculate the shear stress and shear rate.

Shear Stress

$$\tau = \frac{M}{2\pi R_b^2 L}$$

Where M is the torque input by the instrument, R_b is the radius of the spindle, and L is the effective length of the spindle.

The shear rate equations will vary depending on if the Small Sample Adapter configuration is used or not.

Shear Rate for Small Sample Adapter

$$\dot{\gamma} = \frac{2\omega R_c^2}{R_c^2 - R_b^2}$$

Shear Rate for all other spindles

$$\dot{\gamma} = \frac{2\omega R_c^2 R_b^2}{x^2(R_c^2 - R_b^2)}$$

Where ω is the angular velocity of the spindle, R_c is the radius of the container, and x is the radius at which the shear rate is being calculated.

*R_c should not exceed $2R_b$ for a well-defined shear rate.