Introduction of OpenFoam 12 Programming:

1. Scaled Viscosity Power Law

2. Custom Boundary Condition

3. Scalar Transport

Viscosity:

The **viscosity power law**, often referred to as the **power law model** or the **Ostwald-de Waele relationship**, is a mathematical framework used to describe the flow behavior of **non-Newtonian fluids**—fluids whose viscosity changes with the applied shear rate. Unlike **Newtonian fluids** (e.g., water, air), which have a constant viscosity regardless of the shear rate, non-Newtonian fluids exhibit varying viscosity based on the deformation rate they experience.

The viscosity power law is typically expressed by the following equation:

$$\tau = K \cdot (\dot{\gamma})^{n-1}$$

where:

- **τ** (tau) = Shear stress (force per unit area) applied to the fluid.
- **γ˙** (gamma) = Shear rate (the rate at which adjacent layers of fluid move relative to each other).
- **K** = Flow consistency index (a measure of the fluid's viscosity).
- **n** = Flow behavior index (dimensionless parameter indicating the type of fluid behavior).

Interpretation of Parameters

- **Flow Consistency Index (K)**:
    - Represents the viscosity of the fluid at a shear rate of 1 s^{-1}.
    - Higher KKK values indicate a thicker (more viscous) fluid.
- **Flow Behavior Index (n)**:
    - **n=1**: The fluid behaves as a Newtonian fluid with constant viscosity.
    - **n<1**: The fluid is **shear-thinning** (pseudoplastic), meaning its viscosity decreases with increasing shear rate. Examples include ketchup, blood, and many polymer solutions.
    - **n>1**: The fluid is **shear-thickening** (dilatant), meaning its viscosity increases with increasing shear rate. Examples include certain suspensions like cornstarch in water.

Custom power law:

The custom viscosity power law model is defined by the following equation:

$$\tau = K \cdot (\dot{\gamma})^{\frac{n-1}{S}}$$

where:

- **τ** = Shear stress (force per unit area) applied to the fluid.
- **γ˙** (gamma) = Shear rate (the rate at which adjacent layers of fluid move relative to each other).
- **K** = Flow consistency index (a measure of the fluid's viscosity).
- **n** = Flow behavior index (dimensionless parameter indicating the type of fluid behavior).
- **S** = Scaling factor (dimensionless parameter introduced to modify the exponent).