**Viscoplastic Herschel Bulkley**

**Model Definition:**

This model is useful for modeling fluids that are both shear-thinning and has a yield-stress .

The model is defined by the equation:

Where:

* Yield Stress:
* Consistency Index:
* Flow behavior index:
  + for shear-thinning behavior
  + for shear-thickening behavior
  + for Newtonian behavior
* Shear Rate:

**Fluid Definition:**

We chose a fluid based on work described in “Creeping sphere motion in Herschel–Bulkley fluids: flow field and drag” by Atapattu, Chhabra, and Uhlherr (1995). This paper analyzes different grades and concentrations of Carbopol resin. Specifically, we chose formulation *S-12*, described in Table 1, below.

A table with numbers and symbols

AI-generated content may be incorrect.

*Note: The authors of the paper defined the consistency index as , but we will be using in our analysis.*

Herschel-Bulkley Model Parameters

Fluid *S-12* has:

* Yield stress:
* Consistency index:
* Flow behavior index:

Geometry Parameters:

* Sphere Radius:
* Sphere Diameter:
* Sphere Projected Area:

Fluid Parameters:

* Characteristic Shear Rate:
* Characteristic Effective Viscosity:
* Reynold’s Number:
* Modified Reynold’s Number (Power Law):
* Bingham Number:
* Literature Comparison Parameter:

**Ansys CFD Modeling:**

When modeling in Ansys, we also need to define a Critical Shear rate as 0.01. This is a user-defined variable for avoiding singularities and ensuring numerical stability in regions of low deformation rates.

Each variation of the model for different Reynold’s numbers ran for 100 iterations to ensure stable residuals for continuity, and x- and y- velocities.

**Results**