

ABE 457
Spring 2018
Homework #3

Due: 2/02/18

1. Torque measurements were made in a coaxial cylindrical viscometer with stationary outer cylinder. The sample is tomato ketchup. The radii of the inner and outer cylinders are 0.015 m and 0.02 m respectively. The length of the cylinder is 0.25 m. Torque measurements were made for different rotational speeds of the inner cylinder. The data is given below. The sample has an yield stress. Therefore, the yield torque of the sample is obtained by rotating the inner cylinder at the smallest speed, disconnecting the power and letting the torque indicator become stable. The yield torque is measured to be 3.534×10^{-4} N.m.

Rpm	Torque (N.m)
2	0.011
5	0.021
10	0.034
20	0.056
50	0.106
100	0.172
200	0.279
500	0.53

- (i) Determine the yield stress
 - (ii) Convert torque to wall shear stress at the inner cylinder
 - (iii) Determine the flow behavior index of the sample
 - (iv) Convert the rotational speed to wall shear rate at the inner cylinder
 - (v) Determine the consistency index for the fluid assuming the model of power law with yield stress
2. Following is the experimental data of rpm versus torque for a sample in a concentric cylinder viscometer. The radius of the inner cylinder is 1 cm and the radius of the outer cylinder is 1.05 cm with the inner cylinder rotating. The effective length of the cylinder can be taken as 5cm. The fluid can be assumed to be power law fluid without yield stress.

RPM	Torque (N.m)
0.1	6.55×10^{-7}
0.5	1.72×10^{-6}
1	2.61×10^{-6}
5	6.85×10^{-6}
10	1.04×10^{-5}

- (i) Convert torque to wall shear stress
- (ii) Convert RPM to wall shear rate
- (iii) Evaluate the rheological parameters of the fluid