

Dishwasher Detergent Viscosity Analysis

Understanding the viscosity of dishwasher detergent is crucial for its effective performance. Viscosity impacts how the detergent flows, mixes, and disperses within the dishwasher, influencing cleaning efficiency, coverage, and user satisfaction.

Method 1:

Test Equipment:

- Instrument: DVNX Rheometer
- Spring Torque: HB
- Spindle: HB-3
- Speed Settings: 5, 10, 50, 90, 130, 170, 210, and 250 RPM
- Temperature: Room Temperature (70°-72°F or 25°C)

Test Method:

- Used Brookfield DVNXHB Rheometer with Rheocalc software for automated control.
- Three trials were run using new samples each time to ensure repeatability.



Data Observations:

- Figure 1: Shows "shear-thinning" behavior (viscosity decreases as shear rate increases).
- All three curves overlapped, demonstrating excellent repeatability.

Method 2:

Test Equipment:

- Instrument: DVNX Rheometer
- Spring Torque: HA
- Spindle: SC4-27 with 13RPY Sample Chamber
- Accessories: Small Sample Adapter, TC-550AP Programmable Refrigerated Bath
- Speed Settings: 10 to 220 RPM
- Temperature: 21°C

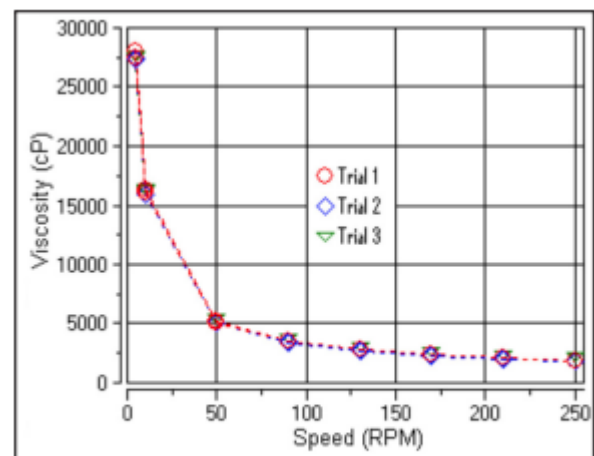


Figure 1: Dishwasher Detergent at 70°-72°F.
Viscosity vs. Rotational Speed

Test Method:

- Brookfield DVNXHA Rheometer used with Rheocalc software; temperature maintained at 25°C using a refrigerated bath.
- Smaller sample size (10.4 mL) tested with a syringe for accuracy.

Data Observations:

- Figure 2: Confirms "shear-thinning" behavior; results were repeatable across tested shear rates.

Method 3:

Test Equipment:

- Instrument: DVNX Rheometer
- Spring Torque: RV
- Spindle: V-73 Vane Spindle
- Speed: 1 RPM
- Temperature: Room Temperature (70°-72°F)

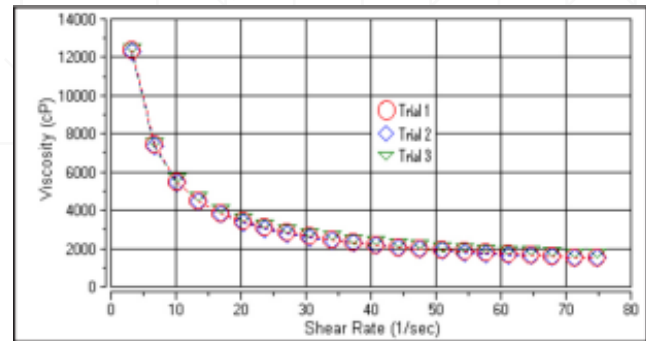


Figure 2: Dishwasher Detergent at 25°C Viscosity vs. Rotational Speed

Test Method:

- Used DVNX Rheometer with EZ-Yield software for yield stress testing.
- Yield stress identifies the force needed to start material flow; stiffness determined by slope of stress-strain curve.

Data Observations:

- Figure 3: Displays stress (Pa) vs. apparent strain (rad); maximum yield stress around 37 Pa.

Figures:

- Figure 1: Viscosity vs. Rotational Speed at 70°-72°F, showing "shear-thinning" behavior.
- Figure 2: Viscosity vs. Rotational Speed at 25°C, confirming "shear-thinning."
- Figure 3: Stress vs. Apparent Strain at 70°-72°F, illustrating yield stress and stiffness.

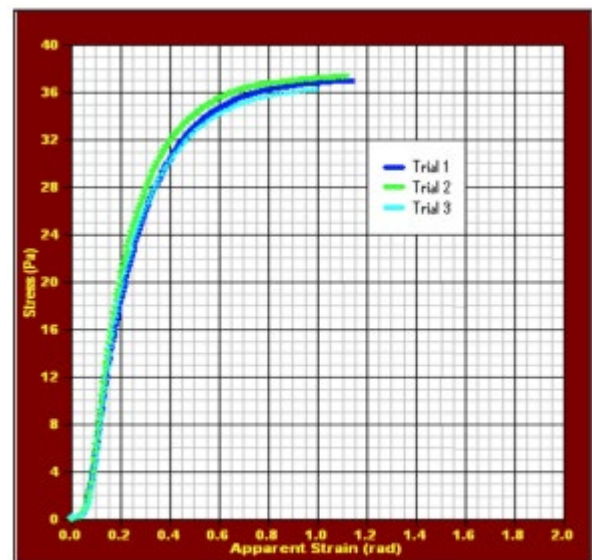


Figure 3: Dishwasher Detergent at 70°-72°F. Viscosity vs. Rotational Speed