

Pharmaceutical Ointment Viscosity Analysis

Testing the rheological properties of pharmaceutical ointments is essential to ensure they meet consumer expectations for both thickness when at rest and ease of application. High viscosity at low shear rates prevents the ointment from flowing away from the intended area, while shear-thinning behavior ensures easy spreadability when applied. Measuring yield stress and shear-thinning behavior with a small sample volume allows for precise formulation adjustments.

Background:

Pharmaceutical ointments are formulated to:

- Exhibit high viscosity at rest to stay on the application site.
- Display shear-thinning behavior, allowing easy application.
- Yield stress and thixotropy are key properties, measurable through controlled shear tests.



Equipment:

- Rheometer: DVNext Cone/Plate
- Spindle: Cone Spindle CPA-40 for low to high shear rate measurements
- Temperature Control: Brookfield TC-550 Circulating Refrigerated Water Bath for accurate temperature management of the sample plate
- Sample Volume: Requires only 0.5 mL of ointment

Settings:

- Shear Rate Ramp: 37 sec^{-1} to 375 sec^{-1} , then back down
- Test Duration: 6.5 minutes

Procedure:

1. Prepare the DVNext Cone/Plate Rheometer with CPA-40 cone spindle.
2. Connect the TC-550 Circulating Refrigerated Water Bath to control the temperature of the sample plate.
3. Apply 0.5 mL of the ointment sample onto the rheometer plate.
4. Conduct a programmed shear rate ramp from 37 sec^{-1} to 375 sec^{-1} , then back to the starting rate over 6.5 minutes.
5. Record viscosity data throughout the shear ramp to observe shear-thinning behavior and any thixotropic response.

Observations:

- Figure I: Viscosity profiles of two ointments under shear rate ramp show:
 - Both samples exhibit shear-thinning behavior.
 - Sample #1 demonstrates a significant drop in viscosity due to shearing (high thixotropy), while Sample #2 shows only minor viscosity loss.

Results:

- Sample #1 has a greater loss of viscosity under shear, indicating higher thixotropy.
- Sample #2 maintains viscosity better under shear, suggesting a more stable structure.

Discussion:

- Thixotropy and yield stress values allow manufacturers to adjust ointment formulations to achieve desired application characteristics. Using the DVNext Cone/Plate with RheocalcT software, the data can be fitted to rheological models (e.g., Bingham model) to determine yield stress and plastic viscosity, guiding formulation adjustments to meet product performance standards.

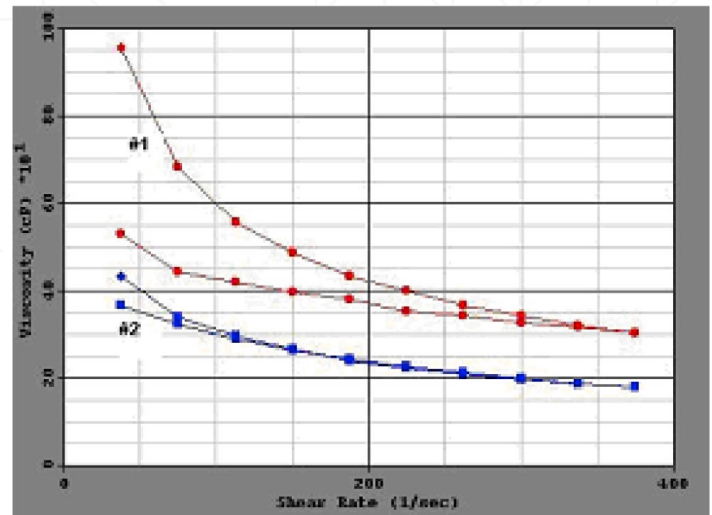


Figure I

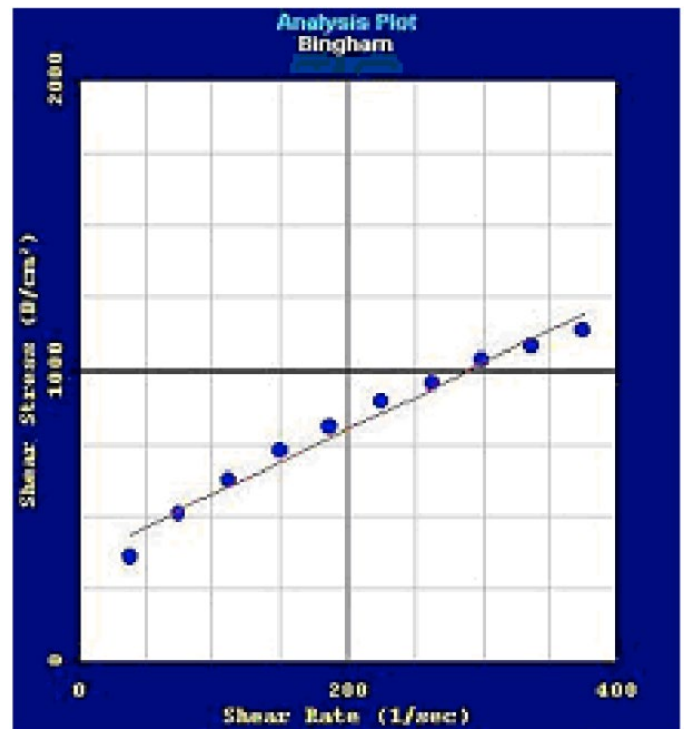


Figure II: Bingham Math Model