

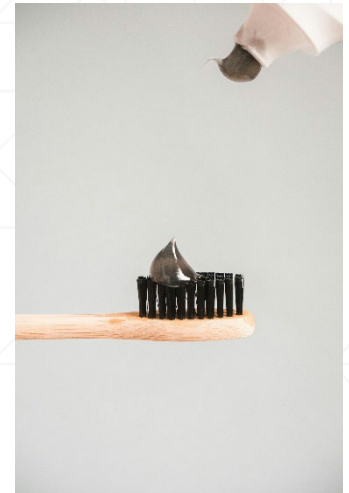
Viscosity of Toothpaste

Toothpaste is a viscous paste, that allows the active ingredients of the toothpaste to absorb deeply into the periodontal pocket or gums. The most acceptable forms are the toothpaste that can be easily extruded from the package, stays stiff enough to remain on the toothbrush, foams adequately, and has the most palatable and refreshing taste. The study of the flow behavior of the toothpaste ensures that it is not too hard to squeeze out of the tube and not too runny not to stay on the brush. Viscosity plays a particularly important role in the makeup of toothpaste.

To study the flow behaviour, viscosity, and yield stress of several types of toothpaste available in the market using the RSX CPS Rheometer with Rheo3000 software.

Measuring the texture of toothpaste is crucial for several reasons:

- Directly impacts consumer satisfaction by influencing mouthfeel and perceived effectiveness, as certain textures can enhance the cleaning experience.
- Consistent texture measurements ensure product quality and batch uniformity, preventing recalls and complaints.
- Understanding texture also aids in optimizing formulations, ensuring ingredient interactions yield the desired consistency and performance.
- Maintaining appropriate texture is crucial for regulatory compliance and ensuring the toothpaste is easy to dispense and spread.
- Texture measurement is vital for product development, quality control, and consumer satisfaction.
- The toothpaste available on the market is either in gel form, soft paste form, or paste form with natural ingredients making it slightly granular in mouth feel.



Four different market samples of toothpaste were studied for viscosity with varying shearing rates and yield values:

1. Sample A: Red gel toothpaste
2. Sample B: Light pink chalky toothpaste
3. Sample C: White chalky toothpaste
4. Sample D: Brown chalky toothpaste

For this test, the RSX-CPS-FH Rheometer [for use with a circulating temperature bath (-20°C to 200°C)] was used with spindle RCT-50-1.

The analysis was carried out by connecting the instrument with Rheo 3000 software (CFR Part 11 compliant software).

INSTRUMENT USED:


Instrument model: RSX-CPS-FH

Spindle: RCT-50-1

Bubble level: RK-PFT11

Rheo3000 software: version 2.3.11.3

INSTRUMENT SETUP:

- Use the supplied RK-PFT11 bubble level to adjust the RSX-CPS to the proper level.
- Switch on the power button of the RSX-CPS-FH, follow the instructions on the display and allow initialization of the instrument.
- Insert the spindle RCT-CPS-50-1 into the coupling. Close the coupling by sliding the coupling sleeve down.
- The integrated barcode scanner will automatically detect your spindle type when the coupling is closed.
- Insert the USB interface cable provided by AMETEK Brookfield into the USB-B socket on the back panel of the RSX Rheometer.
- Connect the other end of the cable to a free USB port on the computer on which Rheo3000 is installed.
- Select 'EXTERNAL MODE' from the RSX-CPS home screen.
- Launch Rheo3000 Software on the computer.
- Click on the device's "Watch" icon () in the software main page to establish communication with the RSX-CPS-FH Rheometer.
- Select a new program file and prepare the following program:
Block 1: Rotation Ramp Measuring Block, CSR, log, Shear Rate 1 1/s -> 500 1/s, 120 s, 24 measuring points. No temperature control.
- Select the device, spindle, and temperature controller; enter sample details on the right-hand side of the main page of the software. Save the program.
- After the configuration of your test, press the 'Execution scheduling' button that confirms the device details and launches the "Run Test" page. Press "RUN" and follow the prompts to automatically find the zero-gap position.
- A one-minute spindle tempering step ensures that your system has equilibrated for best gap setting accuracy.
- After tempering the spindle, the RSX-CPS will automatically sense the zero-gap position and then raise the spindle for sample loading.

SAMPLE PREPARATION:

- When prompted, load the sample onto the center of the bottom plate. The appropriate sample volume is indicated on the spindle data sheet.
- Avoid air bubbles in the sample material, as they may result in poor data. Press 'Run' to continue.

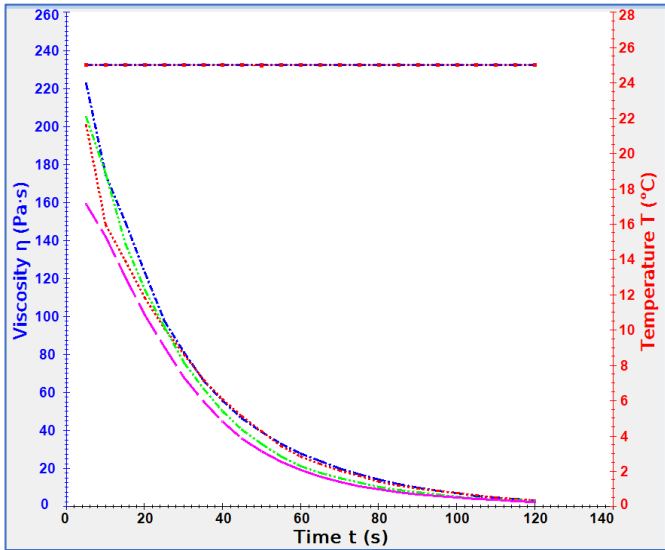
RUN TEST:

- Your spindle will now move into position and the sample will be tempered to the plate temperature.
- Remove the excess sample with the spatula provided with the instrument.
- Proper tempering of the sample will improve the accuracy of your results.
- After tempering, press the "Next" button and trim the overfill carefully.
- Press 'Run' to begin your test.

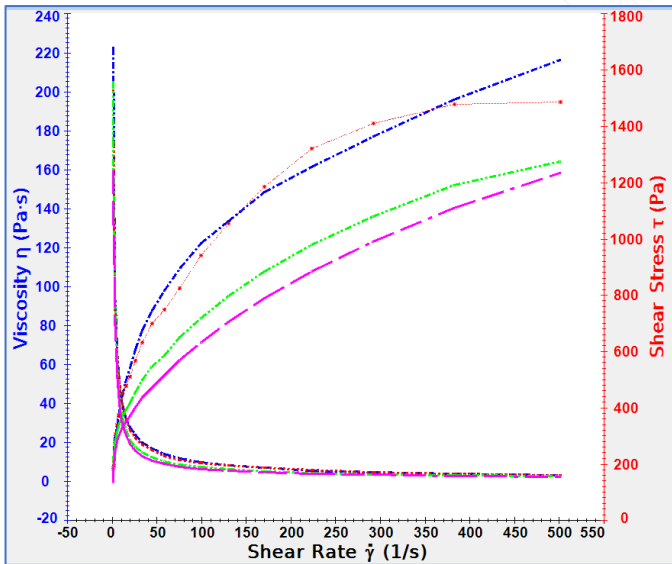
DATA COLLECTION

Sample name		Sample A	Sample B	Sample C	Sample D
Parameters					
Viscosity (Pa·s)	Minimum	2.467	2.550	3.266	2.969
	Maximum	159.154	204.920	222.354	200.301
Torque (mNm)	Minimum	4.479	5.523	5.861	5.994
	Maximum	40.372	41.725	53.475	48.644
Shear Stress (Pa)	Minimum	136.872	168.784	179.103	183.175
	Maximum	1233.773	1275.117	1634.187	1486.558
Shear Rate (1/s)	Minimum	0.860	0.824	0.805	0.915
	Maximum	500.105	500.020	500.347	500.711
Shear Deformation	Minimum	0.004	0.003	0.003	0.003
	Maximum	53.479	53.460	53.409	53.416
Yield stress τ_0 (Pa)		148.9481	189.8953	195.0351	141.2538

The Viscosity vs. Time Graph:



The Viscosity vs. Shear Rate Graph:



Sample A
 Sample B
 Sample C
 Sample D

DISCUSSION

The toothpaste must be hard enough to retain itself on the toothbrush and should liquify when brushed (sheared) on the teeth. This is indicated by the flow curve.

Yield stress is the force required to make the paste flow from the tube.

Minimum viscosity: The viscosity value at almost zero shearing

Maximum viscosity: The viscosity value at the highest shearing rate selected.

Shear deformation: How much the sample deforms at the applied shear.

CONCLUSION

All four brands exhibit close to the same flow curve.

Sample C has the highest viscosity, Sample A has the least viscosity.
 Sample C has the highest yield stress, Sample D has the least yield stress.