# The Impact Of Temperature On Ophthalmic Viscoelastic Devices And The Clinical Implications – A Pilot Study

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## Aim

We set out to evaluate the relationship between temperature and rheological properties of OVDs and consider the implications this may have for clinical practice.

## Introduction

- Ophthalmic surgeons commonly use cohesive or dispersive Ophthalmic Viscoelastic Devices (OVDs) according to their expected rheological behaviours. (1,2)
- We have observed that OVDs behave differently if taken directly from refrigerator storage for immediate intraocular use.

## Methods

- Samples provided in lieu of money from an unrestricted educational grant from Bausch & Lomb.
- Viscous and elastic responses of three OVDs (Eyefill-SC, Eyefill-C, Eyefill-HD; Bausch & Lomb) were measured under shear using a rotational rheometer.
- Tested at a range of clinically relevant temperatures (5°C, 25°C, 37°C.
- Thermal data obtained using laser flash analysis and differential scanning calorimetry.

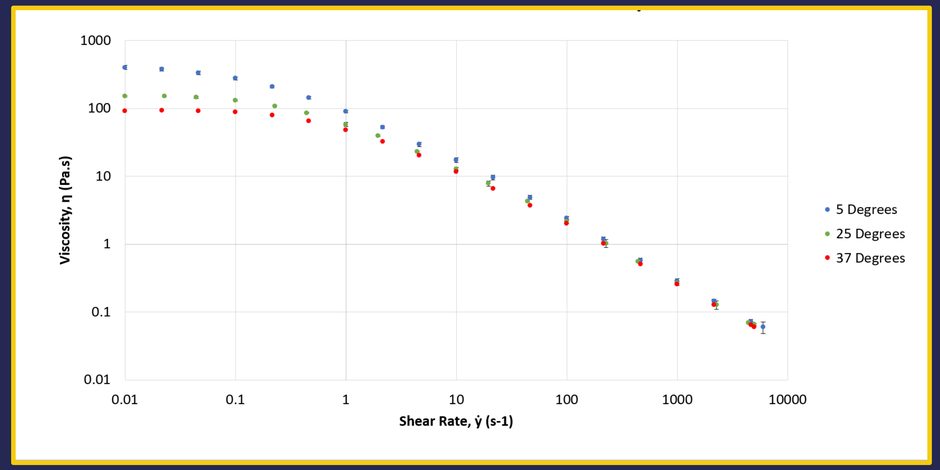



Figure 1 – Viscosity of cohesive OVD reduces as shear rate increases. At low shear rates the viscosity of cohesive OVD increases as temperature decreases.

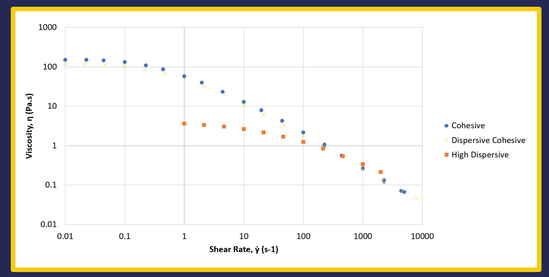



Figure 2 – All OVD's found to be shear thinning. At low shear rates the viscosity of dispersive OVD is less than cohesive.

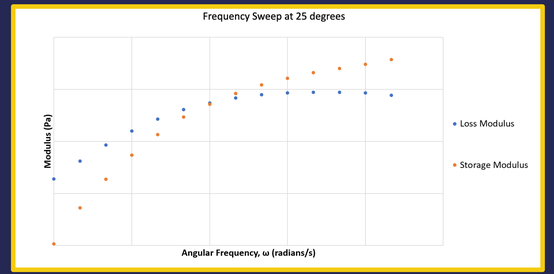



Figure 3 – Viscous properties of cohesive OVD predominated over elastic properties at low angular frequencies. The reverse is true at high frequencies.

## Results

- All OVDs found to be shear thinning - as shear rate increased, viscosity decreased.
- Estimated zero-shear rate viscosity ($\eta 0$) was higher for each of the OVDs at lower temperatures.
- Frequency sweep tests showed Eyefill-C's viscous behaviour dominated over elastic character at low frequencies.
- Thermal property analysis revealed Eyefill-HD had the highest thermal conductivity.

## Discussion

This pilot study confirms our clinical experience that OVD properties are affected by low temperatures. All OVD samples tested were found to have increased viscosity at refrigerator temperature compared to room or body temperature, particularly at low shear rates. To avoid harm from excessive force, surgeons should ensure all OVDs are at room temperature prior to intraocular use for intended rheological behaviours.

## References

1. Arshinoff SA, Jafari M. New classification of ophthalmic viscosurgical devices—2005. Journal of Cataract and Refractive Surgery. 2005 Nov;31(11):2167–71.
2. Wilson DI. What is rheology? Eye [Internet]. 2017 Dec 22;32(2):179–83. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5811736/