

## Application Note

# Temperature dependence of viscosity of commercially available eye drops

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Industry	:	Pharmaceutical
Instrument	:	Viscometer
Measurement method	:	Electro Magnetically Spinning Method
Standards	:	

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## 1. Scope

Viscosity of eye drops is an important element to cover the surface of the eyes and to prevent evaporation of tears by replenishing moisture.

Examples of measuring the temperature dependence of the dynamic viscosity of commercially available eye drops using an EMS viscometer that can be measured by sealing, sterilization and non-contact were shown below.

## 2. Precautions

When performing measurement below the ambient temperature, make sure to introduce dry air to the instrument before starting measurement in order to prevent dew condensation.

## 3. Post-measurement procedure

The sample container and the sample are discarded appropriately.

## 4. Apparatus

- EMS Viscometer
- Control Laptop PC
- Dry Air Unit
- Compressor

## 5. Reagents

- Sample : 3 kinds of the commercially available eye drops

## 6. Procedure

- 1) Enter the following conditions in measurement condition of the sequence mode of control software.
  - ✧ Measurement mode :Sequence mode
  - ✧ Measurement temperature :10-40°C (5°C interval)
  - ✧ Motor rotation speed :1,000 rpm
  - ✧ Measurement time :I (1 second)
  - ✧ Repeat count :10 times
  - ✧ Measurement interval :5 seconds
  - ✧ Waiting time for temperature stability :10 minutes
- 2) Place an aluminum spherical probe of  $\phi$  2 mm and a sample of 300  $\mu$ L in a container, cover with a cap and packing, set the sample container in the EMS Viscometer, and press the measurement button.
- 3) Measure another samples on the same condition after the measurement of the first sample is completed.

## 7. Example

The viscosity measurement results about the temperature dependence of the commercially available eye drops A, B and C are shown in Figure 1 and Table 1 to 3.

The temperature dependence of the viscosity is confirmed for all eye drops.

The eye drops C is a low viscosity sample almost equal to water. However, for the eye drops A and B, the viscosity at 10°C is 10mPa·s or more and a high viscosity compared with the eye drops C.

For your information, it takes about 80 minutes to measure the temperature dependence of the viscosity of one kind of eye drops, therefore 3 kinds of all eye drops can be measured within about 4 hours.

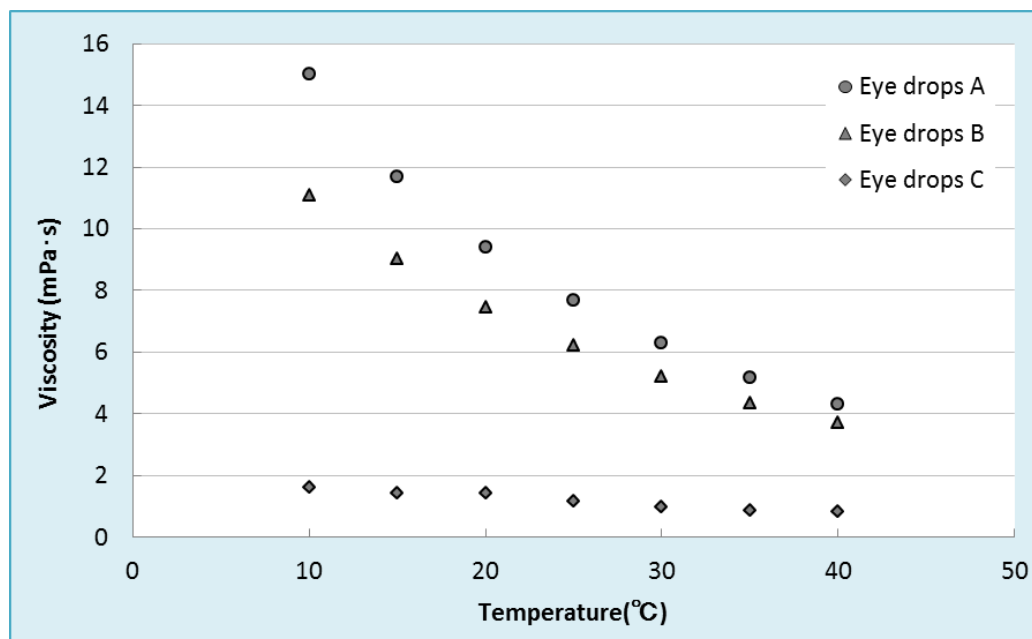


Figure 1. Measurement result about the temperature dependence of the viscosity of eye drops

**Table 1. Measurement result about the temperature dependence of the viscosity for eye drops A**  
(mPa·s)

Frequency of measurement	Temperature (°C)						
	10	15	20	25	30	35	40
1st	15.1	11.7	9.45	7.66	6.28	5.19	4.33
2nd	15.0	11.7	9.42	7.66	6.28	5.19	4.33
3rd	15.1	11.7	9.38	7.67	6.28	5.19	4.32
4th	15.0	11.7	9.37	7.67	6.28	5.19	4.34
5th	15.0	11.7	9.36	7.67	6.28	5.17	4.33
6th	15.0	11.7	9.35	7.73	6.28	5.17	4.32
7th	15.0	11.7	9.35	7.70	6.28	5.21	4.33
8th	15.0	11.7	9.37	7.68	6.29	5.18	4.31
9th	14.9	11.7	9.35	7.71	6.29	5.17	4.34
10th	15.0	11.6	9.45	7.68	6.29	5.18	4.32
Mean	15.0	11.7	9.39	7.68	6.28	5.18	4.33
Standard deviation	0.1	0.0	0.04	0.02	0.00	0.01	0.01
RSD (%)	0.4	0.3	0.4	0.3	0.1	0.2	0.2

**Table 2. Measurement result about the temperature dependence of the viscosity for eye drops B**  
(mPa·s)

Frequency of measurement	Temperature (°C)						
	10	15	20	25	30	35	40
1st	11.1	9.03	7.46	6.21	5.21	4.40	3.68
2nd	11.1	9.02	7.48	6.17	5.22	4.39	3.69
3rd	11.1	9.03	7.48	6.21	5.21	4.35	3.73
4th	11.1	9.02	7.52	6.25	5.21	4.36	3.70
5th	11.1	9.02	7.52	6.25	5.21	4.36	3.70
6th	11.1	9.01	7.49	6.25	5.21	4.34	3.70
7th	11.1	9.01	7.41	6.25	5.21	4.34	3.68
8th	11.1	9.00	7.45	6.24	5.15	4.34	3.69
9th	11.1	9.08	7.46	6.26	5.19	4.34	3.69
10th	11.1	9.04	7.43	6.25	5.20	4.35	3.69
Mean	11.1	9.03	7.47	6.23	5.20	4.36	3.70
Standard deviation	0.0	0.02	0.04	0.03	0.02	0.02	0.01
RSD (%)	0.0	0.2	0.5	0.5	0.4	0.5	0.4

**Table 3. Measurement result about the temperature dependence of the viscosity for eye drops C**  
(mPa·s)

Frequency of measurement	Temperature (°C)						
	10	15	20	25	30	35	40
1st	1.62	1.44	1.40	1.19	0.99	0.87	0.82
2nd	1.62	1.45	1.40	1.19	0.99	0.88	0.80
3rd	1.62	1.44	1.40	1.19	0.98	0.88	0.82
4th	1.63	1.44	1.42	1.19	0.99	0.87	0.82
5th	1.62	1.44	1.41	1.19	0.99	0.87	0.82
6th	1.62	1.43	1.42	1.19	0.99	0.87	0.84
7th	1.62	1.43	1.42	1.18	0.99	0.87	0.83
8th	1.62	1.43	1.44	1.17	0.98	0.87	0.84
9th	1.63	1.43	1.43	1.17	0.98	0.87	0.85
10th	1.63	1.43	1.44	1.17	0.99	0.87	0.84
Mean	1.62	1.44	1.42	1.18	0.99	0.87	0.83
Standard deviation	0.00	0.01	0.02	0.01	0.00	0.00	0.01
RSD (%)	0.3	0.5	1.1	0.8	0.5	0.5	1.8

## 8. Summary

The temperature dependence of the viscosity of the commercially available eye drops can be measured.

The difference of the temperature dependence can be confirmed according to the kinds of eye drops such as smooth eye drops like water or a little viscous eye drops.

Moreover, even the same eye drops has comparatively large temperature dependence, therefore, the feeling of putting the eye drops might be influenced depending on the temperature to be used in the summer or winter.

## 9. References

None.