Application Note
Temperature dependence of melt viscosity of candles

Industry	:	Petroleum, Energy
Instrument	:	EMS Viscometer
Measurement method	:	Electro Magnetically Spinning Method
Standards	:	-

1. Overview

The in-built camera of the EMS Viscometer allows the real-time visualization of your sample during measurement which is helpful in a number of situations such as times when you would like to monitor the melt timing or the timing of other structural changes of interest for your sample.

In this application note, the temperature dependence of the dynamic viscosity of molten candle wax using the EMS Viscometer, a non-contact viscometer that uses autoclavable and airtight sample tubes, is shown.

2. Precautions

None.

3. Post-measurement procedure

All sample tubes and samples are discarded according to proper waste disposal procedures.

4. Apparatus

- EMS Viscometer
- Control Laptop PC

5. Reagents

- Sample: Japanese candle made of domestic beeswax, candle made of paraffin wax

6. Procedure

1) Select sequence mode in the control software and set the following measurement parameters:

✧ Temperature	:100 → 50°C (5°C intervals)
✧ Motor rotation speed	:1,000 rpm
✧ Meas. time	:I (1 second)
✧ Repeat times	:10 times
✧ Meas. interval	:5 seconds
✧ Hold time	:10 minutes/600 sec

2) Transfer a 2mm diameter aluminum probe (φ2mm) and solid candle pieces into a sample tube, seal it with its tube cap and packing, and set the sample container into an EMS Viscometer that has been set to 100°C.

3) Monitor the sample using the in-built camera and software, and once melted click the measurement start button.

7. Results & Discussion

The viscosity data for both candle waxes over the specified temperature ranges are displayed below in Tables 1 and 2, and the temperature dependence of melt viscosity can be visualized in the graph (Figure 1).

The Japanese beeswax candle melted at 65°C, while the paraffin wax candle melted at 60°C, allowing the EMS to perform temperature dependence of melt viscosity studies on both and outlining which wax type is more resistant to melting.
As seen in Figure 1, the viscosity of molten beeswax was more highly dependent on temperature than was paraffin wax.

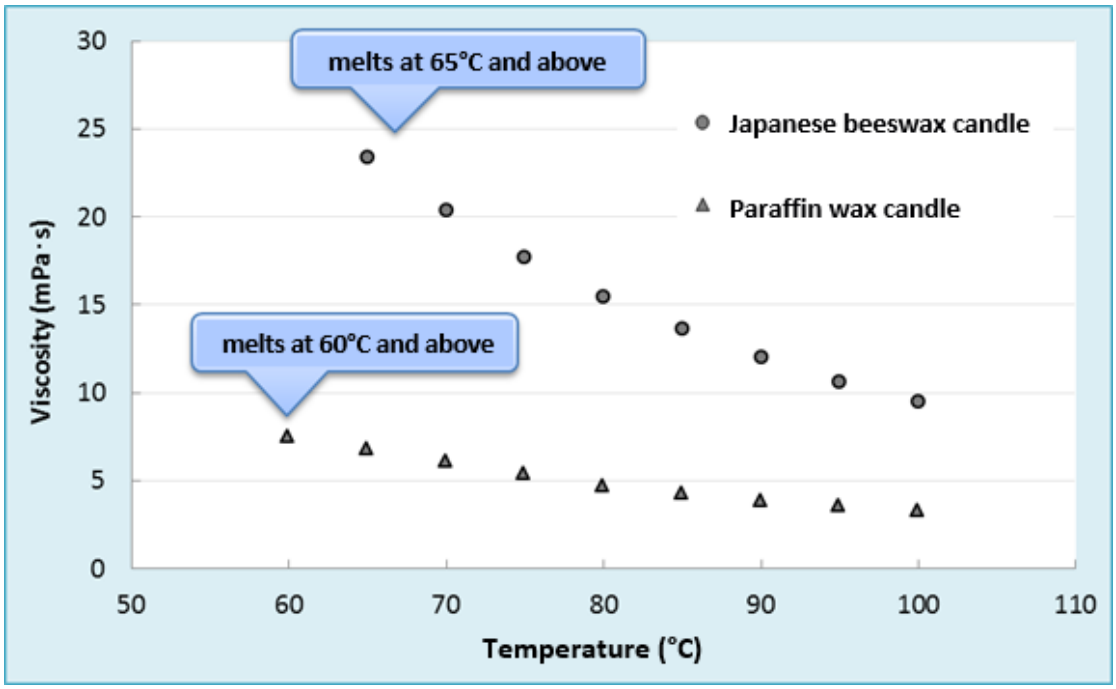

Figure 1. Temperature dependence of melt viscosity of beeswax and paraffin candles

Table 1. Viscosity data for molten beeswax in 5°C increments (65°C - 100°C)

(mPa･s)

Measurement Number	Temperature (°C)							
	65	70	75	80	85	90	95	100
1	23.5	20.3	17.4	15.4	13.6	12.1	10.6	9.50
2	23.5	20.4	18.0	15.4	13.6	12.0	10.6	9.52
3	23.3	20.3	17.6	15.5	13.6	12.0	10.6	9.53
4	23.4	20.4	17.7	15.4	13.6	12.0	10.6	9.51
5	23.5	20.4	17.8	15.4	13.6	12.0	10.6	9.45
6	23.3	20.4	17.8	15.4	13.6	12.0	10.6	9.50
7	23.4	20.4	17.9	15.4	13.6	12.0	10.6	9.49
8	23.5	20.3	17.7	15.5	13.6	12.0	10.6	9.48
9	23.3	20.3	17.6	15.4	13.6	12.0	10.6	9.46
10	23.3	20.2	17.7	15.4	13.6	12.0	10.6	9.51
Mean	23.4	20.3	17.7	15.4	13.6	12.0	10.6	9.50
Standard deviation	0.1	0.1	0.2	0.0	0.0	0.0	0.0	0.03
RSD (%)	0.40	0.34	0.95	0.27	0.00	0.26	0.00	0.3

Table 2. Viscosity data for molten paraffin wax in 5°C increments (65°C - 100°C)

(mPa･s)

Measurement Number	Temperature (°C)								
	60	65	70	75	80	85	90	95	100
1	7.68	6.82	6.06	5.42	4.69	4.35	3.95	3.54	3.35
2	7.65	6.80	6.02	5.46	4.90	4.32	3.83	3.60	3.28
3	7.50	6.85	5.94	5.31	4.86	4.27	3.86	3.58	3.32
4	7.56	6.84	6.35	5.31	4.68	4.24	3.87	3.55	3.30
5	7.46	7.03	6.31	5.40	4.70	4.22	3.86	3.53	3.28
6	7.63	6.80	6.09	5.37	4.66	4.21	3.85	3.68	3.32
7	7.54	6.80	6.02	5.35	4.66	4.27	3.91	3.64	3.30
8	7.51	6.79	5.99	5.49	4.69	4.26	3.99	3.58	3.47
9	7.46	6.91	6.29	5.39	4.68	4.29	3.92	3.58	3.29
10	7.53	6.87	6.20	5.48	4.71	4.26	3.83	3.52	3.27
Mean	7.55	6.85	6.13	5.40	4.72	4.27	3.89	3.58	3.32
Standard deviation	0.08	0.07	0.15	0.07	0.08	0.04	0.05	0.05	0.06
RSD (%)	1.0	1.1	2.4	1.2	1.8	1.0	1.4	1.3	1.8

8. Summary

The EMS Viscometer was able to melt solid wax samples and measure their viscosity successfully and accurately over the assigned temperature ranges of interest. Moreover, differences in melting point and temperature dependence of viscosity for different wax types were confirmable through this application.

9. References

None.