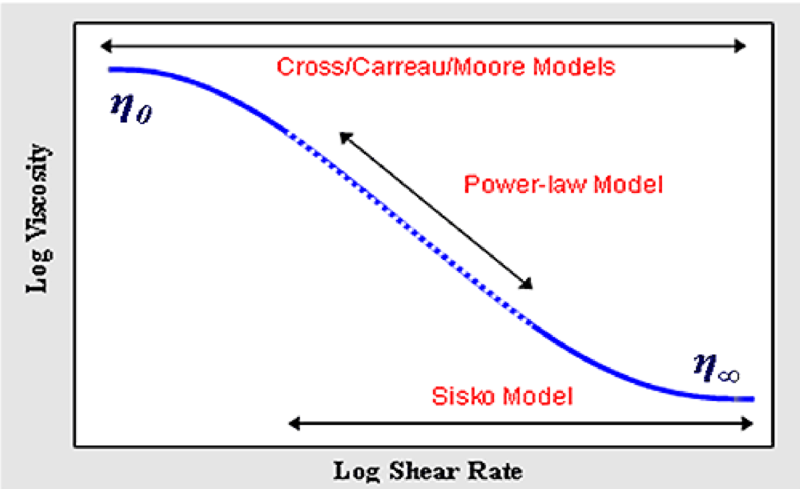
Evaluation of spreading properties of semisolid preparations

Theory

Semisolid preparations (gels, ointments, creams) show plastic flow (shear thinning with yield stress), which occurs after exceeding a certain shear stress (yield stress). As the shear stress increases, the viscosity decreases. The spreadability of semisolid formulations can be assessed by changes in viscosity over a given range of shear rate. Figure 1 shows the ideal course of the viscosity curve and the models for the description. The middle, linear part of the log-log graph is important for the evaluation of spreadability, reflecting the dectruction of the material structure due to the applied stress.

Figure 1. Ideal viscosity curve and corresponding models for description



Mathematically, the linear region of the viscosity curve can be described by the power law (Equation 1).

$$\tau = K \cdot D^n \tag{1}$$

τ	shear stress [Pa]
D	shear rate [s^{-1}]
K	coefficient of consistency [Pa· s^n]
n	index of flow behavior [-]

The coefficient of consistency K is numerically equal to the viscosity at a shear rate $1s^{-1}$. The index of flow behavior n expresses the sensitivity of the system to stress, it is a measure of non-Newtonian behavior. Newtonian materials, whose viscosity is constant, independent of the stress, have a value of n = 1. Preparations with a lower value of the flow behavior index are better spreadable.

Material and devices

Semisolid excipients or medicinal preparations (as specified by the teacher)
Absolute rotational rheometer Kinexus Pro + Malvern Instruments
Measuring geometry CP 2/20

Method

1. Prepare the rheometer for measurement according to the teacher's instructions.
2. Apply the sample in the midle of the lower geometry according to the instructions in the *Load sample* sequence.
3. In the instrument SW, select the *Toolkit_V005 Shear Rate Ramp - Alternative Flow Curve.rseq* and follow the instructions.
4. After the measurement, select the *Unload sample* sequence and follow the instructions to remove the measured sample from the upper and lower geometry.
5. Save the measured data in the folder *C: \ Users \ Operator \ Documents \ VMFT \ Flow curve.*
6. Measure the three newly applied samples (n = 3) in this way.
7. Evaluate the linear part of the viscosity curve using *Analyze_0004 Power law model fit for viscometry.*
8. From the three measurements, calculate the average value of K a n and the standard deviation of the average.

Conclution

Evaluate the spreadability of the tested material and compare with other products.

Protocol

Name of student:

Sample:

Device:

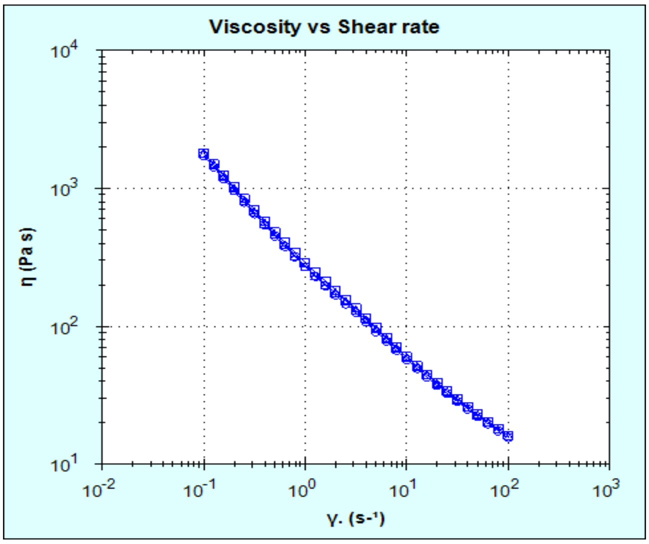
Geometry:

Test sequence:

Analysis:

Temperature:

Shear rate range:



Action Name	Sample Description	K1	n	Correlation coefficient
Power law model fit	Adeps lanae alt. fl. crv. 2	335.9	0.4069	0.9921
Power law model fit	Adeps lanae alt. fl. crv. 1	353.9	0.4024	0.9941
Power law model fit	Adeps lanae alt. fl. crv. 3	352.0	0.3983	0.9937

Measurement	K [Pa· s^n]	n [-]	Corr.
1	335.9	0.4069	0.9921
2	353.9	0.4024	0.9941
3	352.0	0.3983	0.9937
average	347.3	0.4025	
SD	9.9	0.0043	