

Rheology of chocolate from a different point of view

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Introduction

Since the OICCC introduced rheological tests to control the quality of chocolates, measuring the viscosity and the yield stress are a must in the quality assurance of the chocolate industry. An important property for the success of a chocolate, which cannot be predicted using viscosity or yield stress data, is mouth feeling.



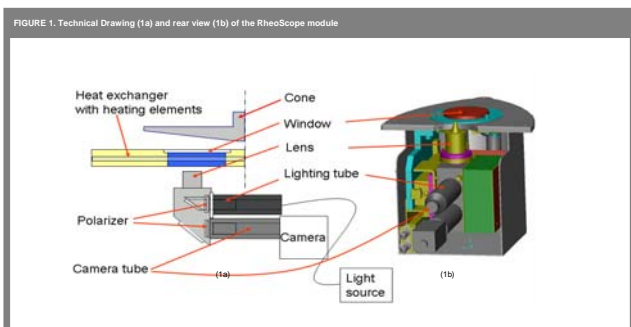
To better understand how to achieve the desired mouth feeling and other physical properties, more detailed measurements on the basic materials, for example the fat contained in the chocolate, as well as on the final product are needed.

Selected measurement results on several fat and chocolate samples measured with the HAAKE MARS in combination with the RheoScope module and the bending tool as well as oscillation tests are presented.

Measurement set-up:

HAAKE MARS with RheoScope Module

The RheoScope module is designed as compact module for HAAKE MARS. The standard version facilitates measurements in the temperature range from -5 up to 120°C, whereas the high-temperature version is equipped with an electrical temperature control unit and an upper heating system for temperatures up to 300°C. Polished plates and cones with different diameters up to 60 mm and with ceramic shaft for reduced heat-transfer at high-temperatures are available. Images with a frame rate up to 15 per seconds can be taken with objectives of 5, 10, 20 and 50 times.



Benefits

- All measuring modes (CS, CR, CD) including normal force available with simultaneous recording of microscopic images
- Modularity: individual lenses, light source and camera can be adapted
- Temperature range: -5 up to 120°C (300°C)
- Rheometer, camera and microscope control with one software
- Visualization and correlation of data and images within one software
- Optional image analysis software SPIP for particle size, particle size distribution and structure analysis

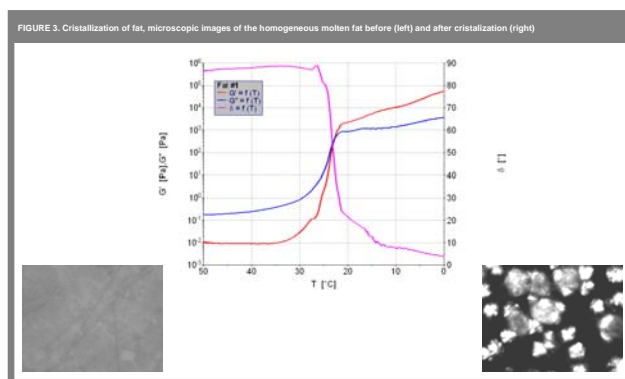


Results

Crystallization behavior of fat

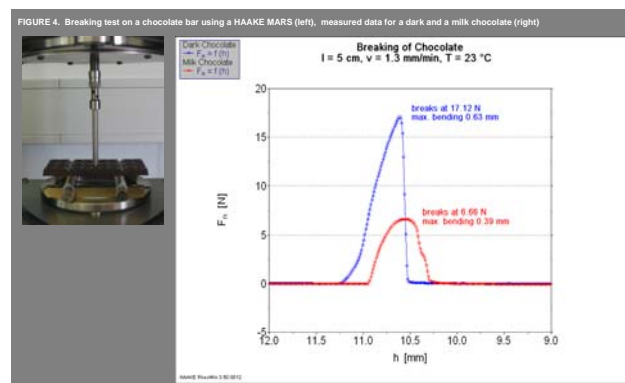
When talking about the recipes for chocolate, the fats used and their complex crystallization behaviour are amongst the most important factors to look at. The different crystalline phases and their individual crystallization points are often difficult to distinguish using a DSC.

With an oscillating rheometer (different) crystallization points can be observed separately. Using an instrument that combines rheometry and microscopy (RheoScope) the melting or crystallization process can be followed with rheological methods while at the same time the growth of the crystals and their individual shapes can be observed.



Breaking behavior of chocolate

The hardness of the chocolate and the force needed to break it also have to fulfil certain consumer expectations. With a specially designed bending tool, using the normal force sensor and lift drive of a standard rheometer, the compliance of the chocolate as well as the force needed to break the chocolate could be determined accurately.



Conclusions

The combination of a high performance rheometer with an state of the art microscope has been presented. Structural changes like the formation of crystals can be observed simultaneously while recording the rheological properties thus leading to a deeper understanding why the rheological properties change in the observed way.

The precision of the lift drive and the normal force detector of the HAAKE MARS enable the performance of bending and breaking tests, which give a valuable additional information about the texture of the chocolate.