



EXOTHERM 8000

Shukoff Cooling Curve (SCC)

Computerized Shukoff Multi Cooling curve for
quality control of fat and fat blends

2 or 4 measuring heads



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INTRODUCTION

The technical behaviour of one product with fat is mainly defined by the fat crystallisation specificities. Several factors could modify the technical characteristics of the triglycerides as for instance the oxidation. Cocoa butter quality may vary depending on variety or seasonal changes in quality of beans, cocoa butter deodorisation can influence the physical properties of the triglycerides. Not only the melting point and the hardness of cocoa butter (evaluated with EXOTHERM 8000) according to the ratio of saturated (stearic) to non-saturated (linoleic, oleic) fatty acids may vary but also the crystallisation capacity of the triglycerides.

The Shukoff cooling curve measure is a simple method, duly experimented, to control the fat crystallisation properties.

The cooling curves provide information on **purity** of cocoa butter and **compatibility** of fat blends.

The cooling curve is correlated with the **contraction** of the chocolate during the cocoa butter crystallisation, it is indirectly related to the **demoulding** properties and therefore it can be used as a prediction method.

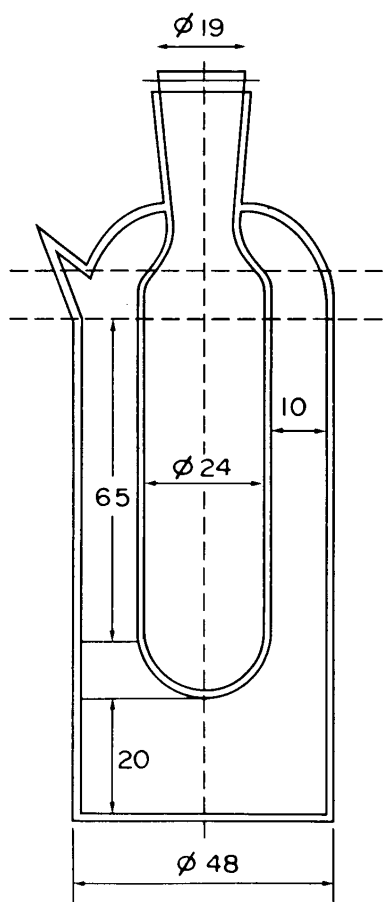
OPERATING PRINCIPLE

The method (IUPAC 2.132) consists of measuring the temperature of the fat to be tested during its cooling.

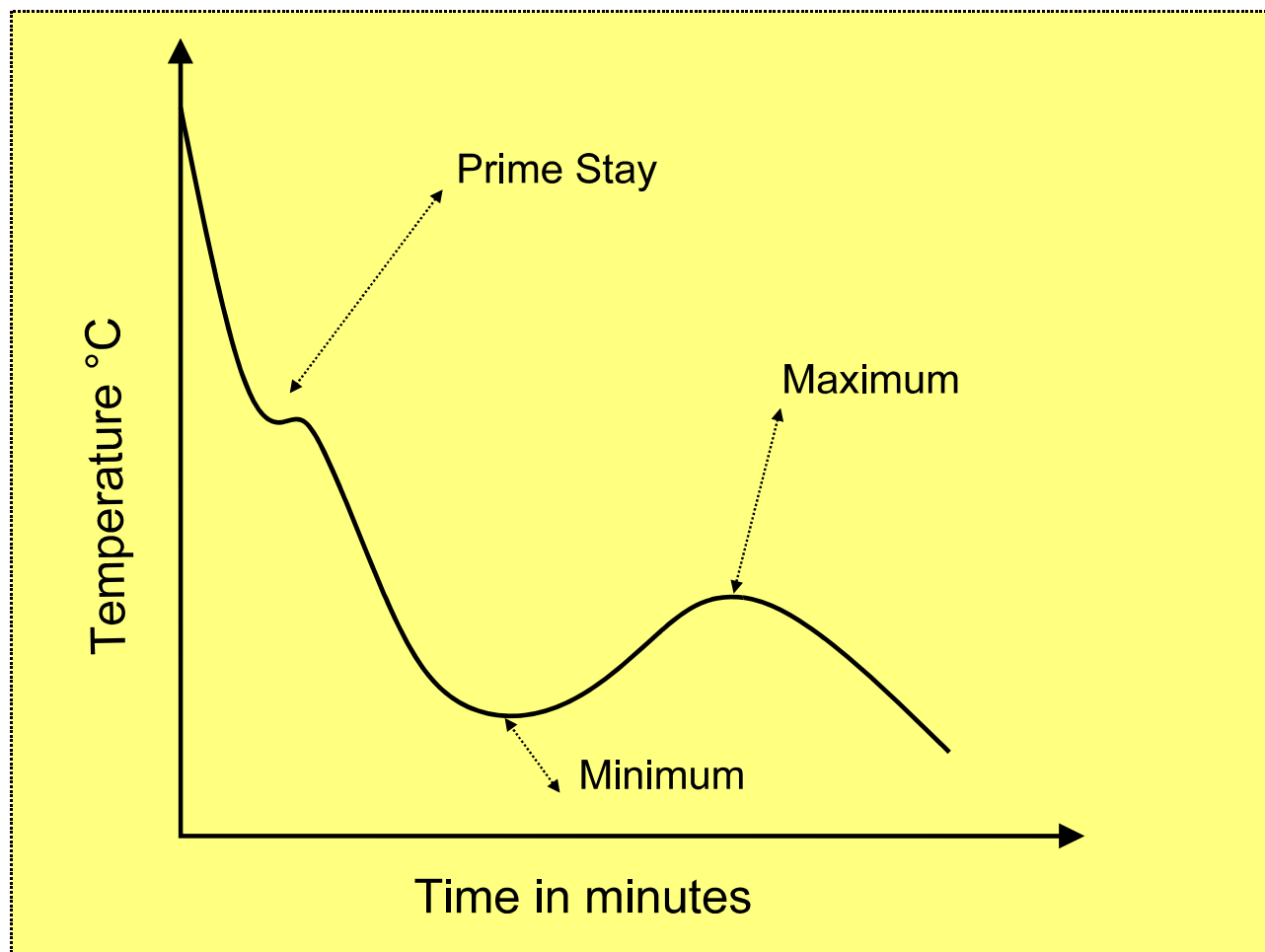
To carry the sample, a special flask (Shukoff flask according to IUPAC specifications) made of glass with double wall (pressure between the wall is 0.01 mm Hg).

The fat is melted in an oven at 60°C. The flask is filled with 25 g. of the melted fat. Both flasks are placed in the temperature controlled bath at 0° C or +17°C depending on the expected results or chosen method. (see further: Results).

The temperature probes are settled in the flask and temperature is recorded versus time as soon as the 40°C has been reached. **Cooling curves are displayed on the screen. Calculation is automatic.**



RESULTS



Results according IUPAC 2.132.7

T [°C] prime stay	t [min] prime	$\Delta t = t_{\text{max}} - t_{\text{min}}$
T [°C] min	t [min] min	$\Delta T = T_{\text{max}} - T_{\text{min}}$
T [°C] max	t [min] max	$Q = \Delta T / \Delta t$

INTERPRETATION OF CURVES AND APPLICATIONS

PURETY AND CRYSTALLISATION ACCEPTABILITY

For a cocoa butter for instance, the cooling curve usually presents a "Prime-Stay", a minimum and a maximum. A prime-stay is often created by impurities such as tri-saturated triglycerides.

ΔT gives an information about the crystallisation capacity. It can tell how rapidly the fat mixture will solidify and if technical difficulties are to be expected in the cooling tunnel of the moulding or enrobing line. A high value of ΔT testifies that a large amount of C.B. is crystallised. (a high SFC value).

Δt is the crystallisation time, the **Q factor** ($\Delta T/\Delta t$) is related to the setting rate. It is commonly accepted in some factories in term of crystallisation behaviour:

$Q > 0.15$	is related to a good cocoa butter
$Q < 0.05$	is related to a non-acceptable cocoa butter

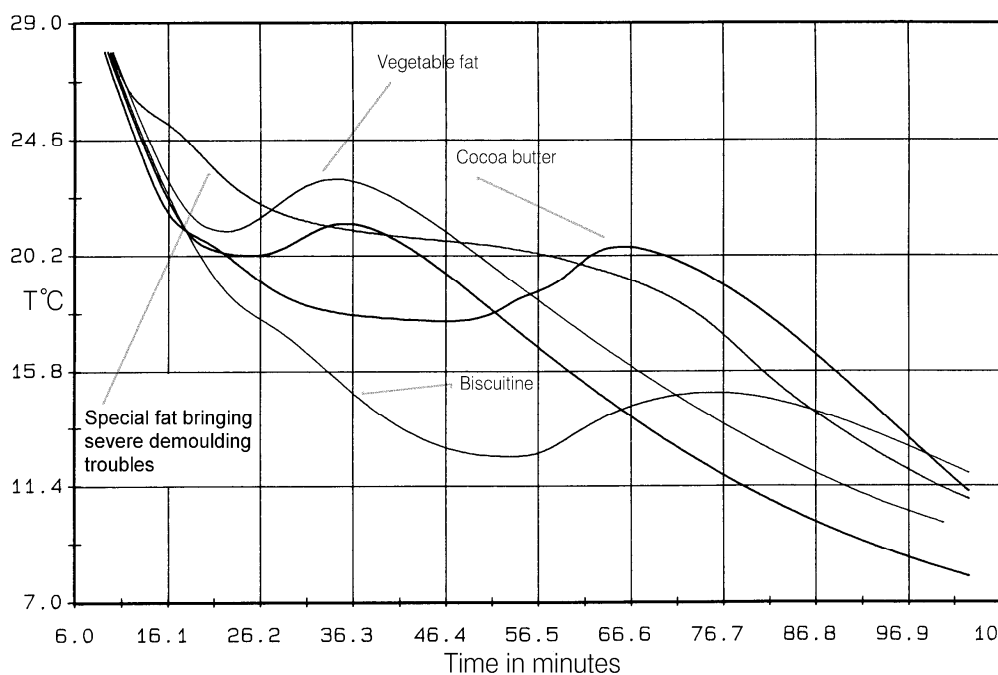
CONTRACTION

Even though very few publications have been published on the correlation between the Shukoff curve and the contraction, we very often notice in our practice developing tempermeter (pre-crystallization curve of chocolate, EXOTHERM 7000) and contractometer, **the relation between Q factor and contraction**

Example:

Chocolate demoulding time under defined cooling conditions and crystallisation state.

	Q Factor	Time
Bahia (soft cocoa butter)	0.15	18 min.
Malaysia (hard cocoa butter)	0.06	15 min.

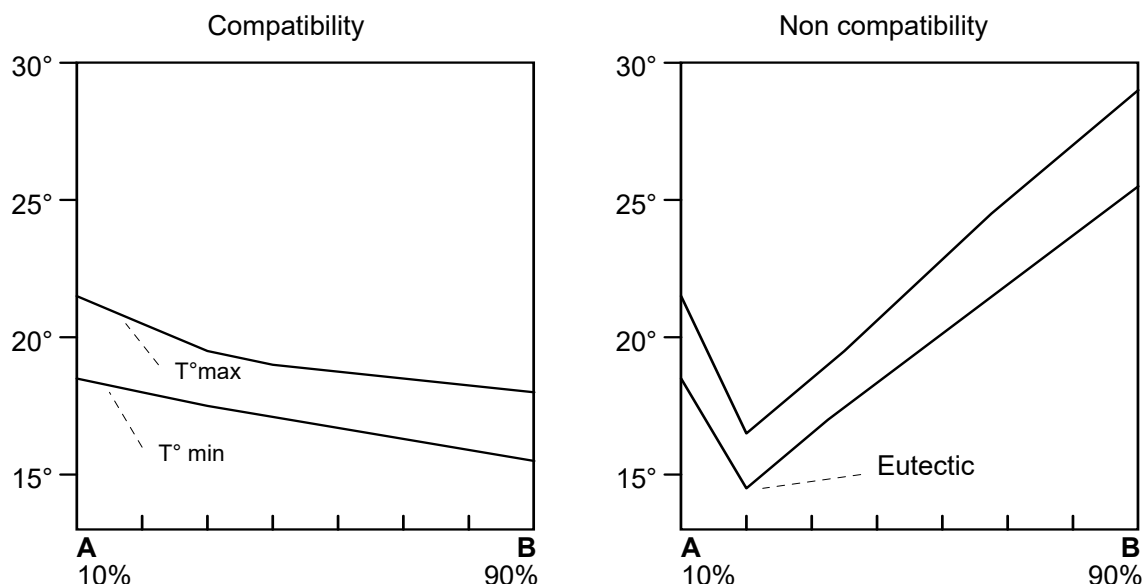


COMPATIBILITY OF OTHER FATS

The use of other fats than cocoa butter is becoming more and more important in confectionery. The degree of compatibility of **fats mixture is one of the main problems** linked to the use of alternative fats.

The presence of eutectics is an indication of no compatibility between the considered fats. Different physical method like SFC by NMR, or DSC can detect the presence of eutectics, but these methods are time consuming and expensive. They require a defined thermal pretreatment in order to stabilise the crystal structure. **The cooling curves are much quicker** and provide the same information.

With the EXOTHERM 8000, you can 2 measurements in parallel, it means that if you want to detect the compatibility between **A** and **B**, you can prepare for example 8 mixtures from 10 % to 90 %. After 4 measurements, you plot on a graph the **T (°C) min** or **T (°C) max** on a Y Axis and your percentage of blend in a X Axis. The non-compatibility is described by lowering followed by climbing up.

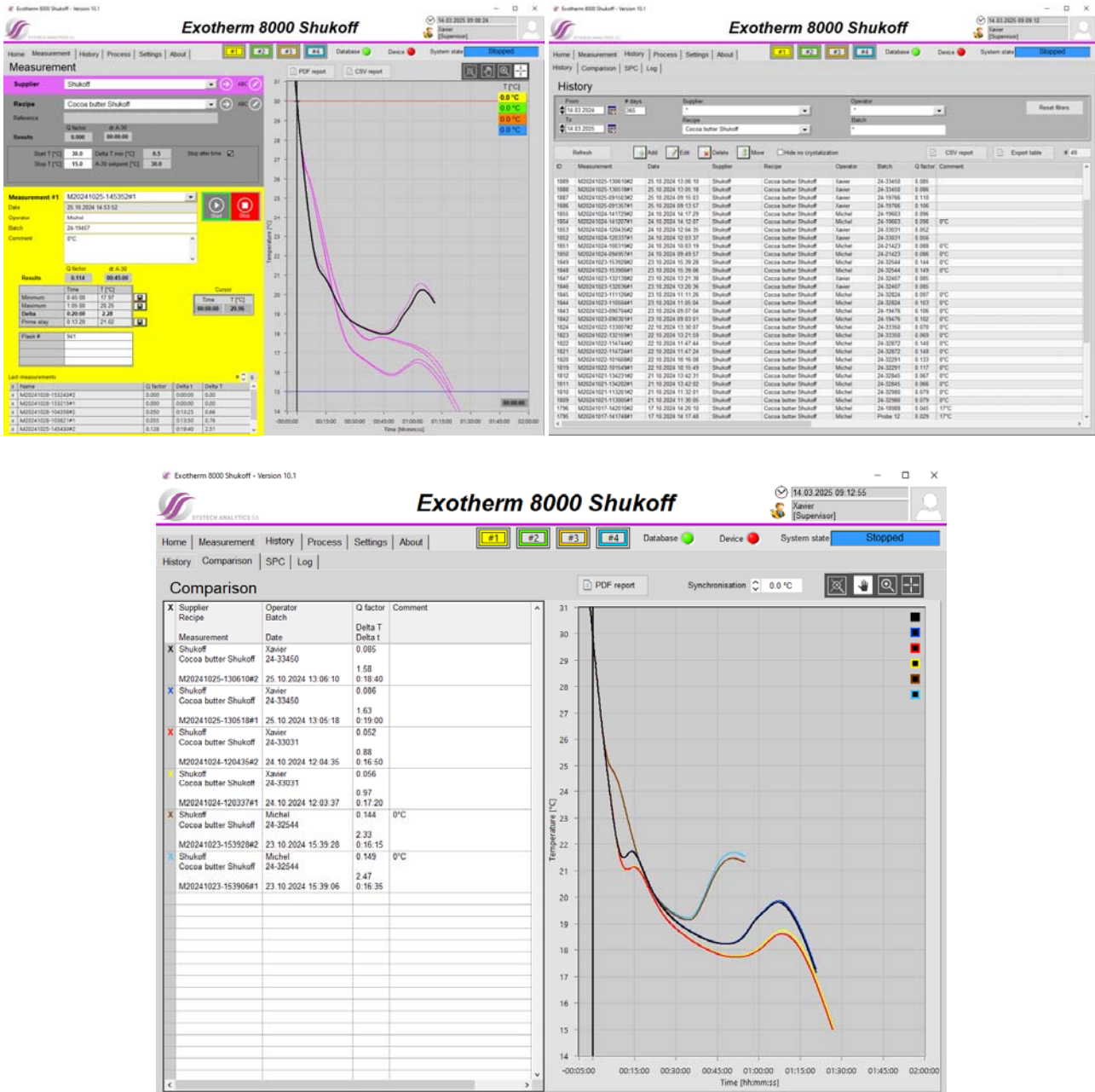


PRODUCTS AND TYPE OF WORK IN R&D

The cooling curve of Shukoff is not only useful in production line but also in research and development for:

- Natural vegetal or animal raw products (Cocoa butter, milk fat, etc.)
- Refined fats or fats modified for industrial purposes (CBE, CBI, CBS, mixtures)
- Various chemical substances and degradation factors influence on crystallisation properties
- Studies various fats mixtures or added emulsifiers influence on crystallisation.

EXOTHERM 8000 SHUKOFF SOFTWARE



- Measuring system for solidification curve of Shukoff (IUPAC 2.132 and IOCC 110-1988)
- Measurement of 4 parallel samples of the same or different fat mass
- Local or network database
- Comparison of curves and history screen
- PDF or CSV measurement report
- High accuracy temperature measurement and easy calibration

EXOTHERM 8000 SPECIFICATIONS

EXOTHERM 8000 COMPLETE

- Overall dimensions (WxLxH) 230 x 430 x 620 mm
- Net weight 32.5 kg
- Operating range +5 to 40°C
- Reading accuracy +/-0.01°C

EXOTHERM 8000 INTERFACE

- Dimensions (WxLxH) 230 x 430 x 80 mm
- Net weight 7.5 kg
- Power supply requirement 100...240VAC / 50-60 Hz
- Power 10 W
- Fuse 500 mA

CRYOSTAT HUBER KISS K6

- Dimensions (WxLxH) 210 x 400 x 546 mm
- Net weight 25 kg
- Voltage input 230VAC 50/60Hz or 110V 50/60Hz
- Heating power 2 kW
- Cooling power at 0°C 0.15 kW
- Temperature control range -25...200°C
- Temperature stability at 70°C 0.05K
- Bath opening (WxLxH) 140 x 120 x 150 mm
- Bath volume 4.5 litres

SHUKOFF FLASK

- Vacuum 0.01 mm HG / 0.013 mbar
- Volume 25 gr