

# Lecithin

## The Natural Choice of Emulsifier for the Chocolate and Confectionery industry

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## 1. Use of Lecithin in Chocolate

It is a well known fact that lecithin gives economic benefits in the production of chocolate and other related products. But it is less known that some types of lecithin are able to entrap water with only small adjustment in viscosity and yield point.

This paper has two sections: Through illustrations the first part is covering the theory behind the use of lecithin in chocolate. The second part covers a study on the use of special-purpose lecithin in Ice cream coating.

### Your benefits of using special-purpose lecithin in chocolate

- Reduction of the viscosity and yield point.
- Excellent flow properties during tempering and moulding.
- Excellent flow during enrobing.
- Cost savings on cocoa butter.
- Tolerates water absorption.
- Reduction of the total processing time.
- Optimizes the rheological properties of coatings.

### What is chocolate?

Chocolate is a dispersion of very fine solid particles in a fat phase. The solids are composed of a homogeneous mixture of finely ground cocoa mass, sugar, milk constituents and cacao butter.

The quality of the chocolate is evaluated by the physical-, surface- and sensory properties.

The physical properties are rheology, particle size, solid fat content, hardness and snap.

The surface properties are colour, gloss and bloom.

Sensory properties are taste, which can be evaluated by a Descriptive analysis or Consumer trials.

### Why use lecithin?

Lecithin is a vital ingredient in chocolate processing. It has a positive effect on the rheological properties, reduces the amount of cocoa butter that has to be added, reduces the viscosity, shortens the processing time, and increases the processing stability during the manufacturing of chocolate. The economic advantages of lecithin in chocolate are demonstrated in a simple comparison of quantities: 0.35% lecithin reduces the viscosity to the same extent as 8% cacao butter.

### The function of lecithin in chocolate

The flow properties mentioned earlier depend to a large extent on the fat content and the lecithin grade used. Lecithin is a supreme emulsifier and surface active agent. Because of its molecular structure lecithin exhibits both lipophilic and hydrophilic properties. These properties are oriented towards the interface between the solid and the liquid phase.

Lecithin facilitates the lubrication of the sugar and cocoa particles and possible the fat crystals thereby making the flow of the chocolate mass more liquid.

Lecithin reduces the viscosity of the chocolate mass and is normally used in a dosage of 0.3-0.5%.

A much higher level is not recommended as the viscosity will not further decrease and the yield point will increase.

The theory is that all hydrophilic sugar and cocoa particles are covered with a lecithin monomolecular layer, giving lubrication with the hydrophobic fats. With increasing lecithin addition over 0.7% the particles are being fully covered and the formation of bilayers and clusters is causing increase of the rheological properties.

#### *Moisture*

Chocolate contains small amount of moisture. If too much moisture is present at the surface of the sugar and cocoa particles the viscosity will be increased. This is caused by the friction between them. When lecithin is added, the hydrophilic groups of the molecules attach themselves firmly to the water molecules on the surface of the sugar and cocoa particles. This reduces the friction, increases the particle mobility and lowers the viscosity.

#### *Temperature*

Beside the flow properties it is reported that lecithin has some effect on the temperature in the chocolate process. When lecithin is added, higher conching temperatures is possible without changing the viscosity. This is important if a special flavour development is desired in milk chocolate.

#### *Tempering*

Tempering the chocolate ensures the development of stable cocoa butter crystals within the liquid chocolate. If unstable crystals are formed during the tempering process the chocolate becomes grey and fat bloom is formed. Lecithin may improve the bloom resistance, gloss and latitude in handling tempered chocolate.

#### *Encapsulation of surplus moisture*

Good encapsulation of surplus of water is not only opportune for controlled flow properties but also for the production of ice bars with a smooth surface and pleasant delicate smooth mouthfeel.

## **Choosing the right lecithin**

Lecithin is not just lecithin. By modifying, deoiling, fractionating and compounding various lecithins, it is possible to generate a large number of different functional properties.

Lecithin can be derived from soya, rape and sunflower seeds. The products described in this bulletin are derived from soya where 65% of the lecithin consists of a group of different phospholipids. Its main constituents are– phosphatidylcholine (PC), phosphatidylethanolamine (PE), phosphatidylinositol (PI) and phosphatidic acid (PA). The remaining 35% are oil and other minor components. By removing the vegetable oil from the product, pure phospholipids, the active substances in lecithin, are left.

Besides the liquid and the deoiled lecithin different fractions are available for the chocolate industry. By fractionation it is possible to increase the content of the individual phospholipids constituents. These individual fractions have different effect on the rheological properties. PC reduces the viscosity while PE intensifies the ability of lecithin to lower the yield value.

The emulsifier Polyglycerol Polyricinoleate (PGPR) has the ability to lower the yield value of the chocolate mass whereas the effect on the viscosity is limited. PGPR is normally used in combination with refined, fluid lecithin to form a synergistically acting dispersing agent, which reduces surface and interfacial tension, reduces plastic viscosity, lowers the yield point, enhances flow properties during tempering and coating, and permits thin coating.

Central Soya's combined PGPR-refined, fluid lecithin product is market as STERNCHOCO.

Another emulsifier used in chocolate manufacturing is the Ammonium phosphatides known as emulsifier YN. This product has the similar functionality as soya lecithin but a slightly different flavouring profile.

### **Test and evaluation methods for chocolate and couvertures**

Several studies in our laboratory have combined the opportunities in investigating the effect on the flow properties in various recipes.

### **Test procedure**

- Industrially processed dark, milk and white chocolate with 34% fat, produced on professional large pilot plant scale, was used for the measurement of flow properties with up to 1% lecithin addition at 0.1% intervals. After addition of lecithin the chocolate mass at 60<sup>0</sup>C was conched for at least 30 minutes before the samples were taken. The samples were measured with a Brookfield DV III (Spindle 29 and small adapter SC-4) at 40<sup>0</sup>C.
- The flow properties were measured and the plastic viscosity and the yield value were calculated with the standard Casson equation. The OICC analytical procedure was used.
- Plastic viscosity expresses the flow resistance when the mass is pumped through a pipe line.
- The yield value of the non-Newtonian chocolate is the spontaneous spread of the mass during enrobing and moulding.

In the chocolate industry a constant yield value is a more important than the plastic viscosity.

The recipes used in the studies were

<b>Recipe %</b>	<b>Dark Chocolate</b>	<b>White chocolate</b>	<b>Milk chocolate</b>	<b>Ice cream coating I</b>	<b>Ice cream coating II</b>
Cocoa powder	20.0	-	5.0	17.0	13.0
Cocoa butter	32.0	27.0	27.0	43.0	20.0
Vegetable fat	-	-	-	-	38.0
Milk powder	-	25.0	24.0	-	-
Sugar	47.5	47.5	47.5	39.0	28.0
Lecithin	0.5	0.5	0.5	1.0	1.0
<b>Fat content</b>	<b>34.0</b>	<b>34.0</b>	<b>34.0</b>	<b>45.0</b>	<b>60.0</b>

**Table 1 Recipes tested in our laboratory**

The lecithin used in the tests were

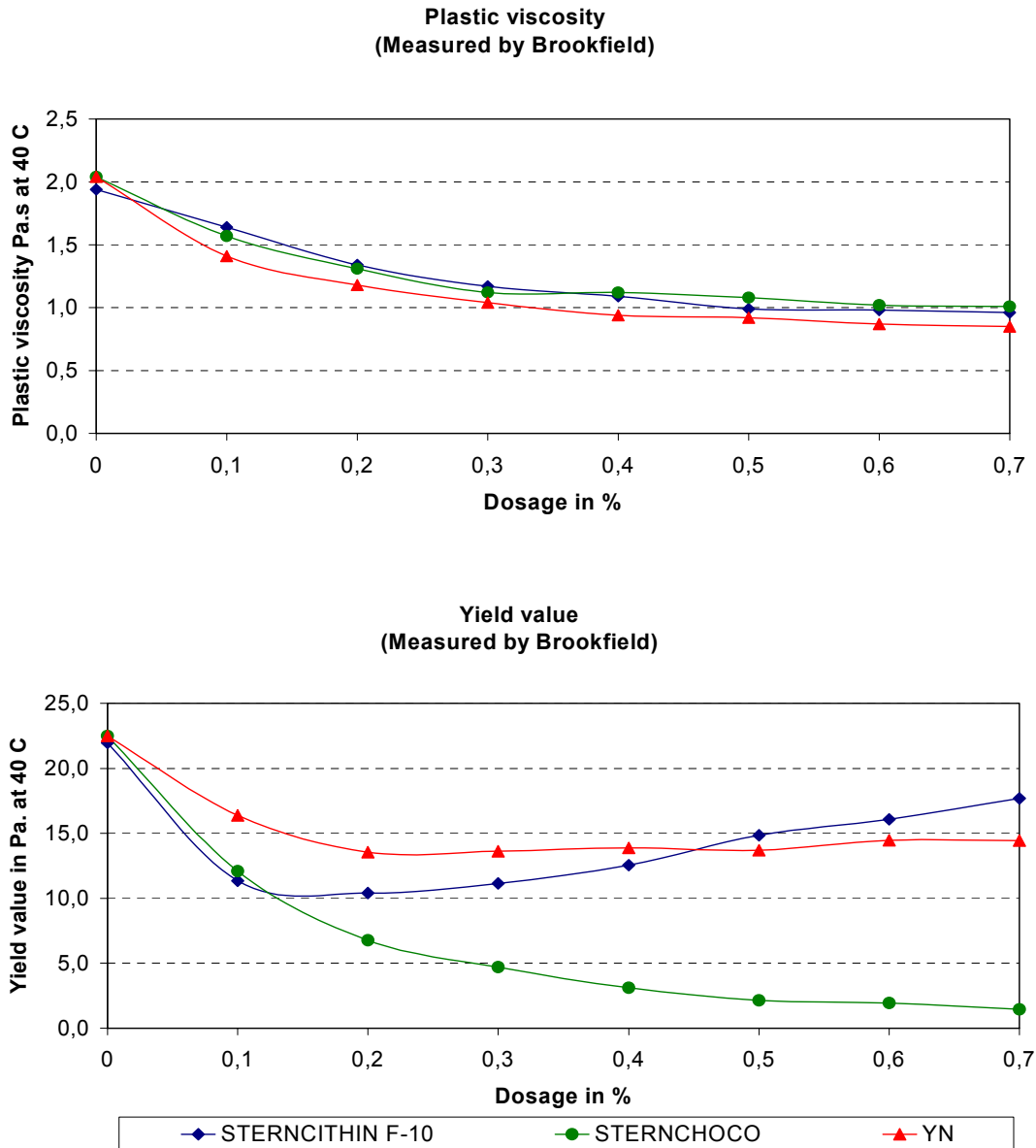
<b>Lecithin tested</b>	<b>Emulsifier description</b>	<b>Dosage in %</b>
STERNCITHIN F-10	Standard Lecithin	0.1 – 0.7
CENTROLEX FP-40	PC enriched fraction	0.1 – 0.7
STERNCHOCO	Lecithin/PGPR	0.1 – 0.7
CENTROLEX F	Deoiled lecithin	0.1 – 0.7

**Table 2 Tested lecithin**

## Results and discussion

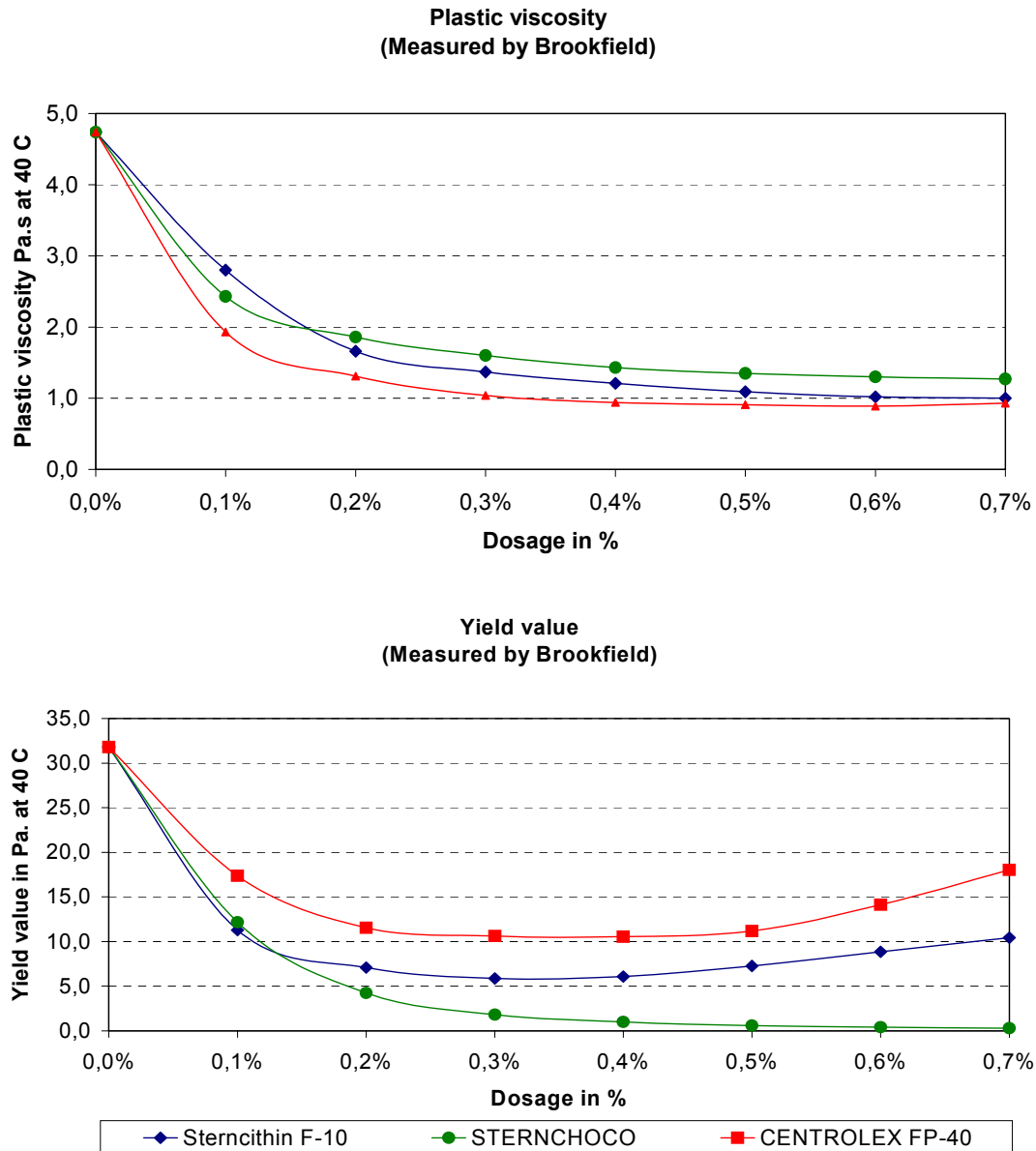
Below the most interesting results of our studies have been highlighted.

### Rheological effect of different emulsifiers in Dark Chocolate



The graphs show that the plastic viscosity in dark chocolate is the same whether using STERNCITHIN F-10, YN Ammonium Phosphatides or STERNCHOCO (Refined fluid lecithin combined with PGPR) whereas STERNCHOCO, compared to STERNCITHIN F-10 and YN lowers the yield point of dark chocolate significantly.

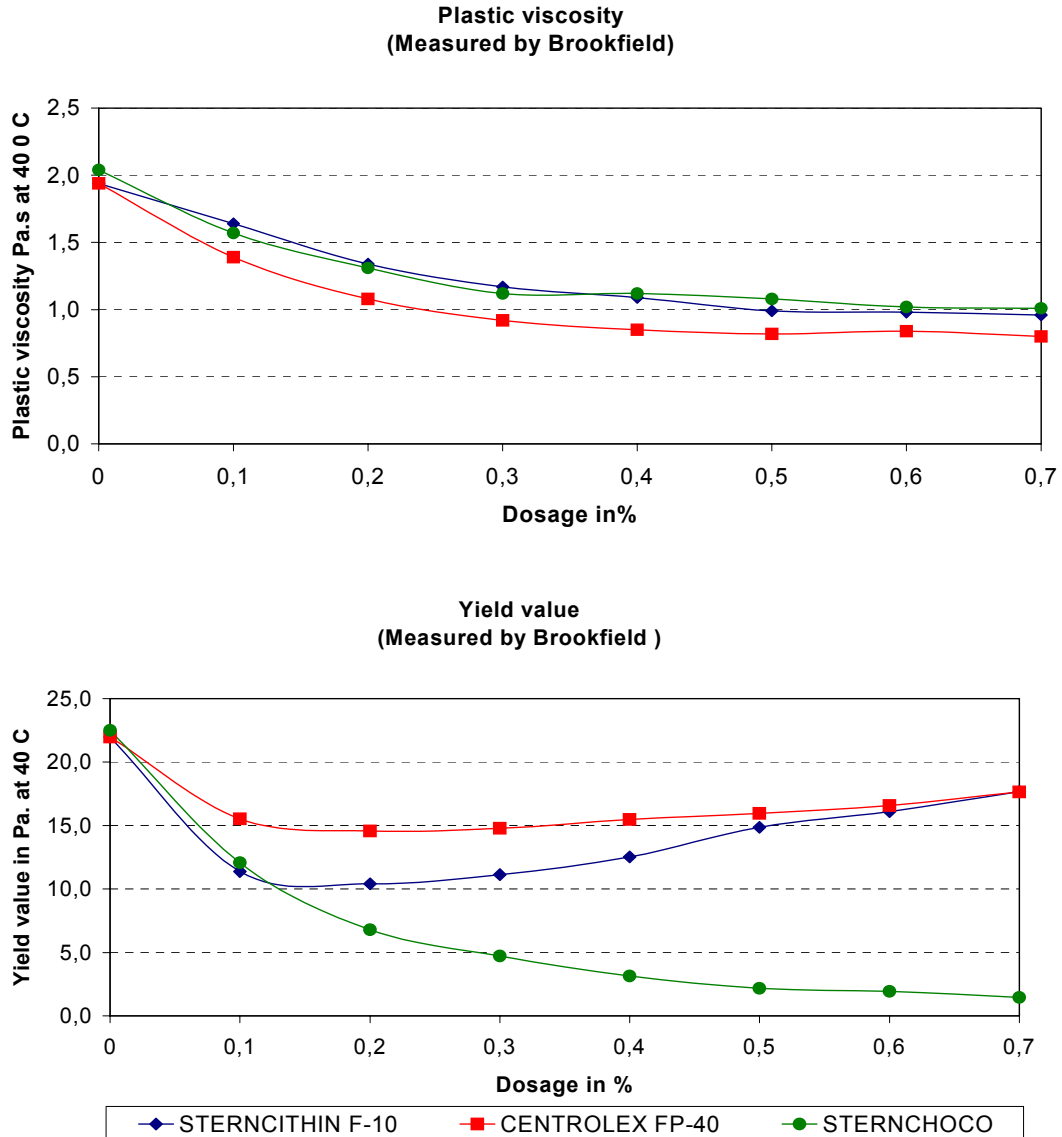
### Lecithin fractions in Milk Chocolate



Compared to other types of lecithin the use of CENTROLEX FP-40 in milk chocolate gives a slightly lower plastic viscosity in a low dosage. As milk powder contains some moisture and CENTROLEX FP-40 is a very effective emulsifier, the viscosity of CENTROLEX FP-40 is lower than the viscosity of the other lecithins tested.

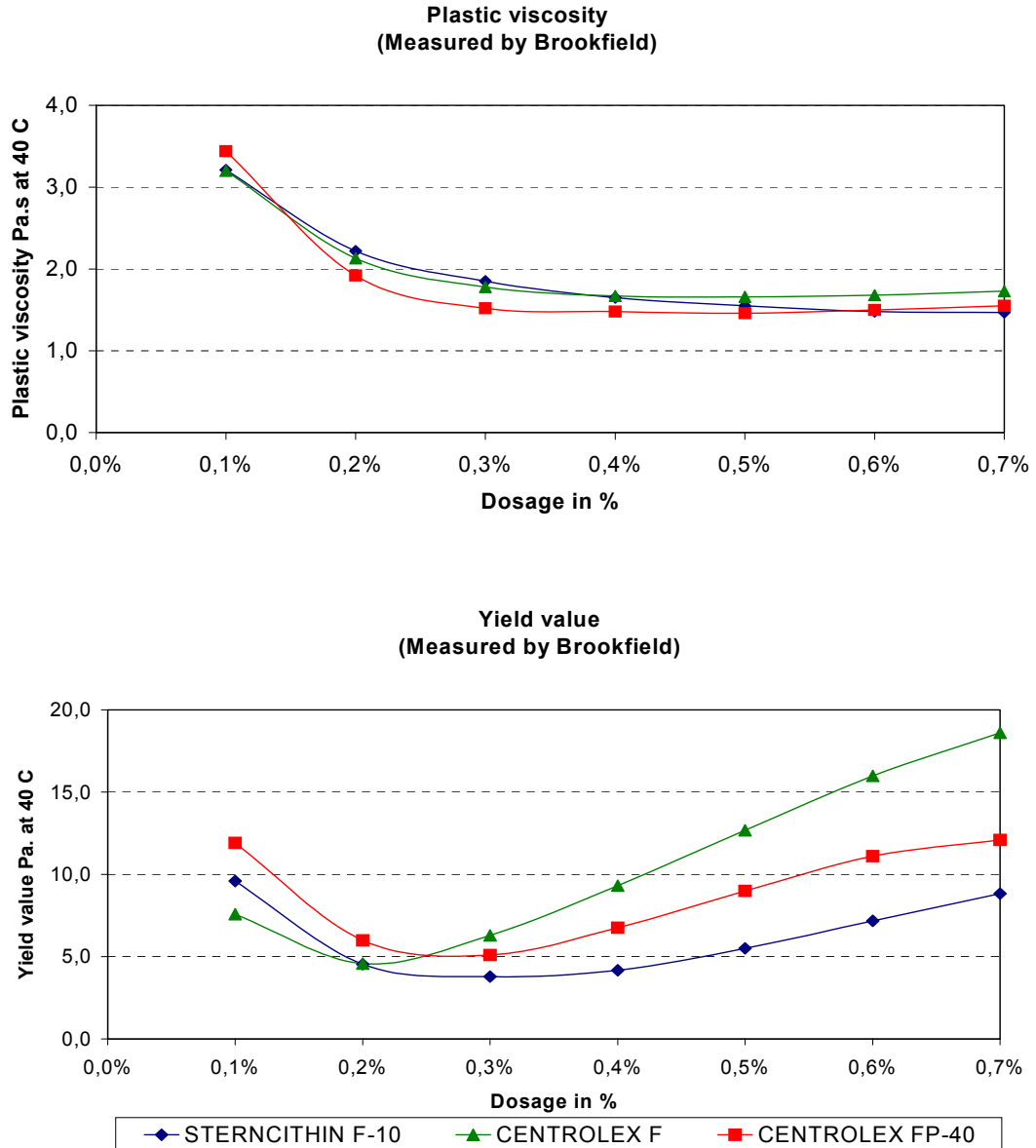
Looking at the yield value there are quite some difference between the lecithins tested. As can be seen STERNCHOCO gives the lowest yield value and continues to drop with increased dosage.

### Lecithin fractions in Dark Chocolate



A comparison of the different lecithins shows that CENTROLEX FP-40 has the lowest plastic viscosity in dark chocolate. Regarding the yield value it can be seen that STERNCHOCO has a decreasing effect on the yield value at increasing dosage while the other lecithins first stabilise the yield value which is followed by an increased yield at a higher dosage.

### Lecithin fractions in White Chocolate



In white chocolate CENTROLEX F, the deoiled lecithin, has been tested due to its more neutral and bland taste. CENTROLEX FP-40 shows a slightly lower plastic viscosity compared to the deoiled CENTROLEX F and STERNICITHIN F-10 - especially at dosage below 0.5%. Both CENTROLEX F and CENTROLEX FP-40 facilitates to a higher yield value.

## 2. Ice Cream Coating with special-purpose lecithin

Ice cream coatings containing 45% and 60% fat and a varying level of lecithin have been tested. The high lecithin dosage entraps the moisture liberated from the ice bar (-12 to -18°C) as it is dipped in the chocolate coating at 40-50°C. The uptake of moisture in the coating tank is usually in equilibrium with the input of fresh coating with low moisture content.

Under certain process conditions, such as start/stop and breakdowns, this balance can be disturbed. *In these situations constant flow characteristics with increasing moisture content are important.*

### Test and evaluation methods for Ice cream coatings

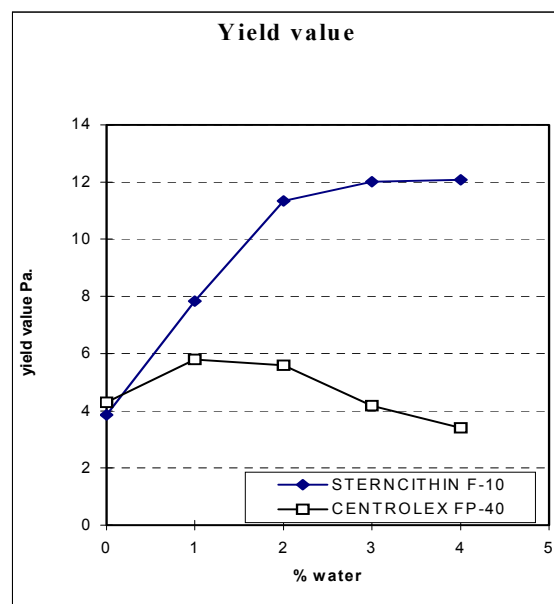
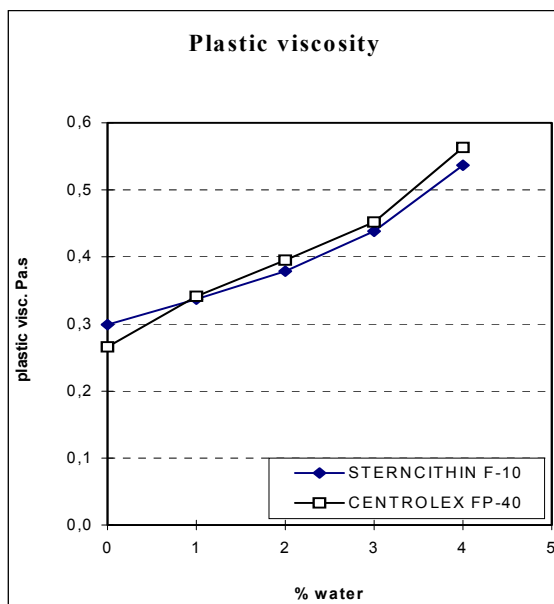
The Z-blade kneader type Winkworth was used as a conche or mixer for making blends at 60°C. In the conche chocolate 34% has been mixed with warm Cocoa butter or coconut oil during 30 minutes. Lecithin was added and conched for 45 minutes.

1-4% water was sprayed finely during conching of batches of the freshly produced ice cream coating. After each 1% water addition the chocolate was conched 30 minutes before taking sample for analysis. Under these conditions the moisture can be dispersed or emulsified very intensively.

A simple test has been used for dipping ice sticks in 60% ice cream coating. Ice sticks of minus 12°C, weight about 53 grams, size 2 x 3 x 9 cm, have been manually dipped in coating of 40°C till a marked height of 7.5 cm. After taking out the stick within 2 seconds the dripping time, the drying time, coating weight and smoothness of coating surface have been registered.

### Results and discussion:

#### Effect of 1% STERNCITHIN F-10 and CENTROLEX FP-40 in a 45% Cocoa butter coating with increasing % moisture

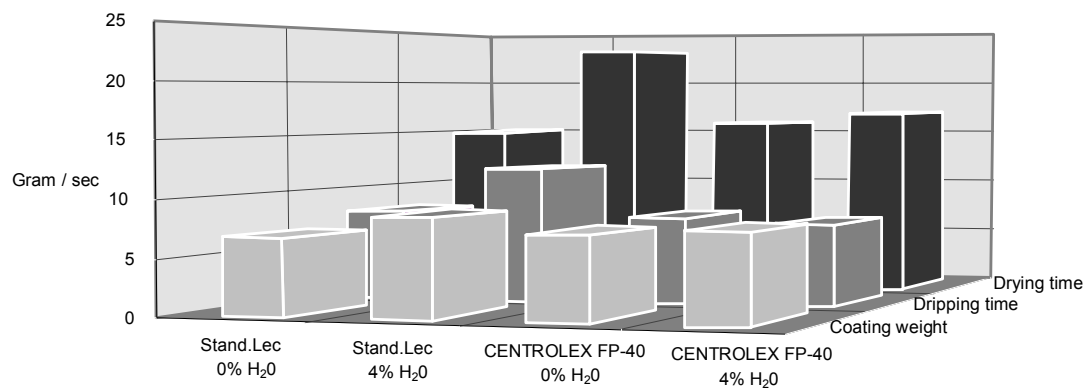


The diagrams show that both lecithins have the same plastic viscosity at an increasing moisture level. In the chocolate industry it is a well known phenomenon that a higher moisture level increases the plastic viscosity and yield value. But the yield values really show a difference. CENTROLEX FP-40 gives a significant lower yield value and keeps it more or less constant over a range of 0 – 4% moisture.

It is assumed that CENTROLEX FP-40 entraps water more efficiently, by which the yield value increase is low.

A 60% Ice cream coating is giving an instable system with increasing moisture addition. The emulsion with standard lecithin collapses with more than 2% moisture, while the fractionated CENTROLEX FP-40 stabilises the yield value.

### Ice cream dipping of dark chocolate with 60% cocoa butter



CENTROLEX FP-40 containing coating seems to support constant and effective conditions in the ice dipping process. Usually increased moisture will lead to longer drying times, a thicker and less smooth coating. CENTROLEX FP-40 suppresses these phenomena.

The coating weight, the dripping time and the drying time remain almost constant when using CENTROLEX FP-40 in contrast to the tested STERNLITHIN F-10. The coatings were smooth and glossy and of a high sensorial quality compared to standard lecithin which gave graininess when the moisture content exceeded 2%.

Standard lecithin will remain the most important chocolate emulsifier. The results among others reported in this bulletin underline the importance of optimal adjustment of the phospholipid composition.

Lecithin fractions can be used for specific application in special recipes and processes, and as a problem solver in dedicated market segments.

### **Food Regulations**

Lecithin from The Solae Company comply with the purity requirements of EU regulation on additive control and are approved as additives. Any restrictions on their use in specific foods must be observed.

The label declaration for lecithin is: Emulsifier Lecithin or Emulsifier E 322

The label declaration for STERNCHOCO is: Emulsifier E 322/ E 476

### **References**

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