SFC Prediction - How it works

Introduction

The calculation of the Solid Fat Content - SFC values - of oils and fats blends results in great difficulties, because the values do not behave linear. In principle, a calculation is possible, but only when larger quantities (greater than 5%) of liquid oils and lauric fats are excluded. The reason is that the triglycerides form so-called eutectics as they are also known of metallic alloys. Some deviations from linear calculated values are shown in the table below (values in absolute %). For mixtures with lauric fats or liquid oils, it is impossible without special tools to estimate the SFC values linear at more than 5% of these components.

Component Group	SFC-Depression
Laurics	ca. 20%
Liquid oils	ca. 10%
Palm products	
Palm olein	ca. 6%
Palm oil	ca. 3%
Palm stearin	ca. 2%
'Trans-Fats'	0%

Some times at 10°C and 20°C there is a small increase in SFC values, eg. for palm products and fully hydrogenated fats. Therefore, we have developed a method to predict the SFC values of fat blends, even multicomponent blends.

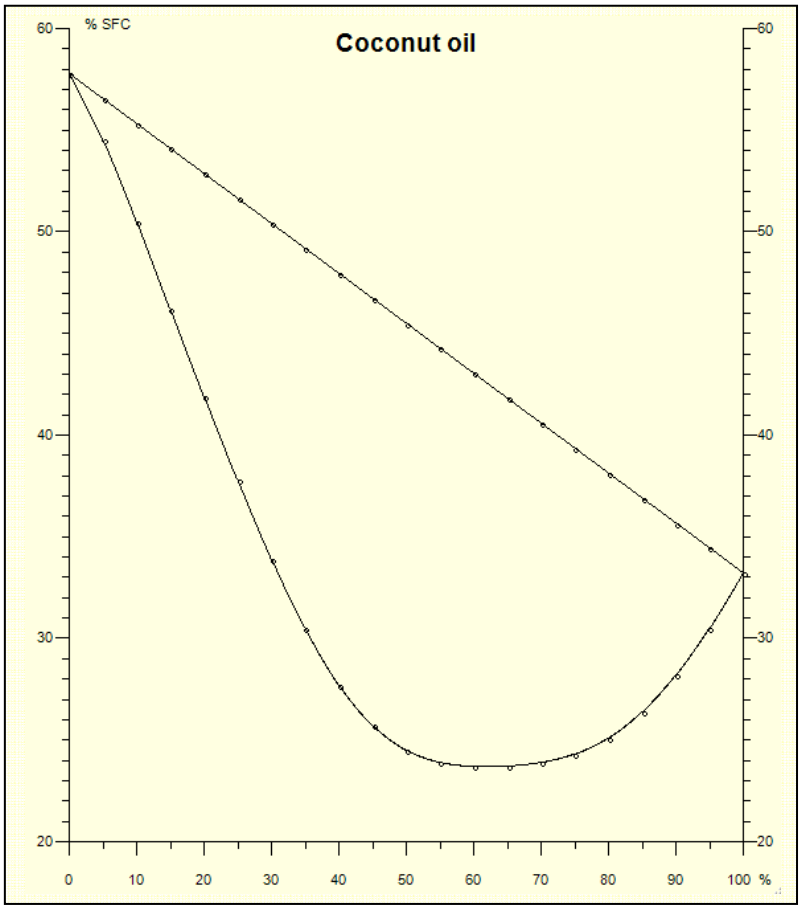
This method is based on four factors, which are used to correct the eutectic behaviour and SFC measurements by different methods, eg. ß-stabilized and non-stabilized methods.

Factors for SFC Prediction

To calculate reasonably correct SFC values, there are three different factors:

1. **Factors to consider the Eutectic behaviour**
   Since it is not possible to calculate with 'eutetics', we have developed a model. owever the model does not correspondend to reality, it is possible to calculate the Solid Fat Content of fat blends with reasonable accuracy.

   We make the following assumption: Oils and fats, which cause a SFC depression, dissolve some of the harder fat contents and result on this way to the depression. This effect is here-inafter referred as 'solubility'. The factors used for the calculation are called 'solubility factors' and determined experimentally for each oil or fat by series of blends. The 'solubility factors' are nothing but the differences between the linearly calculated SFC values and the meas-ured values (Please see graph on next page).



Solubility Factors for Coconut oil.

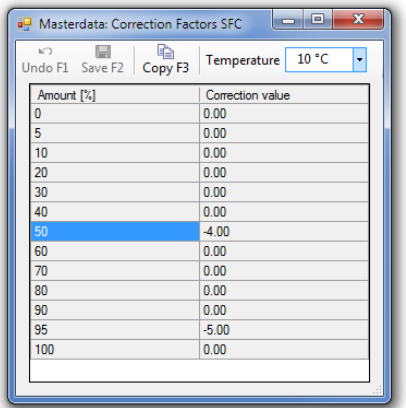
To avoid having to measure each component against each other a standard is used. This standard itself should not have any 'solubility'. This is suitable for hydrogenated rapeseed 36/38, alternatively, hydrogenated sunflower 36/38 or hydrogenated soybean 36/38. The data which are delivered with OilExpert.net are all based on measurements with hydrogenated rapeseed 36/38.

For all measurements to determine the 'solu-bility factors', it is not a question of the absolute values of the SFC values, since only differences are used for the calculations. For all oils and fats included in OilExpert.net oils and fats the 'solubility factors' already exists. How to get the 'solubility factors' is described in detail in the Oil-Expert manual. In many cases it is possible to copy the 'solubility factors' from similar components. If not matching the factors can be adjusted manually without any experimentations.

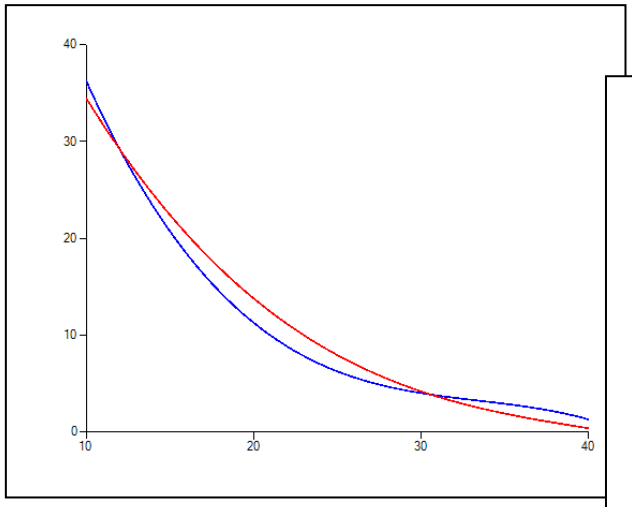
2. Factors for fine tuning

To increase the accuracy, there are factors that allow fine tuning of the SFC results. This factors are added to the previously calculated values.

The correction factors are dependent on the percentage of the component. A practical example is shown in the dialog right side for double fractionated palm olein.

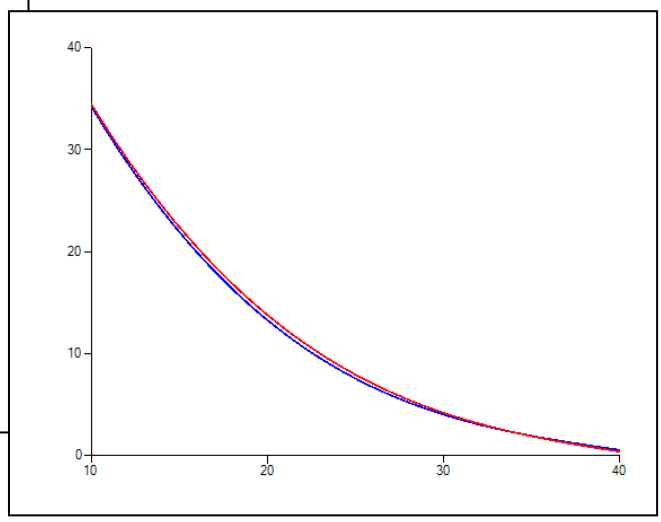


The effect of the new correction factors is shown with the two images below - No correction factors / With correction factors.



No correction factors

With correction factors



3. Global Correction Factors

This correction factors allow a further correction of the SFC values. The global factors are defined one for each temperature. They consider the laboratory-specific characteristics of the SFC measurement. The measured value is multiplied by this factor and is independent of the components and the blending. The range for each temperature is from 0 to 2. The standard value is 1 - that means no correction.

4. Correction factors for SFC measurements with different methods

This factor has nothing to do with the eutectic and solubility behaviour of oils and fats. In practice, it often happens that SFC values are measured by different methods. The measurementt results are usually not comparibel but the differences between the results are reproducible. But even here there are exceptions as far as reproducibility is concerned: Cocoa butter as an example is always measured using a ß-stabilizing method. Mesasurements usind a non-stabilizing method gives different values at each repetition. On the other hand, this is quite possible for Palm stearin. The results between stabilizing and non-stabilizing methods are indeed somewhat different, but the differences are reproducible in most cases.

Usually this is not a problem - to measure fats using different methods. A problem, however, is to predict the SFC values of blends whose components were measured by different methods. For example if the blend contains both polymorphic and non-polymorphic type fats.

Let's see an example of a blend consisting of components whose SFC values were measured by different methods - ß-stablizing and non-stabilizing methods:

50% Shea stearin (measured using ß-stabilizing methd)
30% Palm oil (measured using non-stablizing method)
20% Palm olein (measured using non-stablizing method)

In this case the blend is measured using a ß-stabilizing method. A calculation is not possible, because the SFC values of stabilizing and non-stabilizing methods are nor compatible. To solve this problem, we came up with the idea to adapt the measured SFC values to different methods using correction factors.

Of course, the values are sometimes very different to the standard method. But with the correction factors, we have obtained sufficient accuracy for the production control measurements.

To get more informations please see the Newsletter No. 7.

Setting up the System and Adjusting the Factors for SFC Prediction

1. Input of all raw materials

First all raw materials have to be entered with their parameters - at least SFC values for 10°C, 20°C 30°C and 40°C and the fatty acid composition. Other parameters are possible. Oil-Expert.net is coming with about 50 raw materials. In many cases it is sufficient to adapt these components. If the components are available as EXCEL file, they can be imported automatically. Since Oil-Expert.net can only import flatfiles, a marco is developed in Excel to export each component as a flatfile. But that only makes sense from at least 30 components.

2. Creating the solubility curves

The next step are the eutectic or solubility curves to get the solubility factors. The easiest way is to copy the data from similar components. A copy function is available in Oil-Expert.net. If not working satisfactorily there are two ways of going forward:

- Adaption of the solubility curves for the corresponding components manually by trail and error. That is only a matter of specisliasts. But we have years of experience in it.
- Determination of the solubility curves by experiment as described in the manual. That is always possible, even without experience, but takes a lot of time and laboratory work.

3. Changing the Global Factors

If all measured SFC values are too high or too low compared to the calculated values, a global correction can be made for each temperature. The standard value of the factors is 1 - means no correction. The range is from 0 to 2. Factors < 1 lead to lower values, factors >1 to higher values.

4. Fine tuning

Usually the accuracy is ±2%, in some cases worse. To improve accuracy, there are the factors described on page 3. This is the final step in the set up and adjustment of the factors for SFC.

How to go forward in practice

To calculate the SFC values satisfactorily, the following steps are required:

- Compilation of all raw materials incl. SFC values at 10, 20, 30 and 40°C.
  If the raw material data are available in electronic form, e.g. EXCEL workbook, Text file or LIMS, so much the better.
- Importing of the raw materials, either automatically or by manual input.
- Determintion of the solubility coefficients or adaption of the solubility curves for selected components.
- Adaption of the global factors and fine tuning
- SFC test with real blends. Therefore the SFC values of about 50 blends with two, three and four components are required

Working with Oil-Expert.net

Imprint

We would be glad to provide you with further information. Please feel free to contact us.

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Demo Version
We provide you with a demo version with full functionality. This version is six months runnable and can be extended if necessary. The demo version can be easily downloaded with a link from our website. If interested, please contact any of the above contacts.