Desmet Ballestra,
a leader in oil fat modification technologies

Oils & Fats

desmet ballestra

Science behind Technology

www.desmetballestra.com

Edible Oil Modification

In their native form, most edible oils have only limited application in food products. They are therefore often modified, chemically and/or physically, in order to alter their textural properties.

In the industry, 3 principal modification processes are used:

- Fractionation will separate the fat into a more solid and a more liquid fraction;
- Interesterification imposes a redistribution of the fatty acids over the triglyceride which allows to chemically 'blend' properties of different oil;
- Hydrogenation will saturate the double bonds in the fat, leading to a much harder fat.

Like all our edible oil processing technologies, Desmet Ballestra's proprietary oil modification technologies are continuously reconceived and improved in order to deliver the highest product quality in combination with minimal operation costs and least of environmental load. Indeed, our most contemporary processes like enzymatic interesterification and speciality fats fractionation can boast a much 'greener' image because of their safer, more sustainable and efficient way of operation. Moreover, the ease of use on a daily basis and possibility to integrate various technologies within one processing plant opens the way to even better process control, as well as synergistic combinations between the different modification techniques.

Dry Fractionation Technology

Main Food Applications for Dry Fractionation:

Oleins

- Salad oils
- Frying & cooking oil

Stearins

- Margarines & shortenings
- Confectionery fats (cocoa butter alternatives, substitutes, replacers)
- Coating fats

Fully automated Fractionation Technology *FlexiFrac™*

When oil is gently cooled, crystals will form spontaneously in the melt. After sufficient maturation time, these crystals can be filtered from the remaining liquid fraction, and this process thus results in 2 products: a solid fraction enriched in high melting crystals, and a clear liquid fraction depleted from high melting crystals. Typically this process is applied on oils that have an appreciable content of high melting components. The prime example is palm oil: this semisolid fat is not only the most produced oil in the world, it is also the most fractionated oil in the world since it serves as natural source for interesting solid fats as well as excellent liquid fractions.

FlexiFrac technology successfully combines the two aspects of the process, a controlled, selective crystallization and high-pressure filtration of the crystal suspension, into a smooth and flexible plant operation for a wide spectrum of fats and oils. FlexiFrac features optimized cooling geometries in combination with fully automated process temperature controls (see insert). This way, the hold-up times can be minimized, and consistent high-quality output can be guaranteed, for all kinds of feedstock.

Advantages

- Robust technology applicable to many different fats
- High ratio of cooling surface/oil volume
- Fast and reproducible cooling and crystallization

TX Cristallyzer

Being such a costeffective design, it is typically used for large palm oil fractionation plants, where the long cooling cycle times guarantee steady crystal growth and a smooth filtration.

Mobulizer™

Our state of the art crystallizer, with an innovative cooling-integrated agitation system, offers a true synergy of economics and performance. Its succes lies in the combination of low shear mixing with superior heat exchange properties. Therefore it can perform on those sensitive feedstocks where other designs would simply fail. It is also the only crystallizer design that can be used for FlexiFrac and iConFrac.

Tubular Crystallizers

Profiting from its high cooling surface to oil ratio, this crystallizer is often selected for plants that require forceful cooling and robust mixing of viscous oil slurries (e.g. fatty acid fractionation). The oil can be cooled rapidly and homogeneously, which makes this crystallizer also very suitable for a wide range of applications. The trademark short cycle times of these designs allow to combine great flexibility with high capacity.

A specific application: Free Fatty Acids fractionation

A specific non-food application of FlexiFrac technology can be found in the fractionation of fatty acids. The splitting and concentration of different types of fatty acids is crucial in order to produce basestock for industrial lubricants, cosmetics, softeners…

Although there is a wide selection of different technologies available today, each with its own advantages and limitations, dry fractionation technology is gaining attention and credibility because of its lower environmental impact, while high levels of purity can still be obtained.

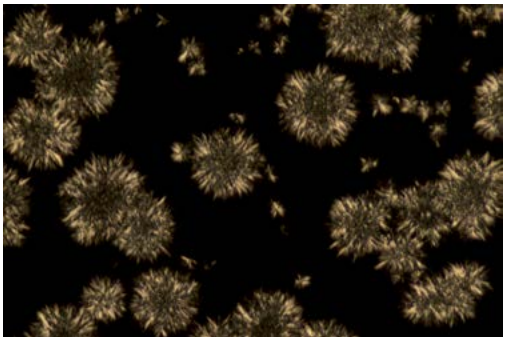
Advantages

- Mild operating conditions/nitrogen blanketed
- No yield losses
- Low operating cost

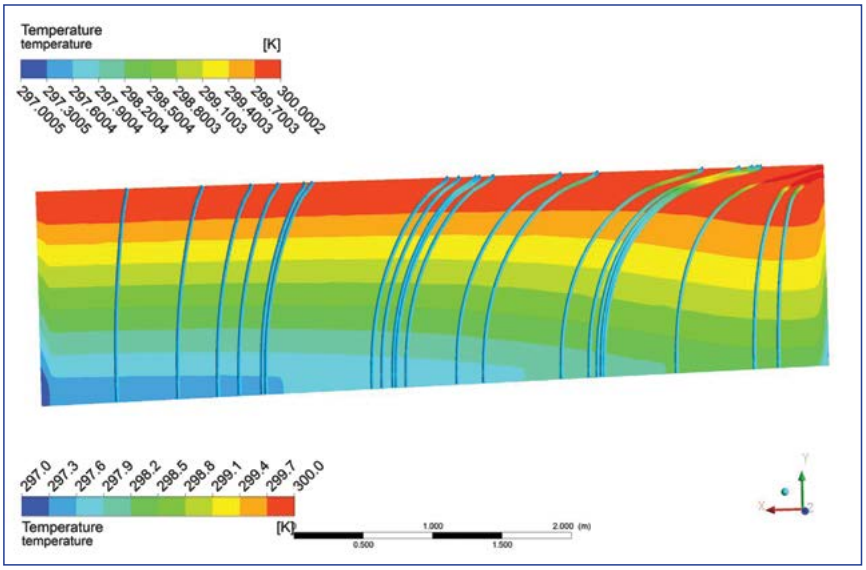
Continuous Dry Fractionation Technology *iConFrac™*

Today, continuous fractionation of palm oil is rightly regarded as the future of dry fractionation technology. True to its technological leadership, after many years of extensive R&D and industrial validation with selected partners, Desmet Ballestra has introduced iConFrac™ to the global market, a real continuous fractional crystallization technology, and an exclusive answer to the industry's demand for enhancing plant performance with lower energy consumption, day in, day out.

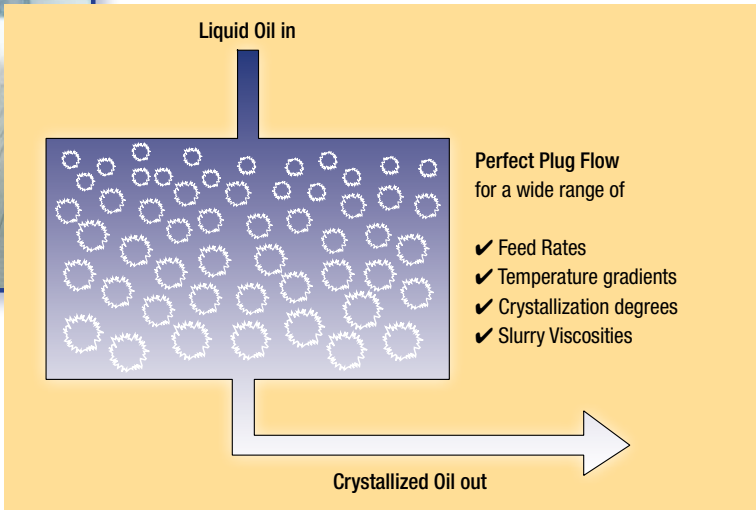
Due to a smart reconception and proper re-engineering of the original MoBulizer™ crystallizer design, these crystallizers can now work 24/7 as effective plug-flow crystallizers, delivering the highest quality fractions at a minimal refrigeration cost. Indeed, for many commodity oil processes, this truly innovative development will thus offer considerable advantages over many batch operated systems: capacity increase, reduced inter-batch variability, improved filtration properties of the crystals and a substantial energy saving. In combination with a transparent process control and fully-automated equipment, iConFrac™ is a true state-of-the-art fractionation technology.



Crystal spherulites of RBD Palm Oil formed with MoBulizer™ Technology



CFD simulation of temperature profile



Advantages

- Minimal operator intervention required
- High energy savings
- Excellent cold stability properties of the olein
- Increased olein yields

Semi-Continuous Technology for Speciality Fats *Statoliser™*

Our patented Statoliser™ technology is a prime example of how Desmet Ballestra has valorized its extensive knowledge about fat crystallization into a high-end fat fractionation technology, with outstanding quality results for speciality fats fractionation in the 21st century.

The principle of this technology lies in performing a static crystallization, which can be adequately controlled by means of increased cooling surface and proper temperature program selections. No shearing of crystals, no encrustation, no crystal lumps, no tripping motors… the Statoliser™ truly keeps performing where conventional crystallizers can fail. As a result, exceptional high degrees of crystallization can be obtained within the reactor, and the stearin yield can be vastly increased compared to many traditional technologies.

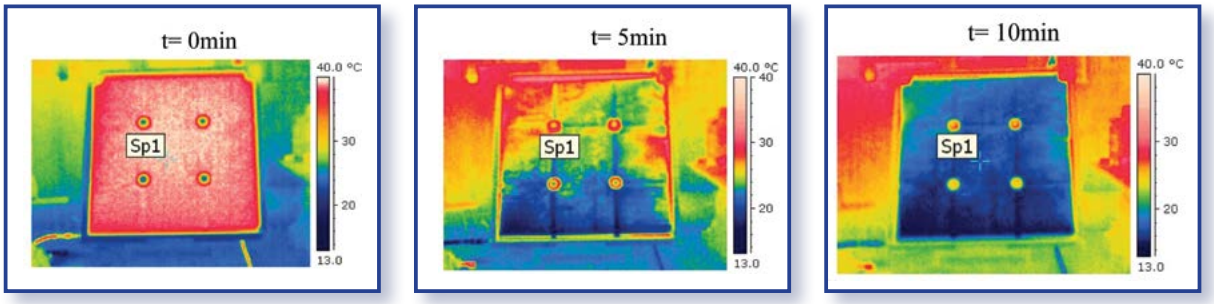
By virtue of the Statoliser's unique design to cope with highly viscous crystal slurries, this prime technology has delivered superior results for speciality fats fractionation. Since its introduction on the market, it has become the industry's standard for production of Cocoa butter Substitutes, Cocoa Butter Replacers and even products suitable in Cocoa Butter Equivalents (hard PMF).

Advantages

- Similar to panning & pressing or solvent fractionation
- Fully automated operation
- Requiring minimal manpower
- Very low operating costs

A complete range of fractionation technologies for all your projects

	Flexifrac™	iConFrac™	Statoliser™
Crystallizer design	Double jacketed Tx-crystallizer MoBulizer	MoBulizer-based	Statoliser (Static Crystallizer)
Main applications	Multistage palm oil Fish oil, Animal fats, Hydrogenated fats	Palm oil fractionation, Fish oil winterization, ...	Speciality fats: palm kernel oil, hard PMF, cocoa butter replacer fats
Typical capacities	10 – 2000 tpd	100 – 2500 tpd	20 – 300 tpd
Features	Flexible & robust design Multipurpose crystallizers	Large utility savings Ease of use Improved olein yield	High stearin yields Large heat exchange surface High pressure filtration



Evolution of Statoliser™ plate surface temperature upon entry of cooling water.
An homogenous temperature and heat exchange is established in a matter of minutes.

Interesterification Technologies

The interesterification of an oil consists in an interchange of the fatty acids between different triglycerides, by means of an appropriate catalyst. Contrary to a mere blending of two types of fat, an interesterification can offer a real synergy between the textural properties and melting properties of the two constituting fats. It is therefore a process that is typically used for those food applications where the plasticity of the fat is of utmost importance for the general appreciation of the product. Nowadays, the production of many margarines, shortenings, coating fats etc… heavily rely on the success of the interesterification process to produce tailor-made fats.

Chemical Interesterification *Interchem™*

Interchem™ technology is to date still a highly appreciated classic in its genre: a versatile, flexible installation that efficiently interesterifies fat mixtures to complete randomization, with minimal product losses. It is especially of interest for producers and fat product manufacturers that desire to have a technology that can adapt on a daily basis to different product recipes. Safe catalyst dosage and discharge, swift stock-change and a seamless integration with any post-bleaching section are the renowned trademarks for this archetypal technology.

Advantages

- Feedstock charge flexibility
- Easy to integrate with Hydrotherm technology

Enzymatic Interesterification *Interzym*

With the ever improving value-for-money of enzymes, the enzymatic pathway to interesterification has been developed by Desmet Ballestra into a full industrially scaled technology, offering various advantages for those producers that look for sustainable technologies that can boast minimal environmental load with maximal profitability of the process. The enzymatic version of this technique is renowned for its better preservation of colour and natural nutrients in the oil such as vitamin E, and overall much milder processing conditions. It is a fully continuous process, so ideal for interesterification of large volumes of commodity fats.

The De Smet Interzym process is designed for the use of Lipozyme® TL IM enzymes from Novozymes.
More information about Lipozyme® TL IM can be found on http://www.novozymes.com

novozymes®
Rethink Tomorrow

Advantages

- Low bio-catalyst use
- Safer bio-catalyst handling than in case of chemical interesterification

Hydrogenation

Hydrogenation is a modification process applied in edible oils processing industries for over a century.

Also called 'hardening', it is mainly used on liquid vegetable oils like soybean, rape or sunflower to increase their oxidative stability and improve their melting properties by reducing their degree of unsaturation. Hardened oils display improved consistency and increased melting points, almost behaving like fats! Hydrogenation is also applied on palm kernel stearin (produced via dry fractionation) to obtain fats with melting properties similar to cocoa butter.

Hydrotherm® semi-continuous process

Through the Hydrotherm® process, Desmet Ballestra uses a semi-continuous «dead-end» hydrogenator, in which hydrogen is dispersed in microscopic bubbles until the gas is fully consumed by the double bonds of the fat. Flexible, this process allows several batches of different fats can be processed in a safe, reliable way.
An automation program ensures full control of essential process parameters such as hydrogen pressure, reaction temperature and mixing speed.

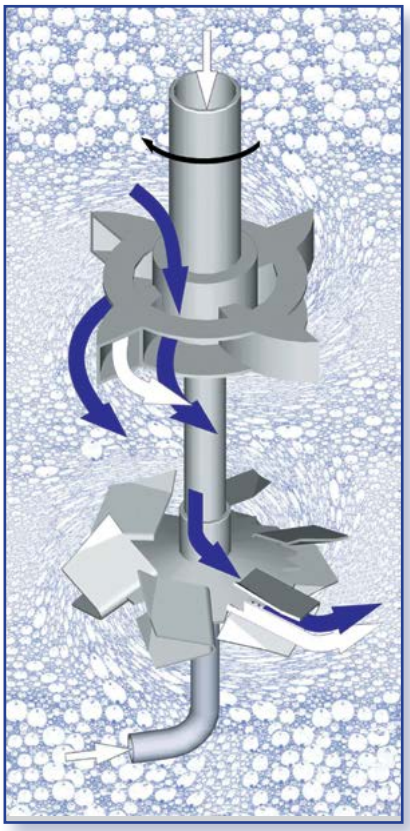
For reduced trans fatty acid formation, a high pressure hydrogenation reactor can withstand up to 20 bar of hydrogen pressure and thereby shift the selectivity of the reaction.

Stable high-quality oils

Hydrogenation is a reaction involving the use of a catalyst, most generally nickel, and is also an exothermic reaction.
For each iodine value unit drop, the oil temperature increases by 1.6 – 1.7°C. This heat is generally recovered to supply the factory low pressure steam headers.

Advantages

- Improved gas dispersion;
- High flexibility with selectivity;
- Low energy consumption;
- Steam production;
- Fully automated plant;
- No venting required as hydrogen is entirely consumed at the end of the reaction.



EKATO Combined Gassing

Perfect mixing

Careful and precise hydrogenation requires that the constituents – oil or fat, gaseous hydrogen and solid catalyst – should be mixed perfectly. This is done in a closed vessel – the hydrogenator – by agitation of the catalyst – fatty material suspension in contact with hydrogen.

The feedstock used for hydrogenation is usually caustic refined and bleached oil. With the improvement of degumming processes, there is a tendency to hydrogenate degummed oils. After hardening, those oils are bleached and physically refined. Oils for hydrogenation must respond to the following quality requirements:

Free fatty acids: < 0.05%
Soaps: < 25 ppm
Phosphorus: < 2 ppm
Moisture: < 0.05%
Peroxide value: < 0.5 meq/kg
p-Anisidine value: < 10

Selectivity

Selectivity is a determining criterion in the reaction as the saturation of the double bonds must not take place at random but according to a specific pattern:

- Selectivity is high when multiple unsaturation in the fatty acid chains is preferentially eliminated and the formation of saturated acids reduced to a minimum.
- Triglyceride selectivity is high when the attack on the fatty acid groups in the triglycerides is at random, that is as if they react as independent molecules. It is low when the attack of the 3 fatty acids in a triglyceride is correlated.
- Specific isomerisation. In any catalytic hydrogenation, isomerisation takes place. The number of trans double bonds formed per double bond eliminated is a measure of the degree of isomerisation.

Desmet Ballestra, your global solutions provider for all fat modification projects

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