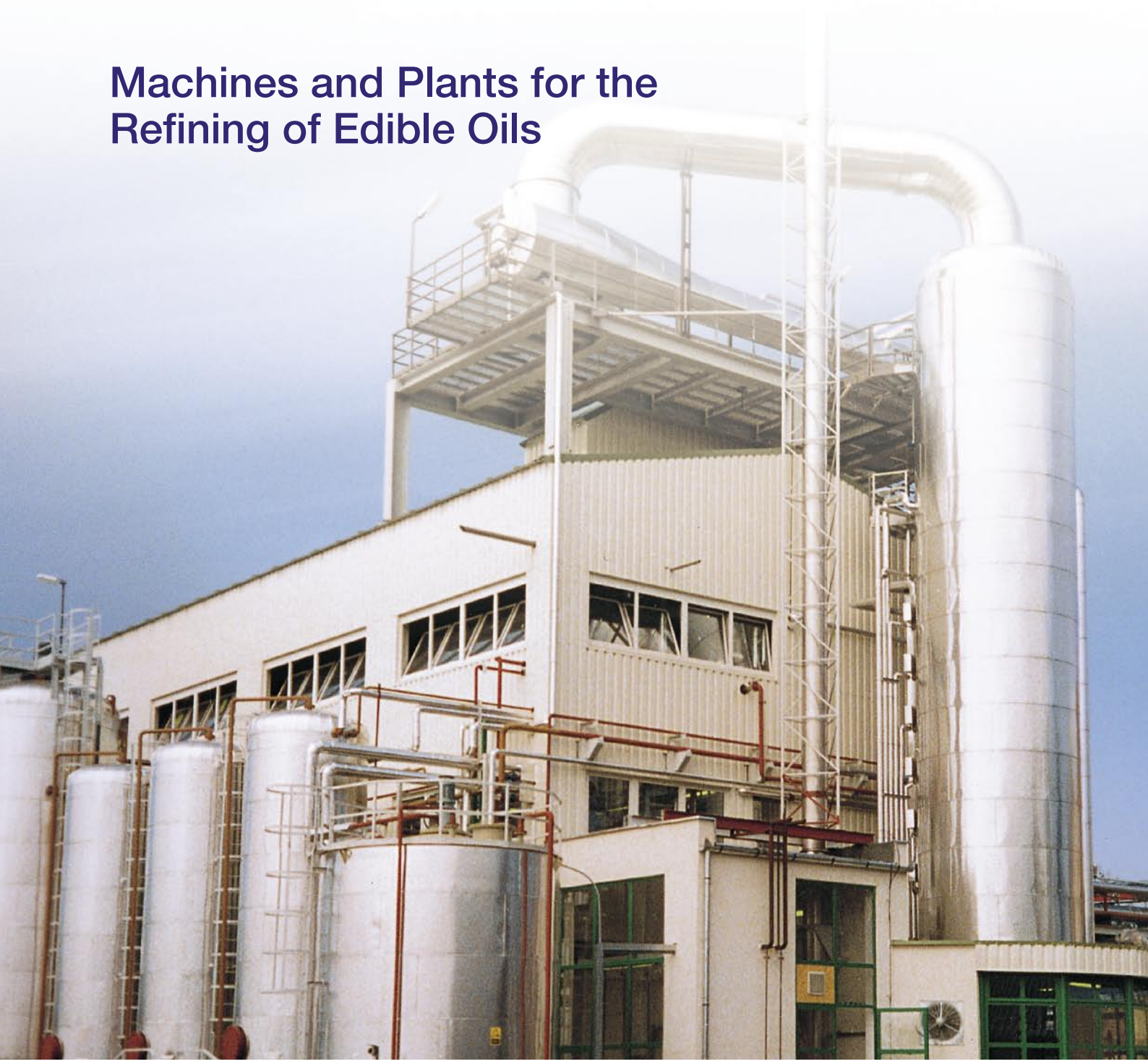
Machines and Plants for the Refining of Edible Oils



HARBURG FREUDENBERGER

We are the experts for professional solutions

For decades we have been the supplier of refining machines and equipment for the edible oil and margarine industry.
Our product range covers all relevant processing procedures.

Today the phrase „Made by Harburg-Freudenberger“ is a global synonym for highest quality, utmost care and high degree of satisfaction - from engineering via implementation to delivery. Reliability, long service life and economic efficiency are always guaranteed.

A refining process is carried out following extraction of crude edible oils by means of screw presses and/or solvent extraction.

In refining, physical and chemical processes are combined to remove undesirable natural as well as environmental-related components from the crude oil.

These components comprise for example phosphatides, free fatty acids, pigments (such as chlorophyll), odors and flavors (including aliphatic aldehyde and ketone), waxes as well as heavy metals, pesticides etc..

Depending on the requirements, the following basic processes are implemented:

- Degumming for removal of phosphatides,
- neutralization for removal of free fatty acids,
- bleaching for removal of color,
- deodorization to distill odors and flavors as well as free fatty acids and
- winterization for separation of waxes.

Refined edible oils are either directly used for human nutrition or serve as feed stock for further processing for example, for mayonnaise, margarine, shortening and for the production of biodiesel. Important process steps in this context are fractionation, hardening and interesterification.

Harburg-Freudenberger offers customized machine solutions for any application or process to meet the individual requirements of the customers.

Centrifuges in neutralization process

Different degumming processes are carried out to remove phosphatides. For efficient and economic application of this procedure Harburg-Freudenberger provides appropriate machines and equipment.

Water degumming

A large part of the phosphatides (gums) can be hydrated quickly and easily.
If the pressed or extracted oil contains a considerable quantity of gums the oil is subjected to the water degumming process immediately following extraction. In this process, water is added to the oil. After a certain reaction period the hydrated phosphatides can be separated either by decantation (settling) or continuously by means of centrifuges.

In this process step a large part of hydratable and even a small proportion of the non-hydratable phophatides are removed.
The extracted gums can be processed into lecithin for food, feed or for technical purposes.

The gum content in the oil is subsequently reduced according to the refining quality requirements.

In principle, the combination and concept of further processing stages is distinguished by

- chemical refining and
- physical refining.

In chemical refining the free fatty acids are neutralized by caustic soda resulting so-called “soap stock” which is also separated either by decantation or continuously by means of centrifuges.

Simultaneously the non-hydratable phosphatides are also separated in this process.

In physical refining the gum content can be further reduced by different processes:

- Dry acid degumming or
- wet acid degumming.

Dry acid degumming

Dry acid degumming is particularly suitable for processing oils with low gum contents such as palm oil, coconut oil, palm kernel oil or animal fats. Intensive mixing is implemented following addition of acid to the pre-heated crude oil. The conditioned gums are absorbed into the bleaching earth and are separated by filtration.

The benefits of the dry acid degumming process are:

- Efficiency as a result of
  - low energy consumption,
  - low operation and maintenance costs (sturdy and reliable control system),
  - long service life
    (the components are acid proof),
  - minimum footprint,
  - low investment costs,
- environmental-friendly as no wastewater or soap stock occur.

Wet acid degumming

Initially oils with higher gum contents (e.g. corn oil) are similarly processed as in dry acid degumming.
However, to achieve gum hydration water is added following acid apportioning. The gums are removed by a separator prior to bleaching.

This process is beneficial as

- centrifuges enable easy separation of gums in oil types with higher non-hydratable gums contents (e.g. rape oil and soybean oil),
- the consumption of bleaching earth is reduced because the oil has already been extensively degummed.

Dry or wet acid degumming are not always sufficient to reduce gums to the value required in the oil prior to the combined deodorization and distillation process.
Thus, we have developed a special degumming process:

UF degumming

The UF process enables effective degumming of oils such as sunflower seed oil, maize oil and rape oil. It is also suitable for other oils in which the gum reduction required cannot be achieved with conventional dry and wet acid degumming prior to final steam refining. UF degumming is suitable for both crude pressed oil and for water-degummed oils resulting from pressing or extraction.

Oil conditioning with acids is generally based on the

- retention of the mixture at a predefined temperature,
- cooling of the mixture and simultaneous addition of caustic soda or a comparable flocculating agent,
- further retention and reaction of the mixture, the heating and subsequent separation of the gums in a centrifuge,
- washing of the oil in a second centrifuge stage to remove any gum residue.

The effective, economical and technical benefits of physical refining process are achieved by the UF degumming process.
Compared to classic chemical refining these processes ensure

- higher yield,
- less operating resources,
- improved environmental friendliness as no soap stock splitting on-site is required,
- reduced consumption of bleaching earth and
- convenient operation due to automation.

The UF degumming features further specific benefits. The UF degummed oil is characterized by increased storage stability as gums as well as prooxidative metals such as iron and copper are also widely removed. This ensures considerable improvement of the product quality.

Existing centrifugal systems can be retrofitted cost-effectively to UF degumming plants. An appropriate UF degumming plant design enables chemical neutralization of minor quality oils which cannot be processed in physical refining.

Bleaching

Today we use a continuous bleaching process apart from special applications and minor processing quantities. This is used for:

- Bleaching degummed oil prior to physical neutralization and deodorization,
- bleaching wet-degummed and chemically neutralized oil prior to deodorization,
- post-refining of hydrogenated and chemically interesterified oils and fats.

In this process a pre-defined quantity of bleaching earth (adsorbent natural or activated earth, mixed with activated carbon if necessary) is continuously added to the oil.

This process is specially characterized by the loop reactor enabling operation without the agitator tanks as well as simultaneous intensive mixture and contact of the bleaching earth with the oil. The bleaching earth is filtrated following reaction period .

In addition to the common target of lightening the oil color the bleaching process also meets numerous requirements:
The bleaching earth adsorbs color pigments as well as oxidation-supporting metal ions, complex compounds, residual soaps and similar substances such as traces of catalyst from hydrogenation.

Furthermore, it serves as a filter for impurities and for gums precipitated by acid in dry degumming.

The benefits of the continuous bleaching process are:

- Enhanced product quality, bleaching under vacuum, gentle heating through optimized temperature control, intensive decoloration of the oil,
- increased efficiency, optimized utilization of the bleaching earth through intensive reaction of the mixture during circulation in the loop reactor, convenient operation and maintenance through sturdy flow and level control, easy filter emptying, degree of automation according to the customer's requirements, energy efficiency through additional heat recovery, higher wear resistance through high quality materials (e.g. special pump seals).

Winterization

For refining products to be bottled as edible oils (e.g. sunflower seed oil or corn oil) winterization is required to achieve the necessary cold stability. Winterization prevents crystallization and clouding of the waxes contained in the oil at ambient temperature.

In the winterization process the oil is cooled by heat exchange with cold water to a temperature between approx. 5 and 10 °C. Crystals causing oil clouding are formed during a mature period of up to 24 hours and are subsequently separated.
This is implemented by continuously adding filtering aids and filtration via horizontal filters.

Combi-process

To avoid undesired by-products such as soaps oil refining is implemented in physical processes. Harburg-Freudenberger combines the wet degumming and winterization processes into a unique process which enables separation of gums and waxes in a single step. The cooling phase in the combi-process is adjusted to the temperature and retention time of the winterization process and the already solid gums are used as germs for wax crystals. The downstream filtration of the degumming centrifuge removes minor wax residues; the use of filter aids is minimal vis-à-vis the classic winterization process.

Deodorization

Deodorization is the quality-defining process step in refining oils and fats and therefore particularly significant. Undesired by-products remain in the oil or fat following the preceding refining processes. These can impair the odor, taste or shelf life of the product and must therefore be removed. Some of these by-products are still bound in the fat molecules. They are only released by chemical transformation provided that the oil has been sufficiently retained in the deodorizer.

Free and low-boiling substances are distilled at higher temperatures in a high vacuum. Steam is added for stripping.

Batch-deodorizers are still used today for smallest throughputs, whilst semi-continuous and continuous plants are found in large-scale operations.

For any application and throughput of deodorization we offer established and state-of-the-art concepts.

Continuous deodorization plants

The use of a continuously operating deodorization plant features highest efficiency for deodorizing large product batches and high throughput requirements. Investment costs and low energy consumption quickly pay off.

With an automatic product change system, our continuously operating deodorizers plant reaps the benefits of the simple product change.
The continuous operation also ensures that benefits such as low steam consumption and a high degree of heat recovery are retained.
An automatic system can be applied for frequent start-up and shut-down operations. The continuous deodorizer operates according to the countercurrent principle:
The product and strip steam are directed in a countercurrent during the entire processing time.

The continuous deodorizer is also an established distillation device. In case of higher concentration of fatty acids an upstream countercurrent column is connected to the deodorizer. This combination is particularly economical as the exhaust vapors from the deodorizer can additionally be used in the pre-deacidification process. This ensures optimal absorbing capacity of the stripping steam resulting in considerable savings of resources for vacuum generation.

The continuous countercurrent deodorizer features extraordinary benefits.

Excellent product quality:

- Gentle cooling under deodorizing conditions,
- uniform processing (narrow retention time spectrum),
- throughput and processing time are infinitely adjustable to product properties.

High efficiency:

- Integrated countercurrent heat transfer with high heat recovery (>80%),
- long service life due to highest pro duction quality and materials, no moving parts, minor footprint through compact configuration (e.g. integrated vapor scrubber).

Optimal operational safety, easy operation and maintenance:

- Trouble-free operation due to level control in the devices ensuring uniform optimal pump operation,
- easy inspection of all trays through the central shaft,
- easy product change (automatic product change system),
- gentle cooling under deodorizing conditions.

Semi-continuous deodorization plants

For generating high-quality oil and fat mixtures for the production of shortening or margarines frequently changing fat or oil batches must be deodorized. The use of a semi-continuously operating deodorizer is recommended for this purpose. The requirements for such production process are fully met and ensure:

- Clear separation of the batches,
- precise adherence to defined retention times and other processing conditions,
- unlimited distillation options.

Our approach for process technology and constructive decisions in building semi-continuous deodorizers is: creating an optimally refined product which is highly resistant against taste reversions and deterioration.

This semi-continuous deodorizer enables easy operation. A programmable controller guarantees fully automated process cycles. The controller can be adjusted to meet the customer's requirements and integrated into the computer-controlled system.

Our semi-continuous deodorizer is characterized by particular benefits.

Excellent product quality:

- Gentle heating and cooling under deodorizing conditions,
- pre-selectable throughput and processing conditions,
- uniform processing for each individual batch as a result of the semi-continuous operating method,
- clear product separation thanks to consistent batch separation, indirect heat transfer and automatic residual emptying during product change.

High efficiency through:

- Integrated heat transfer with high heat recovery, which is also fully maintained during a product change ("Thermosyphon System"),
- long service life thanks to high production quality and materials,
- minor footprint thanks to compact design,
- standard sizes with narrow graduation from 30 t/d up to more than 1000 t/d,
- high operational safety, maximum leak tightness and easy access for inspections.

Fractionation

Natural edible oils are multi-component mixtures consisting of various triglycerides. The complex composition partially results in a very broad melting temperature range. Thus, they are unsuitable for different applications in food technology.

Further applications for such fats are possible by fractionating into components with smaller melting temperature ranges. Different fractions can be obtained from a single crude fat.

Fractionated fats and oils can be widely used in nutrition:

- The low melting fraction of an edible fat can be used e.g. as an adequate substitute for conventional salad oils;
- the higher-melting fraction of an edible fat can be used e.g. for the production of margarine or shortening;
- the mid-fractions can be used as substitutes for the expensive cocoa butter;
- certain special fats, such as deep frying oil, diet margarine, shortening or mayonnaise are preferably made from fat fractions.

In the fractionated crystallization process most frequently used in the industry, the various triglycerides contained in animal or plant fats are separated.

The higher melting components are crystallized and the hard fraction is subsequently mechanically separated from the liquid.

The machines and devices for fractionation manufactured by Harburg-Freudenberger feature a comprehensive range of application. All common fats such as palm oil, hardened fish or rape oil, soybean oil and butter fat can be processed.

We recommend the “dry” fractionation process from the melt because this process operates without any additives resulting in:

- Physiologically neutral products as additives do not cause contamination,
- high operational safety as solvents do not present explosion hazards,
- no contamination of the wastewater or exhaust air as they are completely free of additives,
- dry degumming as the ideal, cost-effective supplement as no wastewater processing is required for the entire system and:
  - fully automatic operation,
  - high flexibility in the cooling profile design,
  - reduced cycle time,
  - improved quality,
  - higher yield.

STAR Crystallizer

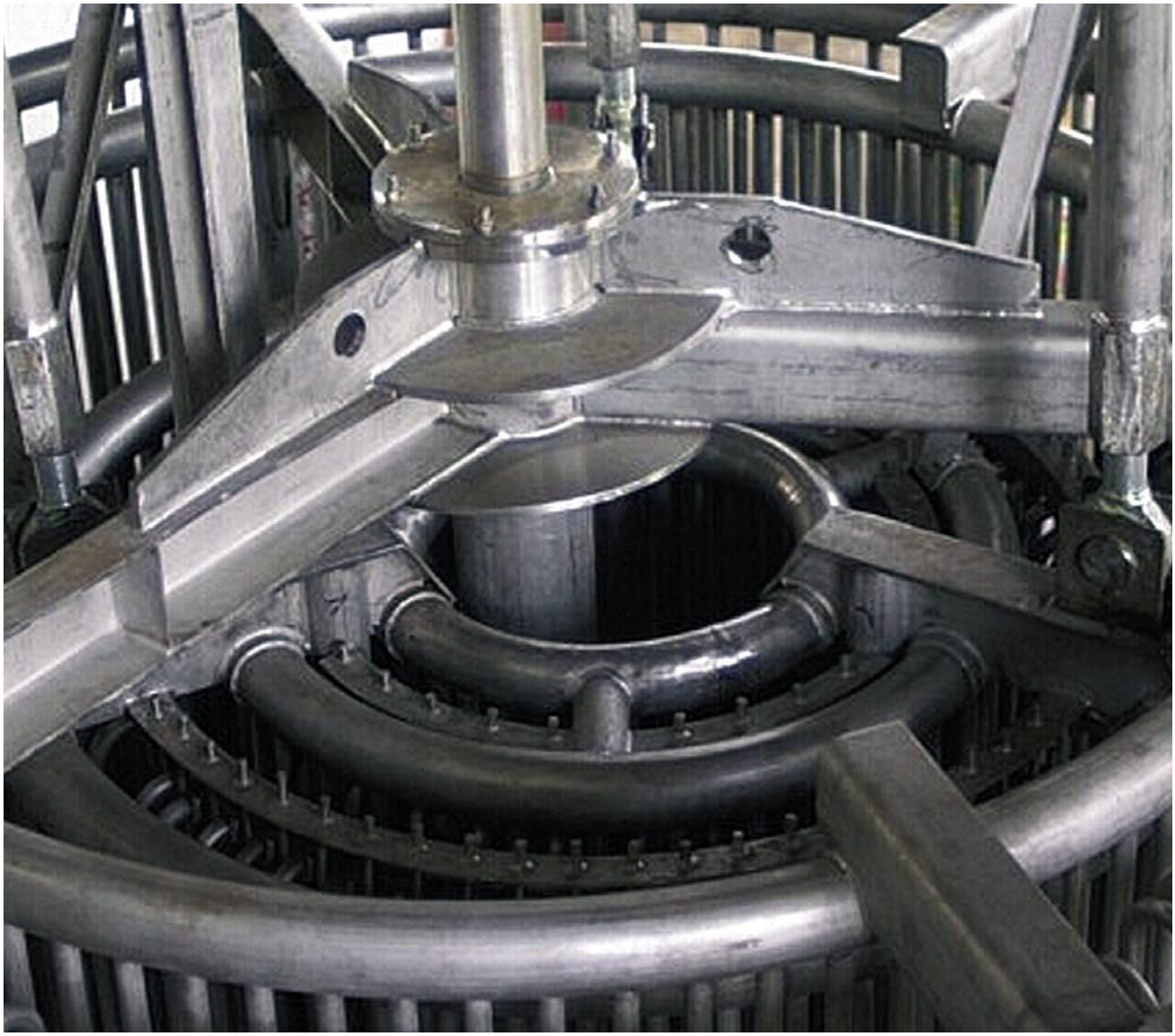
The crystallizer is of particular importance for the entire fractionation process cycle.

We have designed a special device for holistic tempering of the material to be processed.

In comparison with conventional crystallizers, the STAR (stirring area) Crystallizer from Harburg-Freudenberger distinguishes by:

- The improved distribution of the heat exchange surface inside the crystallizer,
- an enhanced cooling surface/ crystallizer volume ratio,
- the improved heat transfer rate (k value).

The modified STAR crystallizer from Harburg-Freudenberger is equipped with movable, vertical cooling pipes arranged in parallel.
The moving speed of the cooling coils in the oil can be adjusted by a variable speed gear or a frequency converter.



Harburg-Freudenberger
We develop, build and distribute machines, lines and systems across our three company divisions based on 150 years of company tradition.

Rubber mixing technology
We provide the most comprehensive range of machines for the rubber and caoutchouc industry including all major preparation and processing stages.

- Complete mixing room systems
- Internal mixer
- Mixing mills
- Dump extruder

Caoutchouc technology
Production machines and lines for the manufacture of tires and technical rubbergoods from raw material feeding to vulcanisation:

- Extruder
- Extrusion lines
- Tire building machines
- Curing presses

Edible Oil Technology
Machines for processing oilseed, crude oils of vegetable origin and animal raw materials as well as screw presses for the dewatering of synthetic caoutchouc and similar products:

- Screw presses
- Extraction lines
- Refining lines
- Process engineering

We are always at your service
With our foreign offices and our service points we have a global presence.

If you would like to learn more about Harburg-Freudenberger or if you require information on specific services, please do not hesitate to contact us.

HARBURG FREUDENBERGER

Harburg-Freudenberger Maschinenbau GmbH
Kautschuktechnik • Speiseöltechnik
Seevestraße 1 • 21079 Hamburg • Germany
Postfach 90 05 52 • 21045 Hamburg • Germany
Tel.: +49 40 77179 - 0 • Fax: +49 40 77179 - 325

Harburg-Freudenberger Maschinenbau GmbH
Gummimischtechnik
Asdorfer Straße 60 • 57258 Freudenberg • Germany
Postfach 11 80 • 57251 Freudenberg • Germany
Tel.: +49 2734 491 - 0 • Fax: +49 2734 491 - 150

Hamburg-Harburg Freudenberg Belišće Topeka Akron Paris Teheran Moskau

www.harburg-freudenberger.com

L3-0606/1. 1-Tö