EDIBLE & ESSENTIAL OILS PROCESSING EQUIPMENT
For over 25 years Armfield has been the world leader in the design and manufacture of miniature-scale processing equipment for the food technology industry. We have equipped laboratories and research facilities around the globe and boast many of the world’s leading food manufacturers among our customers.

Armfield is also a market leader in the design and supply of technical training equipment for engineers and scientists in colleges and universities worldwide. Using this unique experience, in both industry and education, we have developed a range of equipment for introducing food technology into educational and research environments.

Armfield can provide a complete solution to your food technology requirements, offering not just the equipment but also advice, planning, installation, commissioning and training. All this is supported by Armfield’s unrivalled commitment to quality and its extended warranty on all products.

We hope you will find this brochure of interest. If you require further information please visit our website at www.armfield.co.uk where detailed specifications and individual data sheets, describing each piece of equipment, are available for download.

Alternatively you can contact us directly:
by e-mail: sales@armfield.co.uk
telephone: +44 1425 478781
fax: +44 1425 470916.

The benefits of using Armfield miniature-scale food processing equipment:

**MINIMISE COSTS:**
- Reduced space requirements. Many of the products are portable so that a meaningful process line can be installed in even compact laboratories
- No special services or facilities are required, which reduces the demands on technician time
- Smaller capacities introduce lower running costs in terms of raw materials, energy, storage and disposal of waste
- Quality and reliability, backed up by our technical support team, ensure that the cost of owning and operating Armfield equipment over many years is kept to a minimum

**MINIMISE TIME:**
- Smaller-scale processing ensures complete test runs can be performed quickly and easily
- Automatic control and data logging wherever appropriate ensure meaningful information is obtained in the optimum time scale
- A high degree of flexibility, plus self-contained designs, mean different processes can be configured with the minimum delay
- Equipment is readily dismantled for inspection, cleaning and maintenance as described in the comprehensive manuals
- Clean in Place (CIP) facilities built in wherever appropriate

**PLUS…**
- Fully illustrated instruction manuals describe system operation and experimental procedures as well as installation and commissioning
- After sales service, technical support and Armfield’s unrivalled extended warranty

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OILS PROCESSING
Oil is extracted from a number of fruits, nuts and seeds for use in cooking or as an ingredient for other goods such as foods and soap.

PREPARATION AND EXTRACTION
Oil is usually extracted from seeds, fruit or nuts using either a pressure or solvent method or often a combination of the two. Edible Oils are often defined as unrefined or refined. Unrefined oils tend to maintain the identity of their origin and are usually obtained by cold pressing the raw material. Refined oils are usually extracted using chemical solvents and are then passed through various refining processes. Refined oils are often quite bland but are useful for many purposes including cooking at high temperatures when an unrefined oil might smoke or burn.

PRESSURE EXTRACTION
Oil extraction from seeds is often more efficient if the seeds are small. Large seeds such as palm kernels can be processed in the FT2 Hammer/Beater Mill before the oil is extracted mechanically using the FT28 Oil Extraction Screw Press. After pressing, and prior to refining, the oil can be filtered.

SOLVENT EXTRACTION
Edible oil is leached from oil bearing seeds, or from the press cake remaining after pressure extraction, by a solvent using a solid/liquid extraction process. The solvent then needs to be removed from the extracted oils and recovered from the solids. The FT29 Batch Solvent Extraction and Desolventising Unit is a versatile product that first washes the press cake in hexane, which absorbs the oil, and forms a miscella. The remaining processes use a combination of heat, vacuum and direct steam to separate the solvent from the oil in the miscella. These processes enable different oils to be extracted from many kinds of materials. An external steam supply can be provided by the UOP10 Laboratory Steam Generator.

REFINING
The refining of crude edible oil incorporates three stages: first certain natural acids must be removed, then the colour of the oil must be lightened and finally the taste and smell are improved. In the first stage, or pre-refining process the crude edible oil undergoes neutralisation using a strong base such as caustic soda to remove free fatty acids. With some oils de-gumming, by mixing the oil with phosphoric acid, is required. The oil is then washed to remove phosphatides and bleached with adsorbant to remove colour before finally being filtered. These refining processes are all demonstrated by the FT66 Neutraliser/Washer/Bleacher.

FINISHING
In order to 'finish' the refining process, to make an oil, which can be consumed or used in the manufacture of other products, it is necessary to deodorise and 'polish' the oil. Deodorising is performed at high temperature and under high vacuum. It removes the remaining free fatty acids and other compounds, which impart an unpleasant odour to the oils. Cooling is performed under vacuum to prevent oxidation and polishing removes any remaining contaminants by fine filtering, producing a bright oil as the final product. The FT68 Deodorising Unit is used to perform these processes.

HYDROGENATION STATION
Hydrogenation is a process used to modify the refined oil in order to increase the 'hardness' and to give various degrees of saturation of the product and adjust its melting point. Hydrogenated oils can solidify, or partially solidify at ambient temperature and so are often used for subsequent processing such as making soft spreads, margarines and ghee etc. The FT67 Hydrogenation Unit is based on the flat blade turbine converter industrial design and incorporates a leaf filter to remove any traces of catalyst that might be present.

HOMOGENISATION
Homogenisation is a process where oil particles in an emulsion can be broken down to microscopic size to provide greater permanence demonstrated by the FT90 or FT91 Homogenisation Sub-Systems for continuous processes.

BATCH PROCESSING
Batch processing stations are used for preparation of materials prior to other processes. The FT40 Multipurpose Processing Vessel is a versatile batch preparation vat used for the mixing of ingredients plus heating, cooling and emulsification. It can be used as a service unit for the scraped surface heat exchangers in the manufacture of soft spreads. The FT140, FT141 and FT142 are also suitable for this purpose.

SOFT SPREAD PROCESSING
Soft spreads and margarines are manufactured by cooling down the ingredients using scraped surface heat exchangers and then working the crystallising product into a smooth consistency using a pinworker. The FT25 Scraped Surface Heat Exchanger can be used for this purpose.
STANDARD EQUIPMENT RANGE

This diagram shows the typical stages in the processing of edible oils and the range of Armfield products that can be used in each area.

**APPLICATIONS:**

- Rapeseed oil
- Margarine
- Linseed oil
- Recycling fats
- Chocolate fats
- Olive oil
- Essential oil
- Palm oil
- Edible oils
- Monoglycerides
- Soft spreads
- Sunflower oil
- Biodiesel
- Wheat germ oil
- Cream filling fats

*All your oils and fats processing requirements*

This brochure includes QR codes for all listed products to enable quick access to more information and data sheets. Simply scan the QR code with your enabled smart phone and you will be directed straight to the website.
**EXTRACTION AND SEPARATION**

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**FT2 HAMMER/BEATER MILL**

The mill consists of a simple but sturdy overhung beater cross design with ease of accessibility and cleaning. The standard machine is of cast iron. The mill occupies a minimum of bench space. A 1.5kW motor drives a beater cross at 8000rpm above a curved replaceable screen. In its new form the grinding chamber is mounted above the motor and the shaft is driven by means of a short toothed belt.

**FEATURES**
- Sturdy overhung beater cross design
- Eight perforated plate screens with various hole diameters

**BENEFITS**
- Bag collector serves as air filter and collection device
- Extended inlet throat prevents accidental injury

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**FT27 CENTRIFUGE**

The all stainless CentriPeel Centrifuge is a basket type separator designed to save time in R&D operations. It has a capacity of 11 litres per batch and can be operated at up to 400G. It thereby reduces the several hours typically required for gravity setting a liquid to just a few minutes and also gives much improved separation.

**FEATURES**
- Minimum quantities can be run
- Removable bowl for easy cleaning

**BENEFITS**
- Reduces need for gravity settling
- Operates at up to 400G

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**FT28 OIL EXTRACTION SCREW PRESS**

Seed or ground meal is gravity fed to the press from an integral feed hopper fitted with a manually operated shut-off slide. The thickness of the press cake may be varied. Comes complete with feed hopper, manual feed chute, oil discharge chute and suitable base plate.

**FEATURES**
- 60mm diameter bore
- Can be fed manually or via feed chute

**BENEFITS**
- Small capacity press ideal for laboratories
- Press cake thickness can be varied
A highly flexible unit enabling a wide variety of liquid solvents to be used making it ideal for research use.

Two modes of extraction are available:

The extraction can take place by priming the miscella tank with clean solvent, which is then pumped onto the material bed in the extraction vessel. It percolates through the material and drains back into the miscella tank. This miscella is then continuously recirculated through the material.

Alternatively, the solvent can be evaporated from the miscella by heating with steam. The solvent vapour is then condensed and pumped back to the extraction vessel. In this way the extraction always uses clean solvent.

Subsequently to the extraction, it is necessary to extract the solvent from both the spent material and from the miscella. The spent material can be heated with steam (both indirect and direct) to evaporate the held-up solvent. This can be done under vacuum. The subsequent vapour is condensed and the solvent can be separated from the water in a separator tank.

A similar process is used to remove the solvent from the miscella to leave solvent free oil. Again a combination of direct and indirect heating, evaporation and condensation under vacuum are used. The two main processing vessels (the extraction vessel and the miscella vessel) both have facilities for indirect heating using steam, and a direct steam distribution pipe through which steam can be introduced at a variable flow rate. Each vessel is equipped with sight glasses so the process can be observed.

The system requires steam (20kg/hr max), cooling water and a three phase electric supply.

FEATURES
- Fully self-contained system
- Single extraction/desolventiser vessel
- Miscella tank
- Tops condensor
- Solvent/water recovery tank
- All flameproof construction

BENEFITS
- Small-scale version of industrial process
- Wide variety of solid/liquid extractions can be processed
- Small quantities (25kgs) can be processed
- Low disposal rates
The Armfield FT111 uses high pressure and a combination of both static and dynamic extraction phases to achieve a rapid extraction of the active materials with minimum degradation to the product. In the dynamic phases, the solvent is passed through the material providing a forced percolation and agitation.

The process pressure, number of cycles and length of each phase are programmable by the user. In this way the effect of the extraction parameters on the end product can be explored and an optimum set of parameters determined for each product.

The FT111 vessel is loaded with solvent automatically under microprocessor control using a pneumatic solvent pump. Priming of the vessel and pipework is also automatic. Twin pistons (one primary and one slave) are used to generate the pressure in the vessel and to provide the solvent percolation.
REFINING

Crude oil, freshly extracted from seed, contains undesirable impurities, which must be removed. These include free fatty acids, phosphatides, colour pigments and fine particles. Using the FT66, a batch of crude oil can be pre-refined by neutralisation and washing, by bleaching and by filtration.

The main reactor vessel (45 litres) is designed to process a 25 litre batch of oil. It includes a variable speed agitator, a 3kW electric heater and a cooling coil. A vacuum pump provides a typical working pressure of 100 mbar abs.

Reagents and bleaching earth can be added from appropriate feed vessels. The reagent vessel also includes an electronically controlled heater, which can be used not only to pre-heat the reagents, but also to heat water prior to the washing process.

Free fatty acids are removed by neutralising them with a strong base such as caustic soda, which forms a water-soluble soap. The soap is removed by a combination of thorough washing, gravity settling and draining. Phosphatides are removed by the addition of phosphoric acid to form water soluble gums, again followed by washing, settling and draining. The bleaching process uses adsorbents such as fullers earth to remove or reduce the colour pigments.

After bleaching, the fullers earth and any other particulates can be removed by an efficient filtering process. The product is pumped from the reactor vessel, through a pressure leaf filter using a stainless steel centrifugal pump. The resulting filter cake can be dried with compressed air for easy removal from the filter screen.

Typical results on rapeseed oil show the free fatty acids being reduced from 1.5% to 0.1%. The unit requires water, a three phase electric supply and compressed air.

FEATURES
- Surfaces in contact with the process fluid are stainless steel
- Agitation by variable speed flat blade impeller (variable to 1800 rpm)
- Working vacuum of 75 mm Hg (ABS) with liquid ring vacuum pump
- Pressure leaf filter designed to BS5500
- 25 litre vessel designed to BS5500

BENEFITS
- Small quantities of oil can be processed
- Safe and easy to use
- No consumable filter elements required

www.explorearmfield.co.uk/data/ft66
The FT68 is designed to perform deodorising and polishing of small (25 litre) batches of bleached and neutralised oils. Unpleasant odours can be imparted to the oil by free fatty acid, ketone and acetaldehyde. These compounds are removed by steam distillation under high vacuum and temperature.

The batch of oil is heated in the reactor vessel using an integral 3kW electric heater, controlled by an electronic temperature controller. At the same time vacuum is applied. Direct steam injection is used to apply turbulence to the oil and ensure good contact between the oil and steam. In this process, the impurities are carried over into the vapour and condensed in the vacuum condenser.

On completion of the deodorising process, the product is cooled by passing cooling water through the cooling coil in the vessel. The refined oil is then pumped through a ‘polishing’ filter, which removes all contaminants by filtering out particles down to a six micron size, giving the resultant oil a bright appearance.

This system can typically reduce the free fatty acid content of rapeseed oil from 0.1% down to 0.04%, with an overall processing time of less than five hours. Samples can be taken as and when necessary during the deodorising process to gauge the FFA reductions.

The unit requires connection to a three phase electric supply, to a cooling water supply and to a steam source. Armfield can supply a suitable steam boiler if required.

**Features**
- Stainless steel pressure vessel
- Internal cooling coil
- Electrical heating of the oil
- Temperatures to 250° C
- Internal steam sparge
- Vacuum to one Torr

**Benefits**
- Only 25 litres of oil to be processed
- Safe and easy to use
- Economical

www.exploreamfield.co.uk/data/ft68
The FT67 is a 46 litre batch processing vessel complete with controls, instrumentation and services, for performing hydrogenation of up to 25 litres of product under a wide variety of conditions. The oil to be processed is placed in the vessel and brought to reaction temperature by steam heating through the temperature control coil. Hydrogen is admitted and the reaction continues under controlled temperature and pressure (vacuum). As the reaction is exothermic the temperature is controlled by passing cooling water through the temperature control coil. Whilst the reaction is taking place, the product is agitated using a turbine agitator, driven by a pneumatic motor. Agitation is improved by the use of carefully positioned baffles.

The unit includes a pressure leaf filter to remove the catalyst introduced into the reaction. Filter-aid is often used to improve this operation. The hardness of the processed oil increases with processing time. Typically after one hour the iodine value (degree of saturation) of cottonseed oil will reduce from 108 to 70, with values below 60 being achieved in longer times. Because of the use of hydrogen, all electrical equipment is kept to a minimum, and that which is used is flameproof and rated for use in a zone one area. However, local regulations regarding the operation of this type of equipment must always be adhered to.

**FEATURES**
- Stainless steel pressure vessel
- Vacuum liquid ring pump
- Integral steam heating coil and cooling coil
- Temperatures to 180°C
- Accurate control of hydrogen addition

**BENEFITS**
- Only 25 litres of oil to be hydrogenated
- Safe and easy to use
- Reuseable filter mesh

www.exporearmfield.co.uk/data/ft67
The FT87 Hydrogenation system implements the pumped loop system of agitation widely used in industrial-scale plants. In this way the system accurately reproduces the performance of these industrial plants.

The FT88 is very similar to the FT87, with the added capability of being used for interesterification. It is designed to perform trans or intra esterification of different oils and fats using sodium methoxide catalyst. The process provides the capability to produce a wide range of new products including cocoa butter substitutes and zero trans fatty acid hardstocks for margarine production. Both systems are designed to be highly flexible, and operate over a wide range of temperature and pressure conditions. The gas absorption and reaction rates are controllable. An accurate hydrogen measurement module is an option.

Heating and cooling is provided by a separate unit, with automatic temperature control, which is also used to control the exothermic heat of reaction.

Filtration of catalyst is carried out using a plate and frame filter unit, which can be pre-coated with filter aid, thus ensuring highly efficient catalyst removal.

The electric vacuum pump, circulation pump, instruments and control switches are made to international flameproof standards and installed accordingly.

The heating system is designed to be installed outside the operating zone, with thermal heating oil pumped through an external jacket, which is fitted on the outside of the loop reactor.

Standard units are available with maximum capacities of 50 or 75 litres. (FT87-50, FT87-75).

**FEATURES**
- Accurately reproduces the performance of industrial plants
- Can perform trans or intra esterification using sodium methoxide catalyst
- Optional hydrogen measurement module
- Heating and cooling provided by separate unit
- Plate and frame filter for filtration of catalyst

**BENEFITS**
- Highly flexible and operates over wide range of temperature and pressure conditions
- Available is different sizes 50/75L
- Controllable gas absorption and reaction rates
One of the major uses of refined edible oils is in soft spreads. The Armfield FT25 range of scraped surface heat exchangers can be configured to crystallise edible oil based formulations into soft spreads and margarines.

The product is pumped through one (FT25BP) or two (FT25BBP) heat exchanger barrels, where it is chilled indirectly by cold brine. The scraped surface action promotes efficient mixing and crystallisation of the product. The product temperature is set by an electronic temperature controller, which adjusts the temperature of the cold brine in order to achieve the correct product temperature. The brine chiller is mounted inside the washable cabinet.

After the heat exchangers, the product is passed through a pinworker, which modifies the shape of the crystals in order to provide the desired product texture. The process pressure can be adjusted by a manual back-pressure valve. Finally, the product is held for a period of time in a resting tube in order to dissipate some of the heat of crystallisation and make the product suitable for packing.

The unit has been designed specifically for research and development purposes. The throughput of 10-15 Litres/hour makes it possible to create production representative products with only a few litres of material. It is very flexible with control over the pump speed, the heat exchanger barrel speed and the pinworker speed.

**FEATURES**
- Suitable for ice cream freezing, margarine crystallisation and UHT processing
- Modular system, capable of being fitted with up to three scraped surface heat exchanger barrels
- Full control of barrel speeds up to 1000rpm
- Temperature control system
- Integral membrane control panel enabling simple control and monitoring of all major variables
- Enclosed self-contained, mobile, stainless steel service cabinet for easy cleaning and wash down
- Hard chromed barrels
- Hygienic design
- Made from AISI 316 stainless steel

**BENEFITS**
- Simulates full-scale process
- Fast, accurate new product development
- All process parameters under operator control for maximum flexibility
- Rugged and reliable units
- Variable speed pinworker for margarine and soft spreads
- In cabinet pressurised hot water circulation
- Integrated refrigeration system
- Computer data logging facility

[www.exploreamfield.co.uk/data/ft25](http://www.exploreamfield.co.uk/data/ft25)
The FT81 is a miniature version of a production tall form spray chiller. It includes comprehensive instrumentation and full control over all operating parameters.

The oils to be chilled are pumped to the foot of the process chamber by a variable speed progressing cavity pump. They are atomised by a 2-fluid nozzle, and sprayed upwards into the chamber as a fine droplet dispersion. Cold air is blown into the top of the chamber and travels downwards towards the foot. As the oils are sprayed into the airstream, chilling occurs and a powder consistency product produced.

In addition to the variable speed inlet fan, a second variable speed fan extracts the air from the chamber. This ‘push-pull’ fan system provides the flexibility to operate the chamber at variable pressures and with variable residence times.

Two powder collection points are provided, one at the bottom of the main chamber, and one on a cyclone separator in the exhaust airstream. This enables particles of different sizes to be collected simultaneously and separately.

**FEATURES**
- Available as a Spray Dryer FT80 or as a Spray Chiller FT81
- Accessory sets are available to quickly change from drying to spray chilling
- Maximum flow rate of 7 l/hr
- Maximum evaporation rate of 3 l/hr
- Relative humidity control & measurement
- Tall form chamber straight side to diameter ratio of 3:1 conical discharge section
- Advanced two-fluid nozzle atomisation system
- Supplied with optional nozzle configurations for counter- and co-current atomising
- Individual inlet and exhaust fans with variable speed control
- Bag filter and trace heating options
- Flexible controls and full instrumentation provided in the IP65 control console
- Easily dismantled for inspection and cleaning
- Compact, mobile design
- Powder discharges from two points

**BENEFITS**
- No clogging, no need for de-blocking devices
- Co-current flow for drying heat sensitive products
- Counter-current flow maximises chamber residence time for nonheat sensitive products
- Residence times in the drying cylinder variable up to nine seconds
- Easy connections to electrical and compressed air utilities
- Data recording to computer for rapid evaluation and comparison

www.exploreamfield.co.uk/data/ft81
ASSOCIATED PRODUCTS

FT74XTS Miniature-scale HTST/UHT Process System
A miniature-scale UHT/HTST processing system optimised for product development use. The FT74XTS service unit will enable research and development teams to produce high quality samples of new products using minimal ingredients.

FT174X Modular Miniature-scale HTST/UHT Process System
The Armfield FT174X is a modular HTST/UHT processing system designed to treat products at flow rates of 12-40 lph or up to 60 lph for water (or similar low viscosity products). Standard Modules for direct heating (steam injection) or indirect heating (using tubular and/or plate heat exchangers), aseptic processing, upstream or downstream homogenisation and additional chilling are available.

FT94X HTST/UHT Mini Pilot System
The Armfield FT94X HTST/UHT Mini Pilot system extends the range of continuous operation scaled-down units offered by Armfield to 200 L/h (30-100 L/h standard format). The unit combines full flexibility – plate and tubular heat exchanger options - with comprehensive instrumentation demanded of research and development equipment.

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Armfield have two dedicated websites focussed on our two major fields of expertise. For Engineering Education Teaching Equipment head to www.discoverarmfield.com, where you can find information on all our products and services covering Fluid Mechanics, Fluid Machines, Hydraulics and Hydrology, Water Treatment, Irrigation Water Management, Thermodynamics, Heat Transfer, Refrigeration and Air Conditioning, Internal Combustion Engines, Structural Engineering, Mechanical Engineering, Unit Operations, Biochemical Engineering, Process Control Technology and Food Technology.

The Industrial Division covers all our miniature-scale research and development systems for the Food, Beverage, Dairy, Oils and Pharmaceutical industries. Armfield have the widest range of miniature-scale R&D systems and boasts many of the world’s biggest brands and industry leaders as customers. Our commitment to customer satisfaction, training and support has made Armfield a market leader in this field.

Log on to find out more...

EDUCATION DIVISION
www.discoverarmfield.com

Engineering Teaching and Research Equipment

Operating since 1963, the Armfield Education Division designs and manufactures equipment for engineering education and research. Used at universities, colleges, schools and research centres around the globe, Armfield equipment is known for innovative designs and a level of quality unmatched in the industry. The Armfield range covers all of the main engineering disciplines, and is constantly evolving in line with the growing demands of engineering education.

INDUSTRIAL DIVISION
www.explorearmfield.com

R&D Systems for the F&B, Dairy, Oils & Pharmaceutical Industries

The Armfield Industrial Division designs and manufactures research & development systems, primarily for the food, beverage, dairy, edible oil and pharmaceutical industries. Used by many of the world’s leading corporations, Armfield systems allow researchers and product developers to replicate full-scale industrial manufacturing processes on a miniature-scale in the laboratory.
armfield worldwide

Armfield products are distributed throughout the world. It is our policy in most countries to deal direct or through proven and accredited sales agents, who after suitable approval, may become exclusive representatives.
In exchange for this exclusivity they are required to offer a comprehensive service including the highest degree of after sales support.

To locate a contact in your area visit:
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