There are times when oils and fats processors want to expand a product line or optimize their unit operations without tying up a production line. At other times there may be the need to scale up a new process or test a product, but suitable facilities are not available in-house—the plant lacks the proper equipment or production facility or time to conduct scale-up tests.

Most equipment manufacturers have their own test facilities, but they are limited to one or two of their own pieces of equipment without pre- or posttreatment processes. Many universities have large or small facilities that can process limited quantities of oils and fats. However, such installations often lack employees with commercial experience, the systems cannot be easily scaled up, and equipment manufacturers may require additional testing, resulting in additional expenses and time.

Consequently, opportunities exist for a medium-/large-scale pilot facility as well as for a pilot-scale refining processing system.

In October 2000 a survey conducted among 30 French companies and 40 European companies (from Italy, Spain, the United Kingdom, Benelux, and Germany) representative of fat production, distribution, and user sectors revealed that 50% of all interviewees had an interest in setting up a refining platform in France, and 20% declared themselves as being potential users in the short term. These interested companies included producers and distributors of vegetable oils for cosmetics and nutraceuticals, and small- and medium-sized companies producing biological oils.

As an Industrial Technical Center, ITERG (French Institute for Fats and Oils), located at Pessac in southwest France, can now provide the necessary environment and experience to its clients to optimize current processing techniques and help to innovate and adapt new technologies in the areas of oils and fats.

Fully modular refining equipment was chosen to carry out this work, to guarantee reliability and reproducibility of operating parameters and enable traceability of the product at each step in chemical or physical refining (neutralization, degumming, bleaching, dewaxing, deodorization), on a scale representative of a semi-industrial process.

The production potential of one metric ton of refined oil during two to three days of operation satisfies most expressed needs. Qualitatively, users expect guarantees of traceability, skills, confidentiality, and neutrality. The production of crude fats and oils derived either by pressing or by hexane extraction from seeds or fruit can be handled at the same site (in Pessac) with crushing equipment from plants at CREOL (Center for Research and Experimentation on Oilseeds—an experimental subsidiary company of Paris-based CETIOM- [Interprofessional Technical Center for French Oilseeds] and Paris-based SOFIPROTEOL [Financial Organization for the French Vegetable Oils and Proteins Industry]).

Opportunities exist to examine possible concerns of oil producers involved in crushing, refining, or packaging. These areas include optimization of processes (dewaxing, deodorization), validation of the impact of refining on product quality (phytosanitary residues, proteins), and the production of samples under controlled conditions or first batches of a new type of oil. Virgin oil or organic oil producers wishing a high-performance deodorization tool can have access to novel techniques of "soft-refining." For oil distributors and manufacturers working in the nutrition and cosmetics industries, this refining technology holds promise for the production of small tonnages of oil with a high added value. Animal feed and lipid chemistry sectors, seeking product applications, can use the pilot plant to produce and test different by-products of nutritional or technological interest, such as acid oils, waxes, and sterols.

The principal criteria used in selection of the equipment and the design of this system include the flexibility of having state-of-the-art equipment:

- Suitability for refining oil batches with different compositions and qualities
- Flexibility of the installation in terms of treatment capacity (batches of 300 to 900 kg of oil)
- High-performance equipment capable of processing fragile oils and oils considered difficult to refine under good conditions
- Fast heating in reaction vessels, control of operating parameters, and conformation with an ISO 9001 quality system (sensors, adapted regulation, computer-controlled data acquisition, process supervision)
- Efficient cleaning of the installation.
The refining system was designed and constructed by the Belgian “Crystallization & Degumming” company of Charleroi. The system comprises two double-skin stainless steel reaction vessels with a unit capacity of 1000 kg of oil, the first being used for water or acid degumming operations and for chemical neutralization and washings, the second being used for vacuum bleaching (maximum temperature 150°C) or dewaxing (minimum temperature 6°C). These reaction vessels are provided with complementary equipment including a press filter, polishing filter, self-cleaning centrifugal separator, pumps, and buffer tanks.

Deodorization equipment is an essential and critical point in a refining line, with a particularly high performance being desirable. This system makes use of a horizontal thin-layer two-compartment deodorizer for treatment at up to 260°C and a vacuum of 3 millibars. The design of this equipment enables very high efficiency in the elimination of volatile compounds, a low consumption of stripping steam minimizing hydrolysis, genuine flexibility in terms of the capacity (380 to 820 kg for one or two compartments), efficient cooling in the deodorizer, and the possibility of working with short residence times. At the outlet from the deodorizer, oil may be antioxidized in-line and made inert with nitrogen.

The entire installation is thermally insulated and can be heated to refine fats with a high melting point without any risk of crystallization in the pipes. The all-stainless steel installation is designed to enable cleaning in place and optimal purging of tanks. Samples can be taken from each reaction vessel and tank during operation. Special areas are available for the storage of raw materials and finished products, including a cold room for unstable oils and a hot room (up to 90°C) for solid fats. The pilot plant includes an integrated analytical check station for basic monitoring during refining: all other analytical checks (peroxides, phosphorus, soap, color, fatty acids, tocopherols, etc.) can be done in place in ITERG NF-EN-ISO/IEC 17025-accredited laboratories.

Current projects and applications

The ITERG refining line is adapted first for research and development (R & D) work, and second for test production of refined oil batches. A program for optimization of refining unsaturated oils is presently underway to limit the formation of trans isomers of fatty acids and degradation of tocopherols. The efficiency of dewaxing by filtration and by centrifugation is also being examined. Samples representative of different soapstocks, used bleaching and dewaxing earths, and deodorization condensates are to be obtained from several French and European research programs on food and nonfood applications of refining by-products, to characterize them and test their functions for lipid chemistry or cosmetic purposes.

Following the present regulations of food safety, studies are to be carried out on the impact of the refining process on the elimination of chemical contaminants such as pesticides or dioxins, and in the future the residual presence of proteins and DNA after treatment of oils derived from genetically modified (GM) seeds or seeds with an allergenic risk. Oils (hemp, flax, nuts, evening primrose, borago, etc.) could be markers of the quality of the original seeds or fruit during refining. In the case of organic oils, this tool will be used particularly to develop soft-refining in conformity with the organic production label in order to obtain high-quality deodorized oils, free of undesirable compounds such as aflatoxins in peanuts or allergic proteins in sesame.

The pilot plant can be used for contract production and is particularly suitable for the treatment of either liquid or solid crude fats that are generally difficult to refine. Such fats may be very acid, colored (exotic butters, animal fats, etc.), or rich in phospholipids or unsaponifiable products or unstable polysaturated oils such as fish oil or linoleic oils (hemp, flax, nuts, evening primrose, borago, etc.).

Until now, no facilities in Europe have been capable of simultaneously offering guarantees of equipment performance and traceability and operator skills, within an adapted technical and scientific environment, that could be used for small-scale production of good-quality refined oils. Some sectors such as cosmetics, nutraceuticals, pharmaceuticals, and fine chemicals need low tonnages of specialty oils (frequently made outside France) for which refining is not always well-controlled. Finally, the facility is available to offer introductory or advanced training for engineers or technicians under conditions representative of industrial processes.

The ITERG refining facility can satisfy the needs of manufacturers involved in the production or use of fats, and fat marketing organizations. The required work may be done either cooperatively or publicly as part of the ITERG annual research program, or as part of a bipartite contract with strict confidentiality and traceability guarantees conforming to industrial constraints.

This facility, with its high-performance refining line satisfying quality and traceability requirements, offers manufacturers and users of vegetable oils and natural fats with research and production capabilities for the refining and development of new oils and their applications.

Netlinks

www.creol.fr
www.cetiom.fr
www.iterg.com

Xavier Pages-Xatart-Pares is the technology and environment department manager for ITERG, French Institute for Fats and Oils. Contact him at: Rue Monge, Parc Industriel, F35600 Pessac, France; phone: +33-(0)5-56-36-00-44; fax: +33-0-5-56-36-57-60; e-mail: x.pages@iterg.com. Sefa Koseoglu is president, Extraction and Refining Program, a Division of Filtration and Membrane World LLC. Contact him at: 209 University Avenue East, Suite B-2, College Station, Texas 77840, USA; phone and fax: +1-979-260-1747; e-mail: membrane@membraneworld.com.