The New Facilities and Equipment of the ITERG-CETIOM Pilot Plant for Oilseed Processing and Vegetable Oil Processing

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About the article –

JAOCS has previously published reports on academic-research facilities in the fats and oils industry at the Food Protein and Research Development Center in the United States and The POS Pilot Plant facility in Canada. This article describes a third such venture in France. *JAOCS* would welcome reports from similar institutions elsewhere. Information should be sent to: JAOCS News, 508 S. Sixth St., Champaign, IL 61820, USA.

INTRODUCTION

In 1980, ITERG (French Fats and Oils Research Institute) and CETIOM (French Oilseeds Research Center) created a new joint institution called GERDOC (Group for the Study, Research and Development of Oilseeds, Fats and Oils) which operates several pilot plants devoted to the processing of French oilseeds and to the treatment of their products, oils and meal.

GERDOC's plants are integrated in a larger center including: ITERG's research laboratories (decentralized away from Paris); Ecole Superieure des Corps Gras, education and training school, preparing students for the fats and oils industries, (decentralized away from Paris, too); and CETIOM's oilseed technology section. These plants, labs and school are in the city of Pessac, near Bordeaux (in the southwest of France) near the main Faculty of Sciences of that region.

More recently, ITERG shifted from Marseille's Faculty of Sciences to Bordeaux's Faculty its unit on biochemistry of lipids which is now integrated into the new Laboratory of Edible Lipochemistry directed by Prof. Entressangles.

GERDOC's facilities include 4 main plants.

Oilseed-Treatment Plant

This unit studies the precrushing steps of storage, handling, drying, cleaning, and dehulling of the oilseeds, and feeds the crushing plant with cleaned and, if necessary, dehulled seeds.

[1]Presented during the 73rd annual meeting of the American Oil Chemists' Society, Toronto, May 1982.

Crushing or Mechanical Extraction Plant

This unit is able to crush 1 ton/day of any kind of seeds, but can operate on samples as low as 200 kg of seeds coming from breeding studies. This capability makes it possible to accelerate research on new varieties of seeds.

The plant is equipped with classical apparatus for the grinding, rolling, cooking and conditioning of the raw materials. The pressing is performed in a continuous screwpress made by a French constructor named La Mecanique Moderne. All the mechanical parameters of the crushing and pressing may, of course, be controlled and regulated according to the aims of the operation.

Solvent Extraction Plant

This unit, isolated in a safety area with a 30-m radius, allows the extraction by any kind of solvent of expeller meals as well as noncrushed seeds and beans by batch process. Its capacity is 500 kg, but quantities as low as 100 kg may be extracted. The percolator-type extractor is based on French Oil Mill Machinery's stationary basket extractor, licensed by Speichim. The equipment allows the study of meal desolventizing and toasting, as well as their influence on meal quality. Safety problems have been taken into account and also can be studied. In this extraction plant, too, all the physical and mechanical parameters are controlled and regulated, some of them automatically.

Oil-Treatment Plant

This unit allows several batch operations such as physical or chemical refining, hydrogenation, fractionation, etc. Other chemical, physical and even practical treatments—such as isomerization, esterification, distillation, cooking, frying, etc.—may be performed in this plant characterized by its flexibility.

Its equipment, in glass and stainless steel, has been designed to study the reaction or operation influences on the properties and quality of end-products and to determine optimum operating conditions.

The main goals of these plants are: (a) To extract oil, meal and proteins from small lots of new experimental varieties of oilseeds (rapeseed, sunflowerseed, soybeans), which cannot be treated at an industrial level. The products are then tested and checked for their chemical, biochemical, nutritional, and sensory properties as food and feed. (b) To improve the general oilseed and oil processing, to evaluate all new processes which may increase yields, improve finished product quality and safety, as well as conserve energy and raw materials, while protecting the environment.

The analytical studies and controls are done at ITERG's Laboratories (in the same building) which are equipped with the latest scientific equipments (gas liquid chromatography-mass spectrometry [GLC-MS], high performance liquid chromatography, infrared, ultraviolet, atomic absorption spectrometers, etc.), and have panels for flavor and room odor evaluations.

The biochemical, physiological and toxicological studies and tests are made at ITERG's biochemistry unit, and at several other French laboratories in Faculties of Science or Medicine, and in specialized institutes.

GERDOC's operational program includes projects coming from one or both partners (collective or public research), or coming from private companies, oil and meal producers, equipment suppliers, etc. In this case, a contract and an agreement are signed which guarantee proprietary secrecy and confidentiality of all technical and economical information.

EXAMPLES OF STUDIES CARRIED OUT AT THE CRUSHING AND EXTRACTION PLANT

Since the start of the operations at the beginning of 1980, several subjects have been studied or are in progress. These concern mainly the solvent extraction procedure and its

TABLE I

Influence of Seed Dehulling on the Oil and Solvent Content of the Meal

Starting products	Seeds[a]				Kernels		Hulls
No. of washings	6			2	6	2	6
Desolventizing Temp (C)	100	105	110	105	105	105	105
Final meal							
Oil content (%)	2.0	1.9	2.0	2.8	1.2	3.5	2.3
Solvent content (ppm)		891	994	1273	464	408	1020

[a]Initial oil content (%): seed 47.6; kernel 53.2; hull 16.3 (dry basis). Seeds employed: 3,000 kg seeds, 8,857 kg kernels, and 750 kg hulls.

influence on the final products, particularly the meal (oil and hexane content), and on safety. The parameters taken into account are, for example: temperature, number of washings and duration of the extraction itself; temperature and duration of the desolventizing, seed dehulling, seed or flake drying, initial and residual oil content in the meal, as well as others.

Following are some examples of the main results obtained in some studies made for the collective research program (the studies made for private firms being confidential).

Incidence of Seed Dehulling

Our partner CETIOM invented and patented a rapeseed dehuller a few years ago, which is now in the development phase. The purpose of this equipment is to increase the protein content and to decrease the carbohydrate content of the meal.

It was important to determine the influence of dehulling on the oil extraction rate and yield, and particularly on the oil and solvent content in the final meal. To determine this information, three lots of whole seeds, kernels and hulls were crushed, pressed and extracted by hexane in the same conditions, i.e., the same number of washings, extraction temperature and duration, solvent recovery temperature etc.

A summary of the results is presented in Table I.

The data show that: the higher the number of washings, the lower the oil content in the meal; and the higher the number of washings, the higher the solvent content of the meal. And the most important result: meal from kernels (or dehulled seeds) has a lower content in solvent than the one from the whole seed (more than 50% less hexane).

Incidence of Seed and Flake Drying

Several previous observations have shown a direct relation between the moisture content of seed and the final meal solvent content, and the positive effect of a seed drying on this value.

In order to confirm these observations, three experiments of processing have been made on three lots of seeds: the first without drying (7.5% moisture); the second with drying (down to 6.3% moisture); and the third with drying (down to 4.5% moisture).

The three lots have been crushed, pressed and their flakes extracted by solvent under the same conditions (as given above).

The main results obtained in the analysis of the three corresponding meals are shown in Table II.

TABLE II

Influence of Seed Drying Prior to Crushing on the Oil and Solvent Content of the Meal

Starting products	Non-dried seeds	Dried seeds	
Humidity (%)	7.6	6.3	3.5
Final meal			
Oil content (%)	2.1	2.0	1.6
Solvent content (ppm)	951	324	126

Initial oil content in the seeds: 47.4 (dry basis). Seeds used for these experiments: 3,000 kg. Number of washings: 6; temperature in desolventizing: 105 C.

It may be observed that, if drying the seed does not affect the oil content of the meal, it does affect the solvent content which is largely reduced. The solvent balance and the safety conditions are very much improved by seed drying.

A similar experiment has been made in which the drying is performed on the oilcake coming from a screwpress (and not on the seeds themselves). The oily flakes are dried after pressing from 8.5% moisture to 6.9% in a first run and to 4.1% in the second run. The results of the analysis on the extracted final meal show that the efficiency of the flake drying is lower than that of seed drying. Work to confirm all of this data is in progress.

I may add that for the residual solvent content in the final meal, a new analytical method has been developed at our laboratory. This method is based on a head space analysis by GLC with 50% water added in the meal. It has been evaluated in France, by an interlaboratory circular analysis and its standardization by the French Standardization Organization (AFNOR) is expected.

The first results of our crushing and extraction plant

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experiments have led us to reexamine and reorient our research program and to study on a fundamental as well as practical point of view the extraction procedure, particularly for the meal biological quality as feedstuffs on the one hand, and safety on the other hand. The largest French vegetable oil producers are associated as our partners in this new program.

EXAMPLES OF STUDIES CARRIED OUT AT THE OIL-TREATMENT PLANT

This plant has, so far, experimented or is experimenting on several oil treatments, patented or not yet patented, at the development phase. Here are some examples. Selective-hydrogenation of vegetable oils according to two new catalytic procedures based on a Ziegler catalyst (IFP—ITERG patents) and a Pd/C catalyst (ITERG patent). The hydrogenated liquid oils are then refined and deodorized in order to check their physical, chemical and sensorial properties.

Liquid-liquid fractionation of methyl esters of vegetable oils with a high content in linolenic acid, in order to obtain an edible fraction with a low content in this acid.

Catalytic conjugation of polyunsaturated fatty-acid rich oils by a patented procedure using a Ru/C catalyst. These conjugated oils are for industrial purposes.

In each case, we operate at a 5-10 1-scale in order to obtain enough oil for testing its properties. In this plant, we have realized, too, several practical operations such as heating or deep-fat frying in order to control the characteristics of fats and oils used in home or industrial conditions.

In short, I hope that I have shown to you the flexibility, polyfunctionality, and potential of these plants integrated in a larger research center on seeds, oils and related products.

It has been said that it is unique in Europe. The first results are encouraging. We expect that the intellectual, human, and monetary investment put by the French industry and government in this scientific tool will be profitable for our country and people.