The Drupalm® process An exemplary research and development phase A more difficult industrialization phase

The Drupalm® palm oil extraction process originated from the idea of transferring centrifugal extraction technology, which had been widely used since the 1960s for olive oil production, to oil palm, the only other oilcrop fruit used on an industrial scale. This process, which was designed by CIRAD and jointly developed by CIRAD and the Flottweg company, with assistance from ANVAR, provides an alternative to the conventional process.

The first trials designed to determine the feasibility of the process were carried out at the oil mill of the Clermont l'Hérault oilseed cooperative (France) with sterilized fruits prepared and shipped by the Pobé research station in Benin. True scale trials were conducted in Cameroon at the Nkapa factory belonging to the SOCAPALM company.

The Drupalm® process

Unlike the traditional process, the technology does not involve separate extraction of palm oil and palm kernel oil. It extracts oil from the fruit in a single stage to obtain an oil called Drupalm® consisting of a mixture of palm oil and palm kernel oil in proportions approaching 95% and 5%. Drupalm® is a registered trademark and the process, also known as Drupalm®, has been patented.

The figure shows the overall Drupalm® process.

FFB reception

The FFB reception procedure is identical to that applied in a conventional oil mill, with FFB checking and weighing prior to storage.

Sterilization

Sterilization is carried out to enable efficient fruit stripping and to stop acidification of the oil they contain. Unlike the conventional method, no attempt is made to facilitate kernel extraction. Simple steam pressure cooking is therefore enough and the installations, for the same capacity, are therefore smaller than in the conventional process.

Stripping

Stripping is identical to that of the traditional process. Operating in two stages is recommended for large capacities, in order to achieve maximum efficiency. After initial stripping, the empty bunches are passed

through a "empty bunch crusher" prior to a second stripping operation.

Washing-stone removal

Washing and stone removal are not needed in the conventional process, but are essential in this case, to protect the crushers from metal objects and stones, which could seriously damage them. This also serves to remove a large proportion of sand and soil, which occur in large quantities in FFB and are the main cause of wear seen in all the equipment used in traditional oil mills.

Crushing

The sterilized, washed and stone-free fruits are crushed (photo 1) to release the oil contained in the cells. Crushing is carried out in one or more phases, depending on the installed capacity. The supernatant phase containing most of the oil extracted during the washing-stone removal operation is added to the crusher with the fruits to facilitate the operation, reduce the energy consumed, prevent overheating, which is detrimental to the end-quality of the product, and ensure appropriate viscosity in the fruit mash.

Digestion

The purpose of digestion is to trigger and promote coalescence of the oil droplets contained in the mash, so as to form the phases that will subsequently be separated. This essential operation is carried out in a horizontal double inverted-pitch screw digester (photo 2), operating at reduced speed to avoid any risks of emulsion and to ensure efficient and uniform stirring. The digester body has a double steam jacket, to maintain the temperature by circulation of hot water or low pressure steam. Unlike the conventional process, there is no live steam injection into the mass of the product, and there are therefore no risks of quality deterioration due to excessive temperature surges.

Separation

The digested mash is transferred by a volumetric screw pump to a continuous decanter (photo 3), where it is separated into three phases:

- an oily phase containing over 99.5% oil, some dirt (0.1%) and traces of moisture (0.4%),
- an aqueous phase, known also as the heavy phase, primarily consisting of more than 96% water, traces of oil (around 0.5%) and non-oily solids,
- a solid phase containing around 50% water and 8 to 10% oil.

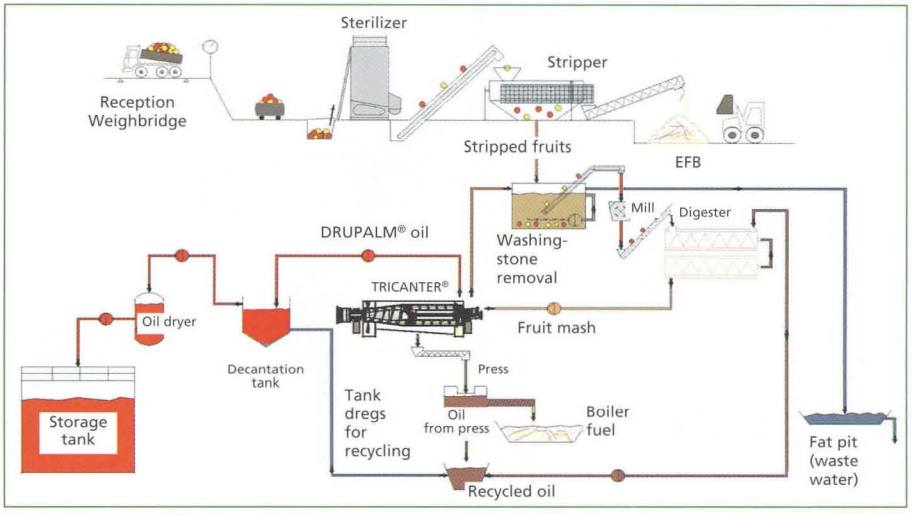

Figure. Diagram of the Drupalm® process.

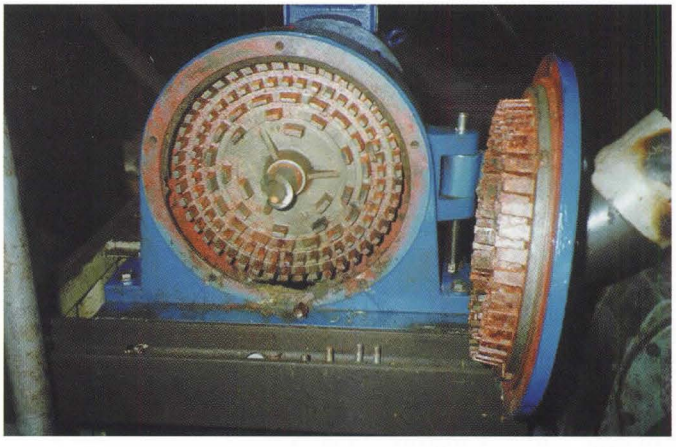

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Photo 1. Disk crusher.

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Photo 2. Digester.

Oil purification

Purification is intended to reduce impurities in the oil to under 0.02%. Depending on the capacity of the installations, purification is carried out by simple static decantation in a heat-insulated tank or by passing through a centrifuge (photo 4). In the latter case, oil moisture is also reduced below 0.3%.

Oil drying

The oil moisture content is reduced to around 0.1% by dehydration carried out in a vacuum dehydrator, in order to prevent any overheating of the product. Under these

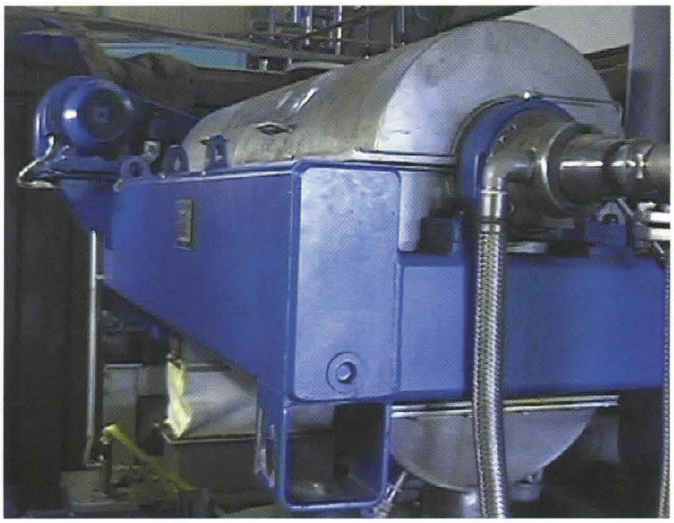

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Photo 3. Three-phase decanter.

impurity and moisture conditions, oil quality is preserved during storage, even over long periods.

Pressing

The solid phase from the decanter contains fruit fibres and pieces of shell and kernel. After drying to reduce moisture content to under 40%, it can be used as fuel in the steam boiler. However, it is preferable to press this solid phase, which still contains oil that is extractable with a simple screw press (photo 5) or even a hydraulic press, depending on the capacities installed. The operation offers the dual advantage of:

- reducing oil losses in the solid phase by about half, and thereby improving the overall extraction rate by around 1% in relation to bunch weight,
- reducing moisture in the presscake to a maximum value of 40%, which is compatible with its direct use in the steam boiler, after simple breaking up in a cake breaker-conveyor.

The liquid from the press, which may contain up to 15% oil depending on the dilutions carried out before pressing, is recycled to the digester, or crusher if needed.

Drupalm® oil

Drupalm® oil (photo 6) is a new product which lends itself perfectly to all downstream processing operations, since:

- its refinability is identical to that of palm oil,
- during fractionation, olein yield is slightly better due to the eutectic effect obtained by the palm oil-kernel oil mixture,
- its possible uses as salad oil, cooking oil, soap and margarine manufacture have been verified and acceptance tests carried out with consumers have proved positive.

Its use to meet the requirements of producing countries no longer raises any problem. However, as a new product, it has yet to find its place on the international market, where it needs to be introduced as soon as production volumes are sufficient.

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Photo 4. Oil polisher.

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Photo 5. Screw press.

Advantages of the process

The merits of the process result from a reduction in the number of operations required. The advantages are therefore multiple and include a reduction in:

- direct or induced investments, equipment and buildings (no kernel recovery station or mill for kernel oil extraction),
- the installed electrical power,
- steam consumption for sterilization and clarification,
- the quantities of effluents discharged and their BOD_5 content (biochemical oxygen demand in 5 days),
- production and maintenance costs.

In addition, the process ensures optimum performance for capacities ranging from a few tonnes of FFB per hour and its modular nature enables investment in stages, as plantation yields rise. This is all the more true in that the energy balance is always favourable, with a fuel possessing a higher thermal capacity and available in large quantities, to meet lower requirements.

Lastly, trials have shown that, unlike in the conventional process, a drift in operating conditions has little effect on the performance of the Drupalm® process.

Research and development phase

The research and development phase took place over a period of four years, from 1992 to 1996. Technical validation of the Drupalm® process was obtained in three sets of trials. During these trials, several dozen tonnes of FFB were processed by this new extraction method, producing almost 20 tonnes of oil.

Industrialization phase

The industrialization phase, which was launched in 1997, has yet to lead to the first firm equipment sale, despite major commercial efforts, such as participation in several conferences and exhibitions. In 1998, the project to construct a 12 t/h oil mill on behalf of an oil palm growers' cooperative in southwestern Côte d'Ivoire almost went ahead, but despite the major guarantees provided by the consortium of constructors and an identified operator, the main funding agency pulled out at the last minute, due to the technological risk asso-

ciated with the use of a new process in an industrial context. However, that decision was primarily due to the absence of immediate outlets on the international market, as outlets at the time for this new oil were restricted to the local market.

In the Autumn of 1999, another 6 t/h unit was sold, subject to performance, to a Peruvian company. Unfortunately, there was a cumulation of very diverse problems for performance of the contract: delayed deliveries due to a ship cancellation, considerable delays in transferring the equipment from the unloading port to the site, multiple technical problems encountered with start-up of the installations, impossibility of extending the duration of temporary importation for the equipment. Flottweg was obliged to re-export the equipment before its performance could be demonstrated.

A unit with the same capacity is currently operating in Malaysia, near Kuala Lumpur. The experience acquired in Peru, which was used to optimize the equipment, and the more favourable technical environment in Malaysia suggest a more successful outcome. In addition, the duration of temporary importation was increased to one year this time, with the possibility of an extension.

If successful, which will only become clear in 2001, it will have taken more than 5 years between the end of process validation trials in the industrial pilot unit, to operation of the commercial demonstration unit. ■

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Photo 6. Drupalm® oil leaving the decanter.

List of publications

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