New Centrifuge Technology for High-Capacity Edible Oil Refining Plants

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Historically, disc separators and latterly solids ejecting separators have become the accepted machines for first stage oil and soapstock separation on high-capacity edible oil refining plants with a capacity in excess of 100 tons/day.

However, solids ejecting separators require periodic manual cleaning if the solids discharge timing has not been optimized. Optimization may have to be done each time the quality or type of crude oil changes.

Recent developments of the horizontal decanting type centrifuge now provide the oil refiner with a centrifuge which discharges continuously any solid material present in the crude oil feed. This advance means that plants are now available to operate independently of the solids content of the feed material, thus eliminating any need for periodic cleaning of the first stage neutralization centrifuge.

The refining centrifuge is a development of the well proven Sharples Super-D-Canter centrifuge. This type of unit has found wide acceptance as the ideal machine for continuous solid/liquid separation duties. Within the vegetable oil industry, decanter centrifuges have been used successfully for many years for the removal of "foots" from expeller pressed vegetable oil. The next logical step was to try to utilize the same type of machine for first stage neutralization. This would provide the refiner with a machine that was mechanically simpler than the currently available machines for this duty and would also be able to discharge any solid material present in the feed along with the soapstock. Pennwalt had for several years experience of operating decanter centrifuges on semiliquid/liquid processes and this unit was used as a basis of the design for the prototype decanter for neutralization.

This machine is a horizontal, solid bowl, scroll discharge centrifuge. It consists of a rotating bowl inside which is a helical screw conveyor. The conveyor rotates in the same direction as the bowl, but at a slightly slower speed.

The oil feed is introduced into the revolving bowl through a stationary feed tube at the centre of rotation. The solids acted upon by centrifugal force are thrown to the bowl wall while the oil and soapstock, being of lower densities, form concentric layers in the bowl. The solids are scrolled by the conveyor to one end of the machine where they are discharged with the soapstock. The neutral oil flows in the opposite direction where it is discharged by a centripetal pump. This pump has a working discharge pressure in excess of 3.5 kg/cm^2. This discharge ability enables the plant to operate without the use of interstage mechanical mixers on both rerefining and/or water washing stages. These mixers are replaced by highly efficient static in-line mixers.

An inherent feature of the refining decanter design provides for much simplified overall plant operation. It has been found that, when handling the full range of commonly occurring edible oils, there is no necessity to vary the machine's operational parameters. This enables the operator to change from one oil to another without shutting down the plant.

Utilizing the refining decanter centrifuge does not necessitate any alterations in conventional methods of process operation in continuous caustic neutralizing plants. It is, therefore, possible to incorporate this new technology into existing refining plants with a minimum of installation work.

The remaining centrifuge stages of the refining plant are equipped with Sharples solid bowl disc separators having capacities of up to 300 tons/day on a single unit.

This new generation of centrifuges enables the refining plant to operate in the normal manner of larger plants with the interstage flows being achieved by centripetal pumps built into the centrifuge discharge. This considerably simplifies the plant installation and relatively reduces the amount of supportive equipment required.

For smaller throughputs of less than 100 tons/day, the successful Sharples tubular bowl Super Centrifuge should still, in our opinion, be the first choice particularly in the developing countries due to:

- Simplicity of design and installation.
- Ease of operation and mechanical simplicity particularly when operated by unskilled labor.
- Flexibility of operation.
- Losses of oil quality at least as good as more sophisticated plants.

Full-scale proving trials of this new range of centrifuge were made in a UK refinery, and results are given in Table I.

TABLE I

Summary of Results—Decanting Centrifuges—First Stage[a]

Oil type	Palm	Soy	Fish
Free fatty acids	3.54-5.12	0.38-0.45	4.51
Temperature (C)	68-78	68-70	68
Caustic (% excess)	20	10	20
Caustic strength (° Be)	24	15.5	24
Flush rate (% oil flow)	10	1.14	10
Flush strength (° Be)	2.9	2.9	2.9
Neutral oil in dry soapstock (%)	34.00[c]	19.9[d]	34.00[e]
Neutral oil in Super Centrifuge (%)[b]	30-35	20-25	not known

[a]Free fatty acids of oil after first stage always below 0.1%.

[b]Range of data from Super Centrifuge operating under identical conditions.

[c]Average of 26 results.

[d]Average of 17 results.

[e]Average of 3 results.