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The Hermetic Separator as a New Approach to Vegetable Oil Refining[1]

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APPROXIMATELY 25 years ago, when vegetable oil was refined, there was only the kettle method available. Processors refined in the kettle, using either wet or dry refining, which was followed by gravity settling in order to separate the refined oil from the soap. Such methods were both slow and inefficient. With the change to centrifugal refining, crude oil could be processed in a fraction of the time formerly required. Perhaps, more important, results were improved because the centrifuge is inherently more efficient than the settling tank.

As time went on, not only were improvements made in the basic oil separators, but complete systems were designed for refining, water washing, and vacuum-drying the finished oil, all as a continuous process. Such a plant is shown in Figure 1, in which

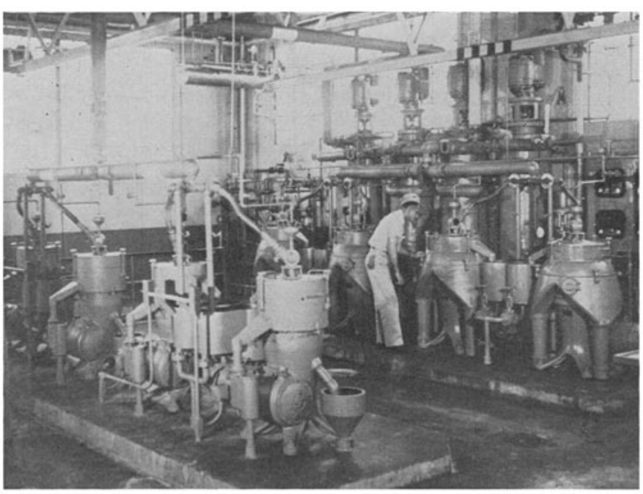

FIG. 1

nearly half a million pounds of oil are caustic-refined per day.

As may be seen from the illustration, the vegetable oil industry has come a long way since the days of open kettle refining. But as good as these refineries are, they still have one thing in common, the refinery operation is open to the atmosphere at various points. Some of the difficulties brought about by open-air exposure are: frothing from air entrainment; oxidation from the intimate contact of air and hot oil; and emulsification of air, oil, and soap.

Oxidation, insidious because it is difficult to trace, often leads to deterioration in the final product. The elements of trouble are present for any vegetable processor whenever air and oil are intimately con-

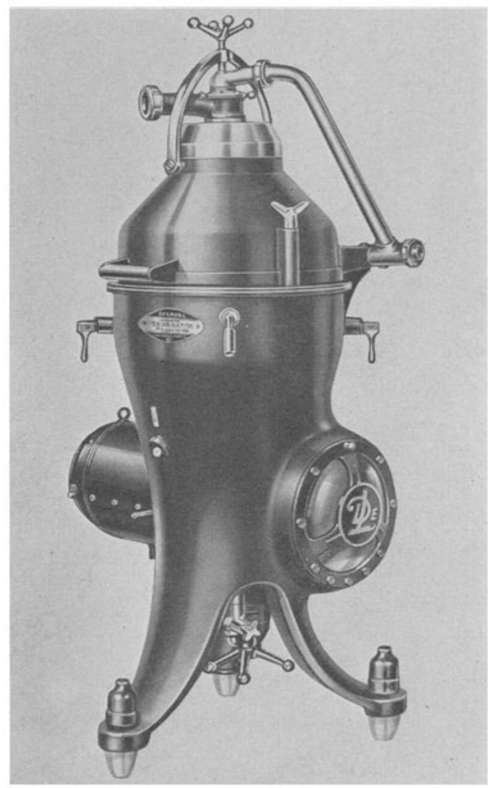

FIG. 2. De Laval model VO-194 ''Hermetic'' Separator.

tacted, especially at elevated temperatures. The discharge connections on an open centrifuge give proof of oxidation. Generally they are coated with oxidized oil, particularly from soybean oil.

Realizing that the need, within the industry, was for a machine that could separate oil and reagent as a part of a fully closed, pressurized system, steps were taken to improve the existing vegetable oil separator. The separator should be fully sealed against the atmosphere and so tight that there would be positive pressure within the bowl of the centrifuge.

The model VO-194 Hermetic Vegetable Oil Separator, shown in Figure 2, was developed to meet the requirements. From the start of the crude oil feed to the time when the final dry refined oil is ready for further processing, no air whatsoever enters the system. Such a machine, with pressure within the high-speed revolving bowl, involved many problems of sealing the centrifuge to the feed and outlet pipes. It was not just a simple problem of putting air-tight covers over the centrifuge for, in this case, it was necessary to have operating line pressure within the

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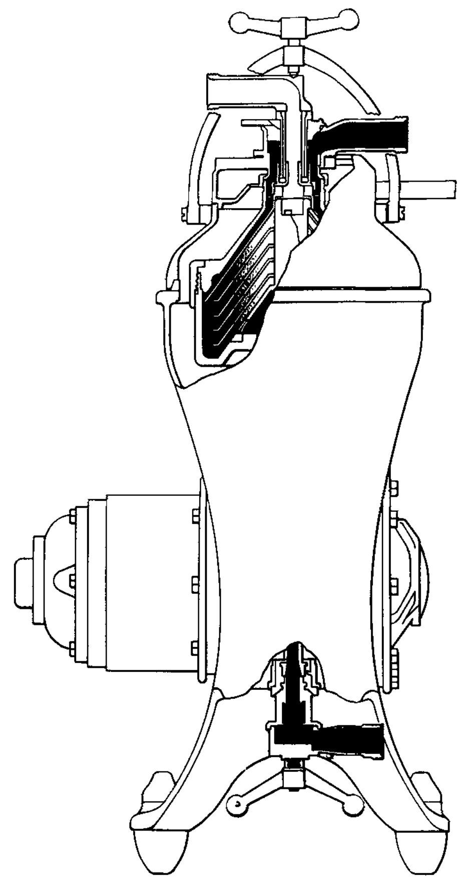

DE LAVAL 'HERMETIC' SEPARATOR

FIG. 3

separator bowl itself, anywhere from 10 to 100 lb. p.s.i.

By looking at a cross-sectional view of the Hermetic Separator shown in Figure 3, it can be seen that the oil-reagent mixture enters the separating bowl through a hollow driving spindle. At the bottom of the moving spindle is a sealing device connecting the inlet pipe to the high-speed spindle. Also at the top, or outlet of the bowl, there are specially designed seals connected to the soapstock outlet and the oil outlet.

The neutral zone diameter (that is, the zone between the two phases) depends primarily on the gravity difference between the two phases and the heavy phase outlet diameter. In the conventional open centrifugal separator, the heavy phase outlet diameter is varied by means of discharge rings located at the top of the bowl. In order to change the zone the separator had to be stopped and partially dismantled for a change of the discharge rings, but with the new Hermetic Separator this change in zone diameter is easily accomplished by a simple calibrated pressure valve on the oil outlet while the centrifuge is still in operation. A slight increase in back pressure on the outgoing oil and the zone moves outward, toward the periphery of the bowl; a decrease in pressure moves the zone in. This adjustment can be made while the separator is operating and producing refined oil.

Another feature of the Hermetic Separator is that pressure within the bowl easily discharges heavy viscous material. The Hermetic Vegetable Oil Separator has processed soybean gums, also heavy soapstock where the pressure has been increased to 100 p.s.i.g. in order to discharge the material. The viscous discharge, under pressure, may be piped directly to a pump for transfer to storage.

With the Hermetic Separator a goal long desired has been reached—a centrifugal separator bowl which may be cleaned in a few minutes while still running. By pumping a flush of hot water or lye back through the discs in a reverse flow, the bowl is stripped of all soap, gums, and meal in a few minutes.

The flow sheet, Figure 4, shows a caustic refining

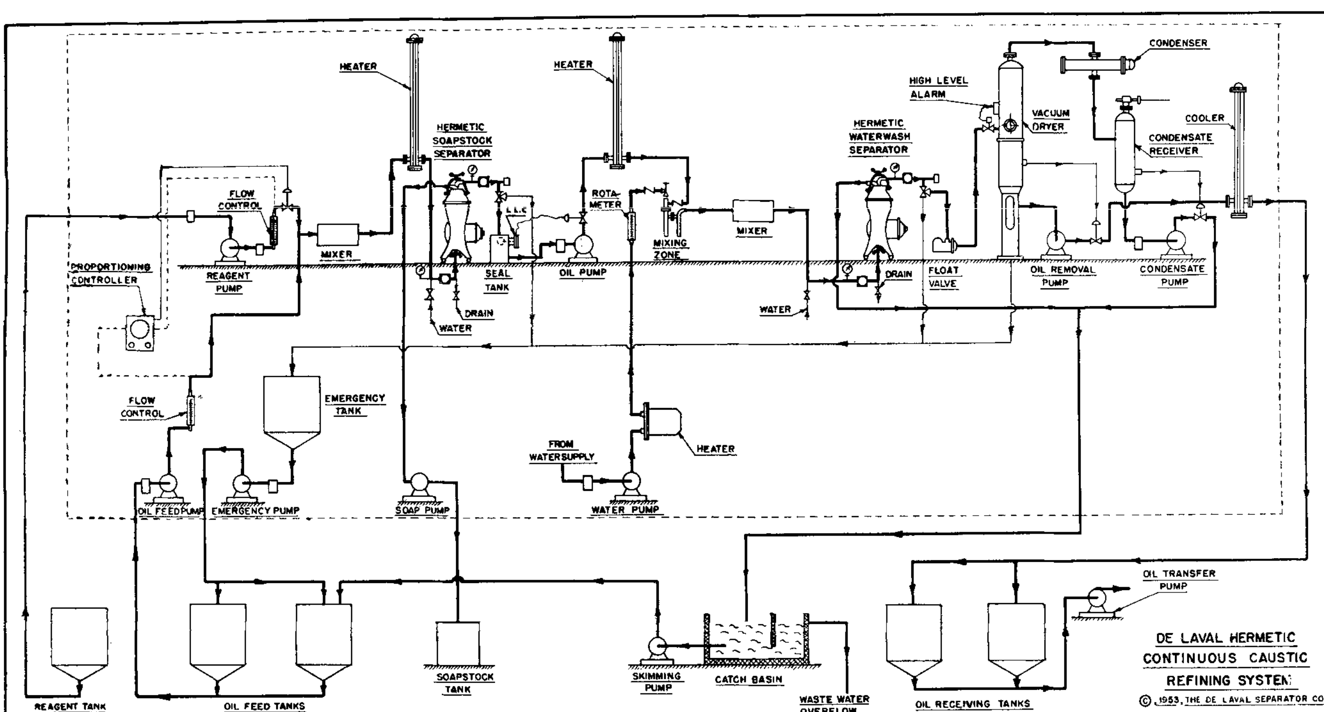

FIG. 4

process using the new Hermetic Vegetable Oil Separator. The crude oil and lye are proportioned together, mixed continuously and separated, all under pressure.

The refined oil leaves the primary Hermetic Separator, water is added to the oil to wash out the small amount of soap remaining and is separated in the Hermetic Water-Wash Separator, all under pressure. The washed oil flows on through the vacuum drier, through a cooler, and to storage.

A novel feature in refining, easily accomplished by the use of the Hermetic Separator, is to substitute soda ash for caustic soda as the reagent and then refine. The refining efficiency will be comparable to the older soda ash system, but look at the advantages:

1. No dehydration.
2. No rehydration soda ash dosage.
3. No difficulty in discharging viscous soda ash soap.

When operating under pressure, the soda ash will not release carbon dioxide and cause frothing in the oil. The carbon dioxide and bicarbonate formed are soluble in the soap phase.

In fields related to caustic and soda ash refining there are obvious advantages for the Hermetic Separator in degumming and miscella refining.

In degumming, it has been possible to produce gums analyzing over 80% acetone-insoluble content on a dry basis. These highly concentrated viscous gums are readily discharged by the Hermetic Separator, operating under moderate pressure.

The use of the Hermetic Separator for refining miscella is logical when it is realized that a closed pressure system is necessary on account of the hexane present with the vegetable oil. With pressure within the bowl of the centrifuge the system may be operated at higher temperatures which give better separation efficiency, both in refining and water washing.

Also in connection with new processes the latest Refining Unincorporated process, the ammonia refining system, should be mentioned. In this, ammonia is used as the reagent to remove the fatty acids and gums. The thick soapstock is easily discharged with the Hermetic Separator under pressure. Also, due to the closed pressure system, there is no escape of ammonia during processing.

The model VO-194 De Laval Hermetic Separator has been thoroughly tested in the new vegetable oil pilot plant of the manufacturer before being introduced to the industry. Here, exhaustive tests on the efficiency of separation of the machine were made, and the machine was studied in actual operation on various types of vegetable oil refining. The pilot plant was built to duplicate field conditions, and oil was actually refined at the rate of half a tank car per day. The pilot plant is shown in Figure 5.

As a result of these tests, and the experience of the Swedish affiliates with their Short Mix Refining Process, it is felt that all conditions that will be encountered in the field with this machine have been anticipated.

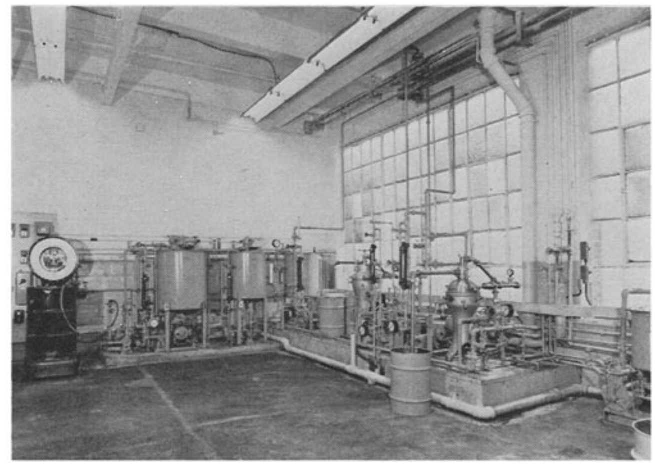

FIG. 5

The new De Laval Hermetic Vegetable Oil Separator will have many advantages in refining. Among them are the following:

1. Discharges drier soap.
2. Separates soapstock from oil more efficiently.
3. Improves the quality of the oil.
4. Improves the refining yields.
5. Simplifies operational procedure.
6. Reduces handling costs in treating soapstock. The drier soapstock reduces the problem of water handling, always present in wet, soft soapstock.
7. Permits easier control of variations in the discharge of the soapstock or the refined oil.
8. Permits adjustment of the neutral zone while it is in operation.
9. Can be cleaned without dismantling the bowl. All meal and soap may be removed from the bowl while the centrifuge is running.

Taken together, these points add up to higher oil yields, a better product, and more profits for the processor.

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Epoxidation of Methyl Oleate With Hydrogen Peroxide[1]

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ORGANIC peracids, which are conveniently formed from hydrogen peroxide and organic acids, were first used in the epoxidation of unsaturated compounds by Prileschajew (9). The epoxidation reaction however has remained a laboratory curiosity until recent years. At present there is considerable interest in the epoxidation of natural fats and oils as a means of utilizing these surplus materials in the manufacture of chemical products and intermediates.

To take advantage of the great number of actual and potential uses (2) for epoxy derivatives, the chemical manufacturer should have available an efficient and economical epoxidation process. An in-

[1] Presented at the 27th annual fall meeting, American Oil Chemists' Society, Nov. 4-6, 1953, in Chicago, Ill.