Filtration in the Oils and Fats Industry

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FILTRATION, despite its wide application and enormous importance in producing crystal-clear salad oils, fine plastic fats, and a host of other edible industrial products of the oils and fats industry, has received little attention in the trade until the last several years. Recent development of new vegetable oil extraction processes and work on fractional crystallization in both the oils and fats fields bid to focus considerable attention on filtration, as a unit operation, in the industry.

Perhaps it would be most appropriate to discuss the subject for the industry by following the order of processing oils and fats from raw to finished products. In the vegetable oil industry the oil mill will serve as the starting point. Up to this time the primary application of filters in the oil mill has been for clarification of oil, after pressing, and of miscella, after solvent extraction from the oil-bearing seeds. Many extraction processes are in use, but in practically every case extraction must be followed by clarification before further processing.

The magnitude of difficulty encountered in the clarification step is dependent a great deal on the type of extraction process. For example, the oil from mechanical or hydraulic pressing is high in viscosity and possesses solids slimy in character, thus making it difficult to filter. Most of the oil from these processes is filtered by means of plate and frame presses or totally enclosed pressure filters, such as the Sweetland, shown in Figure 1, or the vertical leaf type, such as the Niagara, shown in Figure 2.

A typical layout of either type is shown by Figure 3.

Generally speaking, the plate and frame has a lower initial cost and is designed for a higher operating pressure. The operating costs, such as labor and filter media, are higher for plate and frame presses than for totally enclosed pressure units of good design. Cake discharge can be accomplished with greater ease and more cleanliness on a totally enclosed unit. The problem of leakage is also overcome on this type of unit.

Miscella clarification from solvent extraction plants offers an interesting engineering problem in that practically every process produces a slurry of different

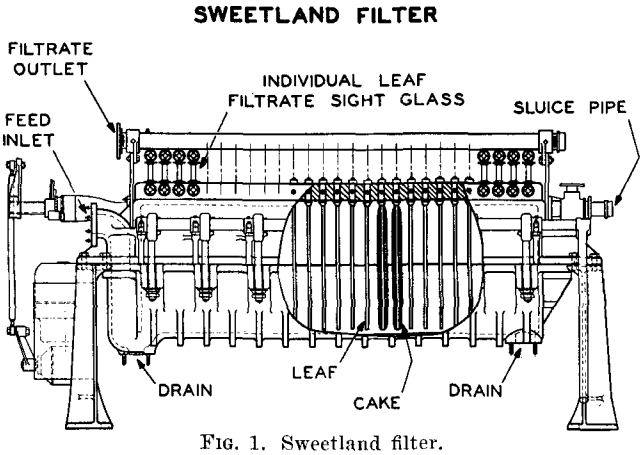

FIG. 1. Sweetland filter.

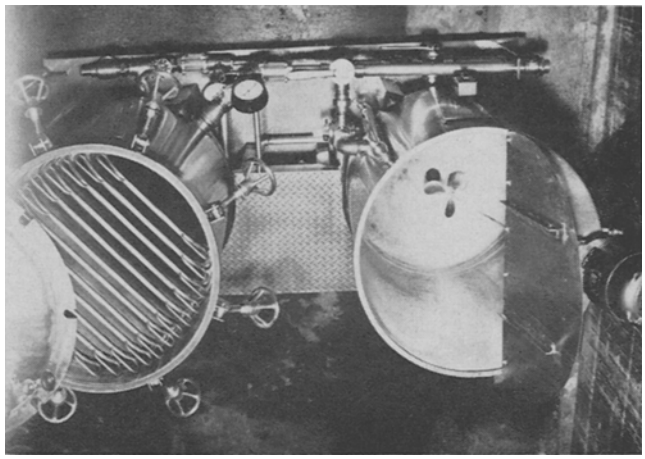

FIG. 2. Niagara filter.

characteristics. For example, percolation-type systems produce a miscella low in solids content, which presents no major problems in polishing. On the other hand, immersion-type systems produce a miscella high in solids content which, at times, requires a considerable amount of equipment to accomplish the desired result.

Some immersion-type extraction systems now in use require two steps to clarify the miscella after leaving the extractor and before being pumped to the desolventizing equipment. These two steps consist of centrifuging, to remove the major bulk of solids, and then pumping through a pressure filter, for final clarification. Plate and frame presses are not applicable for clarification of miscella because of leakage and the danger which would result.

One means for accomplishing the clarification step following the solvent extractor is the continuous Precoat Filter. Use of this unit would eliminate a two-stage operation, such as already mentioned. It would also operate as a totally enclosed system; thus be much safer than a pressure unit, which is opened for

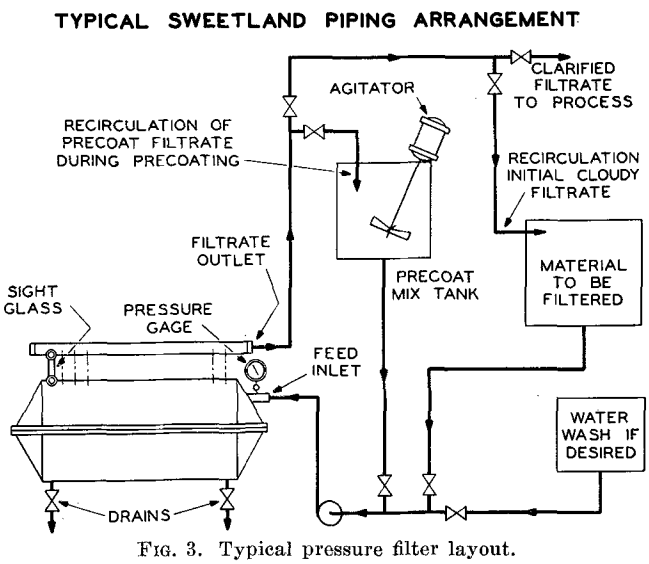

FIG. 3. Typical pressure filter layout.

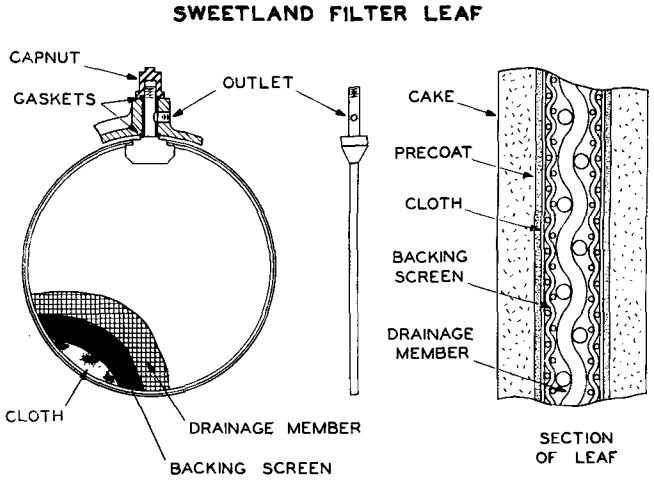

FIG. 4. Sweetland filter leaf.

cake discharge purposes. Solvent losses should also be reduced for this reason. A continuous Precoat Filter of vapor-tight design is shown in Figure 5.

This unit utilizes, as a basis for operation, most of the principles of a conventional Oliver type filter. Its operation differs in two major respects; namely, filter media and cake discharge. The filtering media is a precoat formed of a filter aid, such as diatomaceous earth, prior to the introduction of feed slurry. The precoat is generally put on to a thickness of 2½-3 in. Discharging is effected by a sharp scraper which continuously moves toward the filter drum, removing the cake deposited on the precoat plus a pre-determined thickness of the filter aid.

If the solids characteristics of a miscella from solvent extractors are kept in mind, it can readily be appreciated why a unit, which continuously removes the solids from the filter media, would be applicable for this operation. The field of application for the Precoat Filter is generally where the solids content is low and the characteristics of the cake prevent filtration after it reaches a thickness of 1/32 to 1/16 in. By removing this thin cake, plus a thin layer of filter aid, each revolution of the drum, a clean filtering media is available for each drum cycle.

For applications where the cake formation for each cycle is thin but the solids are granular and do not hinder filtration materially, a timing device is provided to limit the cutting action. This, of course, is in addition to the adjustment for the depth of cut to be taken when cutting continuously.

With the advent of continuous solvent extraction, increasing cost of labor, tightening of safety restrictions, and the lengthening season of oil mill operation, this unit should receive considerable attention from oil processors and oil plant engineering firms for the clarification step.

Previous mention of recent developments in vegetable oil processing was in reference to two new solvent extraction processes which employ filtration as a means for separating the meal from the miscella. The principles for one of the processes, namely, Filtration-Extraction, developed by the Southern Regional Research Laboratory, New Orleans, Louisiana (a part of the Bureau of Agricultural and Industrial Chemistry, U. S. Department of Agriculture), have been adopted by three major oil processing plant builders. Since details of the process are available from any of the three firms, Lukenweld, Blaw-Knox, or Wurster and Sanger, only the filtration phase will be discussed here.

The nature of the miscella-meal slurry causes the bulk of the solids to settle very rapidly, thus, in effect, leading to high filtration rates. Since this slurry will form a 2-3 in. cake in several seconds, it is ideally handled on a Horizontal Filter. A slurry of such rapid settling characteristics would, in all likelihood, pose an agitation problem if filtration were attempted on a conventional drum type unit.

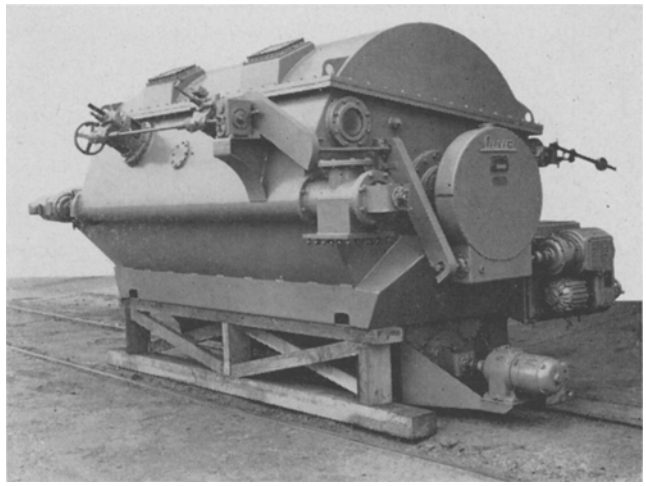

FIG. 5. Vapor-tight precoat filter.

When a slurry from this process is put into a tank, the large solids sink to the bottom rapidly, leaving the fines in the upper strata. This condition can lead to low rates on a drum type unit if the fines are permitted to deposit on the filter media as the drum goes into submergence. Where this happens further cake formation is dependent upon flow of miscella through this tight layer of fines. Generally, it is impossible to pick up the coarse material over the fines. To overcome this condition it would be necessary to adjust the filter valve to begin cake formation at the bottom, where the large particles have settled. With the shortened cake-forming time less capacity would result.

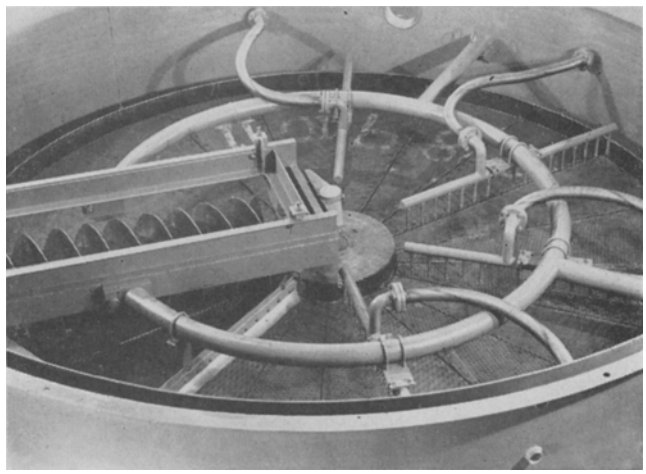

FIG. 6. Horizontal filter (top view).

On the Horizontal Filter, shown by Figures 6 and 7, the slurry is fed directly to the table, eliminating the need for agitation.

By an ingenious blow-back, located directly beneath the filter feed, the fines are blown upward, causing a stratified cake formation. The coarse particles are desirably located next to the filtering media while the fines are trapped in the upper portion of the cake, thus rendering a low solids miscella.

The Horizontal Filter lends itself very well to counter-current washing operations, and the Filtration-Extraction Process employs such a system. Figure 6 is a top view of the Horizontal Filter with the wash apparatus and scroll discharge in place.

The miscella fines from the Filtration-Extraction system are granular, and the clarification step is very easily accomplished. In fact, if pressure filters are used for this step, the size is based on cake capacity rather than pressure limitations.

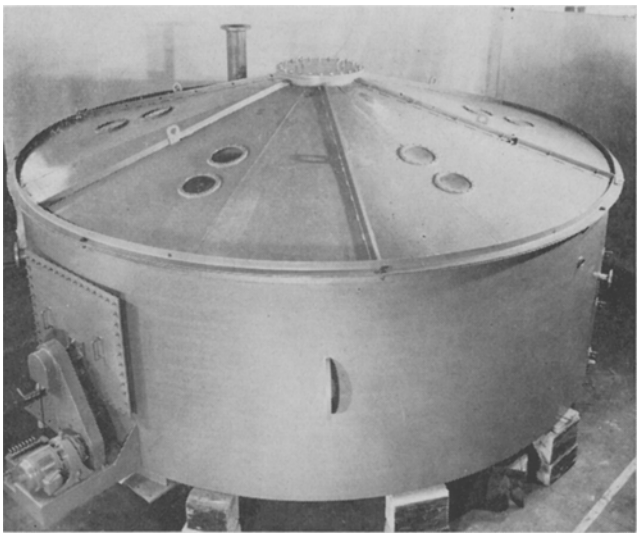

FIG. 7. Vapor-tight horizontal.

The other recent process development in the vegetable oil solvent extraction field is the Vibroil Process by Allis-Chalmers. This process produces a uniform solids slurry, which is very nicely handled on a properly designed drum type filter. A drum type filter of vapor-tight design is shown in Figure 8.

Since the solids are separated from the miscella by a tight filter media in the Vibroil Process, the clarification operation is a simple one. The percentage of fines in the miscella is very low.

In the refining division there are generally four filtration applications. In the bleaching operation recessed plate presses are normally preferred although plate and frame presses, as well as totally enclosed pressure filters, are used. The chief reason for preference of the recessed plate press over the plate and frame press is its design for thicker cakes, which are desirable for bleaching action.

The hydrogenation operation also includes a filtration step, with plate and frame presses being the generally preferred units among those commercially available today. It is claimed that a good seal at the inlet and outlet connections is easier to form on a plate and frame than on a recessed plate press and, since a thick cake is not necessarily beneficial, it is preferred.

A totally enclosed pressure filter, designed to meet all the requirements for these two steps, would offer a number of advantages over the press-type units. At the present time there is not commercially available a pressure filter with all the desired features for either of these two operations.

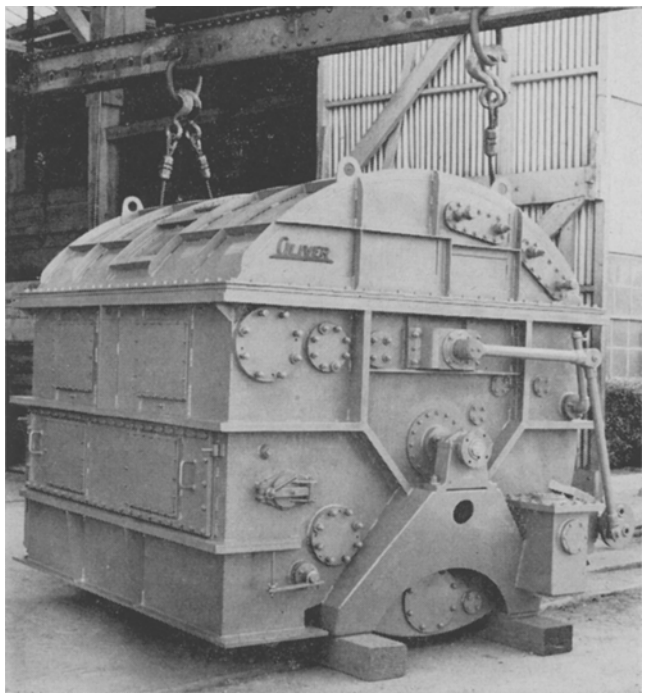

FIG. 8. Vapor-tight vacuum drum filter.

There is also the winterization operation, which requires equipment for removing the crystallized glycerides from chilled oils. Plate and frame presses are generally used for this service.

Discussion of a continuous winterization process dates back several decades, but up to the present none has been developed for commercial operation. There is, at the present time, a sizeable pilot plant installed for winterization work at the U. S. Bureau of Agricultural Chemistry at New Orleans. This pilot plant is equipped with a drum type continuous vacuum filter.

Polishing of oil, prior to and after deodorizing, is a general practice. All types of pressure units are used, but totally enclosed units are preferred, to prevent contact with air of any portion of the finished oil. A Sparkler, shown in Figure 9, is one type used in this operation.

The animal fats industry employs filtration primarily in separating crystallized fatty acids. Some of this is carried out on plate and frame presses, but in recent years chief interest has centered on continuous methods, such as the Solexol Process, which employs propane as a selective solvent; the Emersol Process; the Texas Company Process; and the Spannuth Process.

The processes utilizing propane use a continuous pressure filter, which was specially designed for the

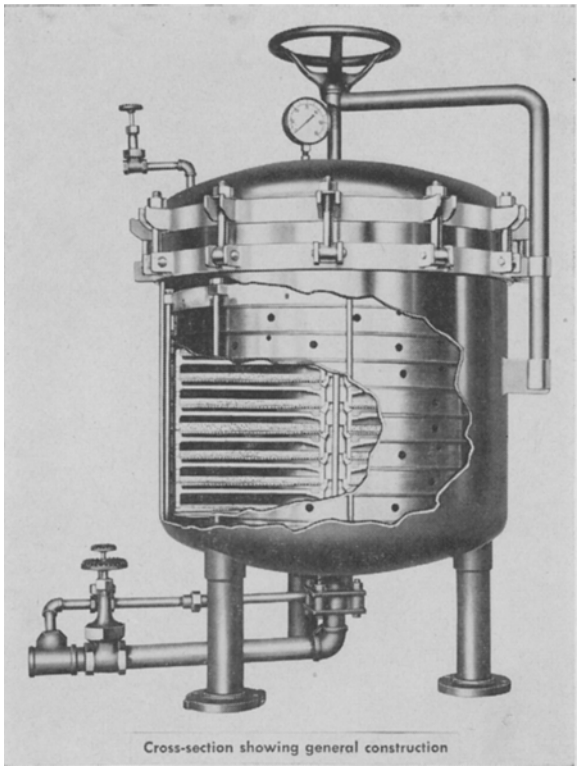

FIG. 9. Sparkler pressure filter.

propane dewaxing process now widely applied in the petroleum industry. This unit, designed for 30 psi. operating pressure, is shown by Figure 10.

Processes employing vacuum filtration use a conventional drum type filter or drum type unit equipped with a string discharge system. When the string discharge unit is used, it is enclosed in a vapor-tight room.

Considerable development activity is in progress in this field, and rapid advancement of technology is expected. It will be noted that in all phases of the vegetable oil and fats industry the emphasis is toward developing continuous processes, whether it be extraction, clarification, bleaching, hydrogenation, winterization, deodorization, or fatty acid crystallization. In its search for equipment to satisfy new continuous processes the industry can expect to encounter no difficulty in finding the necessary continuous type of filtration equipment. This has already been fully developed for the petroleum and chemical industries.

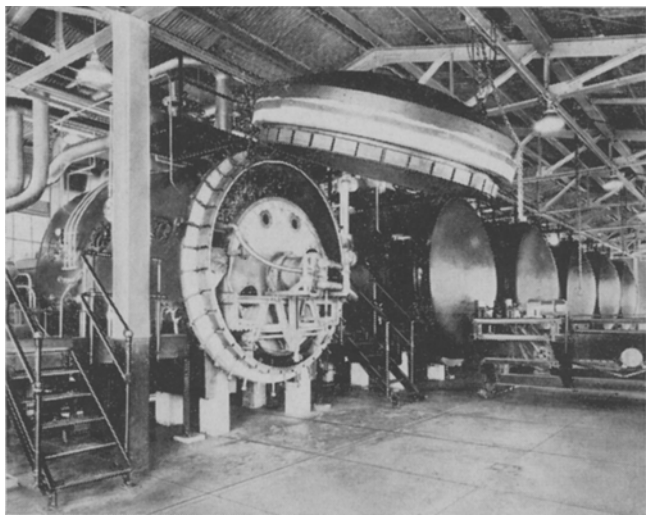

FIG. 10. Vapor-tight Oliver-Kellogg continuous pressure filter.

Acknowledgments

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