Mechanics of Solvent Extraction with the Immersion Type Extractor

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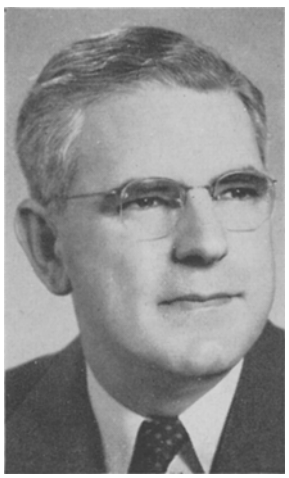
PRIOR to the early 1920's there was in operation in Europe a number of batch solvent extraction plants. In this period there developed out of these batch extraction plants several types of continuous solvent extractors. The two types that were introduced into this country were the Bollman and the Hildebrandt (1). The Bollman was of the basket type and the Hildebrandt of the immersion type of extractor.



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A cross-section view of a Hildebrandt Extractor is shown in Figure 1. The flakes to be extracted are fed into the top of one of the legs and are conveyed downward through the solvent by means of a perforated screw. At the bottom of this leg a horizontal screw carries the flakes over to the other leg of the extractor (3). This "up leg" is rifled to prevent the mass of flakes from turning with the screw and to enable them to be conveyed upward through the solvent to a point several feet above the solvent level. This space above the solvent enables the excess solvent to drain from the extracted flakes (3).

The fresh solvent is introduced into the "up leg" and flows down, across, and up the "down leg" in a true countercurrent manner. The solvent, now rich with the extracted oil, flows through a wedge wire or a perforated metal screen and on out to a receiving tank. It is necessary to filter this miscella before it is sent to the distillation equipment (3).

There are two or more of these extractors in operation in this country. One is in operation on soybeans and one is in operation on pre-press cottonseed (1).

Also a number of immersion type of extractors are in operation on cottonseed in this country, modifications of the Hildebrandt and the Bonotto extractor. They are very similar in design and operation and are manufactured by the V. D. Anderson Company, Cleveland, O., and the Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

Figure 2 shows an extractor similar to those manufactured by Allis-Chalmers, now in operation on cot-

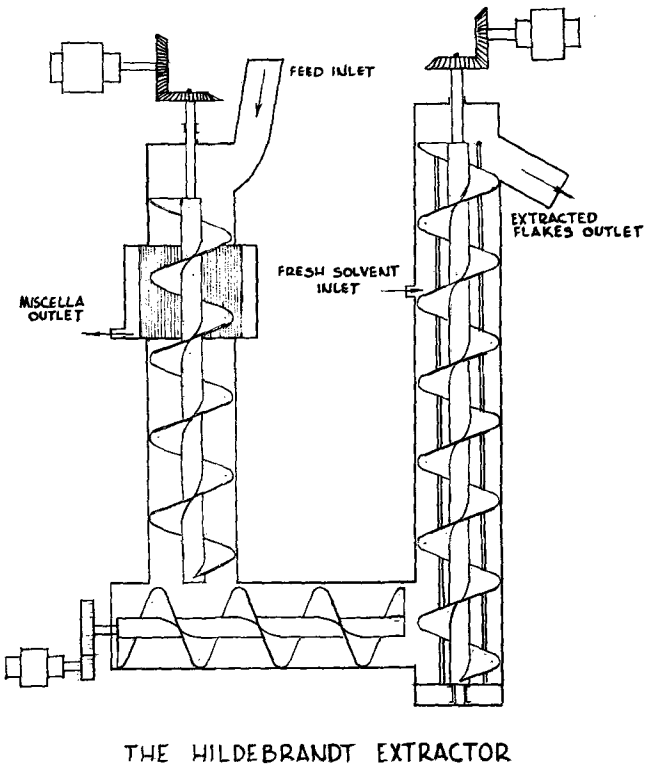


FIG. 1

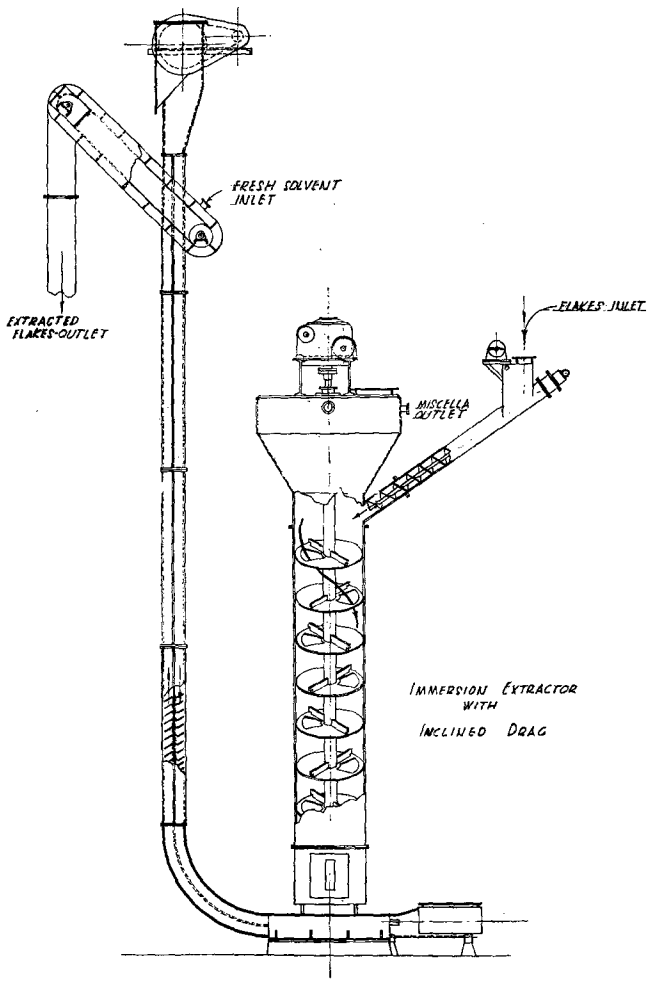


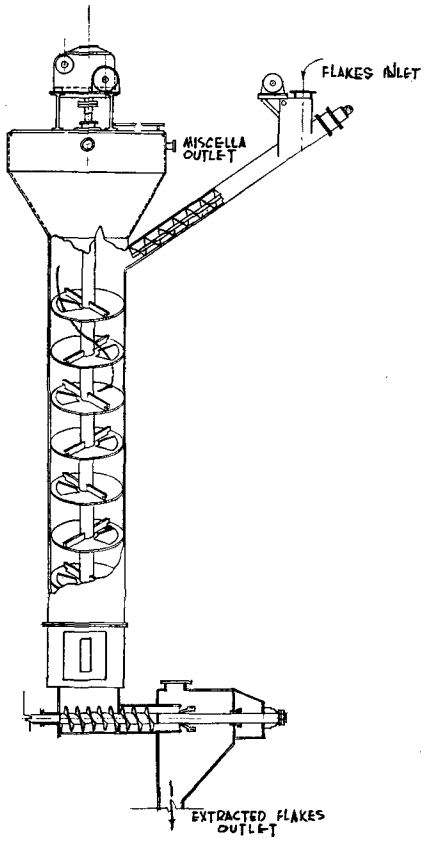
FIG. 2

tonseed. This type is now being used in both prepress and straight extraction of cottonseed (2, 4). In this extractor the flakes are fed into the inclined screw and introduced into the straight section of the extractor. The flakes travel down the extractor from plate to plate through these pie-shaped openings. There are sweeps on each plate that are attached to a central shaft. This central shaft revolves very slowly (from 1 to 3 r.p.m.) and rotates these sweeps. The rotation of the sweeps causes the flakes to travel around on the plate until they drop through the opening in the plate. At the bottom of the extractor the flakes are removed by a drag-chain type conveyor-elevator. This conveyor-elevator is driven with a variable speed drive, which controls the rate at which the flakes are removed from the bottom of the extractor. By varying the speed of this conveyor, it is possible to maintain a flake level in the top portion of the extractor (4).

The flakes are raised in this conveyor-elevator to a point several feet above the top of the extractor. Here they are discharged into an inclined drag. In this drag the extracted flakes are washed with fresh solvent and are given two-minute drainage to remove the excess solvent before they are discharged into the solvent removal driers. The fresh solvent that is introduced into this drag drains by gravity down the back leg of the elevator and flows up the extraction column countercurrent to the descending flakes. This oil rich solvent, or miscella, then enters a settling head, where the larger particles of meal settle out before the miscella flows down to a collection tank. The miscella is filtered before going to the distillation equipment.

Another modification of this extractor is the use of a plug discharge on the bottom of the extractor. This plug discharge consists of a heavy screw conveyor, driven by a variable speed drive, and a cone that applies pressure against the spent flakes as they leave the extractor. This pressure forms a tight plug that prevents the liquid in the extractor from draining out with the extracted flakes. The solvent is introduced into the bottom of the extractor and flows upward countercurrent to the flakes. A flake level is maintained in the upper part of the extractor by the regulation of the speed of the plug discharge conveyor (1). A number of extractors of this design are being operated on pre-press cottonseed cake.

The plug discharge is rather critical as to moisture and temperature of the flakes in the extractor. Because of troubles that have been encountered some of the plants have recently added a drainage section to the conveyor elevator and are operating their plug discharges as a conveyor only and are letting the solvent fill the conveyor-elevator. The excess solvent is drained off in a screen section and flows down to the bottom of the extractor.



IMMERSION EXTRACTOR WITH PLUG DISCHARGE

FIG. 3

The immersion type of extractors have their advantages and disadvantages when compared to basket extractors. Some of the advantages are: a) much lower initial investment; b) greater flexibility in moisture and particle size; and c) less building space. Some of its disadvantages are: a) more fines due to the agitation of the flakes during extraction (1); b) the necessity of providing larger filters for an immersion type of extractor; and c) more power requirement to drive extractor (1).

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