Mechanical Pressing

DEAN K. BREDESON, The French Oil Mill Machinery Co., Piqua, OH

ABSTRACT

The major current movement of screw presses into the U.S. vegetable oil field is as prepresses. Except for highly industrialized nations outside the U.S., the screw press retains a major part of the oilseed processing market. The three essential requirements for efficient extraction are discussed, including operating parameters for various oilseeds. The trend is toward larger capacity screw presses.

From the emphasis placed on solvent extraction one would almost assume that screw presses were obsolete in the United States. In spite of the great number of medium and large solvent plants, there are still over 100 mills in the U.S. using screw presses for extracting vegetable oil. There is a cotton seed crushing mill in Little Roch, AK, that employs ten screw presses, each equipped with a 100 HP drive motor crushing 450 tons of seed a day to a residual oil of 3.5%. There are many more mills, mostly of smaller size, but using screw presses with 200 and 300 HP, that continually crush seed in competition with the solvent plants. However, in the United States there is no trend to installing new screw press mills for cottonseed, soybeans, flaxseed, etc., except in very special situations. Occasionally a processor who has a good market situation with screw press meal will replace small worn out screw presses with modern large presses (Fig. 1).

Screw presses are still being purchased and installed in the United States for the full extraction of oil from special high oil content nuts, for corn germ, for chocolate extraction, for coffee oil extraction, and for use in extracting grease and tallow in packing house and rendering use.

The major current movement of screw presses into the vegetable oil field in the U.S. is as prepresses to pre-extract high oil bearing materials prior to solvent extraction. For years the trend in the industry was to speed up an old full press screw press, change the shaft and screen bar spacing, and utilize this equipment for the prepress operation. Now the press manufacturers have designed efficient large presses with features and prices in relation to tonnage capabilities that make it a better investment to purchase new prepress equipment (Fig. 2).

With the exception of the highly industrialized nations outside the U.S., the screw press retains a major part of the market for the extraction of oilseeds. Many of the less developed countries, or undeveloped countries, have large, efficient screw press mills employing the latest types of high horsepower screw presses presently designed and manufactured. And if the infrastructure of a country makes it feasible to utilize solvent extraction, the latest in high capacity prepresses are employed with modern solvent extraction plants. No brief summary of the utilization of screw presses would be complete without saying that the fast expanding oil palm industry is just graduating from the hydraulic press stage to the screw press era, and special screw presses are having wide acceptance in Africa and the East Indies.

A decade ago we were all talking about higher capacity presses; longer drainage cages, which were preceded by extension cages; the importance of rolling seed to rupture oil cell walls; and the importance of a proper cook. With our equipment, the cottonseed meats from 45 tons of whole cottonseed per press per 24 hr can be processed to a residual oil of 3 to 3.5% with good quality oil and bright cake because of the water cooled cages and shafts. Not too much has changed except we, as well as many of our competitors make larger rolls, larger cookers, larger screw presses with more sophistication.

Before looking at today's screw presses it might be well to review a few basics. There are three steps to good full extraction, all of major importance. The first is thorough and complete rolling of oilseed meats to uniformly rupture the greatest number of oil cells and to present a homogenous flake to the cooker conditioner. The second is a leisurely complete cook in a cooker that agitates the meats a minimum but insures no scorching, burning, or short cycling, and ruptures all of the remaining unruptured oil cells as well as coagulates the protein. The cooker must quickly increase the temperature above 180 F to inhibit destructive enzymes and then dry to pressing moisture at a minimum temperature.

The third step is to have an efficient screw press. A screw press for full pressing usually has a high speed feed screw to compact the cooked meats, eliminate entrained air, and exert low pressure on the cooked meats. The first low pressure screw will press out 40 to 50% of the oil which can be removed in the press. In French presses this high speed feed screw usually starts with a 6 in. pitch and ends with a 4½ in. pitch. It usually turns three to four times faster than the main shaft. The feed screw and the main screw rotate in a cage which is lined with case hardened

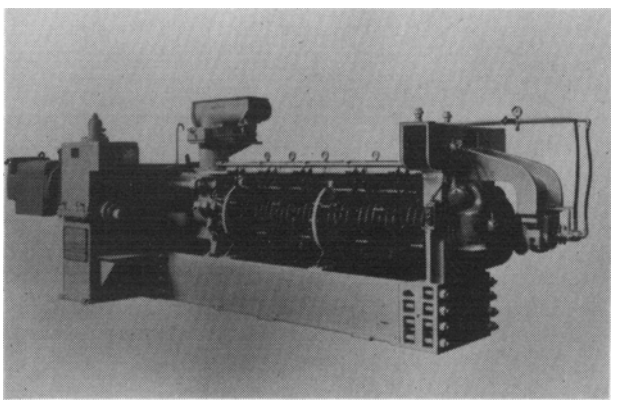

FIG. 1. C3300 Full press screw press. 10¼ in. inside diameter, two speed shaft, 102 in. drainage, driven by 300 HP.

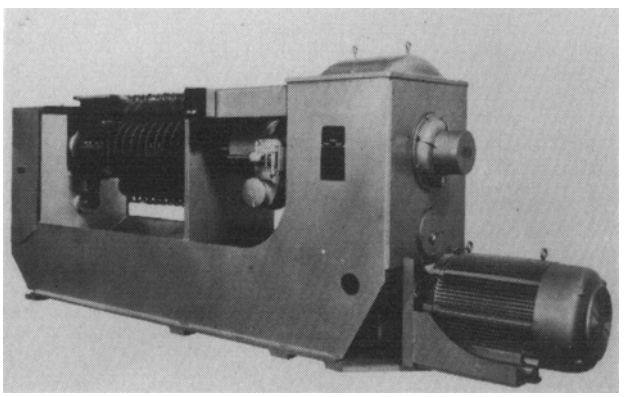

FIG. 2. B2100 Prepress. 12 in. to 10¼ in. inside diameter, 50 in. to 72 in. drainage, driven by 200 HP.

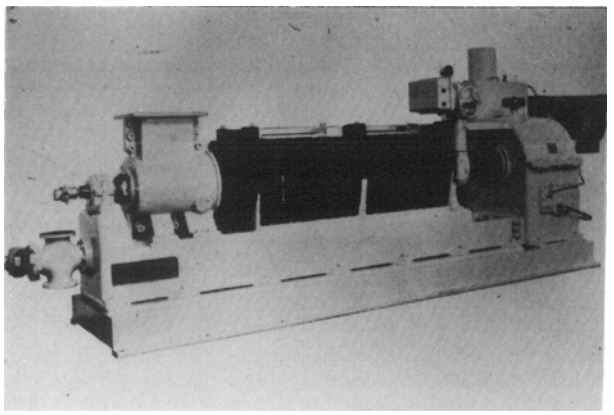

FIG. 3. H2-6600 Prepress. 16 in. to 14 in. inside diameter, 102 in. drainage, driven by 600 HP.

tool steel screen bars 1 in. thick, ½ in. wide and 11-1/16 in. long and mounted around the periphery of a cage with spacers of from .020 to .005 between the bars. This small space or slot permits the drainage of the oil as the pressure is increased on cooked meats. After the slightly pressed meats leave the feed screw section, they pass into the slower speed high pressure section which is usually about six times longer than the low pressure section. The pitch of the pressing worms decrease from 6 in. to 3 in. and the body diameters increase from 75% of the inside diameter of the cage to 95% of the inside diameter. The pressing worms are reversible and are interrupted by tapered collars between the worms. Breaker bars extend to within 1/16 in. of the surface of the tapered collars from the ID of the cage to inhibit rotation of the pressed meats. At the discharge end of the shaft a moveable cone or choke permits the establishment of a restrictive orifice to control the final pressure. The pressure in full pressing ranges up to the 14,000 to 15,000 psi range. This great pressure gradually increasing through the length of the cage squeezes out the remaining recoverable oil after the low pressure section and results in residual oil in cake of 3 to 3½%. Of course the great pressure results in the generation of heat and the tendency to wear, so most worms and collars are hard coated with various types of stellite to resist abrasion and establish the proper coefficient of friction. The excess heat generated is dissipated through water cooled cages and a water cooled shaft.

Today in a new installation for the full extraction of the meats from cottonseed we would recommend a large 5 ft high 60 in. wide crushing roll to thoroughly roll the meat to the equivalent of .007 to .009 in. thick. We would furnish one cooker/conditioner of 100 in. or 132 in. in diameter with sufficient kettles to furnish a residence time of 50 or more min. The cooker would quickly increase the temperature of the meats in the top rings to 190 F, the moisture would be increased by a steam/water spray to the 10% to 13% range, and the meats would be held at this temperature and moisture content for about 20 min. The meats would then be dried to a pressing moisture of about 3½% and 250 F at the feeder to the screw press. Our screw press might be driven by a 200 HP electric motor, have an 8½ in. diameter low pressure feed section and a 7 in. diameter high pressure cage. The drainage cage would be eight sections of 11-1/16 in. long screen bars. The cages would be held together with quick removable clamps rather than dozens of heavy hard-to-remove bolts. The cages and shaft would be water cooled. This 200 HP screw press would have the capacity of 70 metric tons, whole seed basis, and would produce a bright cake with 3 to 3½% residual oil. Or the press might be driven by a 300 HP motor, have a 10¼ in. inside diameter cage, of nine or ten sections of 11-1/16 in. screen bars and have a capacity of 105 metric tons, whole seed basis.

If the installation was for peanuts we might replace the crushing rolls with two pair of high cracking rolls 10 in. x 42 in. or 12 in. x 52 in. The drainage of the cage and perhaps the shaft arrangement would be changed somewhat to take care of the additional oil in peanuts.

The above presses could be speeded up and modified to allow prepressing. But with the specialized presses for prepressing available it might be possible to replace many full press machines with one prepress. Prepressing is, as its name implies, a lighter pressing so requires a less massive cage. It is possible to process twice the tonnage of peanuts in rolls and cookers because the rolling is not critical and the cook becomes a conditioning. The temperature is increased only to 160 to 220 F depending on the seed. The moisture is brought down to the 6 to 8% range. A screw press for final pressing is usually a two speed affair, so is necessarily more complex and more expensive. A prepress need be only single speed, and a single speed 200 HP driven screw press can prepress from 100 to 125 tons per day to 14 to 16%. And adding a 15 HP force feed will increase capacity nearly 50% while keeping the residual in the 16 to 18% range.

Larger presses with 600 HP single speed drives are available that triple the above tonnage. All presses are available with water cooled shafts and cages and an infintely variable choke at the discharge (Fig. 3).

As time goes on, it seems that more and more specizlized screw presses are being required. Currently we are building many screw presses equipped with electric motors or steam turbines of 1000, 2000, 4000 HP and with diameters of 14 in., 18 in., 24 in., 32 in., 36 in., and 48 in. Admittedly many of these are for industries other than the vegetable oil field, but who knows what application they might find in some oil mills of the future.

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