

Oilseed Pre-Pressing and Preparation Line Process Description

Summary: the line consists of a system to press oilseeds to partially remove oil content. Operations consists of cleaning, cracking, hulling, flaking, conditioning, pressing and oil filtering.

Seed cleaning. Seeds are stored in a large storage silo, then transferred to a shift silo via screw conveyors and bucket elevators. The shift silo holds approximately 60 MT of soybeans or other grains with similar density. The silo is elevated and beneath it there is a seed cleaning machine, which consists of a vibratory deck (or sifter) with two steel mesh screens, a larger one for large pieces (sticks, stones, etc.) and a smaller one for finer particles (dirt, sand), the middle fraction is the clean seed; it also has provisions for air-suction in order to scalp light pieces; if the latter is desired, a fan and a bag-house dust collector is needed (not in list).

Cracking. After seed is cleaned, it goes to the cracking mills, these are quadruple-roll cracking mills, consisting each of two sets of horizontal twin rolls one set atop the other. Rolls are grooved and rotate at different speeds, the spacing between the rolls is adjustable in order to calibrate the degree of breakage. Cracking of seeds is desirable in order to loosen hulls (when hulling is needed), but also to start putting energy into the particle reduction; in other words, if the downstream processes include other type of particle reduction or modification, the horsepower used in the primary cracking saves horsepower in any downstream operation (i.e. pressing, flaking, etc.). Hulling can be entirely by-passed by transferring the cracked seeds directly to the flaking operation.

Dehulling. The mixture of cracked seed and loose hulls is then transferred to the hulling system (hulling or de-hulling mean the same thing) via a vertical screw conveyor. The main component is another vibratory deck, of identical construction to the seed cleaning deck, but with different calibration; in this case the fines consists of those small seed kernel particles, which are sent to the next step (flaking), and the large ones consist mainly of hulls. The middle fraction is the kernels. At the discharge of the vibrating screening there is suction pulled by a fan, the light particles (mainly hulls) are sucked by the fan and sent to a cyclone to separate the solids from the air; the solids are directly fed to a kernel recovery system, a fluid-bed vibrating screen; the goal of this piece of equipment is to make another separation: separate those entrained kernels, pulled by the air, from the stream; the kernels that precipitate at the bottom are sent to the next processing step (flaking) along with the main stream of kernels produced by the hulling sifter and the fines. The clean hulls produced by the kernel recovery (hull cleaner), are pulled by another fan, separated in a twin-cyclone system and discharged into a hammer-mill that sits atop of ground hulls bin. The idea is to store hulls in ground form and not as whole hulls, because the latter are too light and occupy a lot of space if not ground.

Flaking. This a very straightforward process. The kernels (also called meats) from the previous hulling stage, are transferred to two flaking rolls, consisting each of twin horizontal rolls. The rolls press the meats into flakes of varying thicknesses, around 25 mils. The goal of flaking is to rupture the oil-containing vesicles and facilitate downstream operations (i.e. pressing, extruding, solvent extraction). This system presses the kernels in cold form, if hot-flaking is desired a seed heater prior to the flakers is necessary (not included). Flaking can be entirely bypassed allowing transfer from the hulling system (or from the craking mills if hulling is bypassed) directly into the conditioning. One example is safflower, which is usually lightly cracked and then directly pressed after prior conditioning.

Conditioning. Once the flakes are produced by the flaking mills, these are elevated via vertical screw conveyor to a stack-cooker-conditioner, which consists of a vertical cylinder with 6 stages of heating, both indirectly (steam jacket) and directly (sparged steam). The flakes leave the cooker at a temperature above 100°C and with varying levels of moisture. The goal of conditioning is to prepare flakes for proper pressing (next step), by reducing viscosity and facilitating release of the oil in the presses. Conditioning can be bypassed if cold-pressing is desired.

Pressing. Two continuous presses - sitting on the floor right beneath the conditioner - receive the hot flakes and press them. The continuous press consists of a screw flight with ever-increasing shaft diameter inside a grooved cage (or barrel); the reduce void volume cause by the increase of diameter of the body of the flight shaft results in high pressures which squeeze the oil from the feed in a continuous manner, the oil is drained from the barrel by the action of pressure. The grooves in the barrel are produced by bars which are separated by spacers of varying sizes, the openings are larger in the first part (or section) of the barrel, and smaller at the end of the barrel. Very high pressures are generated and the degree of tightness or squeeze can be varied by a manual choke at the exit of the pressed cake.

Filtering. The oil coming out of the presses contains a large amount of seed solids entrained during the pressing. This oil is first sent to a continuous settling tank (or screen tank), via a bucket elevator. The use of a bucket elevator and not a pump to transfer oil into the screen tank solves many problems associated with pumping solids-containing liquids. The screen tank is a rectangular vessel with a continuous loop of chain and scraping blades. The scrapers swipe the bottom of the tank where solids have precipitated and strain them over a horizontal screen on the upper part of the tank; the oil dripping from the solids (or foots) falls back into the tank and the strained solids are returned to the pressing system at different points, in some cases fed back into the conditioner where they get re-agglomerated. The clarified oil from the screen tank is pumped into the next stage (filtering) to remove the last traces of solids. The filters consist of two plate-and-frame type filters. A large filter is usually on-line, and when this large filter is stopped to remove the foots or filter cake once it is full, a smaller back up filter become on line while the large filter is cleaned. The cake of the filter is either recycled to the pressing system or mixed with the press cake. The filtered oil (dubbed crude, un-degummed oil) is pumped to storage tanks for further processes.

Downstream operations. The line produces two main items: a) crude, un-degummed oil, and b) press cake. The degummed oil can be sold as-is (dubbed press or expeller oil, also first-pressing oil) or can be further refined for either human consumption or to render it suitable as a feedstock for biodiesel production. Neither of the downstream refining equipment is offered for sale. The cake can either be sold as animal feed (depending on the type of seed), or can be further extracted with solvents to exhaust the remaining oil content depending on the amount of oil left in the cake; solvent extraction system is not available for sale too. Some companies pelletize the expeller cake to increase its density and make it a better-handling bulk solid, pellet mills are not offered too.