Integrated Oil Mill Processing

JAMES K. SIKES, Plains Cooperative Oil Mill, Lubbock, Texas

SIGNIFICANT ADVANCES have been made in recent years at the oil mill level which now make feasible the taking on of other closely related processes. For instance, the advent of continuous degumming of cottonseed oil and reincorporation of gums into the meal (4) has paved the way for at least two areas of consideration, refining of the oil and quality improvement of the meal. A look at equipment arrangements, advantages of multiple uses of equipment, and costs will be given. Meal will be discussed in the light of nutritional upgrading, also it will be pointed out how an oil mill may expand its meal operation to include custom-mix rations.

The Refining Picture

In a cottonseed oil mill that uses solvent extraction to remove oil from cottonseed several avenues of approach are possible. Conventional refining, either by continuous single-stage caustic or by continuous two-stage soda ash refining, is relatively simple and presents no real problem. In a solvent-extraction plant there is also the possibility of using continuous miscella refining. Miscella from the extractor need only be concentrated to the desired level, then refined continuously by using single-stage caustic refining. Two things make this process a little more expensive initially than conventional refining. The first is the necessity for very critical control of the solvent concentration when it leaves the evaporator and goes to the refinery. Unless an exact concentration is known and unless it remains steady, then flow rates, lye treats, and percentage of oil will vary greatly, giving erratic results because of under-refining one minute and over-refining the next. This fluctuation may be controlled in at least two ways.

One is to have a surge tank into which the evaporator discharges. Control of the concentration is maintained by a specific-gravity controller, which shuts off the flow from the evaporator if the concentration is too low, allowing the concentration of oil in the evaporator to build up to the proper level before discharging. If the concentration is too high, extra hexane is bled in from a separate small tank, the valves of which are actuated by the specific-gravity controller. Specific-gravity changes on account of varying amounts of oil present in the hexane at any constant temperature are rather minute so a very sensitive instrument is required.

Another method of controlling fluctuations in miscella concentration is by coupling the lye-proportioning pumps to the flow stream of miscella. However this does not take into account a second variation in the percentage of oil in the hexane, which is independent of the change of flow *per se*. Continuous specific-gravity readings and temperature readings with corresponding minor changes to lye-dosage regulators are not very satisfactory because of the constant attendance necessary and because of the changes in temperature between the evaporator and the refining stage, which of course bring changes in the percentage of oil present in the miscella. A cold miscella contains more oil by weight than a hot miscella. The former system is the one currently in use at Plains Cooperative Oil Mill.

Temperature as a means of control is out for obvious reasons. A mixture of oil and hexane boils at a constant temperature over at least 90% of the entire range of concentration, particularly if high-purity hexanes are used. This is true for a constant pressure. Increased pressure only raises the boiling point and only further complicates control because of minor variations. In other words, it is impossible to control concentrations of oil in miscella by temperature alone when concentrations anywhere from 10 to 95% boil at exactly the same temperature for any given pressure. The range just quoted has not one single degree of variation when using high-purity hexanes. Other hexanes offer no solution to the problem either because their ranges vary from 30 to 60%; *i.e.*, their "flat" boiling ranges are of these magnitudes. Such wide latitudes preclude any possibility of using temperature alone as a means of control.

The other item which increases the intial cost of miscella refining is the necessity of using explosion-proof equipment throughout. This needs no amplification as everyone is aware of the hazards involved when working with large volumes of hot inflammable solvents.

Concerning layout, in addition to solvent extraction and degumming, it was necessary only to add five more De Laval VO 194 hermetically-sealed centrifuges, the specific-gravity control apparatus mentioned previously, some lye mixing and storage tanks, and some refined oil-storage tanks, and we were in business.

We use the same oil dryer that we use when only degumming. We use the same final still for removing hexane from the refined oil that we do for removing hexane from crude oil before degumming. By this "doubling-over" process, we are able to realize considerable savings over having to furnish everything necessary to refine. Our two degumming centrifuges can be used as primary refiners with no alterations. We have three more centrifuges which are also primary refiners. We have two more centrifuges used for water washing. This arrangement allows for greater flexibility. Depending on market conditions, we can go any one of three ways. We can a) degum with two machines, or b) degum with two machines, then refine with three machines and water-wash with two machines (single-stage caustic process), or c) use two machines for soda ash refining, two for caustic re-refining, and two for water wash, leaving the seventh machine as a stand-by.

Perhaps some clarification is necessary at this point as to whether or not any or all of the aforementioned flexibility applies to miscella refining and/or miscella de-

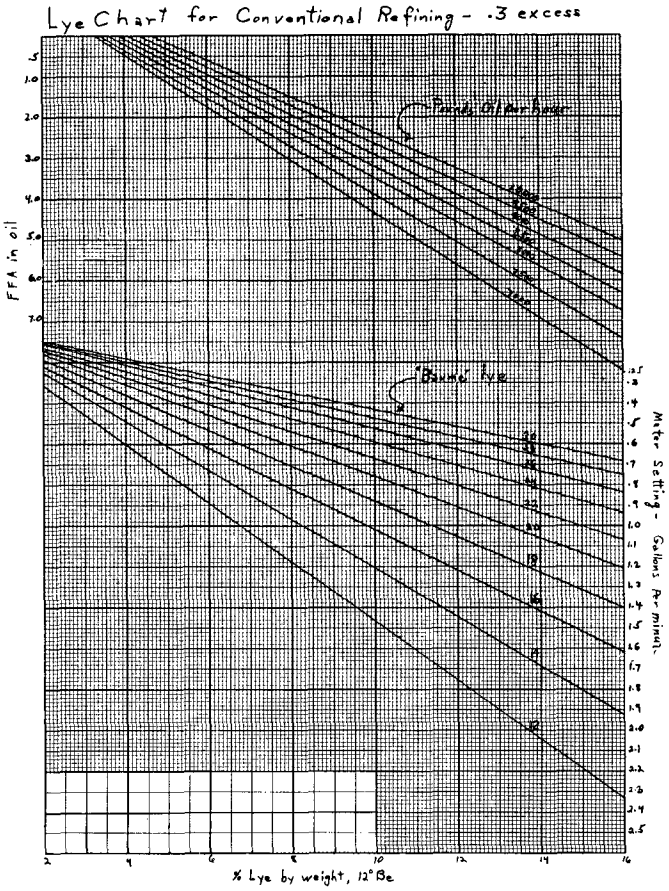

FIG. 1