Processing Control of Crude Oil Production from Oilseeds[1]

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Abstract

Control of oilseed processing for best quality and yield requires attention to many details, starting at the seed unloading station and continuing through to the loading of products. Present trading rules encourage practices that degrade oil and meal. Better cleaning would pay handsomely in quality products. The continuous mechanical screw-press process and the solvent extraction process have many common problems which involve quality and yield control. Time, temperature, and moisture are the variable involved in all the unit processes that comprise oilseed milling. These unit processes and some recent developments in low-temperature processing are described. Oilseed milling is still "rough terrain" with regard to automation, but labor costs as a percentage of total processing costs are relatively low in large-capacity plants.

Introduction

IT HAS BEEN 10 years since the last Short Course on oilseed processing was given at Purdue University in 1956 (1). Since that time there have been many design improvements in oilseed machinery and new advances in extractor design. These have been covered in publications so this paper will be concerned chiefly with processing control and particularly with quality control, beginning with the quality of oil and meal from the time the oilseeds are received at the mill.

The problem goes back even farther because it is true that the factors which influence quality are most important in proportion to the earliness with which they are applied to oilseed. In other words, the basic quality of a vegetable oil is not improved. All of the processing steps do not improve the quality of an oil but only minimize the damage done to the oil. The best methods of processing to produce crude oil and the best methods of refining, bleaching, hydrogenation, and deodorizing do not really improve oil quality but only hurt it less than if it were treated with less than the best techniques.

Problem of Trading Rules

One severe problem with quality control of vegetable oil involves trading rules for oilseeds and for fats and oils. Although it may be beyond the scope of this paper, it seems appropriate to voice criticism of current trading rules, particularly in regard to soybeans, which are set up by processor associations. The soybean trading rules have allowed up to 2% of foreign material in soybeans without penalty. It is gratifying to see that the problem has been recognized to some extent by the reduction, only this year, of the limit, without penalty, to 1%. The result is that most farmers and practically all country elevators add enough dirt and trash to bring the percentage up to at least the maximum. When soybeans are loaded in barges from terminal elevators, it is common to see a bean spout and a dirt spout, both feeding metered quantities of material to the barge. It is economically necessary for the soybean shipper to make sure that every shipment has the maximum percentage of foreign material, which means dirt and trash, which is allowed. It is economically necessary for the shipper but ensures a much greater economic loss to the processor of the beans or to the user of the oil and meal. This practice costs the country hundreds of thousands and probably millions of dollars every year. Even foreign material above the 1% limit is treated as a nonharmful diluent.

In truth, the dirt and trash and weed seeds not only cause hundreds of thousands of dollars of damage in the abrasion of conveyors and equipment and in capital investment to provide extra cleaning facilities but also results in a tremendous quality damage to the oil (2) and the meal. After this harmful, fine material consisting of weed seeds, dirt, and trash of every description is added, most mills think it uneconomic to remove a considerable part of it because they lose small pieces of broken beans which are also fine and would be lost through the sand screens of their cleaners. Consequently most mills blank off their sand screens and permit all of this harmful material to pass through their processing plants. Again, the effect of oil quality is much greater than is readily apparent or penalized by trading rules set up for crude oil. The actual damage to flavor is greater than is shown by any difference in refining loss or refined color determination, and the crude oil producer is not penalized to the extent that the manufacturer of edible products suffers in the actual damage done to his product.

The solution is for the trade associations to set up standards which will provide more severe penalties for trash and to start the penalties at the zero level. The penalties should take into account the damage to quality in addition to the actual weight factor.

Advances in Quality

The greatest quality advances in milling practice in the last 20 years involve improvements in receiving, drying, storing, and cleaning of oilseeds. These are not spectacular and do not lend themselves easily to evaluation. Many oilseed processors, whose operating experience is limited to the last 20 years, are following standard practices without realizing the importance these practices have in maintaining good quality. Probably the greatest change in oil mill practice has been the matter of drying. Only a few may now remember the major crises that used to occur regularly in the oil mill industry at harvest time when wet raw materials were brought into the plant. This occurred with both cottonseed and soybeans and undoubtedly with other oilseeds and all grains in general. The widespread use of driers in plants, in country and terminal elevators, and even on the farm has been a major revolution in the past 15 to 20 years, which has added millions of dollars each year to the gross national product.

In discussing process control, it is necessary to treat the oilseeds separately since specific process requirements to preserve quality for one are sometimes unimportant and even produce the reverse effect on another seed. It is also necessary to treat mechanical screw press operation and the solvent extraction operation separately. Although there are many common quality problems, there are many more differences.

Continuous Mechanical Screw-Press Process

In the mechanical screw press process the emphasis will be on cottonseed since about 60% of the cottonseed crop in the United States is still processed through screw presses, either for prepressing or for complete pressing.

Fig. 1 is a flow chart of the continuous mechanical screw press as applied to cottonseed. In this the cottonseed from unloading or storage is brought first to a cleaner, *1* on the chart, from which it goes through linters, *2*. Actually most oil mills have a whole room full of first-cut and second-cut linters. The delinted cottonseed is then hulled by cutting the seeds in bar hullers, *6*, and the meats are separated from the hulls in a series of seed separating machines, which are represented as *7*.

The cottonseed meats containing 10 to 15% hulls are then passed through a crushing roll, *8*. This is an im-

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