Stirred down with 20% hardstock, No. 6 oil gave a buttery yellow product much more highly colored than oils 7, 8, and 9. In other words, the pigment in oil No. 6 intensifies greatly on dilution or on observation through a shortened column.

The use of any system of measuring oil colors is dependent upon a set of rules governing the conditions under which an oil shall be read. Such oils as No. 6, which will be placed in different positions depending upon the conditions of the test, make the specifications necessary. From the data so far obtained on the Klett-Summerson equipment, oils could be satisfactorily graded by specifying that any filter-photoelectric system may be used having a filter-photocell response comparable to that shown in Figure 1 for the No. 50 filter, that oils having an apparent color density up to 0.3 (300 on the Klett instrument) shall be read on a 40 mm. column, above 0.3 on a 40 mm. column shall be read on a 10 mm. column, and above 0.3 on a 10 mm. column shall be read on a 2.5 mm. column. Other conditions such as light source, temperature of oil, etc., should be specified.

Using the above conditions for length of column, the 12 oils were read on the Klett instrument using the No. 50, No. 56, No. 60, and No. 66 filter. The results are as follows:

Oil No.	No. 50	No. 56	No. 60	No. 66
1.	6.5	—2.8	—1.3	—5.5
2.	22.1	4.0	0.2	—3.5
3.	23.5	—0.5	—2.4	—6.1
4.	52.2	1.5	—1.9	—5.2
5.	145	21.1	4.2	5.5
6.	279	8.0	1.0	1.7
7.	155	44.3	30.0	33.2
8.	137	45.7	18.8	11.2
9.	189	65.8	34.5	32.4
10.	182	67.7	64.9	85.0
11.	160	60.0	31.1	40.0
12.	310	130	69.0	70.0

The use of a sufficiently higher refractive index blank than water would eliminate all of the negative values.

How do the readings on the Klett-Summerson instrument compare with readings on other instruments reported in Tables No. 2 and No. 3? Exact comparisons are impossible since exact comparisons necessarily demand that exact filter-photocell combinations be used. It appears however that any of the photoelectric instruments used in the study will do a good job of differentiating between the oils studied and any single instrument or combination could, therefore, probably be adopted for the purpose of grading oils.

Conclusions

The Committee feels that the work so far completed justifies the belief that a filter-photocell instrument, or a grating-photocell instrument can successfully be used to measure oil colors.

A filter (or grating setting) having a maximum transmission in the neighborhood of 500 mu. would probably be the most successful in differentiating between both dark and light oils. The possibility of using a filter-photocell combination having a response approximating normal visual sensitivity must not be overlooked.

The Committee hopes after a careful study of all the information so far obtained to continue the work on additional oils limiting the work to specific conditions that may later be adopted as accepted procedure.

No recommendations can be made at this time other than that the work of the Committee be continued.

Respectfully submitted,

G. Worthen Agee, Chairman,
Color Committee.

The Problem of "Fines" in Continuous Solvent Extraction Systems

MICHELE BONOTTO
Production Engineering Company, Inc., and Extractol Process, Ltd.
New York City

If a check were made of the patent literature on the subject of continuous solvent extraction—literature very crowded, indeed—it would be surprising to discover how much attention has been given to continuous extractors and how little to the handling of the material itself before, during, and after extraction. Even in the matter of distillation of the miscella it apparently has been taken for granted that no solids exist in the liquid to be distilled, and all the attention has been given to the thermo-dynamics.

The main advantage of the continuous system over the old batch systems is the steady flow of the material under process, and its outstanding feature is the high degree of safety derived from the fact that the material flows throw vapor-tight apparatus, pipes, and conveyors without the necessity of periodical interruptions or manual intervention.

The continuity of the flow, however, is frequently and often unexpectedly interrupted by the presence of "fines" and dust in the system when the equipment is unable to cope with it. Instead of trying to solve the problem radically, only temporary remedies have been adopted so far as, for example, using auxiliary equipment such as filter presses in the miscella cycle or elaborate dust collectors in the vapor lines to protect condensers—both devices more or less originally designed for entirely different operating conditions.

A rational solution of the problem would be to first attempt to avoid the production of "fines" as far as possible during the several steps of the process and then to design adequate equipment to handle them without trouble.

Only a long experience in operating continuous solvent extraction plants will give an idea of how such a simple process is complicated by seemingly trivial matters and how the best and most efficient continuous extractor can be rendered inactive by the uncontrolled presence of "fines."

"Fines" are a necessary evil and may be created during any of the various steps of the extraction operation; in the flaking equipment, in the conveying of the flakes to the extractor, during the extraction operation and, finally, during the elimination of the solvent from the extracted meal.

"Fines" During Extraction

The proper conditioning of the material to be extracted affects the time and degree of extraction. For a given material the production of "fines" is in proportion to the thickness of the flakes, if the percentage of moisture remains constant. With proper care it is possible to control to some extent the "fines" in producing flakes of the desired thickness. However, the physical characteristics of vegetable oil-bearing materials vary to a wide degree. In flaking such materials as soybeans or corn germ, the "fines" may easily and economically be kept at a minimum. On the other hand, with such materials as cottonseed, flaxseed, sesame, and rape seed, such exacting and costly operating conditions are required to produce flakes without "fines" that any equipment which has difficulty in handling "fines" may be considered a technical and economical failure when called upon to process such difficult seeds. Peanuts may also be added to this list as well as all cakes from the presses.

All the "fines" created during the flaking operation are then conveyed to an extractor along with the flakes. Usually there is no substantial increase of "fines" during this step inasmuch as adequate and specially designed elevators and conveyors are now available on the market. If "fines" are created, it is due to gross inexperience of the plant designer or to a false economy in first investment imposed by the customer.

The extractor itself may be a serious possible source of more "fines," especially in instances where the extractor is so designed that mechanical stirring devices are needed to force the material through the apparatus. If such extractor is not mechanically able to handle this increased amount of "fines," accumulations usually occur which cause uneven extraction, uneven flow of the material through the extractor, by-passing, back-washing, choking, and clogging of straining devices wherever they may be located. On the other hand, if the extractor is such that it is mechanically able to handle the "fines" only those of a coarser size are carried towards the outlet with the extracted meal; the finer solid particles are carried out in the miscella stream and no conventional screen would be able to retain them without periodical cleaning, which means also periodical disposal of the "fines."

"Fines" in the Miscella

The "fines" in the miscella may be separated without serious trouble and without interrupting the continuity of the extraction operation when the percentage is kept under reasonable limits, which in my experience may be considered from one-half to one-tenth of one per cent.

In spite of the bulky extra equipment involved a couple of filter presses interposed between the extractor and the distillation system may be considered a satisfactory compromise when processing soybeans. However, the total filtering surface must be so calculated that the cleaning cycle of each press is not less than from 12 to 14 hours. There may be some objection to the presence of filter-aid in the filter-cake which does render it unfit for animal consumption or for some technical applications, but the amount of such contaminated cake would be relatively small and the loss involved of not too great concern. But when the amount of "fines" in the miscella reaches a certain proportion, the filter press is no longer a filter but virtually becomes a batch extractor with a solvent-eliminating and recovery equipment of its own.

A continuous centrifuge could be used instead of the filter presses, and there are inclosed vapor-tight centrifuges now on the market that may safely operate in the presence of flammable solvent vapors. But then, again, there would be the problem of the separated solids, solids which would be impregnated with solvent and would contain a high percentage of oil. To deal with such solids would again mean the introduction of a secondary extraction and solvent recovery system within the primary one.

In a conventional distillation system the separation of the "fines" from the miscella is a really important problem because their presence causes a great deal of trouble, the principal one of which is the sticking of these solid particles to the heating surfaces of the

SYMPOSIUM ON SOLVENT EXTRACTION OF OILSEEDS

K. S. MARKLEY

AT ABOUT the beginning of the present century there occurred in Europe, particularly in England, France, and Germany, a change in oilseed processing which has since that time developed into a virtual technical revolution. I refer to the introduction of solvent extraction for the recovery of fats and oils from a variety of oleagineous materials.

The first installations were single unit batch extractors which were in turn followed by multiple batch extractors operating on the counter-current principle, and ultimately by a variety of continuous extractors. The extraction process was highly developed in Europe by the time it was first introduced into the United States. In the latter country the first extractors were also of the batch type and were used principally for recovery of bone and meat scrap greases, and residual oil from castor pomace. With the advent of soybean processing on a large scale there was introduced principally from Germany various types of continuous extractors. The success achieved by the soybean industry has resulted in recent years in considerable interest and experimental work on the application of solvent extraction to peanuts, cottonseed, tung nuts, and other oilseeds.

Because of this growing interest in solvent extraction, A. M. Altschul, chairman of the technical program committee, arranged a symposium at the 37th annual meeting of the American Oil Chemists' Society in New Orleans on May 15-17, 1946, with the hope that the papers would contribute materially to an understanding of the possible developments which may be expected to attend the solvent extraction industry.

[EDITOR'S NOTE: *Papers in the symposium were "Solvent Extraction of Oilseeds" by W. H. Goss; "Processing of Cottonseed. II. Factors Determining Distribution of Pigments in Products Prepared by Solvent Extraction of Cottonseed" by C. H. Boatner, C. M. Hall, L. E. Castillon, and Maisie Caravella; "The Problem of Fines in Continuous Solvent Extraction Systems" by M. Bonotto; and "Lipids of the Cottonseed" by V. L. Frampton and H. H. Weber. Each will be published as soon as approved by the Editorial Advisory Board of Oil & Soap.*]

distillation and solvent recovery system. The consequent scorching causes discoloration of the extracted oil.

"Fines" in the Dryers

In the dryers the "fines" are in the form of a dust and are even more troublesome than the "fines" in the miscella. The conventional dryers now in use for soybeans and corn germ were designed essentially for driving off moisture from granular material and later in Europe were adapted to drive off solvent when processing soybeans in relatively coarse form. The dust is a result of disgregation caused by the mechanical agitation to which the extracted meal is subjected in these dryers, facilitated by the action of the heat from the jacketed walls and by the gradual decrease in moisture content during the process. These fine dust particles are carried to the condenser by the stream of solvent vapors generated in the dryer, with the resultant fouling of the condenser tubes and the carrying-over of part of the solids with the condensate. Those solids are ultra-fine particles of protein material soaked with water and solvent and constitutes a gooey sediment in the bottom of the storage tanks or, being heavier than solvent and lighter than water, if conveyed through the water separator, settle as an intermediate layer. Breaking the continuity of the operation, manual intervention is necessary to dispose of this layer. This results in a loss of solvent, as well.

Here, again, I must emphasize the fact that the dust created when handling soybeans and corn germ may be kept reasonably under control but when cottonseed, flaxseed, sesame seed, and other similar materials are to be processed, the amount and fineness of the dust produced is such that a radical solution of this problem rather than a compromise must be found. Dusty materials or those which disgregate easily should not be sent through such dryers.

Compromises have been made in existing solvent plants by interposing one or more dust collectors, and sometimes a scrubber, to catch the dust before it reaches the condensers. Here, again, if the amount of "fines" is small, such dust collectors may be accepted as practical but when the amount of "fines" is high, a considerable loss of material occurs and eventual cumbersome arrangements are needed if an attempt is made to overcome this loss. In a plant processing 120 tons of cottonseed meats, in every 24 hours 32 tons of solvent must be recovered from the extracted meal under these trying conditions. Only the creation of new machinery will solve the problem by simplifying rather than by complicating the process.

It is my opinion that no continuous extractor is good if it is not linked in a system where the material is kept in continuous flow in the right direction; that no one of the several steps in the extraction process can be considered independently from the others. Solvent elimination and miscella distillation, as well as the preparation of the material to be extracted, are as important as the extraction itself, and the extractor's characteristics must be complemented and integrated by the characteristics of specially designed subsidiary equipment. Since "fines" are a necessary evil, then all the equipment—even the distiller—must be able to handle them.

A successful extraction system, to me, is one that includes an extractor that extracts and filters at the same time in 100% countercurrent way, one which does not in itself produce "fines" but which can accept "fines" returned to it after being separated from the miscella; a system which includes solvent eliminators which can handle material no matter how dusty without sending dust particles to the condensers; a system which also includes a distilling system so designed that it may process miscella containing a reasonable amount of "fines" without impairing the quality of the oil—all the above to be realized with the least possible equipment and the most simple plant layout.

A successful extraction plant must be able to process not only the easy-to-handle materials but also cottonseed, flaxseed, and similar seeds, as well as cake derived from the mechanical presses. Such a plant need not be idle after a seasonal crop such as cottonseed has been processed.

I am especially proud of a plant built according to the above ideas which has been in continuous successful operation since 1940.

Recently imitations, adaptations, and modifications of some of my most discussed processes and equipment have begun to show up. This is very comforting to me, and encouraging. It is an indication that my principles and theories, not completely understood six years ago, are now beginning to be recognized and accepted.