# Filtration Facilitated by Filter Aids

## Clarification of Crude or Refined Oils Best Accomplished Through Use of Special Filtering Earths

By ARTHUR ELSENBAST

THE modern trend of all manufacturing practice is toward improvement of quality and co-ordinate reduction of production costs. All progressive manufacturers, in fact, all manufacturers who hope to remain in business (and who does not), are constantly striving to raise the standards of quality of their products and to reduce the cost of production and handling of those products.

### Impurities Present in Liquid Products

To the producers of liquid products; in which class are included manufacturers of chemicals, dyes, glues and adhesives, paints and varnishes, beverages, sugars and syrups, animal, vegetable and mineral oils, and many other commodities; one of the major problems of production is clarification, i.e. the manufacture of a clear, brilliant and pure liquid, free from suspended, emulsified or flocculent impurities. These impurities may be present in particles of sizes varying from those quite easily discernible to the unaided eye, down to the colloidal size which puts the impurity almost, but not quite into solution in the liquid medium, resulting in a marked departure from clarity and brilliance in the appearance of the product. The impurities which may occur in any liquid product vary, of course, according to the nature of the product, but those most frequently occurring in organic liquids of vegetable origin consist chiefly of resins, gums, albuminoids, etc., which are of such amorphous nature that they are not removable by settling or simple filtration. They can sometimes be eliminated by centrifugation, but where the volume handled is large, the investment cost of centrifugal equipment is sometimes prohibitive, the power charges being also a handicap when, as above stated, the volume is large.

### Impurities of Vegetable Oils

The crude vegetable oils, coconut, peanut, soya bean, olive, and particularly cottonseed oil, as expressed from the original oil-bearing material, generally contain a considerable amount of meal, gums, resins, albuminoids and moisture, which are sometimes partially removed by sedimentation before shipment of the oil, but which remain in some amounts in practically all crude vegetable oils which reach the market, most particularly in great quantities in cottonseed oil.

In vegetable oil refining, where caustic soda is employed, there is always a finely divided flocculent soap present in the oil before filtration. If the oil is to be bleached this soap will interfere to a marked extent with the action of the bleaching mediums and if the oil is to be filtered without bleaching, these traces of soap are very difficult to remove by an ordinary filtration.

### Animal Oil Impurities

Animal oils and greases, edible and inedible, are subject to impurities similar to those found in crude vegetable oils, and in addition to

particles of tissue, bone, crackling, gelatin, etc. The clarification of animal oils and removal of these impurities present the same problems to the manufacturer of this class of products as those which confront the producer of vegetable oils.

## Filter Aids

In comparatively recent years producers of oils, fats and greases, vegetable and animal, have had available for their use as filter aids in the clarification of their products, types of materials known under the general classification of "infusorial" or "diatomaceous" earths. These products may be described as absorbent siliceous earths, which consist almost entirely of the fossilized siliceous skeletons of countless untold trillions of tiny extinct vegetable organisms, microscopic in size. In only a few known localities of the earth are found vast beds of clayey material which consists of the closely-packed skeletons of these pre-historic mites.

The nature of their origin accounts for the effectiveness of these earths as filter aids, since their skeletonal structure makes them exceedingly porous and absorbent, and their composition of practically pure silica renders them chemically inert, so that they do not react with any liquid in which they are used, therefore not affecting flavors or compositions.

The object of this article is to bring to the attention of the entire oil industry the news of the production of these new and improved filter-aids which can be used in such small quantities and with such good results as to make possible at low cost certain types of filtrations and clarifications which were always held desirable but which previously could not be carried out economically, such as the filtration of crude cottonseed and other vegetable oils at the crushing mills.

These new and improved filter-aids are now in wide use throughout the general chemical industries and wherever filtration and clarification work is done. They have been adopted as filter-aids by the more progressive companies engaged in animal or vegetable oil production.

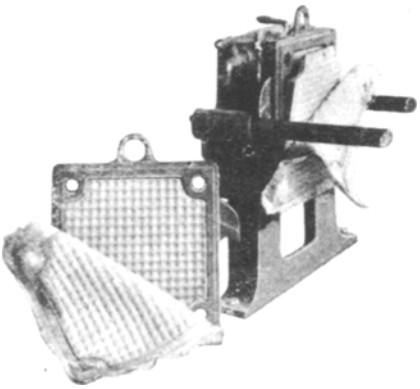
## Distinction Between Diatomaceous Filter-Aids and Bleaching Clays

There is a distinct difference between, the bleaching clays and Fullers' Earths ordinarily used for filtering and clarification, and the diatomaceous earth filter-aids which we are describing in this article.

The clays are mechanically disintegrated rock products consisting of mainly aluminum calcium silicates. The clay particle is a fragment of the crushed rock with no particular crystalline form or shape. A cubic foot of these clay particles will weight ordinarily about 40 to 60 lbs., which shows that it is a very heavy dense rock originally. The reason for the bleaching properties of the clays is not very well understood but is undoubtedly due in part to their chemical composition. These clays do have decided bleaching actions on some types of both animal and vegetable oils but on certain oils and certain colors have very little effect. There are many classes of vegetable oil filtrations in which Fullers' Earths and clays have comparatively small bleaching power, particularly in view of the fact that they can only be used in comparatively small quantities by weight on the oil handled. Quantities as

a rule over 2% impart decided tastes and flavors to the oil which are impossible to remove later. On the finest and most delicately flavored lards and compounds not more than five tenths of a percent of clay can ordinarily be used. The clays pick up moisture and become gluey and gelatinous and undoubtedly either the clay is changed chemically or the oil which is treated is changed chemically by this material.

The diatomaceous earth on the other hand is inert and removes the impurities by filtration through the microscopically porous cake which is formed in the filter press. There is a certain absorption of color and impurities due to the tremendous surface area which the diatomaceous earth particles possess and to this extent the diatomaceous earth also has a certain decolorizing and bleaching effect on many liquids including vegetable oils. There are many problems in vegetable and animal oil refining in which it is only necessary to remove the suspended matter in which cases the clay or earth is added to the oil merely to act as a filter-aid. The diatomaceous earth products by virtue of their porous characteristics build up a porous cake in a filter press and give a perfect clarification. The other types of clays on account of their dense impalpable powdered structure form a very heavy dense cake on a filter cloth giving a very low rate of flow and comparatively poor clarification. Where these diatomaceous silica filter-aids are applicable, usually only about one-sixth or one-eighth of the amount by weight which would be required of ordinary bleaching clays, is needed. There are increasingly large fields becoming discovered in animal and vegetable oil work in which clarification is the only requirement.



*Typical Filter-Aid Press Cake*

These "keys to economical filtration are used to advantage in any standard type of filter, preferably in the press type. They can be used with hot fluids as readily as with those at ordinary temperature. In their use, full advantage is taken of the possibilities of pressure filtration and of the adaptability of the modern filter press to commercial production requirements. Many liquors now being filtered could not possibly be clarified in a filter press economically without their aid. In hundreds of standard filtration processes, costs have been reduced to a fraction of their former amount, and the quality of the filtrate materially improved through their use.

### Varieties of Filter Aids

Maximum economy in filtration work demands the use of different grades of filter aids with liquids of various properties. The Celite Products Company, who are prominent manufacturers of this class of material, have published a brochure containing a very interesting description of their various filter aid products, as follows:

### Filter-Cel

Since 1912, Filter-Cel has been adopted as a standard aid to filtration in one industry after another. The product itself has been continually improved so that the Filter-Cel available today is far more effective for filtration than ever before. Its uniform quality is assured by careful selection of the raw materials used and absolute control over every stage in its manufacture.

The use of Filter-Cel in filter presses assures sharp and positive separation of solids from liquids. The rate of flow secured in most cases is not as great as may be obtained with Standard or Hyflo Super-Cel.

### Standard Super-Cel

This improved filter-aid gives brilliant clarity of filtrates together with very high rates of flow. It is particularly suited for the filtration of such products as sugar, syrups, extracts, cereal beverages, glycerine, pectin, many fruit juices, glue and gelatine boiling-liquors, and in general where high capacities of filter stations together with positive clarity of filtrates are desired.

### Hyflo Super-Cel

This super filter-aid is adapted for the filtration of liquids which are particularly difficult to filter, in which the solids to be removed are of such size, character and quantity as to permit its use to best advantage. The rates of flow secured are often startlingly high when compared with any other method. In some classes of filtration, rates of flow more than seven times those secured with lower grades have been recorded.

Among the products which are filtered to best advantage with Hy-

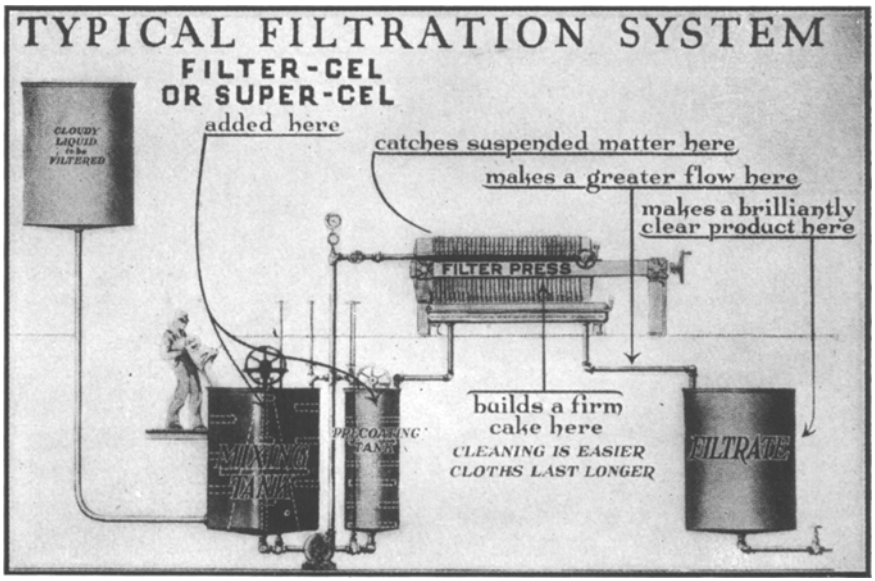



Photo courtesy Celite Products Co.

*Filtration Equipment Layout*

flo Super-Cel are varnish, adhesives, cider, linseed oil, tallow, chemical products, liquid soap, evaporated glue and gelatine liquors, vegetable oils (cold filtration) and some sugar liquors.

All filter-aids should be effectively sterilized in the process of manufacture. This is a direct advantage in some types of filtration.

In processes where the filter cake is "washed" to recover liquor contained in the cake, the use of Standard or Hyflo Super-Cel greatly facilitates "washing." Furthermore, due to the small percentage of Super-Cel ordinarily employed as compared to other filter-aids there is less loss of the product due to retention in the cake.

### The Selection of Filter-Aids

Celite filter-aids are most generally applied to "clarification filtrations." This covers liquids in which the volumetric percentage of solids to be removed is less than 2 per cent of the total liquid.

In some liquids the particle size of the suspended solids verge to the ultra-microscopic or colloidal and the total weight of these solids may be less than one-tenth of one per cent of the total weight of liquor. The size of the solid particles as well as their physical characteristics, whether they are gummy, rigid, etc., determine which grade of filter-aid should be used.

It is possible to select the particular Filter-aid which will form filter cakes of any desired capillary resistance to correspond with the variation in size, type and amount of suspended matter which must be removed from the liquid by filtration.

Filter-aids afford a wide range of possibilities in filtration work. To select the grade which will give maximum economy and use it to the best advantage often require plant and laboratory tests with each filter-aid.

### Making Plant Trials

In making plant trials to determine which filter-aid to use, it is suggested that the highest grade aids be tried first inasmuch as this material gives the maximum rate of flow with minimum filter-aid consumption where its use is practical.

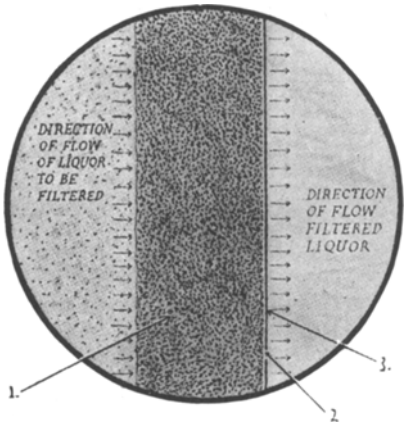
A safe excess of filter-aid should always be used on the first run in order to insure maximum rate of flow and brilliantly clear liquor. On succeeding runs the amount of filter-aid can be gradually cut down until the minimum quantity which can be used successfully is determined. This will depend on the length of the filtration cycle obtained, the appearance of the liquor and the filter cake formation.

### Filtration Procedure

An initial charge of the clear liquor containing a suspension of filter-aid is first mixed in the "precoating tank." Ordinarily an amount of liquor equivalent to twice the holding capacity of the press is used. An average of 10 to 15 pounds of filter-aid per 100 square feet of filter area is employed as a suspension in this charging liquor.

The charging liquor is then pumped through the press, depositing the filter-aid in a thin film over the entire surface of the filter cloths. (If desired, unfiltered or "raw" liquor may be used to carry the filter-aid suspension for the precoat). Generally the pre-coat charge flowing through the press is circulated back to the pre-coating tank until clarity of filtrate is obtained. This ordinarily takes from three to six minutes.

The main charge of liquor to be




**Diagrammatic Cross-Section Through a Filter Cake**

***An Enlarged Sketch Illustrating the Manner in which a Filter-Aid Prevents Passage of Finely Divided Impurities Through the Filter Cloth.***

1. THE FILTER CAKE. All the impurities suspended in the liquor being filtered are accumulated here. The cake is kept open by the filter-aid which is mixed with the charge liquor.

2. THE PRE-COAT. A thin film of filter-aid is deposited on the filter cloths by pre-coating. This thin film is open to the passage of clear liquors but positively impervious to all solid impurities. It serves to keep the main filter cake containing the impurities being removed from coming in direct contact with the filter cloth.

3. THE FILTER CLOTH. Its sole function is to support the filter cake. Slimes and gums do not reach it to clog the meshes and slow down filtration, or penetrate the cloth and cause cloudy filtrates.

There is an economic ratio between the given amount of filter-aid used for precoating and that mixed with the charge liquor in each filtration process. In many actual cases it has been possible to reduce the actual quantity of filter-aid used per unit of output by changing or manipulating the ratio of filter-aid used in the main liquor supply and that used for pre-coating. Longer filtration cycles and more rapid filtration are thus obtained, resulting in lower unit costs for pre-coating. This will depend to a great extent on the type of filter press used and the cost of removing and cleaning the cloths. In most clarification filtrations it is more economical to pre-coat than to remove cloths and to wash and replace them.

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filtered is then pumped through as usual; the proper amount of filter-aid having been previously added and thoroughly mixed in the "mixing tank." In large cycle operation the filter-aid is generally added to the mixing tank continuously in proportion to the raw liquor being forced through the system.

The use of filter-aids does more than speed up filtration and insure clarity of filtrates. The pre-coating film protects the filter cloths from any gummy and slimy impurities in the liquor. The filter-aid mixed with the solids filtered out insures filter cakes that are firm and porous, easily washed and readily removed from the press. This results in a large saving of time and labor in cleaning presses, and greatly prolongs the life of the filter cloths.

## Advantages of Filter-Aids

The benefits gained by using a filter-aid in any individual filtration process may be reflected in two ways:

1. An improvement is usually realized in the desirability and consequently the selling value, of the product manufactured with the assistance of a filter-aid over that of the product which has been filtered without a filter-aid.

2. A reduction in the total manufacturing cost is almost invariably effected.

The first advantage is readily apparent. The use of the proper type of filter-aid to insure brilliant clarity of filtrate helps greatly in producing and maintaining the highest quality of finished product.

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