# OIL FILTRATION

By D. R. SPERRY

To cover the whole subject of oil filtration in a single paper of ordinary length is quite out of the question. This paper therefore pretends only to cover the high spots of the subject and will be confined strictly to the subject of filtration.

No effort will be made to touch upon the various methods of refining oils except as it may be necessary to mention them when considering that portion of the process involving filtration.

The matter in this paper therefore starts with the tank of oil to be filtered and does not go back of that.

There are four principal reasons for filtering oils, as follows:

1. To clarify with or without the use of a filter aid added for that purpose.

2. To clarify and remove a substance that has been added incidental to its refining or use.

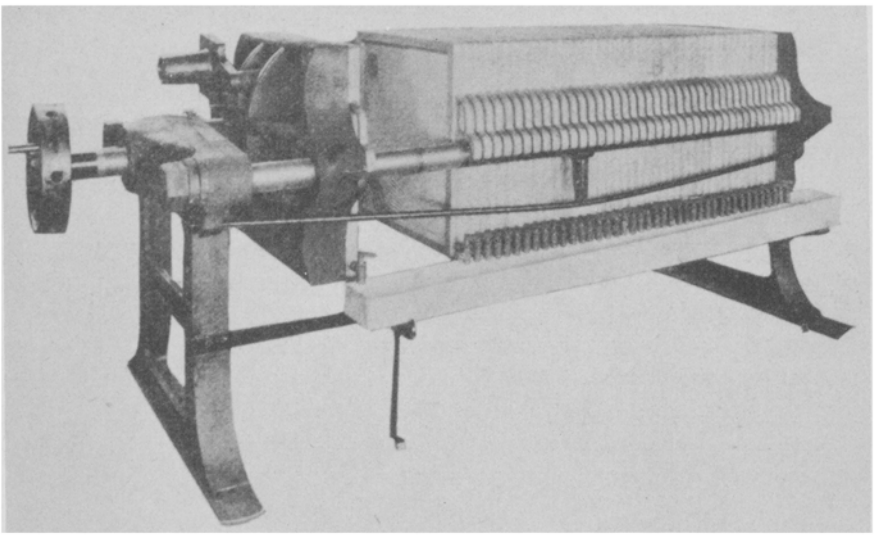
3. To remove a substance that has been intentionally precipitated from the oil itself.

4. To change the physical state of the oil.

## Clarification

When the object of filtration is clarification only it is seldom advisable to operate without a filter aid of some kind.

Usually the particles to be removed are of a colloidal or gluey nature



A Filter Press equipped with recessed plates, with radial grooved plates.

and the filter cloths soon clog up, or else the particles are so small that they pass through the cloth with the oil producing no filtration.

Clogging of the filter cloth is explained by the fact that the particles caught on the cloth form a very minute system of capillary channels for the oil to pass through. This, together with the viscosity of the oil causes a low rate of flow. When this occurs the tendency of the operator is to increase the pressure, a condition which causes the deposited layer to be squeezed down more tightly, thus decreasing the size of the capillary channels, and possibly decreasing the flow.

Filter aids are used to produce larger capillary openings in the deposited layer and to make the mass less compressible under increased pressure.

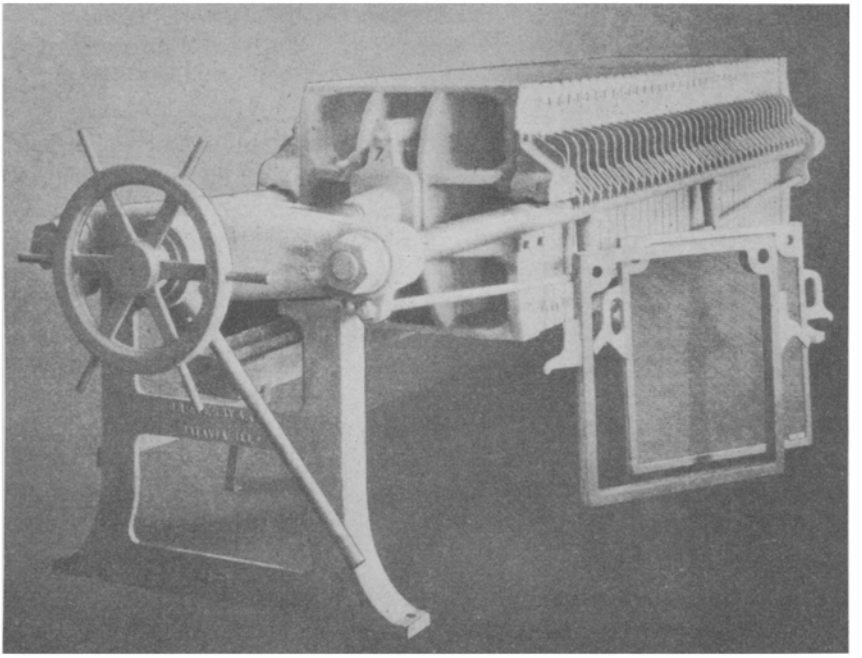
A porous, open mass such as kieselghur is often used either as a predeposited coat on the cloths or as an alloy by mixing with the oil, or both.

A layer of filter paper placed over the filter cloth may also be used as filter aid.

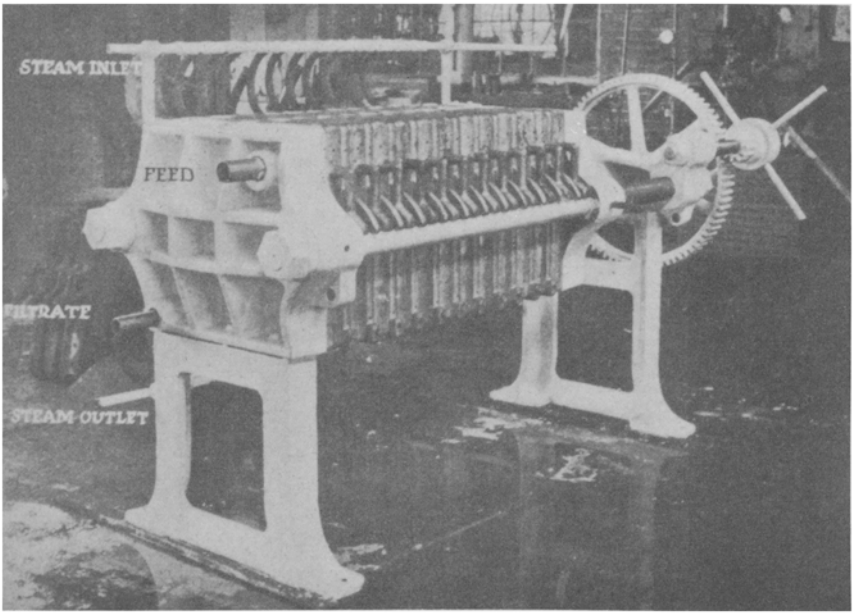
In the case of particles that are not caught on the filter cloth, but pass through either because of their fineness or because they are not adsorbed by the cloth fibres at the start of filtration, a filter aid is used to make the capillary channels smaller and longer. This tends to arrest the particles either by adsorption or fouling.

Where no filter aid is used low pressure should be employed, to prevent the particles from packing or squeezing too tightly together. Filters fed by gravity of ordinary heads available in manufacturing plants are thus sometimes employed when no filter aids are used. In this case the filter operates over quite a period of time, as over night, in order to compensate for the low rate of flow.

The proper kind of filter aid to use must be determined for each problem. In general prepared kieselghur is preferred, although there are cases where paper may be best. The cost of filter paper is greater than that of kieselghur, but its use may be warranted through reduction of operating labor. It is sometimes used over the filter cloth in a layer, at the start, ten thicknesses deep. At each opening of the filter the outer layer is stripped off and the chambers immediately closed. Labor incidental to the removal of filter cloth, washing and replacing it may thus be greatly reduced. In other cases a single layer of filter paper is used and each time the filter is opened the sheet is torn off and a clean one stuck on in less time than the filter cloth could be removed and replaced. These instances may be looked upon as special cases, as ordinarily the oil should be mixed with a filter aid prior to filtration so as to cause adsorption of the fine particles by the larger filter aid particles, thus building up a cake that is porous and capable of clarifying the oil.



A Filter Press equipped with plates, with surface plates.




A steam heated Filter Press with external connections for steam. Instead of steam, refrigerating brine may be used for filtering at low temperatures.

In nearly all cases of oil filtration it is best, unless prevented by economic or chemical reasons, to heat the oil. This greatly decreases the viscosity of the oil and therefore increases the rate of flow. Heating is not always desirable, however; in fact, quite the opposite is true in some cases. Certain oils show a haze at winter temperatures, but not at summer temperatures. In this instance the haze is due to a substance that melts at summer temperatures and can therefore only by filtered out when the oil temperature is low enough to show the haze. Where filtering is done under these conditions the rate of flow is for ordinary oils quite low.

Where no filter aid is used, recessed plates or flush plates and frames may be used. If filter paper is used only the flush plate and frame arrangement will suffice, due to the fact that paper breaks if used with recessed plates. When a filter aid in the form of an admixed alloy or pre-coat is used either recessed or flush plate and frames may be employed.

Examples of oils filtered for clarification only are linseed oil, cotton seed oil, whale oil, seal oil, petroleum oil.

**Removal of a Substance Added Incidental to Refining or Use**

Removal of a substance previously added to the oil incidental to refining, such as Fuller's earth or decolorizing carbon, is very easily accomplished. The oil is generally hot, thus reducing the viscosity and producing a rapid flow of filtered material. No filter aid is needed due to the fact that the Fuller's earth or carbon acts in that capacity.

The usual method of procedure is to pump the hot oil, with the solids in suspension, into the filter press. This forces the oil through the filter cloth, and its layer of deposited solids, producing a brilliant filtrate. The pressure developed by the pump varies from zero at the start to 75 or 100 pounds per square inch at the finish. The chambers at the end of a run are full or nearly full of solids.

When the pump is stopped live steam is fed into the filter press through the same channel previously pumped into. This has the effect of displacing the oil held by the cake so that when the filter is opened a quite dry crumbly cake is found.

After the cake is removed from the chambers the press is closed, either using the old cloths again or replacing them with new or washed cloths, depending on the conditions.

Examples of oils filtered to remove a substance added incidental to refining is that of removing Fuller's earth from cotton seed oil or grease, and removing earth from reclaimed motor oil.

When it is desired to remove a substance added incidental to the use of the oil, quite a similar process is gone through as described above with the possible exception of steaming out the cake. Examples of oils filtered to remove some substance added incidental to use, is that of re-

moving catalyser from oil in the hydrogenation process, and carbon from quenching oil.

Recessed or flush type plates and frames may be used for removing substances added to oils in refining or use. The flush type filter plate, while more expensive than the recessed type of plate is frequently used on account of the fact that filter cloths last longer on plates where there are no recesses.

### Removing a Substance Precipitated from the Oil

A good example of removing a substance precipitated from the oil itself is that of filtering out stearine from cotton seed oil. In this instance the filtration must be carried out at a temperature low enough to prevent the stearine from melting or getting too soft. To accomplish this a refrigerated filter press may be used or a regular filter press may be placed in a refrigerated room. Cotton filter cloths are used and they are steamed out after the filter press has been emptied and closed, to prepare them for the next run.

### Filtering to Change Physical State of Oil

Oils are sometimes filtered to change their physical state. A good example of this is that of filtering an emulsion of oil and water. The effect of running this material through the filter is that of changing its state from an emulsion to separate masses of oil and water. In other words the mixture of oil and water which would not separate prior to filtration will quickly separate by settling after filtration.

Minute quantities of water may also be removed from oil such as transformer oil by passing through a filter press.

In both of the cases given above a filter aid is used either in the form of a powder or in the form of filter paper.

It is not known exactly what occurs in these cases, but it is probable that the small particles of water are caused to coalesce by being brought into intimate contact with each other as they pass through the capillary channels formed by the filter cloth and filter aid.

For work of this sort the flush type of plate with frames is usually employed; in fact, must be employed where filter paper is used, although where a powdered filter aid is used the recessed type may be employed.