FILTERING AND STRAINING PAINTS AND VARNISHES:

Including basic principles of filtration, theory of filter aids,
suggestions on filtering practice,
and a comparison of clarifying methods

A. C. Kracklauer
President, Sparkler Filters Inc.
Finish, April 1950, Vol. 7. No. 4

LIKE so many other problems in the paint and varnish industry today, the clarification and filtration of varnishes and lacquers, and the straining of pigmented enamels and paints can be a rather comprehensive subject if we were to consider the many details and technicalities that the subject presents. This article will be confined to some of the fundamentals of the overall problem.

Most paint and varnish manufacturers today, are so fully aware of the importance of thoroughly clarifying paints and varnishes that we need spend very little time on this phase of the problem. We all appreciate that clarifying and filtering a varnish, resin, or paint not only improves its appearance but its intrinsic qualities as well. For instance, we know that filtering dirty insulating varnishes will improve their dielectric properties from 30 to 200 per cent, and their heat endurance 10 to 20 per cent. Or, again, a fine protective coating may be rendered pervious through minute dust or dirt particles present.

Basic principles of filtration

Before discussing the specific problem of filtering varnishes, the basic principles of filtration will be covered. Because, as is so often the case, once we understand the theory the application becomes almost automatic. Basically, filtering is the separation of fine solids from liquids or gases. If the solids are relatively coarse we usually refer to it as straining. Up to 50 or 60 years ago, this separation was accomplished by means of a fixed septum or membrane having pores fine enough to withhold the solids to be removed, and large enough to permit the liquid to pass. It is easy to see what happened in those days when the solids being removed were of a colloidal or jelly-like nature as they so often are in varnishes or when the liquid that is being filtered had a high surface tension such as varnish.

In removing colors, odors, and tastes from liquids by means of kieselguhr, or powdered charcoal, the chemists of those days found that the throughput of a given filter area was increased somewhat when these powders were mixed with the liquid being filtered. The reason for this is the fact that the porous and crystalline nature of the charcoal particles tended to keep the slimy particles separated from each other as they were deposited on the filter paper or cloth. Some years later it was found that some of the diatom deposits in this country, due to their irregular shape, cellular construction and chemical inertness, proved to be remarkable filter aids. Once this discovery was made, the grading and purifying of these diatomaceous earths progressed rapidly so that today they are the finest and most efficient filter aids that we have.

Theory of the filter aid

We can see from this that fundamentally the theory and use of filter aid is quite simple. The cellular, irregular particles of filter aid simply keep the jell-like particles in the varnishes separated as these particles are deposited on the filter paper, thereby keeping the filter area porous, and permitting the varnish to flow through much longer and at far less pressure. As these irregular shaped, cellular diatoms are dispersed in the liquid being filtered, the j ell particles in the liquid become attached to them so that when the diatoms are trapped on the filter paper they also trap the jell particles. For this reason and the fact that the diatoms are porous themselves and thus permit liquid to actually pass through their structure, diatomaceous earth also acts as an efficient clarifying agent' as well as an anti-clogging agent.

Basic facts on filtration of varnishes

To take full advantage of the benefits of these filter aids, however, some rather basic facts should be kept in mind, especially in the filtration of varnishes. Although these diatomite cells are quite strong structurally, it should be remembered, that they can be broken down and compacted either through velocity or pressure, or a combination of both. Good filter practice indicates, therefore, that the velocity and pressure should be kept relatively low.

It is always a strong temptation for the filter operator at the beginning of a cycle, when the filter is clean, the pressure low, and the varnish flowing fully and brilliantly, to "give her the gun." This, however, frequently does not produce the maximum results or throughput. The reason being that if the mixture of filter aid and slim particles strike the filter bed with too high a velocity, it tends to impact them too lightly, resulting in decreased cake porosity and decreased ultimate throughput. Experience indicates that most varnishes are filtered to best advantage at a maximum rate of 40 to 50 gph per square foot. Of course, where it is a problem of merely removing coarse skins, scale particles, etc., this rate can be increased considerably y.

Again, in filtering with diatomaceous filter aid, we can defeat our purpose quite easily with too much pressure because excessive pressure may break down the very filter aid cells that we have introduced to keep the filter bed porous. Here again it is quite a temptation for the operator to conclude that the remedy for a slowing up of flow rate is more and more pressure, whereas the remedy usually is more filter aid or occasionally a coarser filter aid.

Amount of filter aid

From the foregoing outline of the use of diatomaceous filter aid, it becomes obvious that the amount of filter aid that we use is of vital importance. If the porous diatoms are to keep the slim particles separated, there should naturally be enough diatoms to do the job or they'll get "snowed under." The proper amount for varnishes can vary by weight from 1/10 of 1 % for a fairly clear and light bodied alkyd to 1 % by weight for very dirty natural gum varnish or gloss oil. Most varnishes are filtered very successfully with ¼ to 1/2 of 1 % by weight of diatomaceous filter aid. The filtration engineer usually can work these formulas out for the particular product with but a few trial runs.

It is not sufficient, however, to merely have filter aid in adequate quantity. It is just as important that it be properly dispersed. Here, the fact that varnishes are usually made and filtered batch wise is advantageous because the best dispersion is always obtained - especially with a viscous liquid - by introducing the indicated amount of filter aid into the liquid and then thoroughly mixing it by means of mechanical agitation. Proper agitation is extremely important. Frequently it is not convenient, or it may even require a substantial expenditure, to rebuild a plant to obtain good agitation, but in the long run it is bound to payout. This decision is, of course, nothing more or less than the familiar decision that management is called on to make so frequently today-namely to engineer the job right from the start and make the necessary plant investment once and for all, or to keep spending good dollars year in and year out on makeshift plant and methods.

Temperature considerations

In dealing with viscous liquid the temperature of the liquid and grade (for size) of the filter aid naturally are important factors. It would appear that, within limits, the higher the temperature and the coarser the filter aid the better. We find, however, that this theory is subject to some serious limitations. Even with present day scientifically controlled cookers and refined raw materials, we can still find many varnishes that contain jell particles and microscopic colloidal suspensions. If these varnishes are filtered at too high a temperature, say around 2500 F., these fish eyes may be in solution, pass through the filter bed and coagulate, after filtering, as the temperature drops. If these elusive fish eyes are a source of trouble, filtering at a lo,,~ temperature - around 1500F .should be tried. Again, there are many hazy materials, particularly some synthetics that cannot be cleared up with the coarsest grades of filter aid, and here a medium grade is indicated.

A varnish maker of many years experience recently told me of a quick and simple method of detecting these jell particles in filtered varnish samples. Since this is not always so easy to do, because these particles are transparent, it may be of value to mention it here. He fills a standard Gardner-Holt bubble tube with the varnish, then pours off about 2/3 of the contents, and when the remainder has cooled off, the tube is tilted and if jell particles are present they are visible on the walls of the tube.

Filtering "un-cooked" materials

Up to now we have considered the clear cooked materials only. Spirit varnishes, or cold cuts, shellacs and pigmented materials require altogether different handling. Spirit varnishes usually contain such a large amount of solids and have to be filtered at such a low temperature due to the volatile thinners that an altogether different approach is indicated. These materials frequently are first settled, and then decanted off and filtered. As a rule, a very coarse filter aid and a filter with a large amount of area rather than cake space, such as a plate and frame, is preferred. The clarification of these materials naturally is always more troublesome and costly than it is with the cooked variety. Shellacs, due to the coarse solids that usually are to be removed, are best filtered through a fairly porous filter paper, and without filter aid. Here, flow rates up to 75 to 100 gph per square foot can be obtained.

Centrifugal clarifiers

We have treated the whole subject of clarification so far from a standpoint of static filters rather than centrifugal clarifiers. To make this article complete we should mention both methods. With the centrifugal clarifier it is not necessary to use filter aid or a filter paper or filter cloth. In some cases a centrifugal may be cleaned more easily than some types of filters. A filter will usually do a finer and sharper clarification of the more difficult to clean products in which the solids often have the same specific gravity as the liquid being filtered.

Pressure straining

Considerable work has been done in connection with the pressure straining of pigmented enamels and paints. The big problem here is to decide on the proper filter or strainer media for the particular job to be done. Up to the present, this has frequently been a trial and elimination process. However, certain types of synthetic, very porous paper and certain grades of felt that can be washed and re-used have proved very successful. Tremendous production increases have been made over the old type hag strainer tied over the outlet pipe, and a better and more uniform quality is being maintained. The choice of the filtering machine is important here-it should be easy to assemble and clean, and above all it should be so designed that any type of media that is indicated is readily interchangeable in the filter-be that felt, paper, doth or wire mesh.

In the filtering of varnishes and paints, it is always important to eliminate any unfiltered residue or heels at the end of a run. Usually this is accomplished by blowing the filter down with CO2 gas. If your filter is of proper design this can be done very successfully. This however, should never be done with compressed air because it represents a very dangerous explosion· and fire hazard. (Spontaneous combustion may be caused by friction of the air passing through the filter cake.) The paint and varnish industry has made many advances in the improvement of their products from a clarification viewpoint and may be justifiably proud of its accomplishment.