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# FILAMENT FILTER CONTAINING A HYGROSCOPIC COMPOUND

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This invention relates to filament filters, which filaments carry additives on their surface. More particularly, this invention concerns filament filters wherein the filaments carry on their surface a special bonding layer and a solid additive.

This application is a continuation-in-part of my earlier applications, Serial Nos. 413,950, now U.S. Patent No. 2,881,769, and 564,172, now U.S. Patent No. 2,940,456. In these earlier applications it has been pointed out that filament filters may be improved by adding certain solid additives thereto. However, in the industry there has been certain problems encountered when utilizing additives. One problem which has been encountered is that some of the additives tend to sift out of the filters. Such loss of additive reduces the efficiency of the filter.

As already mentioned, in many prior procedures of applying additives in a number of instances the additives are not very strongly bonded to the filament base to which the additive is applied. Consequently, if a filter containing additive is jarred or tapped or in many instances, even with conventional handling, the additive may tend to sift or dust off from the filter.

It is apparent, therefore, that the development of improved procedure for applying additives to filament filters represents a highly desirable result.

In accordance with the present invention it has now been found how additives may be more firmly bonded to filament filters in a relatively simple and economical manner.

This invention has for one object to supply an improved procedure for applying additives to filament filter material. Another object is to provide procedure whereby powdered additives may be more strangly bonded to such filaments. Still another object is to provide methods for preventing powdered additives from sifting out of filament filter materials. Still another object is to provide a method of the class indicated which is relatively economical and simple. Other objects will appear hereinafter.

As indicated above, a number of the prior art methods for applying additives such as where it is attempted to bond the additives to filaments by electrostatic forces have not, in a number of instances, caused the bonding of the additives to the filaments in a sufficiently strong manner to prevent sifting out. The sifting out of the additive is undesirable from the standpoint that it reduces the filter's effectiveness. Also, in the instance of a tobacco smoke filter if the additive sifts out into the smoker's mouth this may be objectionable.

In order to prevent the sifting out of additives, it has been proposed to apply more or less conventional adhesive to the surface of the filter base materials. While the addition of such adhesive serves to bond powdered additive onto the filaments there are a number of processing problems which arise in connection with the use of conventional type adhesive. The tacky nature of the adhesive causes the filaments to adhere to the fabricating machinery used to make filters. Also, adhesive may accumulate on the equipment thereby causing the repeated shut-down of the machines for cleaning purposes.

In accordance with the present invention, problems as aforesaid which have been encountered in the prior type operations are minimized or eliminated. In the broader



aspects this invention consists of adding a finely divided hygroscopic type powder along with the additive to the surface of the filaments which are to be used in making a filter. Preferably this hygroscopic powder is applied prior to or together with the application of the powdered additive. The choice of the particular hygroscopic powder to apply to the filaments is of some importance. The particular hygroscopic compounds which I prefer to use are ones which change to a liquid when stored under moderate or high relative humidity conditions. By moderate humidity is meant a relative humidity of for example from 45 to 65% R.H. As is apparent, high humidity means a humidity above moderate.

The hygroscopic powders which I have found particularly suitable for this purpose are preferably selected from one of the following type of water-soluble, non-toxic hydroxy-containing types of compounds: powdered glucose, powdered sucrose, powdered sorbitol, powdered α-methyl-D-glucoside.

The amount of the hygroscopic compound which should be blended with the powdered additive to prevent the additive from sifting out of the filament filter is between 10–60%. Preferably the blend should be between 25–50% of the hygroscopic compound and 75–50% of the additive. The particle size of both the hygroscopic material and the additive usually should be small enough to pass through a 200 or 300 mesh screen.

In effect, the addition of the hygroscopic compound to the filaments in accordance with the present invention for preventing the sifting out of the filter additive seems to be somewhat similar to the spraying of the filaments with a water base adhesive but without the disadvantages of using an adhesive. The present invention is particularly advantageous in that after the hygroscopic compound of the present invention is added to the filaments, it later becomes liquid and exhibits adhesive properties. This eliminates the various problems of spraying a liquid tacky adhesive directly onto the filaments during the processing of the filaments into a filter element.

In accordance with my preferred procedures, I spray a plasticizer onto the opened-up filaments before the filaments are dusted with a mixture of the hygroscopic compound and the powdered additive. However, the spraying of the filaments with a plasticizer is not an immediate requirement for preventing the additive from sifting out of the filter. Also, although I prefer the first spray on the plasticizer, the plasticizer application may take place after the dusting procedure.

There are a substantial number of powdered additives which can be bonded to filament filters by means of the hygroscopic powder of the present invention. The present invention is particularly useful for improving the bonding of the water-insoluble calcium and magnesium salts described in detail in parent application, now U.S. Patent No. 2,940,456. The various starch additives described in the other application referred to above may be used. Also there are a number of other additives such as powdered natural gums, hydrophilic cellulose derivatives exemplified by hydroxyethyl cellulose, carboxymethyl cellulose, sodium cellulose sulfate and the like. Additives such as powdered pectin and various calcium and aluminum stearate powders may be more effectively bonded by the present invention. Likewise a newer type of additive exemplified by cellulose triacetate powder may be more effectively bonded. Other powdered additives will be apparent to those skilled in the art.

For further understanding of my invention reference will be made to the following specific examples which are set forth for illustrating certain of my preferred embodiments.

## EXAMPLE I

A five-foot length of cellulose acetate tow containing 14,000 filaments of 5 denier per filament and having an average of 9 crimps per inch along its entire length, was spread out to a width of 12 inches. While in this spread-out condition the tow was sprayed on both sides with glycerol triacetate until 12% plasticizer (based on the total weight of the combination) had been added. After the spraying operation the spread-out tow was dusted on both sides with a fine powder consisting of a blend of 60% rice starch and 40% sorbitol. The dusted tow was then pulled back into a compact bundle or cord and fed into a cigarette filter plug making machine which paper wrapped it and cut it into filter rods 90 mm. in length and 25.5 mm. in circumference. Some of the rods were tapped against a metal plate while they were held in an upright position. This tapping procedure dislodged some of the powdered additive from the filters. Several other rods were stored for 12 hours at 25° C. and at a relative humidity of 80% to allow the sorbitol powder to liquefy. They were then allowed to dry at a relative humidity of 45% (25° C.). The powder did not sift out of these conditioned rods when they were tapped on the metal plate in an upright position. Upon examination of the fibers in the rods it was observed that the sorbitol powder had been converted to a tacky film which held the rice starch particles to the surface of the fibers.

The humidified and air-dried filter rods were cut into 15 mm. filter tips. Ten of these tips were attached to standard king size cigarettes (Brand A) which had been shortened by 15 mm. to compensate for the length of the filter. The filter cigarettes were then smoked to butt lengths of 35 mm. on an automatic smoking machine. The machine was similar in design and operation to the machine described by Bradford, et al., in Ind. Eng. Chem., 28, 836–839, 1936. The collected smoke which had passed through the cigarette was analyzed for nicotine and tar content. The results are shown on Table I.

Control filters containing 12% glycerol triacetate plasticizer but no powdered additive were prepared from the same crimped cellulose acetate tow in the manner described above. These filters were attached to 10 king size cigarettes (Brand A) shortened by 15 mm. The filtered cigarettes were also smoked to butt lengths of 35 mm. on the smoking machine. The collected smoke which passed through the cigarettes was analyzed for nicotine and tar content. The results are shown in Table 1.

*Table 1*

MILLIGRAMS OF NICOTINE AND TAR FROM SMOKING CIGARETTES CONTAINING CELLULOSE ACETATE FILTERS AND CELLULOSE ACETATE POWDERED ADDITIVE FILTERS

| | Av. Inches pressure drop | Mg. Tars from 10 cigarettes | Mg. Nicotine from 10 cigarettes |
|---|---|---|---|
| Cigarettes with filters consisting of 12% glycerol triacetate and 88% cellulose acetate | 3.9 | 130 | 25 |
| Cigarettes with filters consisting of 8.4% glycerol triacetate, 18% powdered rice starch, 12% sorbitol and 61.6% cellulose acetate | 4.1 | 100 | 20 |

Pressure drop expressed as inches of water at an air flow rate of 17.5 ml./second through the cigarette. The unfiltered cigarettes (Brand A) of full length had an average pressure drop of 3.2 inches.

These results show that the filters containing the powdered additive removed 25% more tar and 20% more nicotine than the control filters. The addition of the powder increased the pressure drop of the filter cigarette by only 5%.

## EXAMPLE II

A five-foot length of cellulose acetate tow containing 14,000 filaments of 5 denier per filament and having 9 crimps per inch along its entire length was spread out



to a width of 12 inches. While in this spread-out condition, the tow was sprayed on both sides with glycerol triacetate until 10% plasticizer had been added. After the spraying operation, the spread-out tow was dusted on both sides with a fine powder consisting of a blend of 65% calcium carbonate and 35% methyl glucoside. At the end of this operation the tow consisted of 63% cellulose acetate, 7% plasticizer, 19.5% calcium carbonate powder, and 10.5% methyl glucoside powder. It was converted into filter rods and 15 mm. tips from these rods were evaluated as a cigarette filter in the manner described in Example I. The results indicated that the fibers removed 24% more nicotine and 22% more tar than the control filters of Example I. When the filter rods were tapped some of the powder was removed. However, after a storage time of three days at 60% RH and 25° C. no traces of powder could be dislodged from the rods by tapping.

## EXAMPLE III

A five-foot length of cellulose acetate tow containing 14,000 filaments of 5 denier per filament and having 9 crimps per inch along its entire length was spread out to a width of 12 inches. While in this spread-out condition the tow was sprayed on both sides with glycerol triacetate until 10% plasticizer has been added. After the spraying operation, the spread-out tow was dusted on both sides with a fine powder consisting of a blend of 65% powdered cellulose and 35% powdered dextrose. Both powders were capable of passing through a 200-mesh screen. At the end of the dusting operation the tow consisted of 66.4% cellulose acetate, 7.4% plasticizer, 16.9% cellulose powder, and 9.3% dextrose powder. It was converted into filter rods and 15 mm. filter tips from these rods were evaluated as a cigarette filter in the manner described in Example I. The results indicated that the filters removed 26% more nicotine and 26% more tar than the control filters of Example I. It was observed that some of the cellulose and dextrose powder sifted out of the filter rods when they were tapped. However, after three days storage at 60% RH and 25° C. the powder was firmly bonded to the fibers in the filter. Examination of the filter rods after this conditioning period showed that the dextrose powder had melted to a liquid which strongly bonded the cellulose to the filaments. The powdered cellulose is a commercial product sold by Brown Corporation under the trade name "Solka-floc BW–200."

In my studies comprising several trials and tests using starches I have found that a type of starch obtained commercially from Corn Products Refining and sold under the trade name Dry-Flo is particularly suitable for use in my process. Such type of material is a starch derivative containing a small proportion of hydrophobic groups chemically bound to the starch granules. Due to the presence of these groups the powder is free flowing and is therefore highly suitable for a number of commercial dusting operations.

While in the above examples we have referred to the use of certain plasticizers exemplified by glycerol triacetate, various other plasticizers such as glycerol tripropionate, di-(methoxy ethyl)phthalate or methyl phthalyl ethyl glycolate may be used. Likewise, while we have referred in the above examples to the use of calcium carbonate, starch and the like as additives, as already pointed out earlier in the present specification, various other additives may be more strongly bonded to filaments by the present invention. In general, the powdered additive would be of a mesh size within the range of 100–300 mesh. In general, between 10–60% by weight of the additive based on the total weight of the filter may be firmly incorporated into the filter by the process of the present invention.

It is believed apparent from the foregoing description it may be seen that the present invention provides a rela-

tively simple and economical way of improving the bonding of powdered additives to filament filters. By combining hygroscopic powder and additive in one dusting operation, this operation can be carried out in a single booth without the necessity of installing added equipment. As apparent from the foregoing description the resultant tobacco smoke filter obtained from utilizing filaments treated in accordance with the present invention exhibits improved removal of nicotine and tars from the main smoke stream and otherwise is advantageous.

I claim:

1. A tobacco smoke filter comprised of a bundle of continuous, longitudinally aligned filaments in which substantially all of the filaments extend through the full length of the filter from end to end, said filaments being essentially comprised of cellulose acetate and a plasticizer therefor, said filaments carrying on their surface a powdered additive and more than 10% of a finely divided hygroscopic compound from the group consisting of sorbitol and methyl glucoside, said hygroscopic compound being in a form that it will liquefy to some extent under humidity conditions of the order of 80% relative humidity and thereby function to more firmly bond the powdered additive to the filaments.

2. A tobacco smoke filter comprised of a bundle of continuous, longitudinally aligned filaments in which substantially all of the filaments extend through the full length of the filter from end to end, said filaments being essentially comprised of cellulose acetate and a plasticizer therefor, said filaments carrying on their surface 10–60% by weight of a powdered additive and said filaments carrying more than 10% of a hygroscopic compound in a sufficiently finely divided condition that said compound will at least partially liquefy under humidity conditions of the order of 80% relative humidity and the hygroscopic compound thereby functions to more firmly bond the powdered additives to the filaments.

3. As a new article of manufacture for use in the manufacture of tobacco smoke filters, a bundle of filaments of at least 50,000 total denier, said filaments carrying on their surface more than 10% by weight of the filaments of a powdered hygroscopic compound from the group consisting of sorbitol and methyl glucoside, said hygroscopic compound being in a form that it will liquefy to some extent under humidity conditions of the order of 80% relative humidity.

4. As a new article of manufacture a tobacco smoke filter comprised of a bundle of continuous, crimped synthetic filaments, said filaments being plasticized, the filaments carrying on their surface a mixture of two powdered starches wherein one of the starches is sufficiently finely divided and otherwise possess properties which assist in causing the other starch to be more firmly bonded to the filaments, said filament material thus carrying the starch mixture being formed into wrapped elements suitable for filter use.

5. A process of manufacturing a tobacco smoke filter comprised of filaments which carry an additive on their surface which comprises opening up said filaments, applying plasticizer to the opened up filaments and then applying to the filaments a powdered additive and a finely divided hygroscopic compound which compound has the properties and is in a form that it will liquefy to some extent under humidity conditions of the order of 80% relative humidity and thereby function to more firmly bond the powdered additive to the filaments, forming the filaments which have been thus treated with powdered additive and hygroscopic compound into a rod-like member and wrapping the rod-like member.

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