United States Patent

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[54] **CIGARETTE FILTERS**
6 Claims, No Drawings

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ABSTRACT: The invention concerns an improved filter for tobacco smoke comprising a tobacco-smoke filtering material supporting an addition of zinc acetate in conjunction with an addition of an organic or inorganic base capable of keeping the surface of the said filtering material substantially alkaline during filtration the base utilized is selected from the group consisting of polyethylineimine, triethanolamine, sodium acetate and borax.

CIGARETTE FILTERS

This invention concerns improvements relating to filters for tobacco smoke. Tobacco smoke consists of a particulate phase which comprises largely the less volatile constituents of the smoke in solid or liquid form and a vapor phase which comprises the more volatile constituents as vapors of gases mixed with the so-called permanent gases.

Many forms of filter for tobacco smoke consist, for example, of fibrous, filamentary or sheet material capable of removing the particulate phase by mechanical means. Commonly, additional materials are incorporated into such filters to improve their effectiveness by removing a proportion of the vapor phase, or specific substances therefrom. Such materials are usually substances which can remove the less pleasant constituents which are present in the tobacco smoke and have an adverse effect on the taste of the filtered smoke. Of these less pleasant constituents of tobacco smoke, the presence of hydrogen sulfide and hydrogen cyanide and the more volatile phenolic compounds may be undesirable.

An object of the present invention is to provide means whereby substantial quantities of hydrogen sulfide, as well as of hydrogen cyanide, can be removed, together with considerable amounts of steam-volatile phenols, from the smoke of burning tobacco.

According to the invention, a filter for tobacco smoke comprises a tobacco-smoke filtering material, suitably a fibrous, filamentary or sheet tobacco-smoke filtering material, supporting an addition of zinc acetate in conjunction with an addition of an organic or inorganic base, such for instance as polyethyleneimine, triethanolamine, sodium acetate or carbonate or borax, which is capable of keeping the surface of the said filtering material substantially alkaline during filtration, i.e. throughout the combustion period of the tobacco.

The tobacco smoke filter is made by treating a tobacco-smoke filtering material with an addition of zinc acetate in conjunction with an addition of an organic or inorganic base, the said additions remaining supported on the said material as zinc acetate and the said base respectively.

The zinc acetate and the base may be added, together or separately, to the said filtering support material in liquid form as a solution or solutions or suspensions by spraying, dipping, or roller-coating followed by drying under ambient conditions, or by freezing and vacuum sublimation. Alternatively they may be added, together or separately, in the form of powdered solids by dusting. Or a combination of the above procedures may be employed. The amounts of the components added may be up to 50 percent by weight of each component, referred to the original weight of the said filtering material. Suitably between 1 percent and 20 percent of each component is added. Generally not more than 6 percent of the base will be required.

Examples of ways of carrying the invention into effect will now be described:

EXAMPLE I

A solution of polyethyleneimine containing zinc acetate was prepared comprising 24 gm. of polyethyleneimine and 60 gm. of zinc acetate dihydrate in 6 litres of water. This solution was sprayed on to a continuous strip of paper, suitable for use as tobacco-smoke filtering material, of the kind well known as "Myria" paper. The paper was then allowed to dry in ambient conditions. On analysis, the treated paper showed a concentration of 2 percent by weight of polyethyleneimine and 5 percent by weight of zinc acetate, calculated as anhydrous zinc acetate, referred to the original weight of the paper.

EXAMPLE II

A solution was prepared comprising 24 gm. of polyethyleneimine and 120 gm. of zinc acetate dihydrate in 6 litres of water. This solution was sprayed on to a strip of paper as described in Example I. On analysis, the treated paper showed a concentration of 2 percent by weight of polyethyleneimine and 10 percent by weight of zinc acetate, calculated as in example I.

EXAMPLE III

A solution was prepared comprising 60 gm. of polyethyleneimine and 60 gm. of zinc acetate dihydrate in 6 litres of water. After spraying on to paper, drying and analysis as described in example I, the treated paper showed a concentration of 5 percent by weight of polyethyleneimine and 5 percent of zinc acetate.

EXAMPLE IV

A solution was prepared comprising 60 gm. polyethyleneimine and 120 gm. zinc acetate dihydrate in 6 litres of water. After spraying onto paper, drying and analysis as described in Example I, the treated paper showed a concentration of 5 percent by weight of polyethyleneimine and 10 percent of zinc acetate.

From the treated paper produced by each of the above Examples, a continuous filter rod of cigarette diameter was prepared. Filter tips of 15 mm. length were cut from each continuous rod and were attached to cigarettes. These cigarettes were smoked mechanically using a smoking engine which drew one puff per minute of 2 seconds duration with a puff volume of 35 ml.

The proportions of steam-volatile phenols, hydrogen cyanide and hydrogen sulfide removed from the smoke were determined in respect of each example. The results obtained are shown in table 1 .

TABLE 1

Ex.	Additive on filter, percent by weight: Zinc acetate	Additive on filter, percent by weight: Polyethyleneimine	Pressure drop of 15 mm. length of filter [1]	Smoke component removed, percent: Steam volatile phenols	Smoke component removed, percent: Hydrogen cyanide	Smoke component removed, percent: Hydrogen sulphide
I	5	2	3.4	44	58	59
II	10	2	3.4	51	60	71
III	5	5	3.4	52	74	71
IV	10	5	3.4	46	74	91

[1] Cm. water gauge at 1,050 cc. per min. airflow.

EXAMPLE V

Filter-tip sections of 15 mm. length were cut from filter rods consisting of cellulose acetate filaments of filament denier 5 and total denier 72,000. To each tip was added 0.25 ml. of a solution consisting of 1.12 gm. polyethyleneimine and 2.0 gm. of zinc acetate dihydrate in 100 ml. water. The treated tips were allowed to stand for 15 minutes and then frozen in a refrigerator. When thoroughly frozen, they were transferred to a pressure-resistant vessel and dried by vacuum sublimation at a pressure of 0.005 torr. Analysis of the dried tips showed that each contained 2 percent by weight of polyethyleneimine and 3 percent by weight of zinc acetate, again calculated as anhydrous zinc acetate, referred to the original weight of the tip.

EXAMPLE VI

Filter tips were prepared as in Example V except that the solution used to treat the tips consisted of 1.12 gm. polyethyleneimine and 5.0 gm. of zinc acetate dihydrate in 100 ml. water. On analysis these tips were found to contain 2 percent of polyethyleneimine and 7.5 percent zinc acetate.

EXAMPLE VII

Filter tips were prepared as in Example V, except that the solution consisted of 2,8 gm. of polyethyleneimine and 2.0 gm. of zinc acetate dihydrate in 100 ml. of water. On analysis, the tips were found to contain 5 percent of polyethyleneimine and 3 percent of zinc acetate.

EXAMPLE VIII

Filter tips were prepared as in Example V, except that the solution consisted of 2.8 gm. of polyethyleneimine and 5.0 gm. of zinc acetate dihydrate in 100 ml. water. On analysis, the tips were found to contain 5 percent of polyethyleneimine and 7.5 percent of zinc acetate.

The treated tips obtained from each of Example V to VIII were then allowed to stand for 48 hours in a conditioning chamber maintained at 70° F. and 60 percent relative humidity. On removal from the chamber, the tips were attached to cigarettes and smoked as described in Example I. The proportions of steam-volatile phenols, hydrogen cyanide and hydrogen sulfide were determined and the results obtained are shown in table 2.

TABLE 2

Ex.	Additive on filter, percent by weight: Zinc acetate	Additive on filter, percent by weight: Polyethyleneimine	Pressure drop of 15 mm. length of filter [1]	Smoke component removed, percent: Steam volatile phenols	Smoke component removed, percent: Hydrogen cyanide	Smoke component removed, percent: Hydrogen sulphide
V	3	2	6.1	46	85	47
VI	7.5	2	6.1	52	85	63
VII	3	5	6.1	56	72	65
VIII	7.5	5	6.1	50	69	77

[1] Cm. water gauge at 1,050 cc. per min. airflow.

EXAMPLE IX

A solution of sodium acetate containing zinc acetate was prepared comprising 1.04 gm. of sodium acetate trihydrate and 1.26 gm. zinc acetate dihydrate in 100 ml. water. Strips of tobacco smoke-filtering paper weighing 0.83 gm. were sprayed with 4 ml. of the mixture and dried in ambient conditions. Analysis showed that each strip contained 5 percent of sodium acetate trihydrate and 5 percent of zinc acetate.

EXAMPLE X

Filter tips were prepared as in Example IX using a solution of borax (sodium borate decahydrate) containing zinc acetate comprising 1.04 gm. borax and 1.26 gm. zinc acetate dihydrate in 100 ml. water. Analysis showed that each tip contained 5 percent of borax and 5 percent of zinc acetate.

EXAMPLE XI

Filter tips were prepared as in Example IX using a solution of triethanolamine containing zinc acetate comprising 1.04 gm. of triethanolamine and 1.26 gm. of zinc acetate dihydrate in 100 ml. of water. Analysis showed that each tip contained 5 percent of triethanolamine and 5 percent of zinc acetate.

The treated strips obtained from each of the Examples IX to XI were formed into filter tips of 15 mm. length, attached to cigarettes and smoked as described in Example I. The proportions of steam-volatile phenols, hydrogen cyanide and hydrogen sulfide removed from the smoke were determined and the results are shown in table 3.

TABLE 3

Ex.	Additive on filter, 5% of each by weight	Pressure drop of 15 mm. length of filter [1]	Smoke component removed, percent: Steam volatile phenols	Smoke component removed, percent: Hydrogen cyanide	Smoke component removed, percent: Hydrogen sulphide
IX	Zinc acetate--- Sodium acetate---	3.6	44	60	82
X	do--- Borax---	3.6	45	60	74
XI	do--- Triethanolamine--	3.6	48	57	62

[1] Cm. water gauge at 1,050 cc. per min. airflow.

No detrimental effect upon the smoke was observed as a result of the treatment of the filter material in accordance with any of the examples.

It will be seen that the combination of the basic materials with zinc acetate achieves the removal of very substantial quantities of hydrogen sulfide, as well as of hydrogen cyanide, while a considerable proportion of steam-volatile phenols is also removed. Zinc acetate alone can remove hydrogen sulfide and hydrogen cyanide, and polyethyleneimine alone can remove hydrogen cyanide and phenols, but in each case quite high levels of the individual additions are required to achieve adequate removal. The combination of basic material and zinc acetate produces at least similar, and generally higher, removal of all three components and variations of the extent of removal of hydrogen sulfide in conjunction with high removal of hydrogen cyanide and considerable removal of phenols can be effected. Whereas quite a low proportion of zinc acetate, say 3 percent, will effect a high removal of hydrogen cyanide, which then remains substantially unaffected by increase in the said proportion, in the case of hydrogen sulfide the removal increases with the proportions of both the zinc acetate and the basic material. It is considered possible that the effectiveness of the combination of the basic material with the zinc acetate may be due to the basic material stabilizing the reaction products by providing an alkaline environment.

We claim:

1. A filter for tobacco smoke comprising a support of fibrous, filamentary or sheet filtering material which carries a filtering addition material of zinc acetate in conjunction with a base which operates to maintain the surface of said filtering material alkaline during filtration, sad base being selected from the group consisting of polyethyleneimine, triethanolamine, sodium acetate and borax, the zinc acetate and base (alkaline) material addition each amounting to between about 1 and 20 percent of the original weight of the filtering material.

2. A filter according to claim 1, wherein the base comprises polyethyleneimine.

3. A filter according to claim 1, wherein the base comprises triethanolamine.

4. A filter according to claim 1, wherein the base comprises sodium acetate.

5. A filter according to claim 1, wherein the base comprises borax.

6. A filter according to claim 1, wherein the addition of the base amounts to between 2 and 6 percent referred to the original weight of the said filtering material.