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METHOD OF PRODUCING FILTER CORES

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The present invention is concerned with improvements in or relating to cigarette filters and has for its object to provide a relatively inexpensive method of producing a filter core which is of light weight in relation to its volume.

The method according to this invention comprises the steps of extruding through a plurality of die orifices a mass of thermoplastic material containing a thermally labile blowing agent to produce a plurality of filaments having small bubbles formed therein by the thermally labile blowing agent and, while the filaments are still in a soft condition, first permitting the bubbles to expand so as to form irregular enlargements of the cross-section of the filaments at intervals along their lengths and then gathering the filaments together to form a filter rod in which enlarged parts of adjoining filaments adhere together at intervals along the lengths of the said filaments.

All the filaments will normally be gathered together in one stage to form a cylindrical filter rod, but alternatively the filaments may be formed into a coherent tape which is subsequently gathered and bundled to form the required filter rod.

After the filaments have been caused to adhere together, either in the form of a filter rod or in the form of a tape, the rod or tape may be subjected to cooling, e.g. water cooling, in order to cause the material of the inter-adhering filaments to act. If necessary, the setting of the material, after it has been formed into a rod or tape, may be accelerated by water cooling.

The filter rod so formed may be subsequently wrapped in known manner with paper and cut to length to form filter plugs.

The filtering action obtained with such a filter plug is due to the irregular surfaces of the filaments presenting points of impact to the passage of smoke upon which dispersed materials, both liquid and solids, are deposited.

One outstanding advantage of the filter cores according to the invention is their considerably enhanced efficiency weight-for-weight as compared with filter cores produced from conventional filaments. This means that for a given filtering effect in a cigarette a much smaller weight of filter medium is required. Apart from considerations of economy, this is a valuable feature in countries where duty is charged on the total weight of cigarettes inclusive of any filter.

It has been found that polyolefines, such as polyethylene, are particularly well suited to the purposes of the present invention and highly satisfactory results can be obtained with these resins. It is also convenient that polyethylene chips containing a thermally labile blowing agent is at the present time a readily available article of commerce which can be directly used as a starting material for the production of filter cores according to the invention.

It has been found that the pressure required to extrude synthetic materials incorporating a blowing agent is much lower than that required to extrude like thermoplastic

materials incorporating no blowing agent. Consequently, the die plate need have only a correspondingly small thickness, with the result that the cost of drilling the orifices therein is substantially reduced. Further, the power required to extrude the filaments is substantially reduced.

The size of the irregular enlargements of the filaments is dependent mainly on the rate of extrusion of the material, the temperature of the filaments at the extrusion orifices, the take off rate and the amount of blowing agent incorporated in the filaments. It will be appreciated that, if the extruded filaments are unduly stretched, the irregular enlargements will tend to become reduced in size.

The adhesion between enlargements on adjoining filaments may be improved by extruding the filaments through closely spaced apertures.

Two examples of the production of filter cores according to the invention will now be described:

Example 1

A quantity of polyethylene chips containing a blowing agent, as sold commercially for the production of foamed polyethylene, is extruded in a screw extrusion press at a temperature of 200° C. through a die plate having 150 orifices each of 0.38 mm. diameter, the pressure behind the die plate being between 300 and 40 lbs./sq. inch. The extruded material is in the form of filaments containing a large number of small bubbles having a maximum dimension small in relation to the diameter of the filaments. These bubbles are then allowed to expand, the material of the filaments still being hot, so that each filament acquires a large number of irregular enlargements. These enlargements are formed by discontinuous bubbles of irregular shape. The inflated filaments, while still hot and soft, are led on to a moving conveyor band of flexible material which is then passed through a tubular guide, thus gathering the filaments into a coherent rod. The rod is then wrapped with paper on a conventional machine and cut into lengths to form filter plugs.

A filter rod produced by this method has the following properties:

Filament density	0.6 g./cc.
Filament denier	725.
Dimensions of filter rod	66 mm. x 7.5 mm.
Pressure drop across length of rod	2.5 cm. water gauge (at a flow rate of 17.5 cc./sec.).

Example 2

The low density polyethylene containing a blowing agent is extruded through a die with 250 holes of 0.005 inch diameter, which would give a theoretical filament denier of 70. The material swells on emerging from the spinnerette and is thereafter stretched to reduce its diameter. Owing to the low strength of the bubble-containing filaments this stretching is kept to the minimum compatible with the denier required and for this reason the die orifice is much smaller than that used in conventional filament extrusion, where the orifice diameter may be 0.01 inch or larger (and only about 50 orifices are employed in the die plate). Bubbles form in the filaments and the filaments while still in a semi-molten state are brought together to form a rod whereupon the filaments adhere to each other at random points to form a coherent structure.

The following are the properties of a filter rod so produced as compared with a corresponding rod produced from unfoamed polyethylene:

	Conventional Low Density Polyethylene	Foamed Low Density Polyethylene
Filament density (g./cc.)	0.92	0.62
Filament denier	11.2	7.3
No. of filaments in rod	8,200	8,250
Total denier of rod (excluding paper)	92,000	60,000
Dimensions of rod (mm.)	90 x 25.0	90 x 25
Pressure drop (inches water gauge)	24.0	24.5
Weight of rod (grams)	1.065	0.720
Density of rod (g./cc.)	0.248	0.161

While the preferred starting material is polyethylene chips with a blowing agent incorporated in them, other synthetic materials incorporating a blowing agent may be used. In order that they should be capable of being extruded at a relatively low pressure and in order that the bubbles should be able to be formed without the need for incorporating an excessive quantity of the blowing agent, such materials, when molten, should not be highly viscous. In general, materials which are crystalline are to be preferred, because the filaments produced from them are strong, but strong filaments are not essential. In fact, filaments of materials, such as polyethylene already referred to, which are weaker than those normally used for textile materials can be used with advantage. Examples of synthetic materials which could be used instead of polyethylene include polyvinyl chloride and polystyrene.

Where it is desired to use a thermoplastic material which cannot be obtained commercially with a blowing agent already incorporated, it is possible to incorporate the latter by reducing the particle size of the thermoplastic material as far as practicable and blending the powdered blowing agent with it. In such a case NN'-dinitroso-NN'-dimethylterephthalamide may be used as a blowing agent.

What is claimed is:

1. A method of producing a filter core comprising the steps of:

heating and extruding a mass of thermoplastic material containing a thermally labile blowing agent through a plurality of die orifices to produce a plurality of filaments having small bubbles formed therein by the blowing agent;

maintaining said extruded filaments in a soft condition to permit said bubbles to expand in order to form irregular enlargements of said filaments along their lengths;

and subsequently while said filaments are still in a soft condition, compacting said filaments into rod form thereby causing said filaments to fuse together at points corresponding to said irregular enlargements.

2. A method according to claim **1**, wherein the irregularly enlarged filaments are first formed into a coherent tape which is subsequently gathered and bundled to form a rod.

3. A method according to claim **1**, wherein the thermoplastic material is a polyolefine.

4. A method according to claim **1**, wherein the thermoplastic material is blended with NN'-dinitroso-NN'-dimethylterephthalamide.

5. A method according to claim **1**, wherein the diameter of each die orifice is of the order of 0.005 inch (0.125 mm.)

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