Cigarette filter and method of its manufacturing

Technical field

The invention relates to the cigarette filter containing the microfibres and to the method of its manufacturing.

Background art

The function of cigarette filters is to catch the health harmful components of cigarette smoke, especially of organic substances being produced at imperfect burning of tobacco and cigarette paper. Filters are mostly made of filtration or more precisely of crepe papers or fibrous cables or systems in its essence of parallel yarns or threads, while all executions are made of microfibres from material with minimum impact to the „taste" of cigarette, which is e.g. cellulose acetate. At the same time it is necessary, that the material and structure of cable as well as the rest of other parts of filter does not cause distinct increase in pressure gradient between both ends of filter, which could have a decisive and negative influence from the point of view of the consumer.

The general tendency is to increase the efficiency of separation of health harmful components of cigarette smoke, thus reducing the health risks connected especially with active smoking. One possibility how to increase the efficiency of separation is a change of sorptive properties of cigarette filter which leads to a substantial change of its structure and to production of divided cigarette filters. These are the filters created by several sections of cellulose acetate cable or of filtration paper, between which there is positioned a sorptive element containing a substance having advantageous sorptive properties, e.g. the granulated activated carbon. Nevertheless thanks to this change in structure of cigarette filters these show relatively high pressure loss, and moreover the demands and costs for manufacturing of such cigarette filters increase.

From the WO 2005/009150, respectively from analogical US 2005/139223 there is known the cigarette filter formed exclusively from nanofibres. Such filter has a very high specific surface and out of this arising

very good sorptive and filtration properties. Nevertheless the disadvantage is its high price which prevents its usage in practice. Though the patent application describes a low pressure loss of cigarette filter, based on the knowledge of properties of nanofibres textiles it is not possible to agree with this argument, on the contrary it can be presumed, that the pressure loss of cigarette filter formed of nanofibres will be high. The WO 2005/009150 further describes the cigarette filter whose part is formed of nanofibres, namely a section of filter length or a section of filter diameter. Nevertheless these measures lower the above mentioned disadvantages partially only.

The objective of the invention is to eliminate disadvantages of the present state of the art and to form a cigarette filter with high sorptive and filtration properties, at the same time increasing the price as low as possible.

The principle of invention

The objective of the invention has been reached by a cigarette filter containing the microfibres according to the invention whose principle consists in that it contains from 0,5 to 10 % by weight of polymeric nanofibres, which are arranged between the microfibres, while according to the claim 2 it is advantageous if the nanofibres are arranged evenly among the microfibres within the whole volume of cigarette filter. The nanofibres arranged among the microfibres increase substantially the filter specific surface, at the same time due to their low ratio on the total weight of filter and arrangement of nanofibres among the microfibres they increase minimally the filter pressure loss.

The most advantageous content of nanofibres in cigarette filter is within the range of 0,5 to 3,0 % by weight.

The microfibres are arranged into linear or surface configurations, while the spaces being created among these configurations, or more precisely among the configurations containing the microfibres as the main component in the quantity of 90% at minimum, or more precisely among microfibres, are according to the claim 4 filled with linear or surface textile configurations formed of nanofibres. In other advantageous case the textile configurations formed of nanofibres are arranged directly on the surface of textile

configurations created by microfibres, while the characteristic dimension of textile configurations formed of nanofibres does not exceed 5 mm.

The advantage of joining the linear and surface configurations created by microfibres and nanofibres is, that the filtration material, already at relatively small content of nanofibres usually varying in units of percentage by weight, shows relatively high specific surface and at the same time thanks to a high content of microfibres it maintains nearly the same pressure gradient as the cigarette filters created exclusively by microfibres.

According to the claim 7 especially because of the manufacturing reasons, namely disjoining of production of nanofibre textile and the filter itself, it is advantageous if the textile configurations created by nanofibres are the shreds of surface nanofibre textile having dimensions up to 5 x 5 mm.

In one of the advantageous executions of cigarette filter according to the invention the nanofibres eventually the shreds of surface nanofibre textile are applied on the surface of a crepe paper containing microfibres in the quantity at least of 90 % by weight, which is after then rolled down into a shape of cylinder creating the cigarette filter.

In the advantageous execution of cigarette filter according to the claims 9 and 10 the nanofibres or the shreds of surface textile configuration formed of nanofibres are applied on the surface and/or inside of the surface or linear textile configuration formed of microfibres, out of which the body of cigarette filter is further produced, while the linear textile configuration formed of nanofibres is with advantage represented by a microfibrous cable, microfibrous thread or microfibrous yarn.

An advantageous manufacturing method of a cigarette filter according to the invention is a method, when the nanofibres or shreds of surface textile configuration formed of nanofibres are brought to the surface of the configuration designated for production of cigarette filter created at least by 90 % of microfibres, which are deposited on its surface or into its structure in the quantity from 0,5 to 10 % by weight, after then the configuration with nanofibres will be rolled down or otherwise formed into the shape of cylinder creating the cigarette filter.

At this method it is advantageous if the quantity of nanofibres is within the range from 0,5 to 3,0 % by weight.

Another advantageous method is depositing of nanofibres or shreds of surface nanofibrous textile on the surface of the crepe paper, which is after then rolled down through which the cigarette filter is created.

Another advantageous manufacturing method of a cigarette filter according to the invention is depositing of nanofibres or shreds of surface nanofibrous textile on the surface and/or in the volume of the surface textile configuration, which is consequently shaped into a cylinder creating the cigarette filter.

Another advantageous manufacturing method of a cigarette filter according to the invention is depositing of nanofibres or shreds of surface nanofibrous textile on the surface and/or into the volume of linear textile configuration.

Description of the drawing

Examples of embodiment of cigarette filter according to the invention are schematically shown in the attached drawings, where the Fig.1 shows a cigarette with filter, the Fig. 2 a longitudinal section through the cigarette filter of the microfibrous cable with nanofibres among microfibres, the Fig. 3 a longitudinal section through the cigarette filter made of microfibrous cable with shreds of nanofibrous textile among microfibres, the Fig. 4 a longitudinal section through the cigarette filter made of microfibrous threads or microfibrous yarns, among which there are nanofibres, the Fig. 5 a longitudinal section through the cigarette filter made of microfibrous threads or microfibrous yarns among which there are shreds of nanofibrous textile, the Fig. 6 shows a cigarette filter of crepe paper, the Fig. 7 a longitudinal section through the cigarette filter made of crepe paper containing the microfibres on whose surface there are nanofibres, and the Fig. 8 a longitudinal section through the cigarette filter made of crepe paper, among whose layers there are shreds of nanofibrous textile.

Examples of embodiment

At the cigarette 1 shown in the Fig. 1 the cigarette filter 2 is created by a tubular body whose one face is attached to the tobacco tubular section 3 of the cigarette, and the second face is free. From the background art it is known that the tubular body of cigarette filter is formed of fibrous cable or a system of fibrous cables with in its essence parallel fibres, eventually of a system in its essence of parallel threads or yarns while the fibres, yarns or threads are positioned parallel with the direction of fumes flow through the filter and they are created by fibres, whose diameter varies from 1 to 40 micrometers, and therefore hereinafter they will be referred to as microfibres 21. According to the invention among these microfibres 21 there are arranged nanofibres 22 in the quantity up to 10 % by weight. At the same time it is advantageous if the nanofibres 22 among the microfibres 21 are arranged evenly within the whole volume of the cigarette filter 2.

The cigarette filter 2 according to the above mentioned embodiment has a much more greater specific surface, thus also filtration and sorptive properties than it is at the classic cigarette filter, which is created by microfibres only, because for example the mixture, containing 99 percentage by weight of microfibres 21 having diameter of 20 micrometers and 1 percentage by weight of nanofibres 22 having diameter of 0,2 micrometer (200 nm), has a double specific surface than it is at usage of the microfibres 21 only, at the same time thanks to the possibility to regulate the size of poruses upon production of the filter 2, it enables to reach a relatively small pressure loss, which at usage of this material reaches the values less than 5% of the total pressure gradient.

Cigarette filters formed of mixture of microfibres and nanofibres that differ by proportion of individual components, their mutual arrangement and the production itself shall be described in the following text.

The cigarette filter 2 according to the Fig. 2 is formed of the microfibrous cable, at which among the microfibres 21 there are arranged nanofibres 22. In the not illustrated example of embodiment the microfibrous cable may be formed of a system of microfibrous cablets and the nanofibres 22 are arranged both among the microfibres 21 of individual cablets and among the cablets.

At production of the cigarette filter according to the above mentioned example of embodiment the microfibrous cable commonly used for production of cigarette filters in the rolled out status, that means in the shape of a ribbon, led by the continuously running equipment for production of nanofibres, e.g. by an electrostatic spinning device, in which it serves as the base material, on which the produced nanofibres are deposited, while the content of nanofibres in such created filtration material, which is after then in a known manner further processed to the cigarette filter, with advantage varies in the range from 0,5 to 3,0 percentage by weight.

The cigarette filter 2 according to the Fig. 3 is again formed of microfibrous cable, at which among microfibres 21 there are arranged shreds 23 of surface nanofibrous textile having dimensions up to 5 x 5 mm. In the not illustrated example of embodiment they may be formed even of linear nanofibrous textile material, when their maximum dimension varies up to 5 mm.

Upon production of the cigarette filter according to this example of embodiment to the microfibrous cable in the rolled out status there are brought, by means of airstream, the shreds 23 of surface nanofibrous textile which are caught between the microfibres 21 of the cable and for example due to the underpressure in the space behind the rolled out microfibrous cable the shreds 23 will get among the microfibres 21 inside the rolled out cable, which is after then in a common manner formed into the tubular shape and so it creates the cigarette filter according to the Fig. 3. The content of nanofibres 22 in the resultant cigarette filter varies in the range 0,2 – 2,5 percentage by weight.

In examples of embodiment according to the Fig. 4 and 5 the cigarette filter is formed of nanofibrous threads 24 or microfibrous yarns among which, at the embodiment according to the Fig. 4, there are arranged nanofibres 22 , and at the embodiment according to the Fig. 5, among the microfibrous threads 24 or yarns there are arranged the shreds 23 of surface nanofibrous textile.

Upon production of the cigarette filter according to the Fig. 4 the system of microfibrous threads 24 or yarns is straightened into a planar configuration in which the microfibrous threads 24 or yarns are to be found side by side, with advantage closely side by side, in one or in more layers. This planar

configuration is passing through the electrostatic spinning device, while it creates the base material on which the nanofibres 22 are deposited in a known manner. Consequently the system of microfibrous threads 24 or yarns with applied nanofibres 22 is processed in a known manner into a tubular shape and so it creates the cigarette filter.

Upon production of cigarette filter according to the Fig. 5 the system of microfibrous threads 24 or yarns is straightened into a planar configuration in which the microfibrous threads 24 or yarns are to be found side by side, with advantage closely side by side, in one or in more layers, after then the shreds 23 of surface nanofibrous textile having dimensions of up to 5 x 5 mm are brought to this planar configuration by an airstream. Consequently the system of microfibrous threads 24 or yarns with shreds 23 of nanofibres arranged among the microfibrous threads 24 or yarns will be processed in a known manner into the tubular shape and so it creates the cigarette filter 2.

In example of embodiment according to the Fig. 6, 7 and 8 the cigarette filter is formed of a crepe paper 25, which is at least of 90 % by weight composed of microfibres. At the embodiment according to the Fig. 7 on surface of a crepe paper 25 there are applied nanofibres 22, while they create a layer whose thickness may be variable or irregular. At the embodiment according to the Fig. 8, the shreds 23 of surface nanofibrous textile are applied on surface of a crepe paper. The content of nanofibres in both cases varies in the range 0,8 – 3,5 percentage by weight.

Upon production of cigarette filter according to the Fig. 7, the crepe paper 25 before being rolled down into a shape of cylinder brings the base material into an electrostatic spinning device where the nanofibres 22 are deposited on it in a known manner thus creating a layer. Consequently the crepe paper 25 with applied layer of nanofibres 22 will be rolled down into a shape of cylinder creating the cigarette filter 2.

Upon production of the cigarette filter according to the Fig. 8, on the crepe paper 25 in the rolled out status, the shreds 23 of surface nanofibrous textile having dimensions to 5 x 5 mm are brought by an airstream. Consequently the crepe paper 25 with shreds 23 will be rolled down in a known

manner into a shape of cylinder creating the cigarette filter 2.

The quantity of nanofibres 22, which the cigarette filter 2 according to the invention contains may be even higher than it is described in the given examples of embodiment, nevertheless with respect to economy of production of cigarette filters and cigarettes in general, the maximum quantity of polymeric nanofibres 22 in the cigarette filter 2 is from 0,5 to 10 % by weight. Lower quantity of nanofibres 22 than 0,5 % by weight brings only a small improvement of filtration and sorptive properties of the cigarette filter and quantity of nanofibres 22 greater than 10 % by weight increases the filter price considerably. In consideration of filtration and sorptive properties of the cigarette filter 2 and the price availability, the most advantageous content of nanofibres 22 in the cigarette filter 2 lies within the range from 0,5 to 3,0 percentage by weight.

The invention is not limited only to the described embodiments of cigarette filters and method of their manufacturing, but it contains also their combinations and further embodiments of cigarette filters which contain the mixture of microfibres and nanofibres, when the quantity of nanofibres in the mixture varies from 0,5 to 10 % by weight.

List of referential markings

1	cigarette
2	cigarette filter
21	microfibre
22	nanofibre
23	shred of surface nanofibrous textile
24	microfibrous thread
25	crepe paper
3	tobacco part of cigarette

CLAIMS

1. The cigarette filter containing the microfibres characterised by that it contains from 0,5 to 10 % by weight of polymeric nanofibres (22), which are arranged among the microfibres (21).

2. The cigarette filter according to the claim 1 characterised by that the nanofibres (22) among the microfibres (21) are arranged evenly within the whole volume of cigarette filter.

3. The cigarette filter according to the claim 1 or 2, characterised by that the content of nanofibres (22) in the cigarette filter (2) lies within the range 0,5 to 3,0 % by weight.

4. The cigarette filter according to any of the previous claims characterised by that the nanofibres (22) are arranged in the form of surface and/or linear textile configurations, which are positioned among microfibres (21), or among the configurations created by microfibres or configurations which contain the microfibres (21) as the main component in the quantity at least of 90 % by weight.

5. The cigarette filter according to the claim 4, characterised by that the nanofibres (22) and/or the textile configurations formed of nanofibres are positioned on surface of configurations created by the microfibres (21) or containing the microfibres (21).

6. The cigarette filter according to the claim 4 or 5, characterised by that the textile configurations created by nanofibres (22) are the surface and/or linear textile configurations having the typical dimension up to 5 mm.

7. The cigarette filter according to the claim 6, characterised by that the textile configurations formed of nanofibres (22) are the shreds (23) of surface nanofibrous textile having dimensions up to 5 x 5 mm.

8. The cigarette filter according to any of the previous claims characterised by that the nanofibres (22) or shreds of surface nanofibrous textile are applied onto the surface of a crepe paper (25) containing the microfibres in the quantity of at least 90 % by weight.

9. The cigarette filter according to any of the previous claims 1 to 7, characterised by that the nanofibres (22) or shreds (24) of surface nanofibrous textile are applied onto the surface and/or inside the surface textile configuration formed of microfibres (21), out of which the cigarette filter (2) is created.

10. The cigarette filter according to any of the previous claims characterised by that the nanofibres (22) or shreds (24) are applied onto the surface and/or inside the linear textile configuration formed of microfibres (21), out of which the cigarette filter (2) is created.

11. The cigarette filter according to the claim 10 characterised by that the linear textile configuration is the microfibrous cable.

12. The cigarette filter according to the claim 10 characterised by that the linear textile configuration is the microfibrous thread (24) or the microfibrous yarn.

13. The method of production of cigarette filter containing the microfibres characterised by that the nanofibres (22) or shreds (23) of surface nanofibrous textile are brought to the surface of a configuration designated for production of the cigarette filter (2) created at least of 90 % by weight of microfibres (21) and they are deposited onto the surface and/or into the volume of the configuration in a quantity from 0,5 to 10 % by weight.

14. The method according to the claim 13 characterised by that the quantity of nanofibres varies in the range from 0,5 to 3 % by weight.

15. The method according to the claim 13 or 14 characterised by that the configuration designated for production of the cigarette filter (2) is a crepe paper (25), to whose surface the nanofibres (22) or shreds (23) of surface nanofibrous textile are applied and which is after then rolled down into the shape of cylinder creating the cigarette filter (2).

16. The method according to the claim 13 or 14, characterised by that the configuration designated for production of the cigarette filter is a surface textile configuration formed of microfibres (21), while the nanofibres (22) or the shreds (23) of surface nanofibrous textile are being deposited onto the surface and/or

into the volume of the surface textile configuration, which is after then formed into the shape of cylinder creating the cigarette filter (2).

17. The method according to the claim 13 or 14, characterised by that the configuration designated for production of the cigarette filter is the linear textile configuraion formed of microfibres (21), while the nanofibres (22) or shreds (23) of surface nanofibrous textile are being deposited onto the surface and/or into the volume of the linear textile configuration.