A biodegradable cigarette filter has a filter tow surrounded by one or more wrapper layers. The filter tow is a mixture of hemp, a second fibrous material comprising cotton, paper, or a mixture of cotton and paper, and a thickening and bonding agent comprising flour or starch initially added to the mixture as a solution in water. The mixture of hemp and the second fibrous material in the filter tow act as a filtering matrix for the cigarette smoke when consumed by a user. In one example, two wrapper layers comprising a plug wrap and a tipping paper surround the filter tow. The filter tow or one or both wrapper layers, or both the tow and wrapper layers, may contain plantable seeds.
BIODEGRADABLE CIGARETTE FILTER AND METHODS FOR MAKING SAME

RELATED APPLICATION

[0001] The present application claims the benefit of co-pending U.S. Provisional Application No. 61/319,537, filed Mar. 31, 2010, the contents of which are incorporated herein by reference in their entirety.

FIELD OF THE INVENTION

[0002] The present invention relates generally to a biodegradable cigarette filter and more specifically, to a non-synthetic, natural cigarette filter which contains seeds.

BACKGROUND INFORMATION

[0003] Popular smoking articles have undergone significant development in the past 50 years with a recent increased awareness of limiting consumption of chemicals which can impede the emotional enjoyment of smoking cigarettes or other products. In addressing the desire for an enhanced smoking experience, much research and development has centered around the cigarette filter which currently primarily serves the purpose of filtering the smoke generated from burning tobacco. Typically, a filter has a filter tow made from plasticized cellulose acetate and can also include polyhydric alcohols, and the tow is wrapped with an inner and outer layer of cigarette paper. The inner layer is known as the plug wrap and the outer wrapping layer is known as the tipping paper. The description of cigarettes and the various components thereof are set forth in Tobacco Production, Chemistry and Technology, Davis et al. (Eds.) (1999). A cigarette is smoked by a consumer lighting one end and burning the tobacco rod end of the cigarette, opposite from the filter. The smoker then receives mainstream smoke into his mouth by drawing the tobacco smoke through the filter on the opposite end of the cigarette.


[0005] Granules of carbonaceous material can be incorporated into the filter via "dalmation" types of filter regions using the general types of techniques used for traditional dalmation filter manufacture. Prior art has included granules of carbonaceous material that is incorporated into "cavity" types of filter regions using known techniques for producing "cavity" filter manufacture. However, many techniques, well known in the art, are often rudimentary in that particulates or granules of carbonaceous material roughly inserted into the filter element as either a loose powder or a slurry, a process which is often inconsistent and inefficient.

[0006] In other areas of the art, cellulose acetate is known and widely used in cigarette filter material. However, such material is only biodegradable in certain chemical forms, such as in the acetic acid ester form of cellulose. In most forms the biodegradability of cellulose acetate remains relatively low. Further, the biodegradation character of cellulose acetate is most often dependent on the degree of substitution, or the number of acetyl groups per glucose unit of the cellulose acetate molecular structure. For example, if the degree of substitution of cellulose acetate is decreased, the biodegradation rate of cellulose acetate is increased.

[0007] Other inventions have attempted to address the problem of non-biodegradable materials in filter cigarettes. In some studies, investigators have sought to introduce microorganisms which act to accelerate the degradation process. For example, Japanese Patent Application KOKAI Publication No. 8-140654 discloses the method of coating the surface of the cellulose fiber such as wood pulp with a cellulose ester such as cellulose acetate. In such methods however, the biodegradation rate of the entire filter is determined by the biodegradation rate of the material that can be easily biodegraded and, thus, the biodegradation rate of the cellulose acetate itself is not increased.

[0008] U.S. Pat. No. 6,739,344 describes a biodegradable cellulose acetate filter, which purports to provide excellent biodegradability which includes a "biodegradation promoting agent". Specifically, the invention describes a cellulose acetate structure comprising at least one compound selected from the group consisting of a salt of an oxygen acid of phosphorus, an ester of an oxygen acid of phosphorus or a salt thereof, carboxylic acid and a salt thereof. Hence, the manufacturing process is extremely complicated and requires significant investment in set up and capital expenses. Further, such methods do not address the problem of introducing chemical contaminants such as non-biodegradable cellulose compounds and variants thereof into the environment.

[0009] U.S. Pat. No. 6,062,228 discloses biodegradable filter material and method for its manufacture. Specifically, the patent describes a biodegradable filter tow or filter material prepared from renewable raw materials for use as a tobacco filter element of cigarettes. Further, it describes a method of preparing such a filter wherein fibers, films or foams are prepared in an extrusion method from biopolymer based on thermoplastic starch. However, as discussed, such methods require an inordinate up front expense in manufacturing costs with methods of preparation often complex and require significant chemical intermediates for production. Moreover, such methods also do not address the issue of introduction of complex chemical compounds into the environment which leads to pollution.

[0010] As such, there exists a need for a filter element and methods for producing a more environmentally friendly cigarette filter to assist in decreasing pollution and litter from cigarette filters which currently employ use of chemicals and materials that are synthetic, non-biodegradable and harmful to smokers and the environment.

SUMMARY OF THE INVENTION

[0011] According to one embodiment, a biodegradable cigarette filter is provided which contains seeds and which comprises a filter tow with at least one layer of filter wrapper
The seeds may be located in the filter tow, in the wrapper paper, or both. The filter may have two separate wrapper layers, comprising an inner layer or plug wrap paper and an outer layer or tipping paper of filter wrapper paper. In one embodiment, the seeds are located in both the filter tow and one or both layers of filter wrapper paper surrounding the filter tow. The seeds allow germination of plants when the filter is discarded into a soil medium. The filter may comprise a mixture consisting of hemp, cotton or paper, and a bonding agent. In one embodiment, the filter utilizes a starch solution of flour and water which act as a thickening and bonding agent, while the mixture of hemp and cotton or paper acts as a filtering matrix for the cigarette smoke when consumed by a user. In one embodiment, one or both filter wrapper layers are of biodegradable non-acetate paper embedded with plantable seeds on the outer surface, inner surface, or both, or seeds may be located between the paper layers.

The cigarette filter is 100% biodegradable and non-synthetic, with no chemical additives. When discarded into a soil medium, the seeds embedded in the filter can grow to produce various plants, depending on which seeds are embedded. Seeds located within the filter tow break the filter apart, thus accelerating degradation from the inside. Seeds located within the filter tow can be of a larger diameter than those used within the inner and outer layers of filter wrapper paper, when seeds are located throughout the entire filter. Seeds located within one or both filter wrapper layers break the filter plug wrap and tipping paper apart which then releases the filter tow within, accelerating degradation from an outside in approach. Seeds located within the tipping paper and plug wrap are located outside of the smoke column. Types of seed located within or between the plug wrap and tipping paper layers include smaller diameter seeds or varieties that would be damaged by direct interaction with smoke, impede smoke draw through the filter, or alter smoke taste.

The cigarette filter is of a non-synthetic, bio-degradable material that decreases the global environmental impact of the carbon “footprint” of cigarettes, and may assist in providing germination of plants in the environment, further promoting carbon sequestration. This cigarette filter biodegrades at a faster rate and can help reduce the prevalent problem of litter created by known synthetic, non-biodegradable cigarette filters in the environment.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is perspective cross-sectional view of a cigarette including a first embodiment of a biodegradable cigarette filter;

FIG. 2 is a longitudinal cross-sectional view of the cigarette of FIG. 1 including the biodegradable cigarette filter; and

FIG. 3 is a cross-sectional view on the lines 3-3 of FIG. 2.

DETAILED DESCRIPTION OF THE INVENTION

Embodiments described herein provide a biodegradable filter for cigarettes that significantly decreases the amount of litter and pollution in the environment due to the brief period of time required for the filters to break down and decompose, as well a method of manufacture for producing the filters. Embodiments described herein further provide a filter that, when discarded, acts to germinate plants into the environment into which it is discarded.

After reading this description it will become apparent to one skilled in the art how to implement the invention in various alternative embodiments and alternative applications. However, although various embodiments of the present invention will be described herein, it is understood that these embodiments are presented by way of example only, and not limitation. As such, this detailed description of various alternative embodiments should not be construed to limit the scope or breadth of the present invention.

FIGS. 1 to 3 illustrate a cigarette 20 incorporating a first embodiment of a filter 10 at one end. The remainder of the cigarette contains cigarette tobacco 2 surrounded by an elongated cylindrical tube 1 of cigarette paper. The filter 10 is adhered to the remainder of the cigarette and comprises two parts, specifically an interior filter body or filter tow 3 of filter material and one or more outer wrapper layers 4. The filter material 3 includes a number of ingredients including a biodegradable and compostable combination of hemp, cotton and/or paper fibers bound together with a starch solution. In one embodiment, wrapper layers 4 comprise an inner wrapper layer or plug wrap 4A and an outer wrapper layer or tipping paper 4B. The paper is wrapped around the hemp/cotton material 3 and glued along the longitudinal seam 8 using any appropriate liquid starch adhesive. The filter has recessed ends 7.

As best illustrated in FIGS. 2 and 3, one or both outer wrapper layers 4 contain small diameter plantable seeds 6 in one embodiment of the filter. The seeds may be provided on the outer surface, the inner surface, or both, or may be located between the wrapper layers. Alternatively, the filter may have a single outer wrapper layer which optionally contains seeds. In the illustrated embodiment, the filter tow 3 also contains larger diameter plantable seeds 5 which are encased within the interior of the filter tow, as illustrated in FIGS. 1 to 3. Seeds 5 can be of any variety appropriate for containment in the filter. However, inclusion of seeds in the filter tow 3 is optional, and seeds 5 may be eliminated in alternative embodiments, with seeds 6 provided in one or both outer wrapper layers 4 only.

In one embodiment, the filter tow 3 comprises a mixture of hemp and a second fibrous material such as cotton or paper, and a binding agent. The ratio of the ingredients in the filter tow can be changed to accommodate less or more filtering of the cigarette smoke. As envisioned herein, a ratio of 25 to 75% hemp/75% to 25% cotton or paper fiber is used to prepare the filter tow. In one embodiment, a mixture of flour and water is used in the production process as a binding and thickening agent to provide pliability, as described in more detail below. The size and shape of the filter body or filter tow may be the same as a standard cigarette filter as to accommodate current cigarette specifications and existing manufacturing processes.

In one embodiment, the filter tow is produced from a mixture of de-gummed hemp with cotton or paper and flour and water as the binding and thickening agent. Any appropriate liquid starch as known in the art can be used in lieu of the flour and water mixture. In order to produce the filter, 25 to 75% de-gummed hemp is placed into a blending apparatus. Thereafter, 25 to 75% cotton or paper is added and blended with the hemp until the mixture of fibers appears to be uniform. In another embodiment, cotton or paper, or both cotton
and paper are mixed with the hemp. After blending, 0.25 to 2.5 teaspoons of flour is added to 1 to 4 cups of water and thoroughly mixed. After mixing, the hemp based mixture is immersed into the flour/water mixture.

[0024] Alternatively, a starch-based mixture may be employed in place of the flour/water mixture. To prepare the starch solution, a ratio of 0.1 to 1 cup cornstarch or cornstarch-like product is added to every 0.5 to 2 cups of water, followed by mixing. While continuing to mix the solution, 0.5 to 5 cups of 100 degrees Celsius or higher water is added. Other starch based mixtures as known in the art may be employed.

[0025] After soaking the hemp-based mixture, the water is removed. While the blended mixture is damp, seeds are added and the material is once again placed in a blending device or a device used in the production of non-woven fabrics, such as a hydro entangler, until the material is relatively uniform. After the material is blended with the addition of seeds, the material is removed and allowed to dry in a ventilated area. Seeds may also be added to the mixture during the drying process as needed. Without using a heat source, approximately 24-48 hours is allowed for complete drying depending on drying conditions and humidity. Alternatively, the blended filter material is set on an assembly line with a constant and uniform heat source, reducing the time to dry the mix. The steps are repeated to form a stack of sheets or a continuous roll of filter tow. The aforementioned process is adaptable to mass production scale and such processes are encompassed within the scope of the invention.

[0026] A simpler method of manufacture may be employed eliminating the process of blending the hemp based mixture before adding the starch solution. The specified ratio of hemp with cotton, paper, or both cotton and paper, along with a starch solution, is placed into a blending apparatus or a device used in the production of non-woven fabrics such as a hydro entangler and blended until mixture appears uniform. After the material is blended with the addition of seeds, the material is removed and allowed to dry in a ventilated area. Seeds may also be added to the mixture during the drying process as needed. Without using a heat source, approximately 24-48 hours is allowed for complete drying depending on drying conditions and humidity. Alternatively, the blended filter material is set on an assembly line with a constant and uniform heat source, reducing the time to dry the mix. The steps are repeated to form a stack of sheets or a continuous roll of filter tow. The aforementioned process is adaptable to mass production scale and such processes are encompassed within the scope of the invention.

[0027] In order to form the sheets or roll of filter tow into individual smoke filters, the dry hemp and cotton and/or paper blend filter tow, in sheets or continuous roll form, is compacted into or extruded through a cylinder shaped form or die to form a filter rod. The filter rods are then cut into individual filters which are each the length of a typical cigarette filter. Filter tipping paper or plug wrap is made of a biodegradable material such as, for example, wood pulp with the option of plantable seeds imbedded into the paper during the paper making process. The hemp-based filter tow is wrapped in the tipping paper and plug wrap and is recessed from both the mouth or smoking end and the opposite end, as seen in FIGS. 1 and 2. The tipping paper and plug wrap seams are glued using a liquid starch or other adhesive materials as are known in the art.

[0028] The outer tipping paper and plug wrap surrounding the filter tow are each comprised of a biodegradable non-acetate paper and act both to contain the filter tow and attach to the cigarette. Various seeds, including grass seeds, flower seeds and even fruit and vegetable seeds may be embedded into the filter tow as well as within the tipping paper/plug wrap. Alternatively, seeds may be provided only in the filter tow 3, in one or both of the wrapper layers 6, or between the wrapper layers.

[0029] Methods for producing paper embedded with plantable seeds are known in the art. Briefly, the paper is made by first placing wood shavings in a blending instrument and filling with heated water. The material is blended with increasing blending speed until the pulp appears smooth and uniform. A basin is filled with water with the pulp added therein. Seeds may be added to the solution and the contents of the basin are mixed. A mold is then utilized to remove the paper pulp from the water.

[0030] After removing the mold from the water, it is allowed to drain. Any noticeable air bubbles or rough edges are then smoothed out. The molded pulp is compressed and or heated to remove the remaining water. The process is repeated to form a stack of sheets or continuous roll of paper.

[0031] The filter tow is made into the shape of a standard cigarette filter. The tipping paper/plug wrap is wrapped around the filter tow to encapsulate the filter tow with both ends of the filter tow recessed from the respective ends of the paper wrapper and exposed at either end. One end is attached to the cigarette body 1, 2 and the other is used to intake smoke by the smoker. This filter performs the same function as a standard cigarette filter but lacks the chemical toxins used in the existing process and the unpleasant taste ordinarily produced by standard cigarette filters.

[0032] One embodiment for producing the filter in a larger scale manufacturing process is summarized by the following procedures, which may be varied to allow for lesser or greater filtering capacity. To begin, hemp fiber is mixed with cotton or paper fiber, or both, in a blending device until the fibers are uniformly mixed to form a hemp-based mixture. Flour is added to water in a ratio of one part flour to ten to forty parts water, followed by mixing to form a flour/water mixture. The hemp-based mixture is then immersed into the flour/water mixture, followed by removal of the water from the hemp-based mixture by wringing, spinning, ventilating, or heating.

[0033] The hemp-based mixture is combined with plantable seeds and then placed in a blending device or a device used in the production of non-woven fabrics, such as a hydroentangler, until the material is relatively uniform.

[0034] Following blending, the hemp-based mixture is removed and allowed to dry. The mixture is laid into molds for creating stacks of sheet filter tow, or onto a moving belt or production line to form large continuous rolls of filter tow. The sheet filter tow is extruded or drawn through a die to form an extradrate. The extradrate, then called a filter rod, is wrapped with one or two layers of a non-acetate paper to form a single filter element, which is cut to appropriate size.

[0035] The filter described above can be produced and configured to fit larger smoking devices such as cigars, hookah hoses, or any number of smoking devices as known in the art. The stand-alone filter tow may also be used in a roll-your-own cigarette device as a simple, bullet-shaped insert.

[0036] The term “flour” as used herein refers to either white or wheat flour as is known in the art. The term also includes
flour generated from sources other than wheat such as, for example, corn, soy or the like.

[0037] The term “starch” as used herein refers to a naturally abundant nutrient carbohydrate, \( (C_{6}H_{10}O_{5})_{n} \), found chiefly in the seeds, fruits, tubers, roots, and stem pith of plants, notably in corn, potatoes, wheat, and rice, and varying widely in appearance according to source but commonly prepared as a white amorphous tasteless powder.

[0038] The term “hemp” as used herein refers to soft, durable fiber that is cultivated from plants of the Cannabis genus, cultivated for industrial and commercial (non-drug) use. Examples of modern industrial use of hemp include production of paper, textiles, and biodegradable plastics, used in construction, health food, fuel and in the medical industry.

[0039] Advantages of the present invention over the known art include the ability to provide a cigarette filter that is biodegradable and hence, does not harm the environment. The invention also provides a method of manufacturing free of the complex and often harmful chemical components of standard cigarette filters. Further, the present invention capitalizes on the harmful impact of cigarette butt littering by providing the user a filter containing seeds that will grow in whatever location it is discarded.

[0040] Other advantages of the present invention relate to the prevalence of smoking and litter of used cigarette butts. Typically, a smoker discards the filter when the cigarette has been consumed. With the present invention, the used filter biodegrades and provides the environment with germinating seeds that, in appropriate conditions, will result in new plants and flowers. When the used filter is discarded into an organic environment, i.e. (dirt, grass, etc.) the combination of the biodegradable hemp and cotton combined with water from rain or sprinkler systems will facilitate the growth of the seeds into grass, flowers and any other type of plant.

[0041] Although the invention has been described with reference to the above example, it will be understood that modifications and variations are encompassed within the spirit and scope of the invention. Accordingly, the invention is limited only by the following claims.

1. A biodegradable cigarette filter, comprising:
   a first part comprising filter tow, the filter tow comprising a mixture of hemp, a second fibrous material, and a binding agent, the second fibrous material being selected from the group consisting of cotton, paper, or a mixture of cotton and paper;
   a second part comprising at least one wrapper layer of biodegradable non-acetate paper wrapped around the filter tow; and
   at least one of first and second parts including a plurality of embedded seeds.

2. The biodegradable cigarette filter of claim 1, wherein the binding agent comprises a starch material initially added to the mixture of hemp and second fibrous material as a starch solution.

3. The biodegradable cigarette filter of claim 1, wherein the binding agent comprises flour initially added to the mixture as a mixture of flour and water.

4. The biodegradable cigarette filter of claim 1, wherein seeds are embedded throughout the filter tow.

5. The biodegradable cigarette filter of claim 1, wherein seeds are embedded throughout the wrapper layer.

6. The biodegradable cigarette filter of claim 1, wherein seeds of a first size are embedded throughout the paper wrapper layer and seeds of a second, larger size are embedded throughout the filter tow.

7. The biodegradable cigarette filter of claim 1, wherein said second part comprises an inner wrapper layer and an outer wrapper layer, the inner wrapper layer comprising a plug wrap surrounding the filter tow and the outer wrapper layer comprising a tipping paper around the plug wrap.

8. The biodegradable cigarette filter of claim 7, wherein only one of the wrapper layers contains seeds.

9. The biodegradable filter of claim 8, wherein the tipping paper contains seeds.

10. The biodegradable filter of claim 8, wherein the plug wrap contains seeds.

11. The biodegradable filter of claim 7, wherein both wrapper layers contain seeds.

12. The biodegradable filter of claim 7, wherein seeds are located between the inner and outer wrapper layers.

13. The biodegradable filter of claim 7, wherein both the tipping paper and plug wrap are biodegradable non-acetate paper.

14. The biodegradable cigarette filter of claim 1, wherein the filter tow comprises approximately 25 to 75% hemp and approximately 25 to 75% of the second fibrous material.

15. The biodegradable cigarette filter of claim 14, wherein the ratio of hemp to the second fibrous material is varied to control the amount of filtering of cigarette smoke.

16. The biodegradable cigarette filter of claim 1, wherein said seeds comprise plantable seeds capable of germination.

17. A method for manufacturing a biodegradable filter comprising:
   a) mixing hemp with a second fibrous material comprising cotton, paper or both cotton and paper;
   b) immersing the mixture of hemp and a second fibrous material into a solution of a bonding and thickening agent in water;
   c) before or after the step of immersing the mixture into a solution of bonding and thickening agent in water, blending the mixture in a blending device until the fibers are at least substantially uniformly mixed;
   d) removing a major portion of the water from the mixture of hemp, the second fibrous material and the bonding and thickening agent;
   e) allowing the mixture to dry completely;
   f) extruding the mixture through a die to form a filter rod;
   g) wrapping the filter rod with at least one layer of non-acetate paper, and
   h) forming single filter elements by cutting to size.

18. The method of claim 17, wherein the solution of bonding and thickening agent is made prior to the immersing step by adding flour to water in a ratio of one part of flour to five to twenty parts of water and mixing to form a flour/water mixture, and the hemp-based mixture is immersed in the flour and water mixture.

19. The method of claim 17, wherein the step of immersing the mixture into a solution of a bonding and thickening agent in water comprises immersing the mixture into a starch solution.

20. The method of claim 17, wherein the hemp is 25 to 75% de-gummed hemp.

21. The method of claim 17, wherein the second fibrous material is 25 to 75% cotton or paper.
22. The method of claim 17, further comprising adding plantable seeds to the hemp-based mixture after the mixture is blended in step (c), and blending the hemp-based mixture with the seeds until the hemp-based mixture with seeds is relatively uniform.

23. The method of claim 17, wherein the at least one layer of non-acetate paper is embedded with plantable seeds.

24. The method of claim 24, wherein the plantable seeds are selected from the group consisting of grass seeds, flower seeds, herb seeds, fruit seeds, vegetable seeds, and other seeds with the ability to germinate.

25. The method of claim 17, wherein the step of wrapping the filter rod comprises wrapping with first and second layers of biodegradable non-acetate paper, the first layer comprising a plug wrap and the second layer comprising tipping paper.

26. The method of claim 25, wherein one of the layers contains embedded seeds.

27. The method of claim 25, wherein both layers contain embedded seeds.

28. The method of claim 25, further comprising placing plantable seeds between the two wrapping layers.