METHOD OF MAKING RECONSTITUTED TOBACCO


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4 Claims

ABSTRACT OF THE DISCLOSURE

A reconstituted tobacco product created from a slurry of tobacco particles in water having an equilibrium amount of dissolved air and thermogelling gum in which the slurry is uniformly heated throughout without adding a foaming agent or additional air or gas to sequentially liberate the said dissolved air prior to the gelling of the gum and thereafter micro-wave drying the same to a preselected moisture content.

The present invention is a continuation of co-pending application 627,581 filed Oct. 25, 1967, now abandoned, which itself was a division of S.N. 223,261 filed Sept. 12, 1962, now abandoned.

The present invention relates to reconstituted tobacco products, and particularly, to a method for manufacturing an improved self-sustaining smokable tobacco article from a mixture of particulated tobacco, including tobacco substituents, in admixture with an adhesive binder which together with the tobacco or substitute forms a matrix for the article. As used herein, the general term tobacco is intended to include both tobacco and/or tobacco substituents. Tobacco articles of this type are suitable for cigarettes, cigarettes or pipe cartridges, all of which require a controlled porosity for acceptable “draw” during smoking. Other tobacco articles such as chewing tobacco, which do not require this porosity but will tolerate it, may be made in a similar manner.

The formation of reconstituted tobacco products is of course not a new art. Products such as sheet tobacco have been successfully made for some time and the art has indicated more than one procedure for obtaining a porous expanded product. Attempts at creating foamed structure, however, have invariably been directed to pumping air or other gases into otherwise non-foamed tobacco slurries. Reference here is made to the German Pat. 382,633 and 354,134 in the name of Otto Hymen. Notwithstanding these attempts, the tobacco products obtained, did not have any more porosity or open cellular structure than other similar, but less worked, products.

A procedure for the formation of shaped tobacco articles wherein a smoking article is prepared from a tobacco slurry and subsequently dried to form a relatively rigid porous structure is described in the U.S. patent application of R. J. Moshy et al., Ser. No. 493,950, filed Aug. 20, 1965, now Pat. No. 3,404,691. That application involves the creation by whipping or heating of a foam and its stabilization subsequently in each of the successive steps, tobacco incorporation, forming and drying in order to obtain a product of the desired weight, bulk density and draw.

The present invention provides alternate means for the preparation of a shaped smoking article which does not involve foaming the tobacco slurry and wherein, in lieu thereof, the matrix for the tobacco article is formed or shaped merely by surface adhesion of tobacco particles to produce an integrated porous network in which the solid particles appear welded or sintered into a relatively rigid mass. In this regard the present method may be characterized as a “non-foaming” (i.e. process) as opposed to the whipping or foaming process of the aforementioned Moshy et al. application.

The method, as described herein, consists essentially in preparing a tobacco slurry containing tobacco suspended in a solution of a specific type of binding agent and dried under specified conditions. The system must be such that on drying the tobacco particles are contained in a discontinuous or porous structure or matrix of binder yielding a product with the desired draw, bulk density, taste, feel, etc.

We have determined that several factors are involved in the development of non-shrinking, porous structures. One factor is the dissolved air in the solvent, which plays a major role in the development of porosity. A second factor is the use of a selected water-soluble thermogelling gum. A third factor is the use of a form of energy which heats the structure uniformly throughout its mass, rather than with a gradient from the outside to the center which occurs with most forms of drying. A fourth factor relates to the viscosity of the mass at the time of drying.

In the practice of the present invention a slurry of tobacco particles is made in a volatile liquid, including thermogelling gum, the slurry being made to contain a quantity of dissolved air substantially reaching the equilibrium amount for the temperature of the slurry. The slurry is then dried by microwave energy providing uniform heating throughout the slurry mass. As the temperature of the slurry rises, only 2–3 degrees above its initial temperature, dissolved gases are uniformly liberated creating continuous channels through the mass. When the slurry temperature reaches the gum gelatinization point, the mass fixes itself into a rigid, stable matrix comprising a continuous open structure of wall or cell-like members surrounding the channels created by the liberated air. Then as the temperature of the now fixed matrix rises further the residual moisture is driven off, to a degree desired for the resultant product, without further modification of the fixed matrix structure and its channeling or porosity.

Thus it will be seen that the extra and un-natural steps of impressing by pressure, whipping or otherwise, a foam solvent structure into a basically non-foam mass, and the requirements for control of foam density during the foam slurry process are eliminated. The use of a non-foamed system permits less consideration to the type of casting, forming and extruding equipment employed, since the physical nature of the non-foamed slurry is less subject to damage. Weight and bulk density control is simplified by omission of an incorporated gas phase, i.e. only liquid and solid phase need be controlled. The need for foam stabilizers is eliminated. In short, the present system is simpler and more efficient than any previously known.

Among the specific objects of this invention is the objective of providing a cohesive but porous mass of particulate material and a method for making the same.

It is an object of this invention to provide a method of manufacturing a shaped integrated porous smoking article.

A further object of the invention resides in the provision of a shaped smoking article comprising an integrated porous structure in which the adhesive forming the matrix with the particulate solids preferably comprises at least in part a water-soluble thermogelling gum, i.e., a gum which is soluble in cold water but which becomes insoluble or gels at some elevated temperature.

Other objects and advantages of the invention will become apparent as the more detailed description of the invention progresses.
FIGS. 1 and 2 are photographs of tobacco products made in accordance with the present invention. The present invention should not be confused with any of the prior art teachings such as are found, for example in Frankenberg et al. (U.S. Pat. 2,592,553) and Rosenberg et al. (U.S. Pat. 3,042,552). While these patents use methylcellulose and ethylhydroxyethyl cellulose (both thermogelling gums) respectively in the preparation of the reconstituted tobacco sheet products they do not suggest the combination of steps critical to the formation of an open porous structure. Frankenberg uses the thermogelling methylcellulose interchangeable as adhesives for his tobacco sheets, but deaerated the slurry, dried his tobacco sheets at temperatures under 50°C. Where the thermogelling properties of methylcellulose will not be fully utilized and uses conventional heat impingement drying which does not result in the uniformly porous structure of the present invention. We have made sheets according to the Frankenberg patent many times, and they are invariably non-porous. Rosenberg uses thermogelling ethylhydroxyethyl cellulose in a reconstituted tobacco sheet formulation, but uses conventional hot air impingement drying and reports in his Example 1 that the product was non-porous.

We have found that when conventional heating means are employed in the initial shaping of the structure on the dissolved air will be released at different rates throughout the structure depending on the temperature gradient. The outside surface of the structure will gel before the inside, and a uniform series of interconnected channels to the outside of the structure will not result. The articles resulting from such a procedure are generally non-porous or of poor porosity. Additionally, a distortion of the shape of the article frequently results when thermal gelation does not occur simultaneously throughout the structure.

In preparing the particulate tobacco or substitute tobacco material for shaping into the smoking article, the following general procedure is followed. The solid material incorporated herein will be referred to as tobacco but it will be apparent that various tobacco substitutes may be used in lieu of part or all of the tobacco. Tobacco shreds, dust, pieces or combinations thereof are milled with a portion of water to form a slurry or a suspension of sufficient plasticity or viscosity to shape the article. The viscosity of the slurry, is controlled by the relative amount of carrier, tobacco and adhesive used, as well as the physical and chemical nature of the tobacco and adhesive and the temperature. It is by the control of the carrier that in the tobacco slurry should contain approximately a normal (equilibrium) amount of dissolved air. A normal amount can be defined as that maximum amount of air contained by the carrier under normal physical conditions at a given temperature. For example, if water is in the carrier the gum solution or any water added to achieve an appropriate final slurry viscosity should not be deaerated prior to use. The amount of dissolved air in the water at equilibrium depends on the water temperature. For example, 10°C water contains 22.84 cc. air/1000 cc. water, 20°C water contains 18.68 cc. air/1000 cc. water, and 30°C water contains 15.64 cc. air/1000 cc. water. It is noted from these values that the amount of air dissolved in water at equilibrium decreases with increasing temperature. Accordingly, when the shaped tobacco slurry is heated, dissolved gases are released. These dissolved gases which are released on heating play the major role in producing porosity in the final dried article. We have found that if the tobacco slurry is completely deaerated before any heating, a non-porous article results.

The adhesive or binder employed in these formulations should be selected entirely or entirely from the class of water-soluble gums classified as “thermogelling” gums. Water solutions of thermogelling gums will gel on heating to their specific thermal gelation temperature. The mechanism by which thermal gelation occurs is believed to be as follows: Cellulose derivatives which exhibit thermal gelation are long thread-like polymer molecules jacketed with layers of water molecules which increase the bulk of the aggregate. These water molecules act as a lubricant that enables the long cellulose ether chains to slide easily over another, giving the solution the property of a smooth-pouring, viscous liquid. As the temperature increases, the viscosity is initially lowered and the energy of these more or less loosely-bound water molecules is increased, the outer layers of water molecules break away. When enough of the attached water molecules are displaced another cellulose ether chains, the lubricating action is lost, the chains lock and the solution is transformed into a gel. The process of thermal gelation is reversible, that is, if the gelled solution is cooled below the thermal gelation temperature, then the gum will redissolve. The actual thermal gelation temperature depends on the nature of the substituent groups of the cellulose chain, the length or molecular weight of the chain, the concentration of the gum in the solution, and the nature of other additives in the solution.

Included in the category of thermogelling gums are methylcellulose and its thermogelling derivatives, such as, methyl - hydroxypropyl - cellulose and methylhydroxyethylcellulose, as well as ethylhydroxyethylcellulose and hydroxypropyl cellulose. Acceptable smoking articles may also be obtained through the use of a particular class of proteins, the water-soluble heat-coagulable proteins, such as egg albumin. Water solutions of these proteins also gel when heated, but here the process involves a denaturation of the protein which is not reversible on cooling. From the point of view of the practice of this invention, however, the water-soluble heat-coagulable proteins are suitable because they gel or solidify on heating. Therefore, as used herein, the term thermogelling gums will include the water-soluble heat-coagulable proteins as well as the particular water-soluble cellulose derivatives normally considered to be thermogelling gums.

A unique function of the thermogelling gums in these formulations is that they gel or set the shape of the structure before any water is removed, and maintain this shape with little or no shrinkage during the process of water removal and drying of the structure to a preselected moisture content. Non-thermogelling gums, on the other hand, do not gel on heating, and will not start to gel firm until after a substantial portion of the water has been boiled off. As a result, shrinkage of the structure’s dimensions will have occurred.

Additionally, the thermogelling gum contributes significantly to the attainment of porosity in the finished article, as will be described more fully below after a discussion of the required methods of drying these formulations.

After addition of the tobacco to the aqueous dispersion of the thermogelling gum, the mixture is agitated thoroughly until a uniform dispersion of a consistency or viscosity suitable for shaping is obtained. Alternatively, the tobacco particles and dry adhesives may be mixed together and added to the required amount of water or to a slurry of a suitable fibrous material such as tobacco or paper pulp. In other cases, the tobacco particles may be dispersed in a portion of the formulation water and then added to a solution of the thermogelling gum in the balance of the formulation water. It is noted that the mixture is agitated. This is to exclude mixing by whipping, beating or other violent methods which tend to incorporate free air or foam into the slurry.

The tobacco mass may then be extruded or molded to form shaped articles using known extrusion or molding techniques, some of which are shown in the aforementioned Mohiy et al. application, as shown in Gelz et al., U.S. 3,145,716 provided that such techniques are modified to provide the uniform microwave heating taught herein.
The method by which the shaped tobacco slurry is dried is critical to the retention of the shape of the article and to the proper development of porosity therein. To retain and develop these essential properties, it is important that the tobacco slurry be heated substantially uniformly throughout its mass until the shape whether as a block, rod or sheet has been firmly set by the process of thermal gelation of the thermogelling adhesive and until the porosity channels through the structure have been created and firmly established. To be sure that this condition has been met, at least 25% of the water in the tobacco slurry should be evaporated using the energy source which will cause substantially uniform heating the tobacco slurry. The energy required to dry the shaped article to the preselected moisture content dictated by the end use (which is frequently in the range of 10–25% moisture content) may be of the same type as was used in the initial phase of the drying i.e. microwave, or it may be of a more conventional type shown in the aforementioned patent which does not heat the article substantially uniformly throughout its mass, since this phase of the drying is decidedly less critical.

The preferred energy type which will heat the shaped tobacco slurry uniformly throughout its mass is microwave energy. As opposed to conventional drying means, such as air impingement drying or radiant heat drying, which invariably heat the shaped mass from the outside inwards and produce a temperature gradient from the outside of the article to the center of the article, microwave energy is absorbed uniformly by all the water molecules throughout the shaped tobacco slurry. Accordingly, the entire structure is raised in temperature uniformly, and all parts of the structure will arrive at the thermal gelation temperature at the same time and gel simultaneously. This condition is most important to the maintenance of the proper shape in the article and to the creation of a suitable porosity in the article.

As the temperature is raised uniformly throughout the shaped tobacco structure, the dissolved air in the solvent is released uniformly throughout the mass. When the thermogelling gum gels simultaneously throughout the mass, the structure is essentially “frozen” in the condition existing at this time, including the network of channels throughout the structure created by the escaping dissolved gas. For gum systems that gel in the range of 35–70°C, the escaping dissolved gas is the major factor in the creation of a suitable porosity. In systems gelling above 70°C, volatilization of the solvent also plays a role in the creation of porosity. Although some distortion of the air channels existing when the structure gels may occur after gelation, the major effect after this point is a diffusion of air (and later of volatilized solvent) out of the structure without the creation of significant new channels.

Production of compositions in accordance with this invention do not exclude the use of various other additives. A crosslinking agent such as glyoxal, dimethylurea, melamine formaldehyde resins or a dialdehyde poly-saccharide as disclosed in U.S. Patent 2,887,414 may be added to improve further the water resistance of the adhesive agent and to prevent distortion of the finished smoking articles under excessively humid or other adverse conditions. If desired, a humectant such as glycerine or triethylene glycol may also be added. A minor quantity of humectant is desirable to prevent excessive brittleness in the final article. A small proportion (about 0.5% by weight) of a suitable fungicide such as captan, may be employed to prevent the growth of non-desired organisms in the product.

The finely divided or fragmented tobacco used in conjunction with the invention may be prepared by dry or wet grinding or by otherwise comminuting tobacco leaf and stems. Finds which are residues from handling of tobacco and would otherwise constitute waste may be used advantageously. Shaped smoking articles using entirely dry ground or shredded tobacco is preferred but the invention is not limited to this form. Satisfactory formed smoking articles can be made from finely divided tobacco which will pass through a 20 mesh screen and will be mostly retained by a 325 mesh screen. A preferred particle size range is between 40 and 250 mesh.

Having taught the general production of tobacco products it is evident that other tobacco products may be advantageously formed by this shaping method. For example, as pipeplug or filters, in addition to rod-like or cigarette forms. Moreover, the paste of slurry may also be cast in continuous sheets in thicknesses approximating the diameters of cigars or cigarettes, then dried and cut into rod-like lengths of cigarettes or cigars. The continuous sheets may also be cast in thicknesses decidedly less than the diameters of cigars and cigarettes. In such cases, cigars or cigarettes may be prepared from these thin sheets by such processes as laminating, novel folding arrangements, or even by shredding or chopping procedures such as are used in the preparation of conventional cigarettes and cigars.

The invention is further illustrated by the following examples:

**EXAMPLE I**

4 grams of methylhydroxypropyl cellulose to form a 2% solution is dissolved in 196 grams of water at 18°C containing an equilibrium quantity of dissolved air (Method 655F—4000 cps.—Dow Chemical Co.—gelation temperature 65°C) to this solution was added 2 grams of glycerine, 0.25 gram capitan, 55 grams of cigarette tobacco shreds and 31 grams water. The mixture was agitated throughout incorporation of undissolved or until a uniform mass was obtained. The resultant mass was extruded into an 8 mm. diameter bore medium porosity diametrical earth filter cylinder. The ends of the cylinder were sealed to obtain more uniform water removal by preventing channeling towards the ends of the cylinder. The loaded mold was placed in a microwave oven, as for example the “Radarange” sold by the Raytheon Corporation, and the tobacco mass was thus heated by the fixed energy input, driving off the dissolved air gelling the structure and drying the mass to approximately 15–20% moisture content.

The resultant product was coherent, rigid and stable porous product suitable for wrapping as a cigarette or cigar having acceptable draw, burn, and feel.

**FIG. I** is a photograph of the material made in accordance with the Example I. It will be noted that the material is cohesive, rigid and stable, having an open cellular construction with a great degree of porosity.

**EXAMPLE II**

A tobacco dispersion is prepared as in Example I, except that the adhesive employed is methylcellulose (Method MC—15,000 cps.—Dow Chemical Co.—gelation temperature 50–55°C) in place of methylhydroxypropyl cellulose. The tobacco dispersion is extruded in a rod form onto a flat surface and is dried unconfined, but supported at its point of contact with the flat surface. Drying is accomplished with microwave energy supplied at a sufficient rate that is little or has no deformation of shape occurs before the gelation point of the mass establishes the shape and eliminates the possibility of collapse during the remainder of the heating period. The tobacco rod is dried to approximately 15–20% moisture content, and may be wrapped with cigarette paper to produce a cigarette with acceptable draw, burn and feel such as produced by Example I.

**EXAMPLE III**

To 200 grams of 2% ethylhydroxyethyl cellulose solution (Hercules Powder Co.—gelation temperature 38–42°C) containing an equilibrium quantity of dissolved air, was added with agitation 55 grams of cigarette tobacco dust dispersed in 180 grams of water, and agitation was continued until a uniform dispersion was obtained. The resultant tobacco dispersion was continuously extruded.
vertically downward, and while in this unconfined, unsupported state was subjected to microwave heating which gelled and thus froze the shape of the extruded shape due to its very weight. The extruded rod was dried to 15–20% moisture content and then wrapped with conventional cigarette paper to produce a smoking article of commercial quality, with acceptable shape, draw, feel, burn and taste qualities. FIG. 2 is a photograph of the product made in accordance with this example. It is noted that because dust is generally more uniform in size and shape the resultant product is more uniform in appearance than that of FIG. 1 (Exp. 1) however both have the same advantageous characteristics.

EXAMPLE IV

A tobacco dispersion is prepared as described in Example I, except for the use of tobacco dust in place of tobacco shreds. The resultant tobacco slurry is cast on an endless non-metallic belt, and is subjected to microwave energy until approximately 25–30% of the original slurry water was removed. The remainder of the tobacco dispersion water is removed by steam impinging on the underside of the belt and hot air impinging on the surface of the slurry. The resultant completely dried sheet is successively cooled, rehumidified to 15–20% moisture content by steam condensation and doctorated from the belt. The sheet made in accordance with the example is for all purposes similar to the rod formed in accordance with Example III except for its overall dimensions. If a cross section were viewed, it would appear as in FIG. 2.

EXAMPLE V

A tobacco dispersion is prepared, extruded and dried as in Example I, except that the adhesive employed is soluble egg albumin in place of methylhydroxypropyl cellulose. A 70 mm. length of the resultant formed cigarette core, then properly wrapped with cigarette paper, exhibits “draw” burn and feel characteristics comparable to conventional cigarettes.

It will be seen from the foregoing examples that an expanded porous stable product is obtained by the combined steps of including equilibrium amount of dissolved air in the slurry, employing a thermogelling gum, and uniform heating. The level of viscosity and the gellation temperature characteristics of the thermogelling gum are not, per se, critical, provided that the gum solution contains dissolved air and is uniformly heated throughout the mass. This can be accomplished by the sequential and uniform release of the dissolved air followed by gellation to create a fixed stable matrix prior to the final drying of the mass.

Various modification changes, etc., may be made to the described form of the present invention all within the concepts being disclosed. The foregoing description is therefore to be taken as for illustration purposes only and the scope of this invention is to be limited only to the claims appended hereto.

What is claimed is:

1. The method of manufacturing a reconstituted tobacco product comprising the steps of creating a uniform slurry of tobacco particles, water, having substantially an equilibrium amount of dissolved air and a thermogelling gum by admixing the constituents without incorporation of a foaming agent or significant amounts of undissolved air or other gases to form a mass suitable for shaping, heating by microwave energy said mass uniformly throughout to sequentially liberate substantial amounts of the dissolved air forming air channels within said mass, gelling said gum to stabilize said mass into a continuous open cell matrix and thereafter drying said matrix to a preselected moisture content.

2. The method of claim 1 in which thermogelling gum is selected from the group consisting of methylcellulose and thermogelling derivatives thereof, ethylhydroxyethylcellulose, hydroxypropyl cellulose, water-soluble heat-coagulable proteins, and combinations thereof.

3. The method of claim 2 in which the derivatives of methylcellulose are chosen from the class including methylhydroxypropyl-cellulose, methylhydroxyethyl-cellulose.

4. The method of claim 1 in which the thermogelling adhesive is ethylhydroxyethylcellulose having a gellation temperature between 38–50° C.

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131—17