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INFUSER WEB MATERIAL, METHOD OF PREPARING SAME AND INFUSION PACKAGE

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ABSTRACT OF THE DISCLOSURE

Infuser web material impregnated in discrete areas with water repellent material, said impregnated areas covering from 0.1 percent to 40 percent of the total surface area of said infuser material.

The present invention relates generally to porous web-like materials and more specifically is concerned with infusion-type filter papers finding primary use in infusion packages for brewing beverages, such as tea, coffee and the like.

It has generally been the practice in making individual cups of brew to either place the pillow-shaped bag of tea or the like in a cup containing boiling water or, alternatively, to place the bag in an empty cup and subsequently add the boiling water. Regardless of the technique employed and as is familiar to most users, the tea bag generally tends to inflate and float to the top of the water for a time despite the high porosity of the infusion paper utilized in making tea bags. This inflation or "ballooning effect" is generally attributable to the entrapped gases and vapors within the bag, which gases are unable to escape because of a surrounding surface-tenacious film of water. The entrapped gases, both condensible and non-condensible, tend to build up a positive pressure within the bag due to the heat of the liquid thereby inhibiting the rate of infusion and requiring a longer time in making the brew. In fact, where it is the practice to place the tea bag in a pot of water and permit it to boil or steep for a length of time, the inflation or ballooning is accentuated, frequently causing the seams of heat sealed bags to open, thus undesirably discharging the tea leaves into the brew and defeating the purpose of using the bag.

It is a primary object of the present invention to overcome the above and related disadvantages by providing a porous material which prevents the buildup of differential pressures on opposite sides thereof and facilitates the passage therethrough of condensible and noncondensible gases without adversely affecting the ability of such material to confine the dispersion of fine solid particles.

Another object of the invention is to provide a method of imparting continual gas permeability to a continuous, infusion-type material which, when wet, would otherwise tend to prevent the free passage of gas therethrough.

Still another object of the present invention is to provide a generally air and water permeable, infusion-type paper suitable for use in tea bags and the like which facilitates not only the free passage of condensible and noncondensible gases through portions thereof albeit the material is in contact with liquid, but also improves the rate of infusion of the liquid through the paper while minimizing the possible delamination of the seals provided therein.

A further object of the present invention is to accomplish the above objects without impairing the over-all strength, porosity or continuity of the infusion material.

A still further object of the present invention is to provide a package utilizing such material.

Other objects will be in part obvious and in part pointed out more in detail hereinafter.

The invention accordingly comprises the several steps and the relation of one or more of such steps with respect to each of the others and the article possessing the features, properties, and the relation of elements, which are exemplified in the following detailed disclosure, and the scope of the application of which will be indicated in the claims.

Broadly, the present invention comprises a continuous, infuser web material provided with small water repellent and air permeable zones or areas which exhibit, when the material is in contact with water, a higher degree of air permeability than the remainder of the material. However, in order that the invention may be more clearly understood and for the purpose of simplicity and brevity of discussion, the present invention will be discussed with relation to its use in infusion packages and particularly wth respect to tea bags and the like.

As used herein the term "continuous" web refers to those webs generally made of fibrous materials which are free from perforations or punctures yet possess a high degree of porosity and particularly to those fibrous materials made on conventional papermaking machines.

Further, as used herein the expressions "water repellent" and "water repellency" refer to the ability of the material to resist "wetting"; that is, the passage of liquid water into the structural components of the paper through capillary action. Such materials are generally characterized by the measurable contact angle between the water and the material. This should be distinguished from both "wet strengthening" and "waterproofing." In the former the water is not prevented from permeating the fibers, rather the treatment provides interfiber bonds which are not susceptible to attack by water, while the latter provides an impermeable barrier in the form of a film or coating which may cover the pores of the paper as well as the fibers.

The present invention in its application to tea bags permits the use of those self-supporting, continuous, infuser webs which are commercially available. These webs are generally soft, tissue-thin fibrous materials characterized by light weight and freedom from rupture in boiling water but when used as described hereinbefore possess the disadvantage of entrapping the air. The webs may be of the heat-seal variety, typical of which is the paper disclosed in United States Patent No. 2,414,833 wherein synthetic thermoplastic fibers form an integral part of the web or of the nonheat-seal variety that require mechanical fastening for the formation of the tea bag. Typical of this latter group are the loosely formed, low density papers made of long fiber lengths and described in United States Patents 2,045,095 and 2,045,096.

The fibers utilized in these webs may be of any of the well-known papermaking fibers or mixtures thereof. For example, they may be natural fibers such as manila hemp, caroa, jute, bleached or unbleached kraft, sisal, and kozu or synthetic fibers such as viscose and acetate rayon, polyamides, vinyl acetate-vinyl chloride copolymers and those fibers disclosed in United States Patent No. 2,477,000.

A variety of infuser webs may be made from these fibers and utilized in accordance with the present invention; however, for purposes of discussion, the invention will be described in its application to commercially available infuser web materials. It will be appreciated that such materials while being extremely porous are generally free from perforations and will not permit the fine dust particles of the tea to filter through the bags made therefrom.

According to the preferred aspect of the present invention, the continuous infuser webs are treated only in particular areas or zones of the web with a suitable water repellent material which, when set, is insoluble in aqueous solutions and unaffected by boiling water. The water repellent materials utilizable must provide not only a re-

sistance to wetting or aqueous absorption in the treated areas but also must provide this property without adversely affecting the air permeability of the infuser throughout the treated areas. Additionally, the water repellent materials utilized according to the invention should exhibit an affinity for being absorbed into the fibers of the web while at the same time substantially retaining the porosity of the web. Accordingly, they are distinguished from materials which form solid films over the entire treated area.

Those materials found most suited for this type of application are the thermosetting resins. More particularly, those thermosetting materials generally categorized as silicones have been used with good success and are preferred due to their ability to substantially permeate the filaments or fibers of the infuser web without blocking or interfering with the porous openings between the fibers. Although various organopolysiloxanes, including mixtures thereof, may be utilized, the alkyl polysiloxanes, and particularly methyl hydrogen polysiloxane, appear to yield consistently good results and are therefore preferred. Additionally, these polysiloxanes show little or no transfer to the brew, are generally nontoxic and do not affect the odor, taste or quality of the brew produced, all of which are important and necessary characteristics in food and food products.

The water repellent material may be applied to the infuser web material by well-known techniques used to produce selective or discontinuous coating. For example, the web may be treated by brush, roll, spray or gravure rolls to effectuate the desired application to the fibers. The silicones generally penetrate quickly through the rather thin and absorbent infuser web, however, lateral migration of the silicone can be minimized and the size of the water repellent zone thereby controlled. Where practicable, the silicone may be applied during a suitable stage in the manufacture of the continuous web. For example, in a conventional papermaking machine a roll coating assembly may be placed adjacent a section of the dryer drums prior to the final drying and collection of the web material.

After treating the infuser web with the silicone, which immediately permeates through the entire thickness of the paper in the treated areas, the paper then is subjected to a thermal or heat cure in order to set the silicone and prevent lateral migration thereof along the web. This operation may be combined with the normal drying steps employed in making an infuser web. Although the conditions of cure may vary as to both time and temperature depending on the particular web material and silicone used, generally a quick cure, for example a cure of about 2 minutes at 250° F. or 30 seconds at 350° F., produces excellent results. Consequently, by using proper techniques, the size and configuration of the water repellent, air-permeable zones may be readily controlled. These treated and cured zones facilitate the free flow or ready release of entrapped gases without substantially reducing the porosity of the web thereby promoting a more rapid infusion and effusion of the contacting liquid medium.

The air-release zones provided in the manner hereinbefore described may take the form of several small, noninterconnected water repellent areas located randomly on the infusion paper; however, it is generally preferred that they be sufficiently numerous so that one or two areas of suitable size and configuration are provided for each tea bag. It will be appreciated that various forms and configurations may be utilized for the zones; for example, they may consist of small squares, dots or other shapes and may take the form of trademarks or trade names.

According to the present invention, it has been additionally determined not only that the gas-release zones should constitute at least a certain proportion of the total surface area of each web but also that the concentration of silicone in the solution or dispersion utilized should be within certain limits. The former is necessary since the zones in each tea bag must be large enough to permit the entrapped gas to overcome the surface tension of the surrounding film of water while the latter is required to prevent the formation of a porosity-hampering film. It will be appreciated however that these limits are flexible depending on the materials utilized as well as the techniques of application employed. The limits broadly required are those which ensure that the porosity of the web is not substantially reduced, that the delamination of heat-seal tea bags is minimized and that the rate of infusion is not substantially decreased but is, preferably, increased.

Although the silicones may be employed in undiluted form or in the form of aqueous emulsions or organic solutions of organopolysiloxanes, the aqueous emulsions are generally preferred. The concentration range of organopolysiloxanes in the carrier medium or solvent can extend from a minor amount of siloxane to about 15 percent by weight of silicone depending on the manner in which they are applied. Generally, the commercially available solutions and emulsions have a concentration range from about 1 to 40 percent by weight; however, the preferred concentration range for the present invention is a silicone content from about 0.5 percent to less than about 10 percent by weight, the lower concentrations being utilized in practice due to the economies effected. For example, as illustrated in Table 1, a decrease in the porosity of the web occurs as the percentage of silicone in the dispersion is increased, the results given in Table 1 being for tea bags in which the entire surface area was treated.

TABLE 1

	Percent Silicone in Dispersion	Porsity (cf./m.)		
		Before Treatment	After Treatment	Percent Decreased
Sample 1	1.0	125	123	1.60
Sample 2	5.0	170	156	8.24
Sample 3	10.0	137	93	32.12
Sample 4	15.0	170	77	54.71

It is known that the size of commonly used tea bags varies substantially providing surface areas ranging from about 50 square centimeters to about 80 square centimeters with the normal surface area being about 65 square centimeters (10 sq. in.). According to the present invention it has been found that the water repellent zones comprising an area as small as about 0.1 percent of the total surface area of each tea bag will function effectively and at the same time give an improved infusion rate without decreasing the porosity of the material. Table 2 shows the optical densities obtained for aqueous solutions of tea after the treated tea bag had been immersed for 30 seconds, thus illustrating the improved infusion obtained according to the present invention.

TABLE 2

Percent of area treated with silicone:	Average optical density
0.0	.050
0.14	.07
0.28	.085
0.55	.078
1.1	.065
2.2	.070
4.4	.078
4.9	.075
8.8	.068
17.6	.058
35.2	.060

Generally, gas release zones covering from 0.5 to 40.0 percent of the total area of each tea bag have been found quite satisfactory; however, the preferred range of area covered by the zones is from about 1.0 to 15.0 percent of the total surface area of each tea bag. Above 40.0 per-

cent, the porosity of the web tends to decrease, the amount of decrease depending not only on the increase in area but also on the concentration of the silicone utilized in the dispersion, as indicated in Table 1.

Although water repellent zones constituting 0.1 percent of the total surface area have proven effective in increasing infusion, the preferred range of area covered by the zones is from about 1.0 percent to about 15.0 percent since it has been found that delamination is most effectively minimized within this range. The procedure employed in testing the delamination of heat-seal tea bags is as follows: A 400 cc. container, such as a glass beaker, is one-half filled with water and heated to boiling. A tea bag is placed in the boiling water and the container is covered. The boiling is continued and the period of boiling time necessary to cause delamination is recorded. Table 3 illustrates the variation in delamination time observed as both the size and number of zones were altered. An untreated reference tea bag was found to delaminate within 55 seconds. Each test was terminated at five minutes.

TABLE 3

Treated Areas		Percent of Total Surface Treated	Treatment With	
Size	No. of Areas		1% Silicone	5% Silicone
			Delamination Time (Sec.)	Delamination Time (Sec.)
1/16" dia.	2	0.275	87	92
1/8" dia.	4	0.55	238	128
1/8" dia.	8	1.1	300+	262
1/4" dia.	1	0.55	77	75
1/4" dia.	2	1.1	243	200
1/4" dia.	4	2.2	300+	300+
1/2" dia.	1	2.2	117	230
1/2" dia.	2	4.4	300+	300+
1" dia.	1	8.8	300+	300+

As can be seen from the foregoing, the present invention provides infuser web material possessing as an integral part thereof gas-release zones comprised of silicone impregnated fibers. These zones facilitate the free and continuous passage of gas therethrough despite the tendency of liquids to form a surface-tenacious barrier or film. These zones assist in pressure equalization on opposite sides of the web and reduce the tendency of heat seals to delaminate thereby discharging the tea leaves into the brew.

As will be apparent to persons skilled in the art, various modifications and adaptations of the web material above described will become readily apparent without departure from the spirit and scope of the invention, the scope of which is defined in the appended claims.

We claim:

1. An infuser material for use in making packages for brewing beverages comprising a continuous, prebonded fibrous web being generally air and water permeable, substantially uniformly and continuously bonded throughout its extent and resistant to partition in boiling water, said web having therein as an integral part thereof a plurality of discrete water repellent, gas-release zones of sufficient size to permit upon immersion in water the continual and free passage of gases therethrough and prevent the buildup of a substantial pressure drop across the thickness thereof, said gas-release zones being water repellent throughout their entire thickness and comprised essentially of fibers impregnated with a water repellent material, the total water repellent area of the paper constituting substantially less than one-half the total area of the paper.

2. An infuser material for use in making packages for brewing beverages comprising a continuous, prebonded fibrous web of high air and water permeability, said web being substantially uniformly and continuously bonded throughout its extent, exhibiting resistance to breakdown in boiling water and having within each 50–80 square centimeters of surface area thereof and as an integral part thereof at least one water repellent, gas-permeable zone of sufficient size to permit the continual and free passage of gas therethrough, said zone extending over at least 0.1 percent and less than 40 percent of the total surface area of said web and being comprised essentially of fibers impregnated with a water repellent material said zone being water repellent throughout its entire thickness.

3. The infuser material of claim 2 wherein the fibrous web is of the heat-seal variety and the water repellent zones tend to minimize delamination of the seals produced therein.

4. An infuser material for use in making packages for brewing beverages and comprising a continuous infusion-type, prebonded fibrous web of high air and water permeability and sufficient wet strength to resist separation in boiling water, said web having for each 50–80 square centimeters of surface area thereof at least one water repellent gas-permeable zone forming an integral part thereof and extending through the web, said water repellent zone constituting about 0.5 to 40.0 percent of the total surface area of said web and comprising essentially impregnated fibers individually defining gas-permeable passages therebetween, the material impregnating said fibers comprising a cured organopolysiloxane.

5. An infuser material for use in making packages for brewing beverages which facilitates the ready release of entrapped gas when in contact with liquid, said material comprising a continuous infusion-type, prebonded fibrous web of high air and water permeability and sufficient wet strength to resist separation in boiling water, said web having for each 50–80 square centimeters of surface area thereof and as an integral part thereof at least one water repellent zone extending through the entire thickness of the web and being continually air permeable, said water repellent area constituting about 1.0 to 15.0 percent of the total surface area of said web and comprising essentially impregnated fibers individually defining gas-permeable passages therebetween, the material impregnated in said fibers comprising a cured methylpolysiloxane.

6. A method of improving the water infusion characteristics of filter media used for beverage brewing packages which when contacted by water normally tend to hinder the free passage of gas therethrough, said method comprising the steps of providing a continuous porous web substantially uniformly and continuously bonded throughout its extent, said web being of high air and water permeability and sufficient wet strength to resist separation in boiling water; treating from 0.1 to 50.0 percent of the total surface area of said web with a water repellent material characterized by its ability to impregnate the filaments of said web within the treated area throughout the thickness of the web without substantially altering the gas porosity of that area; and subsequently curing the water repellent material on the filaments whereby the treated area constitutes a gas-release zone which minimizes the buildup of a substantial pressure drop across the thickness of the material.

7. A method of improving the water infusion characteristic of filter media used for beverage brewing packages comprising the steps of providing a continuous infusion-type web substantially uniformly and continuously bonded throughout its extent, said web being of high air and water permeability and sufficient wet strength to resist separation in boiling water; treating about 0.5 to 40.0 percent of each 50–80 square centimeters of surface area of said web with a water repellent thermosetting material and permitting said material to permeate through the entire thickness of the web, said water repellent material being characterized by its ability to impregnate the filaments of said web within the treated area without substantially altering the gas permeability of that area; and subsequently curing the water repellent material within the filaments whereby the treated area constitutes a gas-release zone which minimizes the buildup of a substantial pressure drop across the thickness of the material.

8. A method of improving the water infusion characteristics of filter media used for beverage brewing pack-

ages comprisiing the steps of providing a continuous, infusion-type, fibrous web substantially uniformly and continuously bonded throughout its extent, said web being of high air and water permeability and sufficient wet strength to resist separation in boiling water; roll coating about 1.0 to 15.0 percent of each 50–80 square centimeters of surface area of said web with a water repellent organopolysiloxane and permitting said siloxane to permeate through the entire thickness of the web, said siloxane impregnating the fibers of said web within the treated area without substantially altering the gas permeability of that area; and subsequently thermally curing the organopolysiloxane within the fibers whereby the impregnated area constitutes a gas-release zone which minimizes the buildup of a substantial pressure drop across the thickness of the material.

9. An infuser package for restraining the distribution of a beverage making ingredient throughout the brew while facilitating the ready release of entrapped gas comprising a prebonded fibrous web being generally air and water permeable, substantially uniformly and continuously bonded throughout its extent and resistant to partition in boiling water, said web having therein as an integral part thereof at least one water repellent gas-release zone of sufficient size to permit the continual and free passage of entrapped gas therethrough and prevent the buildup of a substantial pressure drop across the thickness thereof, said zone extending through the entire thickness of the web, constituting about 0.5 to 40.0 percent of the total surface area of said web and comprising essentially fibers impregnated with a water repellent material and a beverage making ingredient within said package.

10. An infuser package for restraining the distribution of a beverage making ingredient throughout the brew while facilitating the ready release of entrapped gas, comprising a prebonded, fibrous web of high air and water permeability, substantially uniformly and continuously bonded throughout its extent and of sufficient wet strength to resist separation in boiling water, said web having therein as an integral part thereof at least one water repellent zone extending through the entire thickness of the web and being continually air permeable, said water repellent zone constituting about 1.0 to 15.0 percent of the total surface area and comprising essentially impregnated fibers individually defining gas permeable passages therebetween, the material impregnating said fibers comprising a cured organopolysiloxane; and a beverage making ingredient within said package.

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