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(54) GUM BASES BASED ON CROSSLINKED POLYMERIC MICROPARTICLES

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(57) ABSTRACT

The present invention provides gum bases and chewing gums, as well as methods of manufacturing the gum bases. More specifically, the gum bases provided herein contain microparticles comprising a crosslinked polymer selected from the group consisting of crosslinked polyvinyl alkanoates, crosslinked polyvinyl alkenoates, crosslinked polyvinyl aryloates, crosslinked polysiloxanes, and copolymers and mixtures. The microparticles render a gum cud comprising the gum base more easily removable from surfaces onto which it may become adhered than gum cuds comprising conventional gum bases.

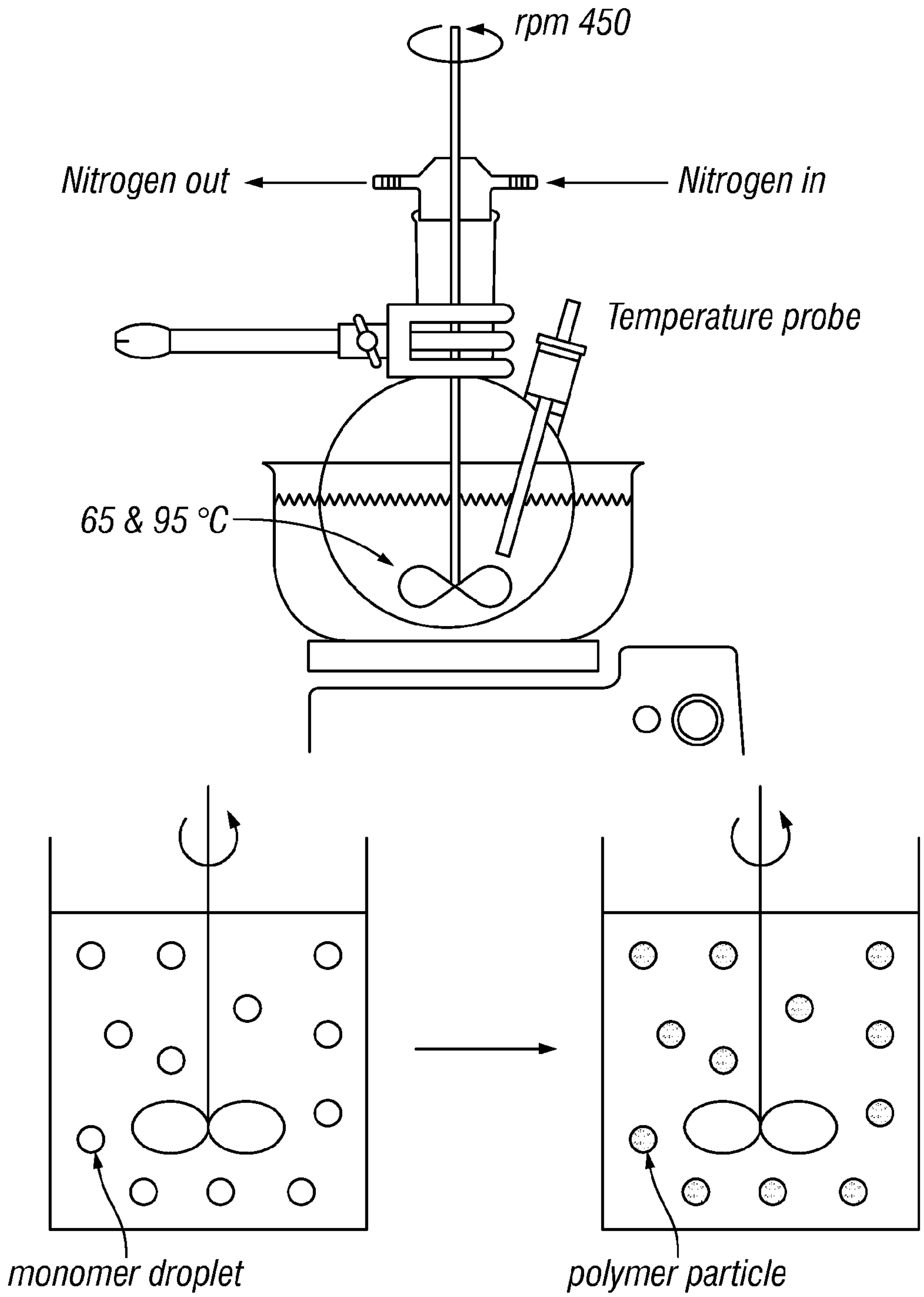

rpm 450
Nitrogen out
Nitrogen in
Temperature probe
65 & 95 °C
monomer droplet
polymer particle

FIG. 1

GUM BASES BASED ON CROSSLINKED POLYMERIC MICROPARTICLES

PRIORITY DATA

[0001] The present patent application is a 371 of International Application No. PCT/US13/48921 filed Jul. 1, 2013, which claims benefit from U.S. Ser. No. 61/668,057 filed Jul. 5, 2012. All of the patent applications listed above incorporated by reference therefrom as if fully restated herein.

BACKGROUND OF THE INVENTION

[0002] The precursor's to today's chewing gum compositions were developed in the nineteenth century. Today's version is enjoyed daily by millions of people worldwide.

[0003] When chewing gum is chewed, water soluble components, such as sugars and sugar alcohols are released with varying degrees of speed within the mouth, leaving a water insoluble chewing gum cud. After some amount of time, typically after the majority of the water soluble components have been released therefrom, the cud may be disposed of by the user. Although typically not problematic when disposed of properly, e.g., when wrapped in a substrate such as the original wrapper, or disposed of in a proper receptacle, improper disposal of chewing gum cuds can result in adhesion of cuds to environmental surfaces such as sidewalks, walls, flooring, clothing and furniture.

[0004] Conventional elastomers and gum bases used in commercial chewing gum products behave as viscous liquids which provide flow and elasticity characteristics which contribute to their desirable chewing properties. However, when the chewed cuds formed from such conventional chewing gum products become undesirably adhered to rough environmental surfaces such as concrete, over time, the elastomeric components flow into the pores, cracks and crevices of such surfaces. The process may be exacerbated by exposure to pressure (for example through foot traffic) and temperature cycling. If not removed promptly, adhered gum cuds can be extremely difficult to remove from these environmental surfaces.

[0005] Thus there is a need for a gum base and chewing gum comprising the same that exhibits the desired characteristics for consumer acceptability, while also producing a cud which is easily removable from surfaces onto which it may have become adhered.

SUMMARY OF THE INVENTION

[0006] There is provided herein a gum base comprising microparticles further comprising at least one crosslinked polymer selected from the group consisting of crosslinked polyvinyl alkanoates, crosslinked polyvinyl alkenoates, crosslinked polyvinyl aryloates and crosslinked polysiloxanes. The crosslinked polymer may have a glass transition temperature of less than about 30° C., or less than about 10° C. or even less than about 0° C. In these, and/or other, embodiments, the crosslinked polymer may have a complex modulus (G*) at 25° C. of less than about 10^9 dyne/cm^2, or less than about 10^7 dyne/cm^2. In yet other embodiments, the crosslinked polymer may desirably have a complex modulus (G*) of greater than about 10^4 dyne/cm^2, or greater than about 10^5 dyne/cm^2.

[0007] The microparticles may have a largest dimension of at least about 0.1 microns or at least about 0.5 microns or at least about 10 microns. The microparticles may have a largest dimension of less than about 1000 microns, or less than about 500 microns or less than about 100 microns.

[0008] In some embodiments, the microparticles may comprise a food grade polymer and may or may not be plasticized. In these, and other, embodiments, the polymer will comprise a crosslinked polyvinyl alkanoate, a crosslinked polyvinyl alkenoate, a crosslinked polyvinyl aryloate or a crosslinked polysiloxane such as polyvinyl acetate, polyvinyl laurate, polyvinyl benzoate, polydimethylsiloxane or polydiphenylsiloxane as well as copolymers of two ro more of these. Furthermore, these microparticles of these polymers may be blended in any combination.

[0009] The microparticles may comprise the entirety of the gum base or may comprise from about 0.1 weight percent (wt %) to about 99 wt %, or from about 1 wt % to about 70 wt % or from about 5 wt % to about 40 wt %, based upon the total weight of the gum base.

[0010] Although the present gum bases are expected to exhibit enhanced removability, in some embodiments, the gum bases may further comprise at least one removability enhancing component. The removability enhancing component may comprise an amphiphilic polymer, a low tack polymer, a polymer comprising hydrolysable units, an ester or ether of a polymer comprising hydrolysable units, or combinations of these.

[0011] The inventive gum base may further comprise at least one elastomer, elastomer solvent, softener, plastic resin, filler, emulsifier, or combinations of these. In certain embodiments, the gum base further comprises a filler, e.g., calcium carbonate, talc, amorphous silica, or combinations of these, in amounts of from about 0 wt % to about 5 wt %, based upon the total weight of the gum base.

[0012] In another aspect, a chewing gum is provided comprising a first gum base comprising a plurality of microparticles comprising at least one of a crosslinked polyvinyl alkanoate, a crosslinked polyvinyl alkenoate, a crosslinked polyvinyl aryloate or a crosslinked polysiloxane or copolymers of these. The first gum base may comprise from about 1 wt % to about 98 wt % of the chewing gum, or from about 10 wt % to about 50 wt %, or from about 20 wt % to about 35 wt % of the chewing gum, based upon the total weight of the gum.

[0013] The chewing gum may comprise the first gum base as the sole gum base component, or, in other embodiments, may comprise a second, conventional gum base. In such embodiments, the first gum base may comprise from about 0.1 wt % to about 30 wt % of the chewing gum, based upon the total weight of the gum.

[0014] In addition to any amounts thereof in the gum base, the chewing gum may include at least one removability enhancing component. In some embodiments, the removability enhancing component included in the chewing gum comprises an emulsifier, that may be encapsulated or spray dried, if desired.

[0015] In another aspect, the use of crosslinked polyvinyl acetate or a crosslinked polysiloxane microparticles as a gum base is provided.

[0016] And in yet another embodiment, methods for manufacturing a gum base are further provided and comprise the steps of adding an aqueous slurry of crosslinked polyvinyl alkanoate, crosslinked polyvinyl alkenoate, crosslinked polyvinyl aryloate or crosslinked polysiloxane microparticles to a mixer, adding at least one of an elastomer, an elastomer solvent, a softener, a resin, a filler and/or an emulsifier to the mixer, mixing the components at elevated temperature for a time sufficient to evaporate at least a majority of the water, and discharging the mixture from the mixer.

[0017] Additional features and advantages of the present invention are described in, and will be apparent from, the following detailed description.

DESCRIPTION OF THE DRAWINGS

[0018] FIG. **1** shows a suspension polymerization reactor useful for preparation of the crosslinked polymeric microparticles of the present invention.

DESCRIPTION OF THE INVENTION

[0019] Unless defined otherwise, technical and scientific terms used herein have the same meaning as is commonly understood by one of ordinary skill in the art to which this invention belongs. The terms “first”, “second”, and the like, as used herein do not denote any order, quantity, or importance, but rather are used to distinguish one element from another. Also, the terms “a” and “an” do not denote a limitation of quantity, but rather denote the presence of at least one of the referenced item, and the terms “front”, “back”, “bottom”, and/or “top”, unless otherwise noted, are merely used for convenience of description, and are not intended to limit what is being described to any one position or spatial orientation.

[0020] Reference is occasionally made herein to a largest dimension of the microparticles disclosed herein. It is to be understood that when particular ranges are indicated as advantageous or desired for these measurements, or that a particular shape of the microparticles may be desirable, that these ranges/shapes may be based upon the measurement or observation of from about 1 to about 10 microparticles, and although it may generally be assumed that a majority of the microparticles may thus exhibit the observed shape or be within the range of largest dimension provided, that the ranges are not meant to, and do not, imply that 100% of the population, or 90%, or 80%, or 70%, or even 50% of the microparticles need to exhibit a shape or possess a largest dimension within this range. All that is required is that a sufficient number of the microparticles exhibit a dimension within the desired range and/or the desired shape so that at least a portion of the desired properties of the microparticles, and thus the gum base and chewing gum, are provided.

[0021] If ranges are disclosed, the endpoints of all ranges directed to the same component or property are inclusive and independently combinable (e.g., ranges of “up to about 25 wt %, or, more specifically, about 5 wt % to about 20 wt %,” is inclusive of the endpoints and all intermediate values of the ranges of “about 5 wt % to about 25 wt %,” etc.). The modifier “about” used in connection with a quantity is inclusive of the stated value and has the meaning dictated by the context (e.g., includes the degree of error associated with measurement of the particular quantity). Further, unless otherwise stated, percents listed herein are weight percents (wt %) and are based upon the total weight of the gum base or chewing gum, as the case may be.

[0022] The present invention provides gum bases and chewing gums, as well as methods of manufacturing the gum bases. More specifically, the gum bases provided herein comprise microparticles further comprising one or more crosslinked polymer(s). The polymeric microparticles may render a gum cud comprising the gum base more easily removable from surfaces to which it may have become adhered than gum cuds comprising conventional gum bases. Advantageously, the present gum bases also have chew properties consistent with those of conventional gum bases. That is, the gum base comprising the polymeric microparticles is elastic yet deformable, more cohesive than adhesive, and readily recombines if torn apart. As a result, a chewing gum comprising the gum base is expected to enjoy a high consumer-acceptability.

[0023] Polymeric microparticles suitable for use in the chewing gum base described herein should be sufficiently pliable at typical mouth temperatures (e.g., 35-40° C.) to give good chewing properties. Further, the polymeric microparticles will desirably be essentially without taste and have an ability to incorporate flavor materials which provide a consumer-acceptable flavor sensation. Typically, the microparticles will have sufficient cohesion such that a chewing gum comprising them retains cohesion during the chewing process and forms a discrete gum cud.

[0024] The polymer(s) used will desirably be crosslinked, either before, during or after the formation thereof into microparticles. As used herein, the term “crosslinked” means the linking of the chains of a polymer to one another so that the polymer, as a network, becomes stronger and more resistant to being dissolved. In at least some embodiments all, or most (i.e., greater than 50% of the polymers, based upon the total number thereof), of the polymers within a microparticle will be crosslinked. In other embodiments, the crosslinking may be incomplete and a minority (i.e., less than 50% of the polymers, based upon the total number of polymers) of the polymers within the microparticle will be crosslinked. However, as long as the crosslinking is sufficient to provide at least a portion of the properties described herein to the gum base and/or chewing gum, the amount of crosslinking will be sufficient for use in at least certain embodiments of the present invention.

[0025] Generally speaking, the polymers used in the microparticles may desirably be crosslinked to a sufficient degree as to prevent, or reduce the degree of, permanent deformation of the microparticles when exposed to pressures, temperatures and shear forces expected in the course of manufacture, consumption and disposal. Conversely, the polymer(s) should not be crosslinked to an extent that could result in the microparticle being brittle and/or incapable of being temporarily deformed. Insufficient polymer crosslinking may result in excessive difficulty in removing cuds comprising the polymeric microparticles from environmental surfaces. On the other hand, excessive polymer crosslinking may result in a gum base that has insufficient adhesion between the microparticles and/or is excessively hard for optimal chewing enjoyment by the consumer.

[0026] Those of ordinary skill in the art are readily able to determine a level of crosslinking within these practical limits. For those requiring further guidance, reference can be made to ASTM method D2765, Standard Test Methods for Determination of Gel Content and Swell Ratio of Crosslinked Ethylene Plastics. In general, polymers having a gel content of at least 25%, or at least 50%, or at least 75%, as tested by this method, are considered to have suitable crosslinking for use in the microparticles of the present invention. In some embodiments, polymers having a gel content between about 80% and 100%, as measured by ASTM D-2675, are suitable for use in the microparticles described herein.

[0027] Using a crosslinked polymer having an appropriate complex modulus is expected to at least assist in providing the present gum base with appropriate and/or acceptable chew properties.

[0028] More particularly, crosslinked polymers having a complex modulus G* at 25° C. of less than about 10^9 dyne/cm^2 (10^8 Pa), less than about 10^8 dyne/cm^2 (10^7 Pa), less than 10^7 dyne/cm^2 (10^6 Pa) or, in some embodiments, even less than about 10^6 dyne/cm^2 (10^5 Pa) can assist in providing chewing gum bases and chewing gums with desirable chew properties. In the case of the polymer(s) having a complex modulus G* at 25° C. or greater than about 10^7 or 10^8 dyne/cm^2 (10^6 or 10^7 Pa) or even greater, it may be desirable to combine the polymer with a plasticizer to reduce effective complex modulus G* to ensure proper chewing texture. In some embodiments, the polymer may desirably have a complex modulus G* at 25° C. of greater than about 10^4 dyne/cm^2 (10^3 Pa) or greater than about 10^5 dyne/cm^2 (10^4 Pa) or even greater than 10^6 dyne/cm^2 (10^5 Pa) to provide a firm texture during chewing.

[0029] Using a crosslinked polymer with an appropriate glass transition temperature may also assist in providing the gum base with appropriate and/or acceptable chew properties. Crosslinked polymers having a glass transition temperature of less than about 30° C., or less than about 10° C. or even less than about 0° C., are expected to at least assist in providing the gum base with chew properties similar to, or better than, conventional gum bases.

[0030] The crosslinked polymer is desirably safe for use in chewing gums, and potentially ingestion. In some embodiments, the polymer used will be food grade. As used herein, the term 'food grade' is meant to indicate that the polymer meets all legal requirements for use in a food product in the intended market. While requirements for being food grade vary from country to country, food grade polymers intended for use as masticatory substances (i.e. gum base) may typically have to: i) be approved by the appropriate local food regulatory agency for this purpose; ii) be manufactured under "Good Manufacturing Practices" (GMPs) which may be defined by local regulatory agencies, such practices ensuring adequate levels of cleanliness and safety for the manufacturing of food materials; iii) be manufactured with food grade materials (including reagents, catalysts, solvents and antioxidants) or materials that at least meet standards for quality and purity; iv) meet minimum standards for quality and the level and nature of any impurities present; v) be provided with an adequately documented manufacturing history to ensure compliance with the appropriate standards; and/or vi) be manufactured in a facility that itself is subject to inspection by governmental regulatory agencies. All of these standards may not apply in all jurisdictions, and all that is required in those embodiments wherein the polymer is desirably food grade is that the polymer meets the standards required by the particular jurisdiction.

[0031] For example, in the United States, ingredients are approved for use in food products by the Food and Drug Administration. In order to gain approval for a new food or color additive, a manufacturer or other sponsor must petition the FDA for its approval. Petition is not necessary for prior-sanctioned substances or ingredients generally recognized as safe (GRAS ingredients) and these are specifically included within the meaning of the term "food grade" as used herein. Information on the regulatory process for food additives and colorants in the U.S. can be found at http://www.fda.gov/Food/FoodIngredientsPackaging/ucm094211.htm, the entire contents of which are incorporated by reference herein for any and all purposes.

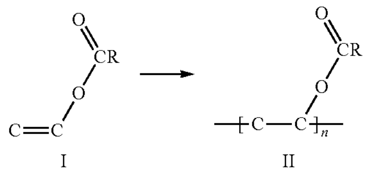
[0032] In Europe, one example of a governing agency is the European Commission, Enterprise and Industry. Information of the European Commission's regulation of the food industry in Europe can be found at http://ec.europa.eu/enterprise/sectors/food/index en.htm, the entire contents of which are incorporated by reference herein for any and all purposes.

[0033] Any polymer(s) capable of exhibiting at least a portion of the desired properties may be suitable for use in the microparticles, and thus gum base, described herein. Polymers that are capable of exhibiting the desired properties if plasticized sufficiently are also suitable for use. Examples of such polymers include, but are not limited to, acrylics, styrene butadiene rubber, nitrile rubber, neoprene, butyl, polyisobutylene, polysulfide, silicone, casein, polyamide from dimer acid, natural rubber, oleoresinous, polyvinyl acetate and copolymers, polyvinyl alcohol, polyvinyl butyral, polyvinyl chloride and copolymers, ethylene-vinyl acetate, polyethylene, Nylon, poly(ethylene terephthalate), phenol-formaldehyde, urea-formaldehyde, melamine formaldehyde, Epoxy, polyester, polyurethane, starch, dextrin, animal glue, wheat flour, soya flour. Graft, random, alternating or block copolymers of these are also suitable Other crosslinked polyvinyl acetate or crosslinked polysiloxane polymers which might otherwise be above the desirable T_g and/or modulus ranges may be used if the crosslinked polymers are suitably plasticized to reduce the T_g and/or modulus values to within the desirable ranges. Unless otherwise stated, the glass transition temperatures cited are for the plasticized crosslinked polymer in cases where a plasticizer is used. Combinations of any of these are also suitable. The desired polymer may typically be prepared from one or more monomer(s). Suitable monomers will depend upon the polymer desirably being prepared.

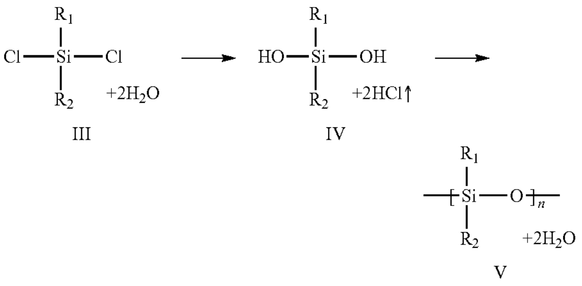
[0034] In preferred embodiments, the polymer comprises at least one crosslinked polymer that may be prepared from a corresponding monomer. Suitable monomers include monofunctional vinylalkanoate, vinylalkenoate, vinylaryloate and silanes. Typically silanes will be in the form of a dichlorosilane which is hydrolysed to a silane diol before polymerization to a polysiloxane.

[0035] Examples of monofunctional monomers suitable for use in preparing the microparticles of the present invention thus include, but are not limited to vinyl acetate, vinyl propanoate, vinyl butenoate, vinyl benzoate, dimethyldichlorosilane, dimethyldiacetalsilane and diphenyldichlorosilane. Copolymers and combinations of these are preferred for use in some embodiments of the gum base.

[0036] Vinyl alkanoates, alkenoates and aryloates are generically shown as (I) below where R represents an alkane, and alkene or a aryl group which is attached to a vinyl (ethenyl) group through an ester linkage. Typically the ester group will comprise two to ten carbon atoms in the case of alkanoates, three to ten carbon atoms in the case of alkenoates or seven to twelve carbon atoms in the case of aryloates. During polymerization, the double bonds in the vinyl groups react with each other through a free radical polymerization reaction to produce a carbon-carbon (alkanyl) backbone with ester groups (alkanoate, alkenoate or aryloate) attached to every other carbon in the backbone (II).



[0037] Dichlorosilanes are shown generically as (III) below where R_1 and R_2 may be independently taken as an alkyl, alkanyl or aryl group. Typically the R_1 and R_2 groups will comprise two to ten carbon atoms in the case of alkyls, three to ten carbon atoms in the case of alkenyls or seven to twelve carbon atoms in the case of aryls. During polymerization, the dichlorosilane reacts with water to initially form a silane diol (IV) which then polymerizes to a polysiloxane (V) through a spontaneous condensation reaction.



[0038] At least one crosslinking agent may be used to produce the crosslinked polymer. The crosslinking agent(s) chosen, and effective amounts thereof, will depend on the polymer desirably crosslinked. The crosslinking agent may be a multifunctional variant of the monomer used to make the polymer and can be readily selected and optimized by those of ordinary skill in the art. For example, in those embodiments wherein the polymer desirably comprises a vinyl polymer, a suitable crosslinking agent may be a divinyl compound such as adipic acid divinyl ester. In those embodiments wherein the polymer desirably comprises a polysiloxane, a suitable crosslinking agent may be methyltrichlorosilane, tetrachlorosilane dithylene glycol di(meth)acrylate and derivatives, methylenebisacrylamide and derivatives, or divinylbenzene.

[0039] In addition to homopolymers of vinylalkanoate, vinylalkenoate, vinylaryloate and silane monomers, the present invention contemplates copolymers of any of these. These may be copolymers of two or more monomers in the above list including random copolymers, alternating copolymers, block copolymers, graft copolymers and combinations of these.

[0040] The crosslinked polymer is desirably provided in the form of a microparticle, i.e., a particle having a largest dimension of at least about 0.1 microns or at least about 0.5 microns or at least about 10 microns. The microparticles may have a largest dimension of less than about 1000 microns, or less than about 500 microns or less than about 100 microns. While not wishing to be bound by any theory, it is believed that providing the crosslinked polymer in such a form can assist in enhancing the removability of the gum bases and chewing gums, e.g., since the microparticles are of a size that will not allow them to flow into the topography of many environmental surfaces, while yet preserving the chewability of the gum bases and chewing gums.

[0041] The shape of the microparticles is not critical and they may be irregularly shaped, or of any shape, e.g., the particles may be in the form of rods, cylinders, spheres, cubes, ovals, etc. In some embodiments, the microparticles may be generally spherical. In such embodiments, the generally spherical microparticles may desirably have diameters of from about 0.1 microns to about 1000 microns, or from about 0.5 microns to about 500 microns, or even from about 10 microns to about 100 microns.

[0042] The desired polymer may be formed into microparticles by any of a number of techniques known to those of ordinary skill in the art.

[0043] If desirably prepared, the polymers may be provided in a microparticle form by a suspension polymerization process in which one or more monofunctional monomers are reacted along with at least one multifunctional crosslinking agent. The reactants will be present as suspended droplets, preferably by subjecting them to mechanical dispersion in an appropriate continuous phase. The particle size of the microparticles can be controlled by adjusting the ratio of the phases, with a greater imbalance in the ratio tending to produce smaller microparticles. Particle size may also be controlled via use of a surfactant, and the adjustment of any amounts thereof or through variations in the temperature of the reaction. Increasing the intensity of agitation will also tend to produce smaller microparticles.

[0044] Alternatively, if the microparticles are provided in the form of a solvent dispersion. They may be mechanically separated from the dispersion medium by chemical or mechanical means such as evaporation, salting out, centrifugation, precipitation or filtration before blending with other gum base or chewing gum components.

[0045] One exemplary method for forming microparticles is described in U.S. Pat. No. 3,691,140, incorporated by reference herein in its entirety, to the extent that it is not contradictory with the teachings provided herein.

[0046] The gum bases described herein contain at least one population of the microparticles described herein, although it is to be understood that the gum base may comprise any number of such populations. In such embodiments, each population may comprise the same polymer, but may be processed differently or comprise different additional components, so that the properties of each population are different. Or, each of the populations may comprise the same polymer, but one population of microparticles may have a different particle size distribution or average largest dimension than the other(s). Of course, each of the populations may also comprise a different polymer, or combinations of polymers, such as a mixture of polyvinyl alkanoate microparticles with polysiloxane microparticles. Such blends of different microparticle populations allow flexibility in formulating products with optimal balance of texture, flavor release, removability, manufacturing ease and cost

[0047] The microparticles may be the sole component of the gum base described herein, or the gum base may comprise additional ingredients, if desired. For example, the microparticles may comprise from about 0.1 wt % to about 99 wt %, or from about 1 wt % to about 70 wt %, or from about 5 wt % to about 40 wt %, based upon the total weight of the gum base.

[0048] In order to further enhance the removability of cuds formed from chewing gums comprising the gum bases described herein, it may be desirable to incorporate other known removability-enhancing features into the gum base and/or chewing gum.

[0049] For example, certain additives such as emulsifiers and amphiphilic polymers may be added. Another additive which may prove useful is a polymer having a straight or branched chain carbon-carbon polymer backbone and a multiplicity of side chains attached to the backbone as disclosed in WO 06-016179 hereby incorporated by reference herein in its entirety for any and all purposes, to the extent that it is not contradictory to the teachings provided herein. Still another additive which may enhance removability is a polymer comprising hydrolyzable units or an ester and/or ether of such a polymer. One such polymer comprising hydrolyzable units is a copolymer sold under the Trade name Gantrez®. Addition of such polymers at levels of from about 1 wt % to about 20 wt % based upon the total weight of the chewing gum base may reduce adhesion of discarded gum cuds.

[0050] Another approach to enhancing removability of the present invention involves formulating gum bases to contain less than 5% (i.e. 0 to 5%) of a calcium carbonate and/or talc filler and/or 5 to 40% amorphous silica filler. Formulating gum bases to contain 5 to 15% of high molecular weight polyisobutylene (for example, polyisobutylene having a weight average or number average molecular weight of at least 200,000 Daltons) is also effective in enhancing removability.

[0051] In those embodiments of the invention wherein the gum base desirably includes ingredients or components in addition to the microparticles, any components typically found in gum bases may be included. For example, the microparticles may be combined with one or more elastomers, elastomer solvents, softeners, resins, fillers, colors, antioxidants, emulsifiers or mixtures thereof and other conventional gum base components.

[0052] In some embodiments, the microparticles may be used as the sole elastomer, while in others the microparticles may be combined with other base elastomers, and elastomer solvents suitable for use in gum bases.

[0053] In some embodiments, significant amounts (more than 1 wt %) of these conventional elastomers and elastomer solvents are not incorporated into a gum base of the present invention, i.e., the elastomer component of gum bases disclosed herein may contain up to about 100 wt % of the microparticles disclosed herein.

[0054] In other embodiments, mixtures of the microparticles with any of the elastomers described below may be used in the present gum bases. For example, the present gum bases may include at least about 10 wt %, or at least about 30 wt %, or at least about 50 wt % or even at least about 70 wt % microparticles by weight of the total elastomer content, in combination with any other desired elastomer(s).

[0055] A typical elastomeric component of the gum bases described herein contains between 10 wt % to 100 wt % microparticles and preferably 50 wt % to 100 wt % microparticles. A gum base having an elastomer component containing from about 75 wt % to about 90 wt %, or from about 90 wt % to about 100 wt. % microparticles is also useful.

[0056] Suitable other elastomers, where used, include synthetic elastomers including polyisobutylene, isobutylene-isoprene copolymers (butyl rubber), styrene-butadiene copolymers, polyisoprene and combinations thereof. Natural elastomers that can be used include natural rubbers such as chicle, jelutong, lechi caspi, perillo, sorva, massaranduba balata, massaranduba chocolate, nispero, rosindinha, chicle, gutta hang kang, and combinations thereof. Additionally, biopolymers, such as those based on modified or unmodified proteins and carbohydrates, may be used as elastomers. Such biopolymers may have the advantage of enhancing the biodegradability of the gum cud after it is discarded.

[0057] Elastomer solvents commonly used for synthetic elastomers may be optionally used in this invention including but are not limited to, natural rosin esters, often called ester-gums, such as glycerol esters of partially hydrogenated rosin, glycerol esters of polymerized rosin, glycerol esters of partially or fully dimerized rosin, glycerol esters of rosin, pentaerythritol esters of partially hydrogenated rosin, methyl and partially hydrogenated methyl esters of rosin, pentaerythritol esters of rosin, glycerol esters of wood rosin, glycerol esters of gum rosin; synthetics such as terpene resins derived from alpha-pinene, beta-pinene, and/or d-limonene; and any suitable combinations of the foregoing. The preferred elastomer solvents also will vary depending on the specific application, and on the type of elastomer which is used.

[0058] Softeners (including emulsifiers) may be added to gum bases in order to optimize the chewability and mouth feel of a chewing gum based upon the same. Softeners/emulsifiers that typically are used include tallow, hydrogenated tallow, hydrogenated and partially hydrogenated vegetable oils, cocoa butter, mono- and di-glycerides such as glycerol monostearate, glycerol triacetate, lecithin, paraffin wax, microcrystalline wax, natural waxes and combinations thereof. Lecithin and mono- and di-glycerides also function as emulsifiers to improve compatibility of the various gum base components. Further, a typical gum base may include at least about 5 wt %, or at least about 10 wt % softener, or up to about 30 wt % and more typically up to about 40 wt % softener, based upon the total weight of the gum base.

[0059] The gum bases of the present invention may optionally include plastic resins. These include polyvinyl acetate, vinyl acetate-vinyl laurate copolymer having vinyl laurate content of about 5 to about 50 percent by weight of the copolymer, and combinations thereof. Preferred weight average molecular weights (by GPC) for polyvinyl acetate are 2,000 to 90,000 or 10,000 to 65,000 (with higher molecular weight polyvinyl acetates typically used in bubble gum bases). For vinyl acetate-vinyl laurate, vinyl laurate content of from about 10 wt % to about 45 wt % of the copolymer is preferred. Where used, plastic resins may constitute 5 to 35 wt. % of the gum base composition.

[0060] Fillers/texturizers typically are inorganic, water-insoluble powders such as magnesium and calcium carbonate, ground limestone, silicate types such as magnesium and aluminum silicate, clay, alumina, talc, titanium oxide, mono-, di- and tri-calcium phosphate and calcium sulfate. Insoluble organic fillers including cellulose polymers such as wood as well as combinations of any of these also may be used. If used, fillers may typically be included in amounts from about 4 wt % to about 50 wt % filler, based upon the total weight of the gum base. However, in some embodiments, it is preferred that the use of common inorganic fillers be minimized such as by limiting their use to less than 5 wt. % and preferably less than 3 wt. % or even 0 percent as a means of further reducing the adhesive properties of the chewed cud.

[0061] Colorants and whiteners may include FD&C-type dyes and lakes, fruit and vegetable extracts, titanium dioxide, and combinations thereof. Antioxidants such as BHA, BHT, tocopherols, propyl gallate and other food acceptable antioxidants may be employed to prevent oxidation of fats, oils and elastomers in the gum base.

[0062] The gum base described herein may include wax or be wax-free. An example of a wax-free gum base is disclosed in U.S. Pat. No. 5,286,500, the disclosure of which is incorporated herein by reference to the extent that it is consistent with the teachings provided herein. It is preferred that the gum bases of the present invention be free of paraffin wax.

[0063] A typical gum base useful in this invention may include from about 0.1 wt % to about 98 wt % microparticles, from about 0 wt % to about 20 wt % synthetic elastomer, from about 0 wt % to about 20 wt % natural elastomer, from about 0 wt % to about 40 wt % elastomer solvent, from about 0 wt % to about 50 wt % filler/texturizer, from about 0 wt % to about 40 wt. % softener/emulsifier, from about 5 wt % to about 35 wt % plastic resin, and about 2 wt % or less, or less than about 1 wt % of miscellaneous ingredients such as colorants, antioxidants, and the like.

[0064] The microparticles may be processed into the gum base according to any known method of doing so. The microparticles may be used as prepared or purchased, typically in an aqueous suspension. In those embodiments wherein the microparticles are provided or purchased as a suspension, the microparticle suspension may be dehydrated prior to inclusion in, or use as, the gum base.

[0065] If used as an aqueous suspension, one exemplary method of manufacturing a gum base comprising the polymeric microparticles includes adding the microparticle suspension to a mixer followed by at least one of an elastomer, an elastomer solvent, a filler/texturizer, emulsifier/softener, plastic resin, color and/or antioxidant to the mixer. the desired components are mixed at elevated temperature, e.g., from about 100° C. to about 120° C., for a time sufficient to evaporate at least a majority of the liquid, and discharging the gum base from the mixer. Any desired additional ingredients may be added by conventional batch mixing processes or continuous mixing processes. Process temperatures are generally from about 120° C. to about 180° C. in the case of a batch process.

[0066] If it is desired to combine the polymeric microparticles with conventional elastomers, it is preferred that the conventional elastomers be formulated into a conventional gum base before combining with the microparticle gum base.

[0067] To produce a conventional gum base, the elastomers are typically first ground or shredded along with at least a portion of any desired filler. Then the ground elastomer is transferred to a batch mixer for compounding. Any standard, commercially available mixer (e.g., a Sigma blade mixer) may be used for this purpose. Compounding typically involves combining the ground elastomer with filler and elastomer solvent and mixing until a homogeneous mixture is produced, typically for about 30 to about 70 minutes.

[0068] Thereafter, any desired additional filler and elastomer plasticizer(s) are added followed by softeners, while mixing to homogeneity after each addition. Minor ingredients such as antioxidants and color may be added at any time in the process. The conventional base is then blended with the microparticle-containing gum base in the desired ratio.

[0069] Where microparticles are combined with conventional elastomers and/or other base components, the completed base may be extruded or cast into any desirable shape (e.g., balls, pellets, sheets or slabs) and allowed to cool and solidify. In some cases, it may be preferable to use an underwater pelletization process for this purpose.

[0070] Alternatively, the gum base may be compounded with both conventional elastomers and microparticles, or, any desired conventional elastomers and the polymeric microparticles may be added separately to a gum base mixing operation along with other chewing gum components.

[0071] Continuous processes using mixing extruders, which are generally known in the art, may also be used to prepare the gum base. In a typical continuous mixing process, initial ingredients (including ground elastomer, if used) are metered continuously into extruder ports various points along the length of the extruder corresponding to the batch processing sequence. If the microparticles are to be compounded into the base, a metering extruder or other specialized means to meter the microparticles into the compounding extruder may be used.

[0072] After the initial ingredients have mixed homogeneously and have been sufficiently compounded, the balance of the base ingredients are metered into ports or injected at various points along the length of the extruder. Typically, any remainder of elastomer component or other components are added after the initial compounding stage. The composition is then further processed to produce a homogeneous mass before discharging from the extruder outlet. Typically, the transit time through the extruder will be less than an hour.

[0073] Exemplary methods of extrusion, which may optionally be used in accordance with the present invention, include the following, the entire contents of each being incorporated herein by reference to the extent that they do not contradict the teachings herein: (i) U.S. Pat. No. 6,238,710, which describes a method for continuous chewing gum base manufacturing, which entails compounding all ingredients in a single extruder; (ii) U.S. Pat. No. 6,086,925 which discloses the manufacture of chewing gum base by adding a hard elastomer, a filler and a lubricating agent to a continuous mixer; (iii) U.S. Pat. No. 5,419,919 which discloses continuous gum base manufacture using a paddle mixer by selectively feeding different ingredients at different locations on the mixer; and, (iv) U.S. Pat. No. 5,397,580 which discloses continuous gum base manufacture wherein two continuous mixers are arranged in series and the blend from the first continuous mixer is continuously added to the second extruder.

[0074] A typical gum base comprising the microparticles as described herein may desirably have a shear modulus (the measure of the resistance to the deformation) of from about 1 kPa (10000 dyne/cm^2) to about 600 kPa (6×10^6 dyne/cm^2) at 40° C. (measured on a Rheometric Dynamic Analyzer with dynamic temperature steps, 0-100° C. at 3° C./min; parallel plate; 0.5% strain; 10 rad/s). A preferred gum base according to some embodiments of the present invention may have a shear modulus of from about 5 kPa (50000 dyne/cm^2) to about 300 kPa (3×10^6 dyne/cm^2), or even from about 10 kPa (1×10^5 dyne/cm^2) to about 70 kPa (7×10^5 dyne/cm^2).

[0075] A variety chewing gum formulations including the gum bases described herein can be created and/or manufactured in accordance with the present invention. Because of the inclusion of the polymeric microparticles described herein into the inventive gum base and chewing gum, a gum cud formed from the chewing gum is more easily removed from surfaces onto which it may become adhered than gum cuds formed from chewing gums comprising conventional gum bases.

[0076] The gum base described herein may constitute from about 0.1 wt % to about 98 wt % by weight of the chewing gum. More typically, the inventive gum base may constitute from about 10 wt % to about 50 wt % of the chewing gum and, in various preferred embodiments, may constitute from about 20 wt % to about 35% by weight of the chewing gum.

[0077] In some embodiments, the gum bases described herein may be used to replace conventional gum bases in chewing gum formulas. In such embodiments, the gum base may comprise from about 15 wt % to about 50 wt % of the chewing gum.

[0078] Or the gum bases described herein may be used in combination with conventional gum bases, in any amount or ratio. In such embodiments, the gum base described herein may comprise from about 0.1 wt % to about 30 wt % of the chewing gum.

[0079] Any of the removability enhancing components discussed herein may also be added to the chewing gum, either instead of, or in addition to, any amount thereof added to the gum base. For example, a polymer comprising hydrolysable units or an ester or ether of such a polymer may be added to the chewing gum at levels of from about 1 wt % to about 7 wt % based upon the total weight of the chewing gum.

[0080] Further, in some embodiments, high levels of emulsifiers such as powdered lecithin may be incorporated into the chewing gum at levels of 3 to 7% by weight of the chewing gum in order to enhance the removability of gum cuds produced therefrom. In such embodiments, it may be advantageous to spray dry or otherwise encapsulate the emulsifier to delay its release.

[0081] Any combination of any number of the described approaches may be employed simultaneously to achieve improved removability. Further, and as described above, the described removability enhancing components, or any other components known to those of ordinary skill in the art to be useful for this purpose, may be incorporated into the gum base and/or chewing gum.

[0082] In one exemplary embodiment, removability of gum cuds formed from the chewing gums comprising the gum bases disclosed herein can be further enhanced by incorporating at least one of from about 0 wt % to about 5 wt % of a calcium carbonate or talc filler, from about 5 wt % to about 40 wt % amorphous silica filler, from about 5 wt % to about 15 wt % high molecular weight polyisobutylene, from about 1 wt % to about 20 wt % of a polymer having a straight or branched chain carbon-carbon polymer backbone and a multiplicity of side chains attached to the backbone, based upon the total weight of the gum base, into the gum base. The gum base according to this embodiment may then be formed into a chewing gum further comprising 3 to 7% of an emulsifier, such as lecithin, which is preferably encapsulated such as by spray drying.

[0083] In addition to the gum base, chewing gum typically includes a bulk portion which may include bulking agents, high intensity sweeteners, one or more flavoring agents, water-soluble softeners, binders, emulsifiers, colorants, acidulants, antioxidants, and other components that provide attributes desired by consumers of chewing gum. Any or all of these may be included in the present chewing gums.

[0084] In some embodiments, one or more bulking agent(s) or bulk sweetener(s) may be provided in chewing gums described herein to provide sweetness, bulk and texture to the chewing gum. Bulking agents may also be selected to allow marketing claims to be used in association with the chewing gums. That is, if it is desirable to promote a chewing gum as low calorie, low calorie bulking agents such as polydextrose may be used, or, if the chewing gum is desirably promoted as comprising natural ingredients, natural bulking agents such as isomaltulose, inulin, agave syrup or powder, erythritol, starches and some dextrins may be used. Combinations of any of the above bulking agents may also be used in the present invention.

[0085] Typical bulking agents include sugars, sugar alcohols, and combinations thereof. Sugar bulking agents generally include saccharide-containing components commonly known in the chewing gum art, including, but not limited to, sucrose, dextrose, maltose, dextrin, dried invert sugar, fructose, levulose, galactose, corn syrup solids, and the like, alone or in combination. In sugarless gums, sugar alcohols such as sorbitol, maltitol, erythritol, isomalt, mannitol, xylitol and combinations thereof are substituted for sugar bulking agents.

[0086] Bulking agents typically constitute from about 5 wt % to about 95 wt % of the total weight of the chewing gum, more typically from about 20 wt % to about 80 wt % and, still more typically, from about 30 wt % to about 70 wt % of the total weight of the chewing gum.

[0087] If desired, it is possible to reduce or eliminate the bulking agent to provide a reduced calorie or calorie-free chewing gum. In such embodiments, the microparticles/gum base may comprise up to about 98 wt % of the chewing gum. Or, a low caloric bulking agent can be used. Examples of low caloric bulking agents include, but are not limited to, polydextrose; Raftilose; Raftilin; fructooligosaccharides (NutraFlora®); Palatinose oligosaccharide; Guar Gum Hydrolysate (Sun Fiber®); or indigestible dextrin (Fibersol®). The caloric content of a chewing gum can also be reduced by increasing the relative level of gum base while reducing the level of caloric sweeteners in the product. This can be done with or without an accompanying decrease in piece weight.

[0088] For example, in these and other embodiments, high intensity artificial sweeteners can be used alone or in combination with the bulk sweeteners. Preferred sweeteners include, but are not limited to sucralose, aspartame, salts of acesulfame, alitame, neotame, saccharin and its salts, cyclamic acid and its salts, glycyrrhizin, stevia and stevia derivatives such as Rebaudoside A, dihydrochalcones, lo han guo, thaumatin, monellin, etc., or combinations of these. In order to provide longer lasting sweetness and flavor perception, it may be desirable to encapsulate or otherwise control the release of at least a portion of the artificial sweetener. Techniques such as wet granulation, wax granulation, spray drying, spray chilling, fluid bed coating, coacervation, and fiber extrusion may be used to achieve the desired release characteristics.

[0089] Usage level of the artificial sweetener will vary greatly and will depend on such factors as potency of the sweetener, rate of release, desired sweetness of the product, level and type of flavor used and cost considerations. Generally speaking, appropriate levels of artificial sweeteners thus may vary from about 0.02 wt % to about 8 wt %. When carriers used for encapsulation are included, the usage level of the encapsulated sweetener will be proportionately higher.

[0090] A variety of natural or artificial flavoring agents, and may be used in any number or combination, if desired. Flavoring agents may include essential oils, natural extracts, synthetic flavors or mixtures thereof including, but not limited to, oils derived from plants and fruits such as citrus oils, fruit essences, peppermint oil, spearmint oil, other mint oils, clove oil, oil of wintergreen, anise and the like.

[0091] Artificial flavoring agents and components may also be used. Sensate components which impart a perceived tingling or thermal response while chewing, such as a cooling or heating effect, also may be included. Such components include cyclic and acyclic carboxamides, menthol and menthol derivatives such as menthyl esters of food acceptable acids, and capsaicin among others. Acidulants may be included to impart tartness.

[0092] The desired flavoring agent(s) can be used in amounts of from approximately 0.1 wt % to about 15 wt % of the gum, and preferably, from about 0.2 wt % to about 5 wt %.

[0093] Water-soluble softeners, which may also be known as water-soluble plasticizers, plasticizing agents, binders or binding agents, generally constitute between approximately 0.5 wt % to about 15 wt % of the chewing gum. Water-soluble softeners may include glycerin, propylene glycol, and combinations thereof.

[0094] Syrups or high-solids solutions of sugars and/or sugar alcohols such as sorbitol solutions, hydrogenated starch hydrolysates (HSH), corn syrup and combinations thereof, may also be used. In the case of sugar gums, corn syrups and other dextrose syrups (which contain dextrose and significant amounts higher saccharides) are most commonly employed. These include syrups of various DE levels including high-maltose syrups and high fructose syrups. In some cases, low-moisture syrups can replace some or all of the bulking agents typically use, in which case usage levels of the syrup may extend up to 50 wt. % or more of the total gum composition. In the case of sugarless products, solutions of sugar alcohols including sorbitol solutions and hydrogenated starch hydrolysate syrups are commonly used.

[0095] Also useful are syrups such as those disclosed in U.S. Pat. No. 5,651,936 and US 2004-234648 which are incorporated herein by reference. Such syrups serve to soften the initial chew of the product, reduce crumbliness and brittleness and increase flexibility in stick and tab products. They may also control moisture gain or loss and provide a degree of sweetness depending on the particular syrup employed.

[0096] In some embodiments, an active agent such as a drug, a dental health ingredients or dietary supplement can be used in combination with the gums and gum bases of the present invention. In such cases, the active agent may be incorporated into the gum base, the chewing gum or into associated non-gum portions of a finished product such as into a coating or a candy layer. In some cases, the active may be encapsulated to control its release or to protect it from other product ingredients or environmental factors.

[0097] The chewing gum formulations provided herein may also comprise one or more other ingredients conventional in the art, such as gum emulsifiers, colorants, acidulants, fillers, antioxidants and the like. Such ingredients may be used in the present chewing gum formulations in amounts and in accordance with procedures well known in the art of chewing gum manufacture.

[0098] Chewing gum is generally manufactured by sequentially adding the various chewing gum ingredients, including the gum base, to commercially available mixers known in the art. After the ingredients have been thoroughly mixed, the chewing gum mass is discharged from the mixer and shaped into the desired form, such as by rolling into sheets and cutting into sticks, tabs or pellets or by extruding and cutting into chunks.

[0099] In some embodiments, the chewing gum may be prepared according to a batch process. In such a process, the ingredients are mixed by first melting the gum base and adding it to the running mixer. The gum base may alternatively be melted in the mixer. Color and emulsifiers may be added at this time.

[0100] A chewing gum softener such as glycerin can be added next along with a portion of the bulking agent. Further portions of the bulking agent may then be added to the mixer. Flavoring agents are typically added with the final portion of the bulking agent. The entire mixing process typically takes from about five to about fifteen minutes, although longer mixing times are sometimes required.

[0101] In other embodiments, it may be possible to prepare the gum base and chewing gum in a single high-efficiency extruder as disclosed in U.S. Pat. No. 5,543,160. Chewing gums of the present invention may be prepared by a continuous process comprising the steps of: a) adding gum base ingredients into a high efficiency continuous mixer; b) mixing the ingredients to produce a homogeneous gum base, c) adding at least one sweetener and at least one flavor into the continuous mixer, and mixing the sweetener and flavor with the remaining ingredients to form a chewing gum product; and d) discharging the mixed chewing gum mass from the single high efficiency continuous mixer. In yet another alternative, a finished gum base may be metered into a continuous extruder along with other gum ingredients to continuously produce a chewing gum composition.

[0102] The resultant chewing gums may be formed into sticks, tabs, chunks, tapes, coated or uncoated pellets or balls or any other desired form. In some embodiments, the chewing gum formulation may be used as a component of a greater confectionery product, for example as a center in a hard candy such as a lollipop or as one or more layers of a layered confection which also comprises non-gum confectionery layers.

[0103] Of course, many variations on the basic gum base and chewing gum mixing processes are possible.

EXAMPLES

[0104] The following examples of the invention illustrate certain aspects and embodiments of the present invention, but do not limit the invention described and claimed. Amounts listed are in weight percent, based upon the total weight of the gum base, or chewing gum, as the case may be.

Example 1

[0105] Cross-linked polymer beads can be prepared by suspension polymerization technique where polymerization is carried out in an aqueous phase containing a stabilizer such an emulsifier. Vinyl acetate monomer, adipic acid divinyl ester and sodium lauryl sulfate (SLS) are dispersed in water. The dispersion is introduced into a vessel reactor such as shown in FIG. **1**. Potassium peroxide is added as an initiator. The reactor is flushed by bubbling nitrogen and then is sealed. The polymerization is carried out at an elevated temperature for several hours resulting in polymeric microparticles of crosslinked polyvinyl acetate suspended in water. The microparticles can be recovered by filtration or centrifugation and washing.

Example 2

[0106] Crosslinked Polyvinylbenzoate microparticles can be prepared by a process similar to that in Example 1 from vinylbenzoate monomer.

Example 4

[0107] Crosslinked Polyvinyl laurate microparticles can be prepared by a process similar to that in Example 1 from vinyl laurate monomer

Example 5

[0108] Crosslinked Polyvinyl acetate co vinyl laurate microparticles can be prepared by a process similar to that in Example 1 from a mixture of vinyl acetate and vinyl laurate monomer.

Example 6

[0109] Crosslinked Polydimethylsiloxane microparticles can be prepared by a process similar to that in Example 1.

[0110] Preparation of silicone microspheres by emulsion polymerization: Application to the encapsulation of a hydrophilic drug, Journal of Microencapsulation, 1998, Vol. 15, No. 2, Pages 227-236.

Example 7

[0111] Crosslinked Polydiphenylsiloxane microparticles can be prepared by a process similar to that in Example 5.

Examples 8-13

[0112] Gum bases can be prepared according to the formulas in Table 1.

TABLE 1

Ingredient	Ex. 8	Ex. 9	Ex. 10	Ex. 11	Ex. 12	Ex. 13
Butyl Rubber	—	—	—	—	—	4.00
Polyisobutylene	—	—	—	—	—	0.80
Polyvinyl acetate	—	—	—	—	—	12.00
Terpene resin	—	—	—	—	—	11.00
Hydrogenated vegetable oil	—	—	—	—	—	8.50
Lecithin	—	—	—	—	—	1.60
Calcium carbonate	—	—	—	—	—	10.40
BHA	—	—	—	—	—	0.03
Microparticles of Ex. 1	100.00	—	—	—	—	—
Microparticles of Ex. 2	—	100.00	—	—	—	—
Microparticles of Ex. 3	—	—	60.00	—	—	—
Microparticles of Ex. 4	—	—	40.00	—	—	—
Microparticles of Ex. 5	—	—	—	100.00	—	—
Microparticles of Ex. 6	—	—	—	—	100.00	—
Microparticles of Ex. 7						51.67
Total	100.00	100.00	100.00	100.00	100.00	100.00

Examples 14-19

[0113] Chewing gums can be prepared according to the formulas in Table 2.

TABLE 2

Ingredient	Example 14	Example 15	Example 16	Example 17	Example 18	Example 19
Gum Base of Ex. 8	33.00	—	—	—	—	—
Gum Base of Ex. 9	—	33.00	—	—	—	—
Gum Base of Ex. 10	—	—	33.00	—	—	—
Gum Base of Ex. 11	—	—	—	20.00	—	—
Gum Base of Ex. 12	—	—	—		50.00	—
Gum Base of Ex. 13	—	—	—	20.00	—	33.00
Sorbitol	44.83	59.27	53.89	52.89	42.89	59.27
Calcium Carbonate	12.74	—	—	—	—	—
Glycerin	3.92	4.08	4.00	4.00	4.00	4.08
Maltitol	2.02	—	6.00	—	—	—
Peppermint Flavor	1.91	1.99	1.49	1.49	1.49	1.99
Lecithin	0.44	0.46	0.45	0.45	0.45	0.46
Menthol	0.34	0.36	0.35	0.35	0.35	0.36
Encapsulated Acesulfame K	0.33	0.35	0.34	0.34	0.34	0.35
Encapsulated Aspartame	0.33	0.35	0.34	0.34	0.34	0.35
Aspartame	0.14	0.14	0.14	0.14	0.14	0.14
Total	100.00	100.00	100.00	100.00	100.00	100.00

[0114] The chewing gum examples are expected to provide sensory experiences within the range of commercially acceptable products and to produce cuds that exhibit improved removability as compared to conventional chewing gum products.

[0115] All patents, patent applications, provisional applications, and publications referred to or cited herein are incorporated by reference in their entirety to the extent they are not inconsistent with the explicit teachings of this specification. Further, while only certain features of the invention have been illustrated and described herein, many modifications and changes will occur to those skilled in the art. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the true spirit of the invention.

1. A chewing gum base comprising microparticles containing at least one crosslinked polymer selected from the group consisting of crosslinked polyvinyl alkanoates, crosslinked polyvinyl alkenoates, crosslinked polyvinyl aryloates, crosslinked polysiloxanes, and copolymers and mixtures thereof.

2. The chewing gum base of claim **1**, wherein the crosslinked polymer has a glass transition temperature of less than about 30° C.

3. The chewing gum base of claim **1**, wherein the crosslinked polymer has a glass transition temperature of less than about 10° C.

4. The chewing gum base of claim **1**, wherein the crosslinked polymer has a glass transition temperature of less than about 0° C.

5. The chewing gum base of claim **4**, wherein the crosslinked polymer has a complex modulus G* at 25° C. of less than about 10^9 dyne/cm^2.

6. The chewing gum base of claim **1**, wherein the crosslinked polymer has a complex modulus G* at 25° C. of less than about 10^7 dyne/cm^2.

7. The chewing gum base of claim **6**, wherein the crosslinked polymer has a complex modulus G* at 25° C. of greater than about 10^4 dyne/cm^2.

8. The chewing gum base of claim **1**, wherein the crosslinked polymer has a complex modulus G* at 25° C. of greater than about 10^5 dyne/cm^2.

9. The chewing gum base of claim **8**, wherein the microparticles have a largest dimension of at least about 0.1 microns.

10. The chewing gum base of claim **9**, wherein the microparticles have a largest dimension of at least about 0.5 microns.

11. The chewing gum base of claim **10**, wherein the microparticles have a largest dimension of at least about 10 microns.

12. The chewing gum base of claim **11**, wherein the microparticles comprise a plasticized crosslinked polymer.

13. The chewing gum base of claim **11**, wherein the plasticized crosslinked polymer has a glass transition temperature of less than about 30° C.

14. The chewing gum base of claim **1**, wherein the plasticized crosslinked polymer has a glass transition temperature of less than about 10° C.

15. The chewing gum base of claim **1**, wherein the plasticized crosslinked polymer has a glass transition temperature of less than about 0° C.

16. The chewing gum base of claim **1**, wherein the microparticles comprise a food grade crosslinked polymer.

17-28. (canceled)

29. A chewing gum comprising a gum base comprising microparticles comprising at least one crosslinked polymer selected from the group consisting of crosslinked polyvinyl alkanoates, crosslinked polyvinyl alkenoates, crosslinked polyvinyl aryloates, crosslinked polysiloxanes, and copolymers and mixtures thereof.

30. The use of microparticles of crosslinked polymer selected from the group consisting of crosslinked polyvinyl alkanoates, crosslinked polyvinyl alkenoates, crosslinked polyvinyl aryloates, crosslinked polysiloxanes, and copolymers and mixtures thereof in a chewing gum.

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