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(54) **CLEANING APPARATUS**

REINIGUNGSVORRICHTUNG

DISPOSITIF DE NETTOYAGE

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Description

Field of Invention

[0001] This invention relates to cleaning apparatus adapted for the application of cleaning compositions to a substrate and for the mixing of two or more precursors of a cleaning composition to provide a composition adapted for the removal of cellulose based gums adhered to a substrate, for example for the removal of chewing gum residues from pavements.

Background

[0002] It is well known that chewing gum residues have a tendency to stick firmly to substrates with which they come into contact. Chewing gum residues on pavements are unsightly and, as the gum residue is substantially non-biodegradable, the residues tend to accumulate over time.

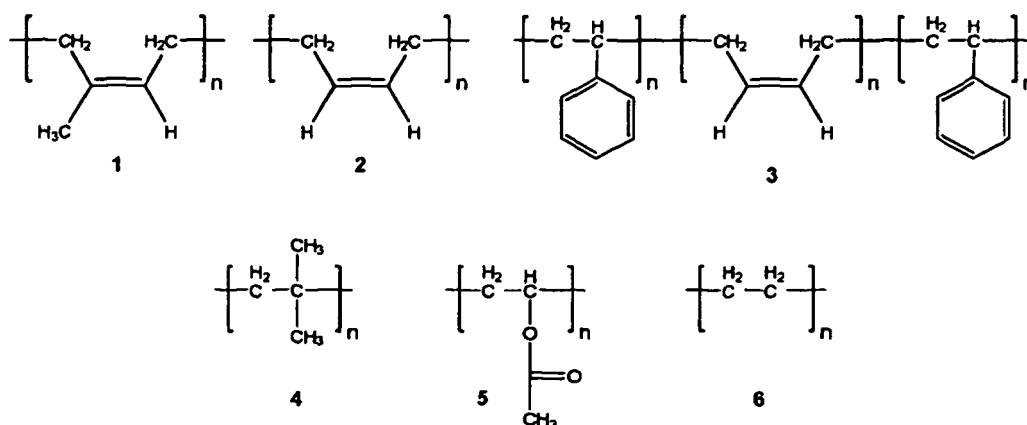
[0003] Conventional chewing gum compositions are a complex mixture of ingredients which comprise a water-soluble portion, which typically comprises sweeteners, flavourings, food colourings and fillers, and a water-insoluble portion, referred to as "gum base", which typically comprises elastomers (which provide the chewy, cohesive texture of the gum), plasticizers, softeners and waxes, together with auxiliaries such as emulsifiers and antioxidants. The gum base provides the textural and masticatory properties of chewing gum. It is the insoluble gum base which remains after the gum has been chewed, and thus it is this part of the gum which is responsible for the occurrence of unsightly deposits on pavements.

[0004] The amount of the various ingredients in a chewing gum composition depends on the type of gum. For instance, bubble gums generally contain lower amounts of gum base, e.g. 15 to 20% by weight, whereas normal chewing gums typically contain 25 to 33% by weight of gum base, although they may contain as much as 60% by weight of gum base.

[0005] All types of chewing gum, including bubble gum, are considered to be within the scope of the present invention. For instance, the present invention is considered to include chewing gums containing between 10 and 75% by weight of gum base.

[0006] Historically, gum base has been derived from natural gums such as chicle. Chicle is a gum derived from the sap of the *Sapodilla* tree, and is a natural polysaccharide elastomer of xylose in a (1→4)-β-D-xylopyranose conformation substituted with D-glucuronic acid and L-arabinose. Other natural gums that are, or have been, used in chewing gums include jelutong, sorva, gutta percha, gutta hang kang, niger gutta, gutta kataiu, chilte, chiquibul, massaranduba balata, massaranduba chocolate, nispero, leche, caspi and rosindinha.

[0007] The use of natural gums in chewing gum has diminished in recent years, due to scarcity and inconsistency of the crops, and the development of synthetic elastomers which give the chewing gum improved flavour and texture. Examples of synthetic elastomers used in chewing gum compositions are polyisoprene (1), polybutadiene (2), styrene-butadiene copolymers (3), polyisobutylene (4), polyvinylacetate (5), polyethylene (6), as well as isobutylene-isoprene copolymer, vinyl acetate-vinyl laurate copolymer, crosslinked polyvinyl pyrrolidone, polymethylmethacrylate, copolymers of lactic acid, polyhydroxyalkanoates, plasticized ethylcellulose, polyvinyl acetatephthalate and combinations thereof.



[0008] The amount of elastomer used in the gum base depends on a variety of factors, including the type, or types, of elastomer used, the desired consistency of the gum, and the other components of the gum base. A typical gum base composition comprises between 5 and 80% elastomer by weight, more commonly between 10 and 60% by weight, and most commonly between 20 and 40% by weight. A notable feature of many of these elastomers is a saturated hydrocarbon backbone that is difficult to break down. For this reason, the elastomer compounds found in gum bases are generally considered to be non-biodegradable.

[0009] The gum base also includes plasticizers and softeners, which are used to soften the elastomer component. Many plasticizers are suitable for use in gum bases, including terpene resins such as polymers of alpha-pinene or beta-pinene, methyl, glycerol and pentaerythritol esters of rosins, and modified rosins such as hydrogenated, dimerized and polymerized rosins, and mixtures thereof. Specific examples of plasticizers include the pentaerythritol esters of partially hydrogenated wood and gum rosins, the pentaerythritol esters of wood and gum rosins, the glycerol esters of wood rosin, the glycerol esters of partially dimerized wood and gum rosins, the glycerol esters of polymerized wood and gum rosins, the glycerol ester of tall oil rosin, the glycerol esters of wood and gum rosins and partially hydrogenated wood and gum rosins, the methyl esters of partially hydrogenated wood and gum rosins, and mixtures thereof. Other plasticizers that may be found in gum include glycerol triacetate and polyvinyl alcohol. Typically, plasticizers constitute around 50% by weight of the gum base composition. The softeners used in gum bases are usually derived from natural fats and oils, and include tallow, cocoa butter, sunflower oil and palm oil. Artificial softeners include various synthetic glycerol esters and triglycerides, such as triacetin. The softener may comprise up to around 20% by weight of the gum base composition.

[0010] In addition, the gum base may include waxes such as paraffin waxes to improve the elasticity of the gum base and to soften the elastomeric mixture. Typical waxes used in chewing gum have a melting point between 45 and 60 °C and are present in the gum base in an amount of up to 10% by weight, more preferably between 5 and 10% by weight. In some cases, the gum base may also include higher melting waxes, such as petroleum wax or beeswax, which are typically present in the gum base in amounts of up to 5% by weight.

[0011] When chewing gum residues are discarded onto pavements, it is the elastomers, resins and wax components of the gum base that are responsible for the adhesive effect of the residues. The waxes promote wetting of the substrate by the soft plastic mass of gum remaining after chewing. As substrate wetting occurs, the gum residue spreads over the substrate and the elastomer and resin components of the gum base are then able to interact mechanically with the microporous structure of materials such as paving stones. When chewing gum residues are dropped on a pavement substrate, e.g. sandstone, it is thought that the polymeric chains of the elastomer and the resin components of the gum base effectively become entangled in the cage-like structure of the sandstone, forming a strong mechanical link which is the physical basis of the adhesion of gum residues to pavements.

[0012] Current methods for removing chewing gum from pavements are generally time consuming and costly, and usually need to be carried out by specialist companies. Most methods of removing gum residues work by disrupting the non-covalent interactions between the gum and the substrate using high pressure water or steam such as disclosed in US 2005/178410. However, these techniques are costly due to the large amounts of energy required to generate high pressure water or steam; they are abrasive and may therefore cause damage to the grouting between paving slabs and to soft substrates such as tarmac; and they cause inconvenience to the public. For such reasons, the use of high pressure water or steam cleaning systems is generally confined to periodic programs for "deep cleaning" street surfaces, usually taking place at night, and is inappropriate for day-to-day cleaning operations. In addition, such techniques are often inappropriate for use in confined areas, interior surfaces, and areas where the use of large quantities of water, steam or chemicals may be restricted.

[0013] An alternative approach is to dissolve the gum using organic solvents. However, most organic solvents that could be used for this purpose are poisonous, flammable or harmful to the environment and are therefore hazardous to operators and unsuitable for use in public places. Chewing gum is hydrophobic and therefore usually considered to be incompatible with aqueous removal compositions.

[0014] Another technique that is sometimes used to remove chewing gum residues involves applying a cryogenic substance, such as dry ice or liquid nitrogen, to the residue such as disclosed in GB 2,428,208. This promotes an elastic-to-glass transition of the polymer in the gum residue. The glass is an ordered, rigid and brittle structure with the polymer chains in an aligned crystalline state. The brittle gum residue can then be fragmented by mechanical means and then swept or vacuumed from the substrate. Obvious disadvantages of such methods are the cost of cryogenic substances, the potential risk to operators using such substances, intensive labour requirements, and inconvenience to the public.

[0015] One approach to the problem of chewing gum deposits has been to develop chewing gums with increased biodegradability or decreased stickiness. However, there has been little progress in this area, mainly because the commercially important features of chewing gum, such as texture, flavour retention and shelf life, tend to be impaired when the chemical structure of the gum base is changed.

[0016] Accordingly, there is a clear need for alternative methods for dealing with contamination by chewing gum residues. Desirable characteristics of any new method for removing chewing gum residues include: reduced cost; reduced need for specialist equipment and specially trained operators; reduced energy and water requirements; reduced labour requirements; reduced risk to operators, the public and the environment; and reduced inconvenience to the public. Accordingly, any composition to be used in such a method will desirably be: non-toxic; non-flammable; environmentally friendly; fast acting; effective at low temperatures; easy to use without special training; and easy to rinse away with low pressure water leaving no residues that require further cleaning.

Summary of Invention

[0017] There is provided a portable chewing-gum residue removal apparatus for removing adhered chewing-gum residues from a substrate by the application of an at least two-part gum removal mixture, the apparatus being adapted for the transportation, mixing and application of the at least two-part mixture and wherein said at least two-part mixture is capable of modifying the chewing gum residue so as to ease its removal from a substrate. The chewing-gum removal apparatus is a backpack.,

[0018] In accordance with the present invention there is provided a chewing-gum residue removal apparatus for removing adhered chewing-gum residue from a substrate by the application of an at least two-part gum removal mixture, wherein said at least two-part mixture is capable of modifying the chewing gum residue, the apparatus comprising:

- a first reservoir for holding a first precursor of the at least two-part mixture;
- a second reservoir for holding a second precursor of the at least two-part mixture;
- an outlet arranged to receive the first and second precursors from the respective reservoirs, and to apply the precursors to the chewing gum residue that has adhered to a substrate;
- a first delivery system operable to deliver the first precursor from the first reservoir to the outlet at a first delivery rate;
- a second delivery system operable to deliver the second precursor from the second reservoir to the outlet at a second delivery rate;
- a delivery rate controller arranged to control at least one of the first and second delivery rates such that the ratio of the delivery rates is controlled; and
- user control means operable by a user to selectively actuate the delivery systems such that the mixed precursors are delivered through the outlet at a rate selected such that the precursors are mixed during application and preferably the at least two-part mixture is at least partially produced by mixing (and preferably reacting) of the precursors in situ on the chewing gum residue, and wherein the at least two-part mixture comprises a first precursor comprising of one or more oxidizing reagents and a second precursor comprising one or more oxidation catalysts.

[0019] In one embodiment, the outlet may comprise a plurality of nozzles, or be in fluid communication with a plurality of nozzles. Where the outlet comprises a plurality of nozzles or is in fluid communication with a plurality of nozzles, different precursors can be ejected through different nozzles. The outlet may comprise for example, from 1 to 20 nozzles, preferably from 1 to 10. Of course, it will be appreciated that the outlet may comprise 2 to 8, 3 to 7, 4 to 6, or even 5 nozzles.

[0020] Preferably the at least two-part mixture has a viscosity of at least 2500 cP, more preferably at least 5000 cP. The viscosity may also be at least 10,000 cP. The at least two-part mixture may have a viscosity of up to 50,000 cP. Particularly preferred mixtures in accordance with the present invention may have viscosities of about 5,000 to 15,000 cP at 25 °C, or at least about 5,000 to 25,000 cP at 25 °C, or even at least about 5,000 to 35,000 cP at 25 °C.

[0021] Preferably at least one of the delivery systems is operable to pump a fluid having a viscosity of at least 2500 cP at a rate of at least 5 ml per second, more preferably a viscosity of at least 5000 cP at a rate of at least 5 ml per second, and even at least at 5 ml per second for a viscosity of up to 50,000 cP. Alternatively, both of the first and second delivery systems is operable to pump a fluid having a viscosity of at least 2500 cP at a rate of at least 5 ml per second, more preferably a viscosity of at least 5000 cP at a rate of at least 5 ml per second, and even at least at 5 ml per second for a viscosity of up to 50,000 cP.

[0022] Preferably at least one of the delivery systems, for example the second delivery system, is operable to pump a fluid having a viscosity of no more than 5cP at a rate of no more than 3 ml per second.

[0023] Preferably the at least two-part mixture is pre-mixed before application to the chewing gum residue. More preferably, the at least two-part mixture is pre-mixed immediately prior to application of the composition to a chewing gum residue. In another preferred embodiment, the at least two-part mixture is mixed on contact with the chewing gum residue.

[0024] Where the at least two-part mixture is pre-mixed prior to application to the chewing gum residue, the pre-mixing may take place in the cleaning apparatus, for example, in a part of the outlet, or at a location where the first and second delivery systems meet, for example, upstream of the outlet. In addition, the mixing of the two-part mixture may take place as the precursors are ejected from the outlet, for example, where the outlet comprises a plurality of nozzles.

[0025] Still more preferably the at least two-part mixture is at least partially formed in situ on the chewing gum residue, for example whilst on the surface of the chewing gum residue. In such an embodiment, the precursors preferably mix on contact with the chewing gum residue.

[0026] Preferably the ratio of the delivery rates is selected in accordance with the concentrations of the precursors that are necessary to form the at least two-part mixture.

[0027] In a preferred embodiment the delivery apparatus comprises a set of interchangeable delivery rate controllers operable to control the delivery rate of one of the first and second delivery systems with respect to the other. Preferably the interchangeable delivery rate controllers control the delivery rates such that precursors having selected concentrations

are delivered to the outlet in the ratio required to form the at least two-part mixture.

[0028] Preferably the reservoirs are containers, and more preferably are made from plastics materials. Suitable materials include HDPE and/or polypropylene.

[0029] Preferably the delivery systems comprise flexible tubing.

[0030] The apparatus may comprise an extendable lance in fluid communication with the outlet, and which may be attached (directly) to the outlet. Preferably the lance has a handle and the lance extends from the handle to the mixing outlet. Preferably the lance is a telescopic lance so that the apparatus may be used comfortably by different users and can reach otherwise inaccessible areas. Where the apparatus comprises a lance, the plurality of nozzles may be located at an end of the lance remote from the outlet. Where the lance comprises a plurality of nozzles, different precursors can be ejected through different nozzles.

[0031] The outlet (or the lance) may comprise a nozzle having two intake couplings and one outlet coupling such that the first and second precursors can be supplied to the intake couplings of the nozzle by the delivery systems and are mixed only during the process of being applied through the nozzle. Preferably one or both of the intake couplings comprise a non-return valve. Preferably the apparatus comprises a plurality of nozzles arranged to be fitted to the outlet dependent on operational requirements. Preferably these nozzles are interchangeable. This has the advantage of enabling a user to change a nozzle which has become blocked or to select an appropriate nozzle for a given application. It will be understood, that the above described nozzle may also be located on the lance and the precursors supplied via the outlet. It will be appreciated that the nozzle may also comprise two intake couplings and two outlet couplings so that the precursors do not mix until contact with the chewing gum residue.

[0032] Preferably the nozzle is shielded by a shroud to enable the application of fluid to a particular area of a substrate without unwanted splashing or dripping of the at least two part mixture.

[0033] The first delivery system may comprise a pump arranged to pump the first precursor from the reservoir towards the outlet. The second delivery system may comprise a pump arranged to pump the second precursor from the second reservoir towards the outlet. Preferably the first and/or second delivery system is coupled to deliver the respective precursor to the outlet such that entry of the mixed precursors into the delivery system from, for example the outlet, is inhibited. A non-return valve may be disposed between, for example the outlet, and the first and/or second delivery system to inhibit backflow of the mixed precursors into the delivery system. These and other examples of the invention have the advantage of enabling mixing of the precursors in an accurately controlled ratio for immediate application to a chewing gum residue on a substrate and without unintentional mixing of the precursors by backflow of the mixture into one or either of the delivery systems.

[0034] The user operable control means may be arranged to control at least one of the first and second delivery systems such that a selected volume of the mixed precursors is delivered through the applicator in response to a single user actuation of the control means. Preferably the selected volume is selected in accordance with the quantity of chewing gum in a typical stick of chewing gum, such as, for example 5ml. Preferably the selected volume is at least 1 ml, preferably at least 4ml, preferably at least 5ml, preferably at least 6 ml, preferably at least 10ml, preferably at least 20ml, preferably at least 30ml, still more preferably at least 50 ml. In one possibility the selected volume is less than 100ml, preferably less than 60ml, preferably less than 40ml, preferably less than 25ml, preferably less than 15ml, preferably less than 7.5ml, preferably less than 6.5 ml, preferably less than 4.5ml still more preferably less than 1.5ml.

[0035] These features of the invention have the advantage of promoting efficiency by enabling the application of a sufficient but not excessive quantity of the at least two-part mixture without the need for specialised user training, thus reducing the cost of the cleaning process and the resources required.

[0036] Preferably the delivery rate of one or both of the delivery systems is selectable by a user, for example using the interchangeable delivery rate controllers referred to above. This has the advantage of permitting the use of different precursors (which are to be mixed in different ratios) to be used in the apparatus.

[0037] The liquid precursors may be stored at any suitable pressure and temperature, and in one embodiment are preferably stored at atmospheric pressure and ambient temperature.

[0038] Preferably the delivery systems used to supply the precursors are separate from each other and, optionally, independently controllable. In one possibility the pressure differential generated by the delivery systems is at least 6.9 kPa (10 psi), preferably at least 13.8 kPa (20 psi).

[0039] Preferably the user control means comprises a pressure switch, for example arranged in the form of a trigger. These and other examples of the invention have the advantage of providing intuitive user feedback about the quantity of at least two-part mixture applied to the substrate which has the advantage of promoting user compliance with desired efficient usage guidelines for the mixture.

[0040] Preferably the overall capacity of each reservoir is at least 10 litres, preferably at least 20 litres.

[0041] Preferably the first and second delivery systems each comprise tubing and a pump operable to pump the respective one of the first and second precursor through the tubing to the outlet. Preferably the delivery systems are battery powered and, in one possibility the cleaning apparatus comprises a rechargeable battery.

[0042] The delivery rate controller may comprise a microprocessor operable by a user to select from a memory one

of a plurality of flow control programs and/or to control the delivery rates in accordance with the selected program. A number of programs may be stored, each program relating to a particular combination of precursors. This has the advantage of allowing the cleaning apparatus to be refilled using any appropriate combination of precursors and adjusted to provide the correct flow rates without the need for specially trained staff to perform the process.

[0043] The delivery rate controller may comprise an adaptation of at least one of the first and second pumps such that the ratio of the delivery rates is within a selected range. In one example this is achieved using a control switch on a pump to control the rate of pumping and/or the pressure differential across the pump. In another example this is achieved using interchangeable delivery rate controllers as set out above, an example of an interchangeable delivery rate controller is a mechanical choke at the outlet or inlet of a pump. This has the advantage of enabling a technician to refill the apparatus with any appropriate combination of precursors and adjust the flow rates accordingly without the need for the apparatus to include complex electronics. In one such example the apparatus includes a set of such mechanical chokes adapted to be applied adjacent the inlet or outlet of one or both of the pumps to adjust the relative flow rates of the pumps in accordance with the required delivery rates for selected combinations of precursors. In one example the sets of chokes comprise pairs of chokes the pairs selected to provide a ratio of delivery rates for a particular combination of precursors. In one example the chokes carry an indicator or label to indicate which combination of precursors they are to be used with. Preferably the chokes are colour coded.

[0044] Each pump may have a pump inlet arranged to receive fluid and a pump outlet for the expulsion of fluid, and in which the delivery rate controller is provided by an arrangement which controls the first and second pumps to generate substantially the same pressure differential so that the flow rates are controlled by the relative internal diameters of the tubing in the first and second delivery systems. Optionally these internal diameters can be modified using one or more mechanical chokes. In one possibility the internal diameter of a section of the tubing is modified by a permanent fitting. Optionally this function may be provided by the first delivery system comprising tubing of a first internal diameter and the second delivery system comprising tubing of a second internal diameter.

[0045] The at least two-part mixture is a chewing gum modifying composition comprising one or more oxidising reagents and one or more oxidation catalysts. In this embodiment, it is preferable that the composition does not comprise an ionic liquid.

[0046] As used herein, the term "ionic liquid" as used herein refers to a liquid that is capable of being produced by melting a salt, and when so produced consists solely of ions. An ionic liquid may be formed from a homogeneous substance comprising one species of cation and one species of anion, or it can be composed of more than one species of cation and/or more than one species of anion. Thus, an ionic liquid may be composed of more than one species of cation and one species of anion. An ionic liquid may further be composed of one species of cation, and one or more species of anion. Still further, an ionic liquid may be composed of more than one species of cation and more than one species of anion. The term "ionic liquid" as used herein includes compounds having both high melting points and compounds having low melting points, e.g. at or below room temperature (i.e. 0 to 25°C). The latter are often referred to as "room temperature ionic liquids" and often derived from organic salts having pyridinium, imidazolium, ammonium or phosphonium cations comprising alkyl-substituted cationic nitrogen or phosphorus atoms. However, ionic liquids may also be derived from a number of other heterocyclic compounds, as would be appreciated by a person of skill in the art.

[0047] The exact mechanisms by which the oxidising reagent(s) and oxidation catalyst(s) facilitates the removal of chewing gum residues are believed to be complex and are not known in detail. Without wishing to be bound by any particular theory, however, it is thought that at least three processes are involved: (i) oxidation reactions break down the polymeric components of the gum residue into fragments of lower molecular weight; (ii) heat generated in the oxidation reaction further softens the gum residue, disrupting the non-covalent interactions within the gum matrix (referred to herein as polymer-polymer interactions), increasing the mobility of the polymer chains in the gum residue and enabling the oxidising reagent to further penetrate the gum matrix; and (iii) release of gases during the oxidation reaction further disrupts the polymer-polymer interactions and the interactions between the gum matrix and the substrate to which it is attached (referred to herein as polymer-substrate interactions). The resulting residue has reduced adhesiveness and is also softer and more fluid, making it easier to remove from the substrate.

[0048] The one or more oxidising reagents may be selected from hydrogen peroxide, organic hydroperoxides, organic peroxyacids, organic peroxyacid salts, and dioxiranes.

[0049] More preferably, the one or more oxidising reagents are selected from hydrogen peroxide, organic hydroperoxides having the formula ROOH, organic peroxyacids having the formula RCO₃H or salts thereof, wherein R is a C₁ to C₁₀ alkyl group or a C₆ to C₁₀ aryl group.

[0050] Still more preferably, the one or more oxidising reagents are selected from hydrogen peroxide or organic hydroperoxides having the formula ROOH, wherein R is as defined above.

[0051] For example, the one or more oxidising reagents may be selected from hydrogen peroxide and tert-butyl hydroperoxide. Most preferably, the oxidising reagent is hydrogen peroxide.

[0052] The total concentration of the one or more oxidising reagents in the at least two-part mixture which forms the chewing gum modifying composition is preferably in the range of from 1.0 to 50 mol·dm⁻³, more preferably in the range

of from 2.0 to 25 mol·dm⁻³, and most preferably in the range of from 5.0 to 10 mol·dm⁻³.

[0053] Preferably the first and/or second delivery system is configured such that the oxidising agent is delivered according to the required concentration.

[0054] Preferably, the one or more oxidation catalysts are selected from lanthanide salts and transition metal salts. For example, the one or more oxidation catalysts may be selected from Fe(II), Fe(III), Mn(VII), Mn(VI), Mn(IV), Mo(VI), Co(II), Zr(IV), Ce(IV), and Ni(II) salts.

[0055] Preferably, the one or more oxidation catalysts are selected from Fe(III), Mn(VII), and Mn(IV) salts, for example Fe(AOT)₃, FeCl₃, Fe₂(SO₄)₃, MnO₂, and KMnO₄ (where AOT represents bis(2-ethylhexyl)sulfosuccinate).

[0056] Most preferably, the one or more oxidation catalysts are selected from Fe(AOT)₃ and KMnO₄.

[0057] The total concentration of the one or more oxidation catalysts in the at least two-part mixture forming the chewing gum modifying composition is preferably in the range of from 0.001 to 1.0 mol·dm⁻³, more preferably in the range of from 0.005 to 0.5 mol·dm⁻³, and most preferably in the range of from 0.01 to 0.1 mol·dm⁻³.

[0058] Preferably the first and/or second delivery system is configured such that the oxidising agent is delivered according to the required concentration.

[0059] The relative concentrations of the oxidising agents and oxidation catalysts depend on a number of factors, including the nature of the oxidising agents and oxidation catalysts, as well as the timescale required for the gum to be removed. Suitable relative concentrations for each combination of oxidising agents and oxidation catalysts can readily be determined by a person of skill in the art by routine testing methods. However, in general, the concentration of the oxidation catalysts will be in the range of from 0.001 to 5.0 mol%, and more preferably in the range of from 0.01 to 1.0 mol% of the concentration of the oxidising agents.

[0060] Preferably the first and second delivery systems are configured such that the oxidising agents and oxidation catalysts are delivered according to the required ratio, such as those exemplified above.

[0061] The at least two-part mixture forming the chewing gum modifying composition may further comprise one or more gelling agents. Preferred gelling agents are hydrophilic, and suitable gelling agents are discussed below.

[0062] In a further aspect, the at least two-part mixture may comprise one or more oxidising reagents (e.g. a first precursor) and one or more gelling agents (e.g. a second precursor). Preferably, the chewing gum modifying composition does not comprise an ionic liquid.

[0063] In accordance with this aspect of the invention, the one or more oxidising reagents and their concentration in the at least two-part mixture forming the chewing gum modifying composition are preferably as defined above.

[0064] The chewing gum modifying compositions used in the present invention are preferably in the form of an aqueous and/or alcoholic solutions and/or suspensions. Suitable alcohols include methanol, ethanol, propanol and butanol, as well as longer-chain alcohols such as octanol. Most preferably, the at least two-part mixture forming the chewing gum modifying composition is in the form of an aqueous solution or suspension. Water is compatible with the oxidising reagents and oxidation catalysts mentioned above. In addition, water is non-toxic, non-flammable, and therefore safe to use in public areas. Thus, in a preferred embodiment, the at least two-part mixtures are substantially alcohol-free.

[0065] It is preferred that the mixtures used in the apparatus of the present invention have a relatively high viscosity, for example a viscosity in the range of from 2,500, 5,000 and even 10,000 to 50,000 cP at 25 °C. Particularly preferred mixtures in accordance with the present invention may have viscosities of at least about 15,000 cP at 25 °C, or at least about 25,000 cP at 25 °C, or even at least about 35,000 cP at 25 °C.

[0066] Mixtures having viscosities above 5,000 cP at 25 °C have gel-like consistencies and are capable of being applied as a coating on the surface of a chewing gum residue, e.g. for spot application of the composition to individual gum residues. In this way, the oxidising reagent(s) and the oxidation catalyst(s) (where present) remain in contact with the gum residue, maximising the extent of reaction possible and reducing waste of reagents. Further, the high viscosities of the mixtures prevents the oxidising reagent(s) and the oxidation catalyst(s) (where present) from being absorbed by the substrate.

[0067] Gelling agents suitable for use in the apparatus of the present invention may, for example, be selected from silica, alumina, clays, and organic polymers.

[0068] Examples of suitable gelling agents for use in the apparatus of the present invention include, among others, fumed silica, precipitated silica, fumed alumina, precipitated alumina, attapulgite clay, bentonite clay, hectorite clay, smectite clay, montmorillonite, polyethylene imine, polyethylene oxide, polyacrylic acid, and polyvinyl alcohol. Particularly preferred gelling agents for use in the apparatus of present invention are fumed silica and polyethylene imine (PEI).

[0069] Where a gelling agent is used, the concentration of the gelling agent in the mixture is preferably in the range of from 1 to 30 weight percent, more preferably from 1 to 20 weight percent and most preferably from 1 to 10 weight percent.

[0070] The compositions used with the apparatus of the present invention may further comprise one or more thickening agents and/or one or more foaming agents to obtain gel-like consistencies.

[0071] The chewing gum modifying composition comprising one or more thickening agents and/or one or more foaming agents have reduced movement away from a target chewing gum residue when applied as a coating (see comments above regarding gel-like consistencies). This improves contact of the composition with the chewing gum residue, max-

imising the extent of reaction thereby minimising both the amount of oxidising reagent and oxidation catalyst applied to the target chewing gum residue and the number of applications of the chewing gum modifying composition to the target chewing gum residue.

[0072] The thickening agent may comprise a polymer thickening agent and/or a silicate thickening agent. Preferred polymer thickening agents are polyethers, such as polyglycols (for example, polyethylene glycols and polypropylene glycols) and polyglycol esters, and polyamines (for example, polyethylene amine). Preferably the polymer thickening agent is a polyglycol, most preferably polyethylene glycol.

[0073] Preferred silicate thickening agents include metasilicates (SiO_3^{2-}), orthosilicates (SiO_4^{4-}), sorosilicates ($\text{Si}_2\text{O}_7^{6-}$), and mixtures thereof. The silicate thickening agent may be an alumino silicate. Preferably the silicate thickening agent has a metal cation. The metal cation may be selected from the group consisting of group I metals (for example Li, Na and K), group II metals (for example Be, Mg, Ca and Ba) and transition metals (for example Cr, Mn, Fe, Zn and Zr). Preferably, the silicate thickening agent is a sodium silicate, most preferably sodium metasilicate. Powdered glass may also be used as the thickening agent. The powdered glass may consist of silica.

[0074] The total amount of thickening agent(s) used in the chewing gum modifying composition may range from about 0.01 to about 100g per litre, preferably from about 0.05 to about 50g per litre, and more preferably from about 0.1 to about 10g per litre.

[0075] The foaming agent may comprise a foaming surfactant. These include non-ionic surfactants, cationic surfactants, anionic surfactants, zwitterionic surfactants, surfactants that contain both anionic and cationic components, and combinations thereof. Preferably the foaming surfactant comprises an anionic surfactant, such as a sulfate surfactant. The sulfate surfactant may be selected from the group consisting of sodium laureth sulphate, sodium lauryl sulphate, ammonium lauryl sulfate, sodium myreth sulfate, sodium pareth sulfate and combinations thereof. Preferably, the sulfate surfactant is a sodium sulfate surfactant, most preferably sodium laureth sulphate or sodium lauryl sulphate.

[0076] The total amount of foaming agent(s) used in the chewing gum modifying composition may range from about 0.01 to about 100g per litre, preferably from about 0.05 to about 50g per litre, and more preferably from about 0.1 to about 10g per litre.

[0077] A preferred chewing gum modifying composition comprises both a thickening agent and a foaming agent. A synergistic effect may be displayed by the combination of a thickening agent and a foaming agent. In one example, the composition may comprise at least one of the thickening agents selected from polyethylene glycol and sodium metasilicate, together with at least one of the foaming agents selected from sodium laureth sulfate and sodium lauryl sulfate.

[0078] The viscosity of a chewing gum modifying composition comprising one or more thickening agents and/or one or more foaming agents may be increased relative to a chewing gum modifying composition that does not comprise a thickening agent and/or a foaming agent. Suitable viscosities are those described above for gel-like consistencies. For example, the viscosity of a chewing gum modifying composition comprising one or more thickening agents and/or one or more foaming agents may be at least about 35,000 cP at 25 °C, or at least about 40,000 cP at 25 °C, or even at least about 45,000 cP at 25 °C. The viscosity of a chewing gum modifying composition comprising one or more thickening agents and/or one or more foaming agents may be up to 50,000 cP at 25 °C. The mixtures used in the present invention may optionally comprise one or more additives selected from the group consisting of surfactants, pH modifiers, emulsifiers, colorants and wetting agents. A wide variety of such additives are known in the art, and the skilled person is capable of selecting suitable additives as necessary for a particular application.

[0079] As noted above, the at least two-part mixture may be pre-mixed prior to application to the chewing gum residue. For example, an aqueous and/or alcoholic solution of the one or more oxidising reagents (i.e. a first precursor) may be pre-mixed with an aqueous and/or alcoholic suspension of the gelling agent (i.e. a second precursor) immediately before application to a chewing gum residue. One or both of said first precursor and said second precursor may further comprise a thickening agent and/or foaming agent. In another embodiment, an aqueous and/or alcoholic solution of the one or more oxidising reagents (i.e. a first precursor) may be pre-mixed with an aqueous and/or alcoholic solution of the one or more oxidising catalysts (i.e. a second precursor), wherein one or both of said solutions optionally further comprises a suspension of a gelling agent. One or both of said first precursor and said second precursor may further comprise a thickening agent and/or foaming agent. It will be appreciated that the use of gelling agents, thickening agents and foaming agents allows the relative viscosities of the precursors to be controlled, and therefore also the rate at which they are dispensed in the apparatus.

[0080] Preferably, any thickening or foaming agent is added immediately before application so as to reduce the risk of "clogging up" of the apparatus of the present invention.

[0081] It will also be appreciated that, in order to minimise the volume of the composition, the foaming agent may be added to a precursor immediately before application of the composition to the chewing gum residue.

[0082] In addition, if necessary, a further application of the one or more oxidising reagents and/or the one or more oxidation catalysts (where present) may be made after a period of time has elapsed from the first application. This may be done by activating the apparatus so as to deliver a further amount of at least two-part mixture, examples of which are described above.

[0083] A preferred form of KMnO_4 for use as an oxidation catalyst is an aqueous solution that comprises KMnO_4 together with K_2CO_3 and NaOH . Preferably, the aqueous solution comprises from 0.1 to 5.0 g KMnO_4 , 1.0 to 15 g K_2CO_3 , 0.01 to 0.5 g NaOH per 100 mL of water. More preferably, the aqueous solution comprises from 0.5 to 2.0 g KMnO_4 , 4.0 to 10 g K_2CO_3 , 0.05 to 0.2 g NaOH per 100 mL of water. For example, the aqueous solution may comprise 1.0 g KMnO_4 , 7 g K_2CO_3 , and 0.08 g NaOH per 100 mL water.

[0084] In accordance with the present invention, the chewing gum modifying composition is preferably contacted with the chewing gum residue for a period of from 1 minute to 1 hour, more preferably from 1 minute to 30 minutes, still more preferably from 1 minute to 20 minutes, and most preferably from 1 minute to 10 minutes. However, it will be appreciated that the contact time is dependent on the choice of oxidising reagents, oxidation catalysts (where present), and other components of the at least two-part mixture, as well as the age and type of the chewing gum residue. Suitable contacting timescales can be routinely determined by persons of skill in the art simply by monitoring the extent of reaction. As noted above, if necessary, a further application of the at least two-part mixture may be made after a period of time has elapsed from the first application.

[0085] The resulting softened chewing gum residues may be removed by techniques including scrubbing, brushing, spraying with low pressure water, or simply allowing the residue to be removed in due course by rainfall. When the chewing gum residue is in a location where public access is required, removal of the softened residue preferably takes place as soon as possible once the chewing gum residue has been sufficiently modified, to avoid the softened gum residues being transferred to the soles of shoes or to clothing.

[0086] It will be understood that suitable removal apparatus may be also be attached to the apparatus of the present invention, for example, by way of a cord or cable.

[0087] The apparatus of the present invention may be used to remove chewing gum residues from a wide variety of substrate materials without damage to the underlying substrate. Examples include stone, concrete, cement, bricks, gypsum plaster, clay, ceramics, glass, asphalt, tarmac, bitumen, metals, wood, lacquer and textiles.

[0088] In a preferred embodiment, the at least two-part mixture consists of an aqueous and/or alcoholic solution and/or suspension of one or more oxidising agents at a total concentration of from 1.0 to 50 $\text{mol}\cdot\text{dm}^{-3}$ and one or more oxidation catalysts at a total concentration of from 0.001 to 1.0 $\text{mol}\cdot\text{dm}^{-3}$, which solution and/or suspension further includes from 0 to 30 weight percent of a gelling agent and from 0 to 10 weight percent of one or more additives selected from the group consisting of surfactants, pH modifiers, emulsifiers, colorants and wetting agents. It will be readily understood that for such an embodiment, the first and/or second delivery system is configured such that the precursors are delivered according to the required concentrations.

[0089] The total concentration of the one or more oxidising reagents in the above mixture is preferably in the range of from 2.0 to 25 $\text{mol}\cdot\text{dm}^{-3}$, and most preferably in the range of from 5.0 to 10 $\text{mol}\cdot\text{dm}^{-3}$.

[0090] The total concentration of the one or more oxidation catalysts in the above mixture is preferably in the range of from 0.005 to 0.5 $\text{mol}\cdot\text{dm}^{-3}$, and most preferably in the range of from 0.01 to 0.1 $\text{mol}\cdot\text{dm}^{-3}$.

[0091] The amount of the gelling agent in the above mixture is preferably in the range of from 1 to 30 weight percent, more preferably from 1 to 20 weight percent and most preferably from 1 to 10 weight percent.

[0092] In a further preferred embodiment, the at least two-part mixture consists of an aqueous and/or alcoholic solution and/or suspension of one or more oxidising agents at a total concentration of from 1.0 to 50 $\text{mol}\cdot\text{dm}^{-3}$ and one or more oxidation catalysts at a total concentration of from 0.001 to 1.0 $\text{mol}\cdot\text{dm}^{-3}$, which solution and/or suspension further includes from 0 to 30 weight percent of a gelling agent, from 0 to 100g per litre of thickening agent, from 0 to 100g per litre of foaming agent and from 0 to 10 weight percent of one or more additives selected from the group consisting of surfactants, pH modifiers, emulsifiers, colorants and wetting agents. It will be readily understood that for such an embodiment, the first and/or second delivery system is configured such that the precursors are delivered according to the required concentrations.

[0093] The total concentration of the one or more oxidising reagents in the above mixture is preferably in the range of from 2.0 to 25 $\text{mol}\cdot\text{dm}^{-3}$, and most preferably in the range of from 5.0 to 10 $\text{mol}\cdot\text{dm}^{-3}$.

[0094] The total concentration of the one or more oxidation catalysts in the above mixture is preferably in the range of from 0.005 to 0.5 $\text{mol}\cdot\text{dm}^{-3}$, and most preferably in the range of from 0.01 to 0.1 $\text{mol}\cdot\text{dm}^{-3}$.

[0095] The amount of the gelling agent in the above mixture is preferably in the range of from 1 to 30 weight percent, more preferably from 1 to 20 weight percent and most preferably from 1 to 10 weight percent.

[0096] The amount of thickening agent in the above mixture is preferably in the range of from 0.01 to 100g per litre, more preferably from 0.05 to 50 g per litre, and most preferably from 0.1 to 10g per litre.

[0097] The amount of foaming agent in the above mixture is preferably in the range of from 0.01 to 100g per litre, more preferably from 0.05 to 50g per litre, and most preferably from 0.1 to 10g per litre.

[0098] In a further preferred embodiment, the at least two-part mixture consists of an aqueous and/or alcoholic solution and/or suspension of one or more oxidising agents at a total concentration of from 1.0 to 50 $\text{mol}\cdot\text{dm}^{-3}$, which solution and/or suspension further includes from 1 to 30 weight percent of a gelling agent and from 0 to 10 weight percent of one or more additives selected from the group consisting of surfactants, pH modifiers, emulsifiers, colorants and wetting

agents.

[0099] The total concentration of the one or more oxidising reagents in the above mixture is preferably in the range of from 2.0 to 25 mol-dm⁻³, and most preferably in the range of from 5.0 to 10 mol-dm⁻³.

[0100] The amount of the gelling agent in the above mixture is preferably from 1 to 20 weight percent and most preferably from 1 to 10 weight percent.

[0101] In a further preferred embodiment, the at least two-part mixture consists of an aqueous and/or alcoholic solution and/or suspension of one or more oxidising agents at a total concentration of from 1.0 to 50 mol-dm⁻³, which solution and/or suspension further includes from 1 to 30 weight percent of a gelling agent, from 0 to 100g per litre of thickening agent, from 0 to 100g per litre of foaming agent and from 0 to 10 weight percent of one or more additives selected from the group consisting of surfactants, pH modifiers, emulsifiers, colorants and wetting agents.

[0102] The total concentration of the one or more oxidising reagents in the above mixture is preferably in the range of from 2.0 to 25 mol-dm⁻³, and most preferably in the range of from 5.0 to 10 mol-dm⁻³.

[0103] The amount of the gelling agent in the above mixture is preferably from 1 to 20 weight percent and most preferably from 1 to 10 weight percent.

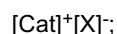
[0104] The amount of thickening agent in the above mixture is preferably from 0.01 to 100g per litre, more preferably from 0.05 to 50 g per litre, and most preferably from 0.1 to 10g per litre.

[0105] The amount of foaming agent in the above mixture is preferably from 0.01 to 100g per litre, more preferably from 0.05 to 50g per litre, and most preferably from 0.1 to 10g per litre.

[0106] In another embodiment, the at least two-part mixture comprises an ionic liquid which has been found to be suitable for modifying chewing gum substrates, even to the extent that the residue may simply be washed away by even low pressure hosing.

[0107] Suitable ionic liquids for use the two-part mixture are described in PCT/GB2009/051097. PCT/GB2009/051097 also describes numerous compositions which are suitable for use with the apparatus of the present invention, and the subject-matter of this application is hereby incorporated by reference in its entirety.

[0108] The ionic liquids may be defined by the general formula:

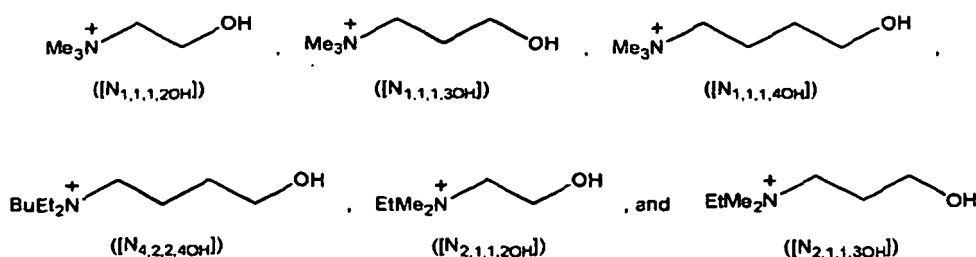


wherein:

$[\text{Cat}]^+$ is a cationic species; and

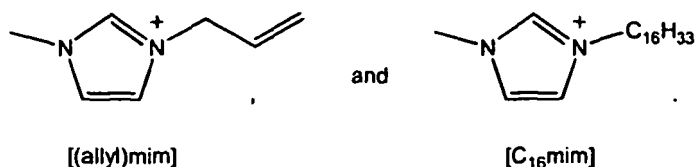
$[\text{X}]^-$ is an anionic species.

[0109] Particularly preferred ammonium cations ($[\text{Cat}]^+$) include:

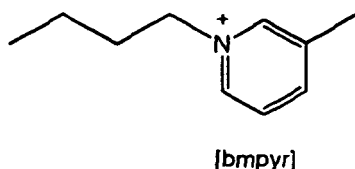


[0110] Particularly preferred imidazolium cations ($[\text{Cat}]^+$) include:



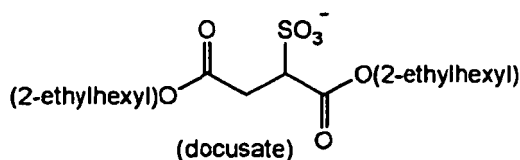


[0111] A particularly preferred pyridinium cation ([Cat]⁺) is:



[0112] Particularly preferred anions ([X]⁻) for use in the at least two-part mixture include:

H₃C-OSO₃⁻, C₂H₅-OSO₃⁻, C₈H₁₅-OSO₃⁻, CH₃CO₂⁻, CH₃CH₂CO₂⁻, CH₃CH(OH)CO₂⁻, Cl⁻, NO₃⁻, (CF₃SO₂)₂N⁻, and



[0113] In a further preferred embodiment, [X]⁻ may be selected from the group consisting of: [F]⁻, [Cl]⁻, [Br]⁻, [I]⁻, [HCO₃]⁻, [CO₃]²⁻, [HSO₄]⁻, [SO₄]²⁻, [H₂PO₄]⁻, [HPO₄]²⁻, [PO₄]³⁻ and [NO₃]⁻.

[0114] Further examples of ionic liquids which may be used include choline chloride, choline docusate, 1-methyl-3-butylimidazolium docusate, 1-methyl-3-butylimidazolium bis(trifluoromethanesulfonyl)imide, 1-methyl-3-allylimidazolium docusate, 1-methyl-3-hexadecylimidazolium bis(trifluoromethanesulfonyl)imide, 1-methyl-3-hexadecylimidazolium docusate.

[0115] The mixtures are not limited to ionic liquids comprising anions and cations having only a single charge. Thus, the formula [Cat]⁺[X]⁻ is intended to encompass ionic liquids comprising, for example, doubly, triply and quadruply charged anions and/or cations. The relative stoichiometric amounts of [Cat]⁺ and [X]⁻ in the ionic liquid are therefore not fixed, but can be varied to take account of cations and anions with multiple charges. For example, the formula [Cat]⁺[X]⁻ should be understood to include ionic liquids having the formulae [Cat]²⁺[X]²⁻; [Cat]²⁺[X]⁻₂; [Cat]²⁺[X]²⁻; [Cat]³⁺[X]³⁻; [Cat]³⁺[X]⁻₃ and so on.

[0116] Preferably, the ionic liquids used have a melting point below 100 °C, more preferably below 80 °C, more preferably below 60 °C, still more preferably below 40 °C and most preferably below 25 °C. Suitable viscosities for the ionic liquid are as described above for the mixtures and the precursors.

[0117] The at least two-part mixture may comprise a co-solvent. Where a co-solvent is used, it is preferably water. However, other suitable co-solvents include methanol, ethanol, and other alcohols (e.g. octanol), acetone, acetonitrile, and ethyl acetate. Preferred solvents have low toxicity and minimum hazard for use in public areas. An ionic liquid and co-solvent may be present in the chewing gum modifying composition in a weight ratio of from 5:95 to 100:0. Thus, suitable weight ratios for the ionic liquid and co-solvent in the chewing gum removal composition include 10:90, 20:80, 30:70, 40:60; 50:50; 60:40; 70:30, 90:10, 95:5, 98:2 and 99:1. In such an embodiment it will be appreciated that the ionic liquid may be considered one precursor and the co-solvent another precursor. Further, the first and/or second delivery system will be configured such that the precursors are delivered according to the required concentrations.

[0118] In another embodiment, the pH of the composition may be controlled by the use of ionic liquids wherein the anion and/or the cation comprise acidic and/or basic moieties.

[0119] The ionic liquid comprises one or more oxidising reagents.

[0120] Preferably the oxidising reagents comprise an oxidation catalyst and an oxygen source.

[0121] Suitable oxidation catalysts include metal compounds, and more preferably metal salts. Preferred metal salts are lanthanide and transition metal salts, with transition metal salts being particularly preferred.

[0122] Examples of transition metal salts that may be used according to this aspect of the invention are iron, titanium, manganese, molybdenum, cobalt, zirconium, cerium and nickel salts. More preferably the transition metal salt is selected

from Fe(II), Fe(III), Mn(VII), Mn(VI), Mo(VI), Co(II), Zr(IV), Ce(IV), and Ni(II) salts. For example, suitable salts include $\text{Fe}_2(\text{SO}_4)_3$, $(\text{NH}_4)\text{Fe}(\text{SO}_4)_2 \cdot 2\text{H}_2\text{O}$, $\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$, K_2MnO_4 , KMnO_4 , K_2MoO_4 , $\text{CoSO}_4 \cdot 7\text{H}_2\text{O}$, $\text{CoCO}_3 \cdot x\text{H}_2\text{O}$, $\text{Zr}(\text{OH})_2\text{CO}_3 \cdot \text{ZrO}_2$, $(\text{NH}_4)_2\text{Ce}(\text{NO}_3)_6$, $(\text{CH}_3\text{CO}_2)_2\text{Ni}$.

[0123] In a preferred embodiment, the catalyst is an iron salt, more preferably a Fe(II) or Fe(III) salt, and most preferably a Fe(II) or Fe(III) chloride or sulphate salt.

[0124] In a further preferred embodiment, the catalyst is a manganese salt, more preferably a Mn(VI) or Mn(VII) salt, and most preferably a MnO_4^{2-} or a MnO_4^- salt. An advantage of using manganese salts is that they do not leave visible residues on treated surfaces.

[0125] Suitable oxygen sources for use according to this aspect of the invention include hydrogen peroxide and hydrogen peroxide-releasing compounds, including perborate salts, percarbonate salts, persulphate salts, perphosphate salts (for example sodium perborate, sodium percarbonate, sodium persulphate, sodium perphosphate, potassium perborate, potassium percarbonate, potassium persulphate, and potassium perphosphate), and urea peroxide. Also suitable are salts having halogen oxyanions, including hypochlorite, chlorite, chlorate, perchlorate, bromate, perbromate, iodate and periodate salts. Further suitable oxygen sources include organic hydroperoxides such as *tert*-butylhydroperoxide, organic peroxyacids such as peracetic acid, and organic peroxyacid salts such as sodium peracetate.

[0126] In a preferred embodiment the oxygen source is selected from hydrogen peroxide, sodium perborate, sodium percarbonate, sodium persulphate, and sodium perphosphate.

[0127] Examples of suitable combinations of oxidation catalysts and oxygen sources in accordance with this aspect of the invention include: sodium perborate and Fe(III) sulphate; sodium percarbonate and Fe(III) sulphate; and hydrogen peroxide and Fe(III) sulphate.

[0128] In accordance with this aspect, the mixture preferably comprises water as a cosolvent. The ionic liquid and water are preferably combined in a weight ratio of from 5:95 to 80:20, more preferably from 5:95 to 50:50, still more preferably from 5:95 to 5:20, and most preferably from 5:95 to 10:90 in order to form the mixture.

[0129] The oxygen source is preferably applied in the form of an aqueous solution.

[0130] In a further preferred embodiment the oxidation catalyst is premixed with the ionic liquid (e.g. a first precursor), and mixed with an oxygen source (e.g. a second precursor). In this way, the first precursor may be combined with the second precursor immediately prior to application of the resulting mixture to the chewing gum residue.

[0131] Examples of preferred chewing gum removal compositions premixed with oxidation catalysts include:

- (i) $[(\text{CH}_3)_3\text{NCH}_2\text{CH}_2\text{OH}]^+[\text{docusate}]^-$, Fe(III) sulphate, and water premixed in a weight ratio of 1:3:10; and
- (ii) $[(\text{CH}_3)_3\text{NCH}_2\text{CH}_2\text{OH}]^+[\text{chloride}]^-$, sodium dodecylsulphate, Fe(III) sulphate, and water premixed in a weight ratio of 0.75:1.5:3:10.

[0132] In addition to the ionic liquid, and the oxidising reagents, the ionic liquid mixtures may comprise various additives, such as surfactants, viscosity modifiers, emulsifiers, melting point suppressants and wetting agents. A wide variety of such additives are known in the art, and the skilled person is capable of selecting suitable additives as necessary for a particular application. Even enzymes may additionally be used.

[0133] In addition to the ionic liquid, and the oxidising reagents, the ionic liquid mixtures may comprise one or more thickening agents and/or one or more foaming agents, as described above.

[0134] The ionic liquid based mixtures are applied in a manner as described above for the other mixtures, and for similar periods of time.

[0135] The inventors of the present application have additionally found that if the individual components of the at least two-part mixture are applied separately (unmixed) the gum modification action of the mixture is sub-optimal. To overcome this problem the inventors have provided a method and apparatus (as set out in the appended claims and the examples of the invention described herein) for applying an at least two-part mixture in a manner which enables the mixture to efficiently break down the chewing gum residue and modify its structure.

[0136] Also disclosed is a kit of parts for use in removing chewing gum residues from substrates comprising:

- (i) A first precursor, which may comprise one or more of the mixture components described above;
- (ii) A second precursor, which may comprise one or more of the mixture components described above; and
- (iii) An apparatus as described herein for dispensing a chewing gum modifying composition comprising a first and a second precursor.

[0137] Preferably, the first and second precursors are chemically distinct.

[0138] Still further, the present invention provides a method of removing chewing gum residue from a substrate comprising the steps of:

- (i) Applying an at least two-part mixture as described above using an apparatus in accordance with the present

invention (and as described above); and

(ii) Removing the chewing gum residue from the substrate.

[0139] An embodiment of the invention will now be described in greater detail, by way of example only, and with reference to Figure 1 which shows a very schematic drawing of a chewing gum removal apparatus.

Examples

Apparatus

[0140] In Figure 1, there is described a user carryable chewing gum removal apparatus 1 which comprises a housing 2 for holding two reservoirs 3, 5, two pumps 9, 11 a battery 13 and a controller 7.

[0141] A first reservoir 3 is in fluid communication with nozzle 15 via pump 9 and tube 20. A second reservoir, 5, is in fluid communication with nozzle 15 via second pump 11 and tube 18.

[0142] Battery 13 is arranged to provide electric power to the pumps 9 and 11.

[0143] A controller 7 is coupled to control the pumps 9 and 11.

[0144] A lance 19 extends between the nozzle and a handle 21. In the example of Figure 1 the handle 21 carries an activation switch 23 to enable a user to control the controller 7. The activation switch 23 can be electrically coupled to controller 7 by wires (not shown) extending along part of one or both of the tubes 18 and 20.

[0145] A shroud 17 is arranged adjacent the nozzle 15.

[0146] In operation the two reservoirs 3, 5 contain a supply of two precursors for preparing the chewing gum removal mixture. The approximate overall capacity of the reservoirs is typically about 20 litres.

[0147] The two pumps 9 and 11 and the tubing arrangements 18 and 20 provide two independent delivery systems to deliver the precursors of the mixture to the nozzle without mixing. These two delivery systems are independently controllable such that the precursors can be delivered to the nozzle in a selected ratio. In the example of Figure 1 pumps 9 and 11 are arranged to be controlled by controller 7 to pump fluid from reservoirs 3 and 5 in a ratio of 6:4. In this example this is achieved by operating the pumps to achieve a selected throughput and, in the event that the fluid pressure differential across one or both of the pumps varies outside a specific tolerance the throughput of one or both of the pumps can be adjusted by the controller to maintain throughput at the desired rate.

[0148] In another example the pumps may be arranged to maintain a selected pressure differential across each of the pumps.

[0149] In the example of Figure 1 reservoir 3 holds fluid having a viscosity of at least 2500 cP, preferably 5000cP and reservoir 5 holds fluid having a viscosity of no more than 5 cP. The internal cross section of tubes 18 and 20 and the pressure differentials created by the pumps 9 and 11 are selected such that the ratio of throughput of the pumps is 6:4. As will be appreciated, the at least two part mixture used to remove the gum may originate from a variety of precursors (such as those described above). Therefore the controller 7 may be adjustable such that the delivery rate of the precursors is selectable by a user.

[0150] In use the two fluids are delivered through the tubes 18 and 20 along lance 19 to nozzle 15. The lance 19 can be manipulated by a user to position the nozzle 15 adjacent a piece of gum to be removed from a pavement so the shroud 17 shields the nozzle and partially or fully shields the gum which is to be removed. The user can then trigger application of the at least two part mixture to the gum using activation switch 23 so that the requisite quantities of the two fluids are dispensed through the nozzle. The mixture of these fluids thus forms an at least two part mixture capable of modifying a chewing gum residue. The at least two part mixture is formed, in this example, by a mixture of a metal catalyst with hydrogen peroxide. The metal catalyst in an active state acts to oxidise the gum. The catalyst is then bound to the gum in an inactive state. The hydrogen peroxide reactivates the catalyst by releasing it from the gum thus breaking down the polymers which make up the gum. However, absent the gum, the catalyst alone will break down the hydrogen peroxide into oxygen gas and water. The present invention has the advantage of mixing the hydrogen peroxide with the catalyst immediately before the mixture is applied to the gum or during application to the gum.

Practical Example 1

[0151] A potassium permanganate gel was prepared by combining fumed silica (10 g) with water (40 mL) and allowing the resulting mixture to stand for 5 minutes before adding 40 mL of KMnO₄ dip [3.0 g KMnO₄, 20 g K₂CO₃, 5 mL aqueous NaOH (5 wt%), 300 mL water]. The mixture was placed in a first reservoir of an apparatus such as described in the example above as a first precursor.

[0152] A hydrogen peroxide solution (35% by weight in water) was added to a second reservoir of an apparatus such as described above as a second precursor.

[0153] A two-part mixture was then applied by means of a nozzle (in a weight ratio of first precursor to second precursor

of about 1:3.5) to a chewing gum residue (~0.5 g) on the surface of a concrete slab, so as to cover the residue.

[0154] After less than 10 minutes the softened chewing gum residue could be mechanically removed from the surface of the concrete slab using a brush or spatula.

Practical Example 2

[0155] Sodium silicate and sodium laureth sulfate were added to a solution comprising a peroxide as the oxidising agent and a permanganate as the oxidising catalyst. A synergistic effect was observed, with the viscosity of the of the resultant composition exceeding the viscosity of the foaming agent and thickening agent alone.

Claims

1. A back-pack cleaning apparatus, carryable by a user and adapted for the removal of chewing-gum residues from a substrate by the application of an at least two-part mixture, wherein said at least two-part mixture is capable of modifying the chewing-gum residue, the apparatus comprising:
 - a first reservoir holding a first precursor of the at least two-part mixture;
 - a second reservoir holding a second precursor of the at least two-part mixture;
 - an outlet arranged to receive the first and second precursors from the respective reservoirs, and to apply the precursors to gum residue that has adhered to a substrate; wherein the first precursor comprises one or more oxidising catalysts and the second precursor comprises one or more oxidising reagent;
 - a first delivery system operable to deliver the first precursor from the first reservoir to the outlet at a first delivery rate; a second delivery system operable to deliver the second precursor from the second reservoir to the outlet at a second delivery rate;
 - a delivery rate controller arranged to control at least one of the first and second delivery rates such that the ratio of the delivery rates is controlled; and
 - user control means operable by a user to selectively actuate the delivery systems such that the mixed precursors are delivered through the outlet at a rate selected such that the precursors are mixed during application; and wherein the at least two-part mixture comprises a first precursor comprising of one or more oxidising reagents and a second precursor comprising one or more oxidation catalysts.
2. A cleaning apparatus according to claim 1, wherein the at least two-part mixture is at least partially produced by mixing the precursors in situ on the chewing-gum residue, preferably wherein the at least two-part mixture is at least partially produced by reaction of the precursors when mixed, and more preferably wherein the at least two-part mixture is at least partially produced by reaction in situ on the chewing-gum residue.
3. A cleaning apparatus according to any one of claims 1 to 2 in which the outlet is in fluid communication with a plurality of nozzles.
4. A cleaning apparatus according to any one of claims 1 to 3 in which the first and second delivery systems each comprise tubing and a pump operable to pump the respective one of the first and second precursor through the tubing to the outlet and wherein at least one of the delivery systems is suitable for pumping fluid having a viscosity of at least 2500 cP at a flow rate of at least 5ml per second.
5. A cleaning apparatus according to any one of claims 1 to 4 in which the delivery rate controller comprises a micro-processor operable by a user to select from a memory one of a plurality of flow control programs and to control the delivery rates in accordance with the selected program, preferably in which the delivery rate controller comprises an adaptation of at least one of the first and second pumps such that the ratio of the delivery rates is within a selected range, and preferably wherein the adaption includes the use of mechanical chokes.
6. A cleaning apparatus according to any one of claims 1 to 4 in which the delivery rate controller comprises an adaptation of at least one of the first and second delivery systems, and preferably wherein the adaption includes the use of mechanical chokes
7. A cleaning apparatus according to claim 4 in which the delivery rate controller comprises a power controller operable to control the delivery of electric power to at least one of the first and second pumps; or in which each pump has a pump inlet arranged to receive fluid and a pump outlet for the expulsion of fluid, and in which the delivery rate

controller is provided by an arrangement which controls the first and second pumps to generate substantially the same pressure differential so that the flow rates are controlled by the relative internal diameters of the tubing in the first and second delivery system.

- 5 8. A cleaning apparatus according to any one of claims 1 to 7 wherein at least one of the delivery systems is suitable for pumping fluid having a viscosity of at least 15000 cP at a flow rate of at least 5ml per second, and preferably wherein at least one of the delivery systems is suitable for pumping fluid having a viscosity of at least 25000 cP at a flow rate of at least 5ml per second.
- 10 9. A cleaning apparatus according to any one of the preceding claims wherein the first delivery systems is operable to pump fluid having a viscosity of at least 2500 cP at a flow rate of at least 5ml per second and wherein the second delivery system is operable to pump a fluid having a viscosity of no more than 5cP at a flow rate of no more than 2 ml per second and wherein the delivery rate controller is operable to control the first and second delivery systems such that the total delivery rate of the two-part mixture from the mixing outlet is about 6.5ml per second, and preferably
15 wherein the pressure differential between the precursor delivery systems is at least 6.9 kPa.
10. A cleaning apparatus according to any one of the preceding claims further comprising a lance in fluid communication with the outlet, and preferably wherein the lance is telescopic.
- 20 11. A cleaning apparatus according to any one of the preceding claims wherein the nozzle has two intake couplings and one outlet coupling such that mixing of the precursors only occurs on application through the nozzle, preferably located on the lance; or wherein the nozzle, preferably located on the lance, has two intake couplings and two outlet couplings such that mixing of the precursors only occurs on application of the precursors to the chewing-gum residue.
- 25 12. A cleaning apparatus according to claim 11 wherein the intake couplings comprise non-return valves and/or the first and/or second delivery systems comprise non-return valves to inhibit backflow of mixed precursors.
13. An apparatus according to any one of the preceding claims wherein the first and second precursor are mixed immediately prior to application to the chewing-gum substrate, or wherein the first and second precursor mix on
30 contact with the chewing-gum.
14. A cleaning apparatus according to any one of claims 1 to 13, wherein the two-part mixture further comprises a foaming agent and/or wherein the two-part mixture further comprises a thickening agent.
- 35 15. A method of removing chewing-gum residue from a substrate comprising the steps of:

(i) applying an at least two-part mixture as described in any one of claims 1 to 14 using an apparatus in accordance with any one of claims 1 to 14; and
(ii) removing the chewing-gum residue from the substrate.

Patentansprüche

- 45 1. Rückentragreinigungsvorrichtung, die von einem Benutzer getragen werden kann und für die Entfernung von Kaugummiresten von einem Substrat durch die Auftragung einer mindestens zweiteiligen Mischung ausgelegt ist, wobei die mindestens zweiteilige Mischung den Kaugummirest modifizieren kann und die Vorrichtung Folgendes umfasst:

einen ersten Behälter, der einen ersten Vorläufer der mindestens zweiteiligen Mischung enthält;
einen zweiten Behälter, der einen zweiten Vorläufer der mindestens zweiteiligen Mischung enthält;
50 einen Auslass, der so angeordnet ist, dass er den ersten und zweiten Vorläufer aus den jeweiligen Behältern empfängt und die Vorläufer auf den Kaugummirest aufträgt, der auf einem Substrat klebt; wobei der erste Vorläufer einen oder mehrere Oxidationskatalysatoren umfasst und der zweite Vorläufer ein oder mehrere Oxidationsreagenzien umfasst;
ein erstes Abgabesystem, das so betrieben werden kann, dass es den ersten Vorläufer aus dem ersten Behälter mit einer ersten Fördergeschwindigkeit zu dem Auslass leitet; ein zweites Abgabesystem, das so betrieben
55 werden kann, dass es den zweiten Vorläufer aus dem zweiten Behälter mit einer zweiten Fördergeschwindigkeit zu dem Auslass leitet;
eine Fördergeschwindigkeitssteuerung, die so ausgelegt ist, dass sie mindestens die erste oder die zweite

Fördergeschwindigkeit steuert, so dass das Verhältnis der Fördergeschwindigkeiten gesteuert wird, und Benutzerbedienelemente, die von einem Benutzer betätigt werden können, um die Abgabesysteme selektiv zu betätigen, so dass die gemischten Vorläufer durch den Auslass mit einer Geschwindigkeit abgegeben werden, die so gewählt ist, dass die Vorläufer während der Auftragung vermischt werden, und
 wobei die mindestens zweiteilige Mischung Folgendes umfasst: einen ersten Vorläufer, der ein oder mehrere Oxidationsreagenzien umfasst, und einen zweiten Vorläufer, der einen oder mehrere Oxidationskatalysatoren umfasst.

2. Reinigungsvorrichtung nach Anspruch 1, wobei die mindestens zweiteilige Mischung mindestens teilweise durch Vermischen der Vorläufer vor Ort auf dem Kaugummirest erzeugt wird, wobei die mindestens zweiteilige Mischung vorzugsweise mindestens teilweise durch Reaktion der Vorläufer erzeugt wird, wenn sie vermischt werden und wobei die mindestens zweiteilige Mischung insbesondere vorzugsweise mindestens teilweise durch eine Reaktion vor Ort auf dem Kaugummirest erzeugt wird.
3. Reinigungsvorrichtung nach einem der Ansprüche 1 bis 2, wobei der Auslass mit einer Vielzahl von Düsen in Fluidverbindung steht.
4. Reinigungsvorrichtung nach einem der Ansprüche 1 bis 3, wobei das erste und zweite Abgabesystem jeweils Schläuche und eine Pumpe umfassen, die so betrieben werden können, dass sie den jeweiligen ersten oder zweiten Vorläufer durch die Schläuche zu dem Auslass pumpen, und wobei mindestens eines der Abgabesysteme zum Pumpen von Fluid mit einer Viskosität von mindestens 2500 cP bei einer Strömungsgeschwindigkeit von mindestens 5 ml pro Sekunde geeignet ist.
5. Reinigungsvorrichtung nach einem der Ansprüche 1 bis 4, wobei die Fördergeschwindigkeitssteuerung einen Mikroprozessor umfasst, der von einem Benutzer so bedient werden kann, dass er aus einem Speicher eines einer Vielzahl von Strömungssteuerprogrammen auswählt und die Fördergeschwindigkeiten gemäß dem ausgewählten Programm steuert, vorzugsweise wobei die Fördergeschwindigkeitssteuerung eine Anpassung mindestens der ersten oder der zweiten Pumpe umfasst, so dass das Verhältnis der Fördergeschwindigkeiten innerhalb eines ausgewählten Bereichs liegt und wobei die Anpassung vorzugsweise die Verwendung von mechanischen Drosseln umfasst.
6. Reinigungsvorrichtung nach einem der Ansprüche 1 bis 4, wobei die Fördergeschwindigkeitssteuerung eine Anpassung von mindestens dem ersten oder dem zweiten Abgabesystem umfasst, und vorzugsweise wobei die Anpassung die Verwendung von mechanischen Drosseln umfasst.
7. Reinigungsvorrichtung nach Anspruch 4, wobei die Fördergeschwindigkeitssteuerung eine Leistungssteuerung umfasst, die die Zufuhr von elektrischem Strom zu mindestens der ersten oder der zweiten Pumpe steuern kann; oder wobei jede Pumpe einen Pumpeneinlass zum Empfang von Fluid und einen Pumpenauslass zum Ausstoß von Fluid aufweist, und wobei die Fördergeschwindigkeitssteuerung durch eine Anordnung bereitgestellt ist, die die erste und zweite Pumpe steuert, um im Wesentlichen die gleiche Druckdifferenz zu erzeugen, so dass die Strömungsgeschwindigkeiten durch die relativen Innendurchmesser der Schläuche in dem ersten und zweiten Abgabesystem gesteuert werden.
8. Reinigungsvorrichtung nach einem der Ansprüche 1 bis 7, wobei mindestens eines der Abgabesysteme zum Pumpen von Fluid mit einer Viskosität von mindestens 15000 cP bei einer Strömungsgeschwindigkeit von mindestens 5 ml pro Sekunde geeignet ist und wobei vorzugsweise mindestens eines der Abgabesysteme zum Pumpen von Fluid mit einer Viskosität von mindestens 25000 cP bei einer Strömungsgeschwindigkeit von mindestens 5 ml pro Sekunde geeignet ist.
9. Reinigungsvorrichtung nach einem der vorhergehenden Ansprüche, wobei die ersten Abgabesysteme Fluid mit einer Viskosität von mindestens 2500 cP bei einer Strömungsgeschwindigkeit von mindestens 5 ml pro Sekunde pumpen können und wobei das zweite Abgabesystem Fluid mit einer Viskosität von nicht mehr als 5 cP bei einer Strömungsgeschwindigkeit von nicht mehr als 2 ml pro Sekunde pumpen kann und wobei die Fördergeschwindigkeitssteuerung das erste und zweite Abgabesystem so steuern kann, dass die Gesamtfördergeschwindigkeit der zweiteiligen Mischung aus dem Mischauslass etwa 6,5 ml pro Sekunde beträgt, und wobei die Druckdifferenz zwischen den Vorläuferabgabesystemen vorzugsweise mindestens 6,9 kPa beträgt.
10. Reinigungsvorrichtung nach einem der vorhergehenden Ansprüche, die ferner eine Lanze in Fluidverbindung mit

dem Auslass umfasst und wobei die Lanze vorzugsweise teleskopisch ist.

11. Reinigungsvorrichtung nach einem der vorhergehenden Ansprüche, wobei die Düse zwei Einlasskupplungen und eine Auslasskupplung aufweist, so dass ein Vermischen der Vorläufer nur bei Auftragung durch die Düse erfolgt, die vorzugsweise an der Lanze angeordnet ist, oder wobei die Düse, die vorzugsweise an der Lanze angeordnet ist, zwei Einlasskupplungen und zwei Auslasskupplungen aufweist, so dass ein Vermischen der Vorläufer nur bei Auftragung der Vorläufer auf den Kaugummirest erfolgt.
12. Reinigungsvorrichtung nach Anspruch 11, wobei die Einlasskupplungen Rückschlagventile umfassen und/oder das erste und/oder das zweite Abgabesystem Rückschlagventile umfassen, um den Rückfluss der vermischten Vorläufer zu hemmen.
13. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei der erste und zweite Vorläufer unmittelbar vor der Auftragung auf das Kaugummi substrat gemischt werden, oder wobei sich der erste und der zweite Vorläufer bei Kontakt mit dem Kaugummi vermischen.
14. Reinigungsvorrichtung nach einem der Ansprüche 1 bis 13, wobei die zweiteilige Mischung ferner ein Treibmittel umfasst und/oder wobei die zweiteilige Mischung ein Verdickungsmittel umfasst.
15. Verfahren zum Entfernen von Kaugummiresten von einem Substrat, das folgende Schritte umfasst:
 - (i) Auftragen einer mindestens zweiteiligen Mischung, wie in einem der Ansprüche 1 bis 14 beschrieben, unter Verwendung einer Vorrichtung gemäß einem der Ansprüche 1 bis 14 und
 - (ii) Entfernen des Kaugummirests von dem Substrat.

Revendications

1. Appareil de nettoyage à dos, apte à être porté par un utilisateur et conçu pour l'enlèvement de résidus de gomme à mâcher sur un substrat grâce à l'application d'un mélange à au moins deux parties, ledit mélange à au moins deux parties étant capable de modifier le résidu de gomme à mâcher, l'appareil comprenant :
 - un premier réservoir lequel contient un premier précurseur du mélange à au moins deux parties ;
 - un deuxième réservoir lequel contient un deuxième précurseur du mélange à au moins deux parties ;
 - un orifice de sortie agencé de façon à recevoir les premier et deuxième précurseurs provenant des réservoirs respectifs, et à appliquer les précurseurs à un résidu de gomme qui a adhéré à un substrat ; cas dans lequel le premier précurseur comprend un ou plusieurs catalyseurs oxydants et le deuxième précurseur comprend un ou plusieurs réactifs oxydants ;
 - un premier système de délivrance exploitable de façon à délivrer le premier précurseur en provenance du premier réservoir vers l'orifice de sortie suivant un premier débit de délivrance ; un deuxième système de délivrance exploitable de façon à délivrer le deuxième précurseur en provenance du deuxième réservoir vers l'orifice de sortie suivant un deuxième débit de délivrance ;
 - un contrôleur de débits de délivrance agencé de façon à piloter l'un au moins des débits, à savoir le premier débit de délivrance et le deuxième débit de délivrance, de sorte que le rapport des débits de délivrance soit contrôlé ; et
 - des moyens de commande Utilisateur exploitables par un utilisateur afin d'actionner de façon sélective les systèmes de délivrance de sorte que les précurseurs mélangés soient délivrés par l'intermédiaire de l'orifice de sortie suivant un débit sélectionné de telle sorte que les précurseurs soient mélangés au cours de l'application ; et
 - cas dans lequel le mélange à au moins deux parties comprend un premier précurseur lequel comporte un ou plusieurs réactifs oxydants, et un deuxième précurseur lequel comporte un ou plusieurs catalyseurs d'oxydation.
2. Appareil de nettoyage selon la revendication 1, le mélange à au moins deux parties étant au moins partiellement obtenu grâce au mélangeage des précurseurs in situ sur le résidu de gomme à mâcher, de préférence le mélange à au moins deux parties étant au moins partiellement obtenu en vertu de la réaction des précurseurs lors de leur mélange, et de plus grande préférence le mélange à au moins deux parties étant au moins partiellement obtenu en vertu de la réaction in situ sur le résidu de gomme à mâcher.

3. Appareil de nettoyage selon l'une quelconque des revendications 1 à 2, dans lequel l'orifice de sortie est en communication fluidique avec une pluralité d'ajutages.
- 5 4. Appareil de nettoyage selon l'une quelconque des revendications 1 à 3, dans lequel les premier et deuxième systèmes de délivrance comprennent chacun un tubage et une pompe exploitable de façon à pomper un précurseur respectif, à savoir le premier précurseur et le deuxième précurseur, à travers le tubage vers l'orifice de sortie, et cas dans lequel l'un au moins des systèmes de délivrance est apte à pomper du fluide ayant une viscosité d'au moins 2500 cP suivant un débit d'au moins 5 ml par seconde.
- 10 5. Appareil de nettoyage selon l'une quelconque des revendications 1 à 4, dans lequel le contrôleur de débits de délivrance comprend un microprocesseur exploitable par un utilisateur afin de sélectionner, à partir d'une mémoire, un programme parmi une pluralité de programmes de commande de flux, et de piloter les débits de délivrance en conformité avec le programme sélectionné, de préférence dans lequel le contrôleur de débits de délivrance comporte une adaptation d'au moins une pompe, à savoir la première pompe et la deuxième pompe, de sorte que le rapport des débits de délivrance se situe dans les limites d'une gamme sélectionnée, et de préférence l'adaptation incluant l'utilisation de dispositifs d'étranglement mécaniques.
- 15 6. Appareil de nettoyage selon l'une quelconque des revendications 1 à 4, dans lequel le contrôleur de débits de délivrance comporte une adaptation d'au moins un système de délivrance, à savoir le premier système de délivrance et le deuxième système de délivrance, et de préférence l'adaptation incluant l'utilisation de dispositifs d'étranglement mécaniques.
- 20 7. Appareil de nettoyage selon la revendication 4, dans lequel le contrôleur de débits de délivrance comprend un contrôleur d'énergie exploitable de façon à piloter l'alimentation en énergie électrique se rendant vers au moins une pompe, à savoir la première pompe et la deuxième pompe ; ou dans lequel chaque pompe possède un orifice d'entrée de pompe agencé de façon à recevoir du fluide et un orifice de sortie de pompe pour assurer l'expulsion de fluide, et dans lequel le contrôleur de débits de délivrance est doté d'un agencement qui pilote les première et deuxième pompes afin de générer sensiblement le même différentiel de pression de sorte que les débits soient contrôlés par les diamètres internes relatifs du tubage dans les premier et deuxième systèmes de délivrance.
- 25 8. Appareil de nettoyage selon l'une quelconque des revendications 1 à 7, l'un au moins des systèmes de délivrance convenant au pompage d'un fluide ayant une viscosité d'au moins 15000 cP suivant un débit d'au moins 5 ml par seconde, et de préférence l'un au moins des systèmes de délivrance convenant au pompage d'un fluide ayant une viscosité d'au moins 25000 cP suivant un débit d'au moins 5 ml par seconde.
- 30 9. Appareil de nettoyage selon l'une quelconque des revendications précédentes, le premier système de délivrance étant exploitable de façon à pomper du fluide ayant une viscosité d'au moins 2500 cP suivant un débit d'au moins 5 ml par seconde, et le deuxième système de délivrance étant exploitable de façon à pomper un fluide ayant une viscosité qui n'est pas supérieure à 5 cP suivant un débit qui n'est pas supérieur à 2 ml par seconde, et le contrôleur de débits de délivrance étant exploitable de façon à piloter les premier et deuxième systèmes de délivrance de sorte que le débit de délivrance total du mélange à deux parties provenant de l'orifice de sortie de mélangeage se situe à environ 6,5 ml par seconde, et de préférence, le différentiel de pression entre les systèmes de délivrance de précurseurs étant au moins de 6,9 kPa.
- 35 10. Appareil de nettoyage selon l'une quelconque des revendications précédentes, comprenant en outre une lance en communication fluidique avec l'orifice de sortie, et de préférence la lance étant télescopique.
- 40 11. Appareil de nettoyage selon l'une quelconque des revendications précédentes, l'ajutage possédant deux couplages d'admission et un couplage de sortie de sorte que le mélangeage des précurseurs se produise uniquement lors de l'application à travers l'ajutage, situé de préférence sur la lance ; ou l'ajutage, situé de préférence sur la lance, possédant deux couplages d'admission et deux couplages de sortie de sorte que le mélangeage des précurseurs se produise uniquement lors de l'application des précurseurs sur le résidu de gomme à mâcher.
- 45 12. Appareil de nettoyage selon la revendication 11, les couplages d'admission comportant des clapets de retenue et/ou les premier et/ou deuxième systèmes de délivrance comportant des clapets de retenue afin d'empêcher tout flux arrière des précurseurs mélangés.
- 50 13. Appareil de nettoyage selon l'une quelconque des revendications précédentes, les premier et deuxième précurseurs

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étant mélangés immédiatement avant leur application au substrat en gomme à mâcher, ou les premier et deuxième précurseurs se mélangeant au moment du contact avec la gomme à mâcher.

5 **14.** Appareil de nettoyage selon l'une quelconque des revendications 1 à 13, le mélange à deux parties comprenant en outre un agent moussant et/ou le mélange à deux parties comprenant en outre un agent épaississant.

15. Procédé destiné à enlever un résidu de gomme à mâcher d'un substrat, comprenant les étapes consistant à :

- 10 (i) appliquer un mélange à au moins deux parties tel que décrit dans l'une quelconque des revendications 1 à 14, en utilisant un appareil conformément à l'une quelconque des revendications 1 à 14 ; et
 (ii) enlever le résidu de gomme à mâcher du substrat.

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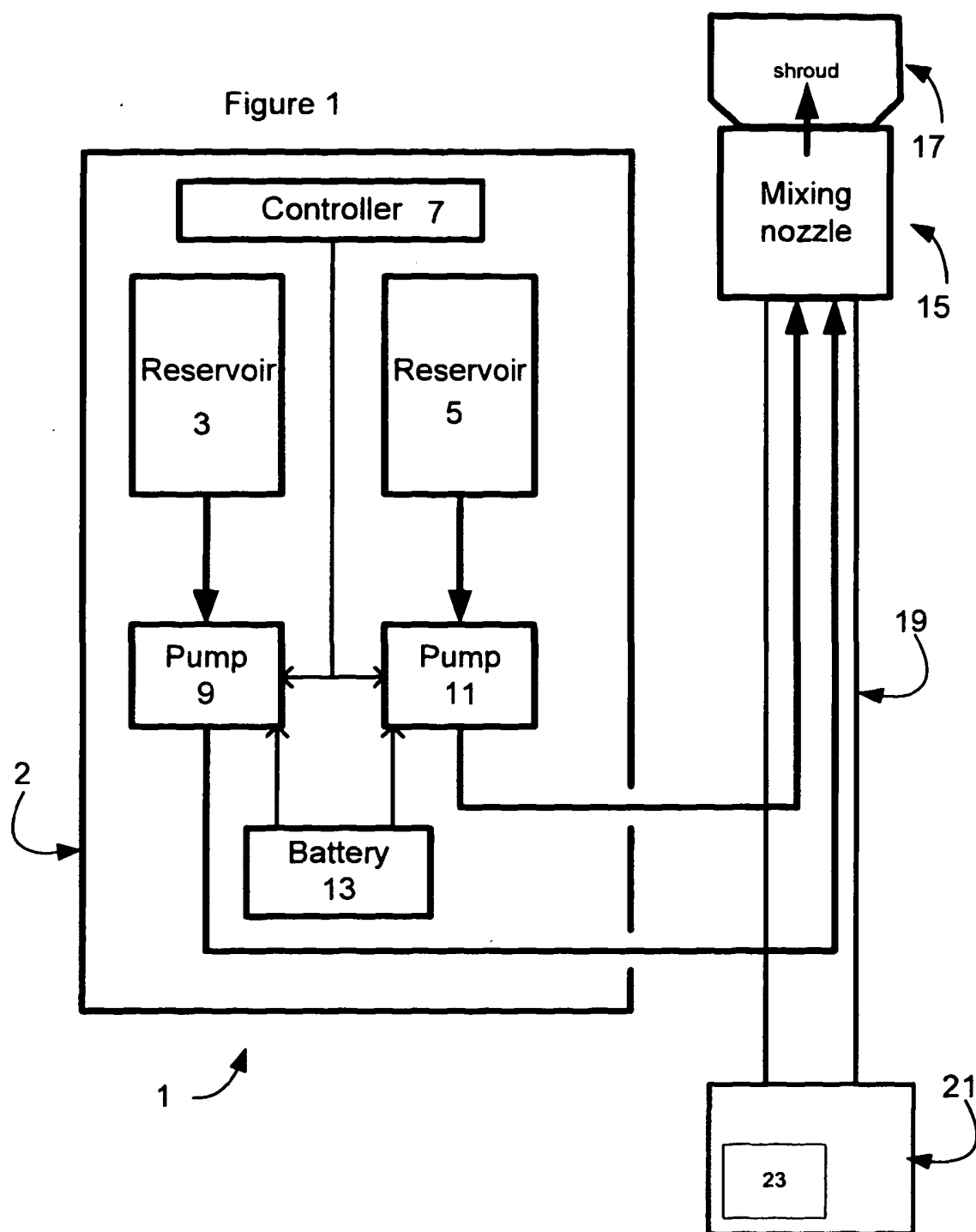
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REFERENCES CITED IN THE DESCRIPTION

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