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(54) **WATER-SOLUBLE INJECTION MOULDED CONTAINER**

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(57) **ABSTRACT**

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A water-soluble, injection-moulded container comprising at least one compartment and having a first opening closed by a first film and a second opening closed by a second film, wherein the first film and the second film have different water dissolution characteristics.

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WATER-SOLUBLE INJECTION MOULDED CONTAINER

[0001] The present invention relates to a water-soluble, injection moulded container having at least one compartment and to a process for preparing such a container.

[0002] It is known to package chemical compositions, particularly those which may be of a hazardous or irritant nature, in films, particularly water soluble films. Such containers can simply be added to water in order to dissolve or disperse the contents of the container into the water.

[0003] For example, WO 89/12587 discloses a package which comprises an envelope of a water soluble material which comprises a flexible wall and a water-soluble heat seal. The package may contain an organic liquid comprising, for example, a pesticide, fungicide, insecticide or herbicide.

[0004] WO 92/17382 discloses a package containing an agrochemical comprising a first sheet of non-planar water-soluble or water-dispersible material and a second sheet of water-soluble or water-dispersible material superposed on the first sheet and sealed to it.

[0005] The above methods of packaging have, however, a number of disadvantages.

[0006] The first disadvantage is that they do not have a particularly attractive appearance. In fields such as containers used in the domestic environment, an attractive appearance for an article is extremely desirable. Liquids contained in envelopes of water-soluble film can have a limp, unattractive appearance.

[0007] The second disadvantage is that it is difficult to form two or more separate compartments in the packaging such that two or more incompatible components are both enclosed but separated from each other. Although an arrangement has been described to separate incompatible materials in flexible pouches in WO 93/08095, the method proposed is complex and is not currently achievable in large-scale manufacturing. It cannot, therefore, be used for producing large numbers of containers having at least two compartments. Additionally it is not possible to ensure that different components are released at different times or in different environments such as in environments of different temperature or pH.

[0008] The third disadvantage is that there is only a limited control of the release profile of the compositions held in the containers. For example, when a composition is held between two planar water-soluble films or in a thermoformed package, the composition is simply released at the time when the films dissolve or disperse in water. While it may be possible to control to a certain extent the timing of the start of release of the contents, there can be no control over the rate of release of the contents since the entire film dissolves or disperses at about the same time. Furthermore it can be difficult to provide an extended time before the contents of the package are released. An additional problem also arises with thermoformed packages. If the thermoforming is not carefully controlled there may be inadvertent thinning of the film material at the points where the film material is drawn down into the mould when it is thermoformed. This could result in release of the contents of the package early.

[0009] The fourth disadvantage is that the containers cannot be produced at a particularly fast rate. When the containers are produced by heat-sealing planar films or by thermoforming, the containers have to be immediately filled and sealed. All of these procedures have to be carried out in succession. This means that it is not possible to obtain a quick throughput for mass-market goods such as household products. For example, standard thermoforming machines can only produce about 400 to 800 containers per minute, and vertical form fill sealing machines can only produce about 120 containers per minute.

[0010] U.S. Pat. No. 3,823,816 describes water soluble capsules containing powder or granules which have several holes in the sides which are covered in a water-soluble film that dissolves prior to the capsule.

[0011] The present invention seeks to provide a water-soluble container which overcomes some or all of the above disadvantages.

[0012] The present invention provide a water-soluble, injection-moulded container comprising at least one compartment and having a first opening closed by a first film and a second opening closed by a second film, wherein the first film and the second film have different water dissolution characteristics.

[0013] In a preferred feature of the invention we provide a water-soluble, injection-moulded container comprising at least two compartments, a first compartment containing a first composition and having a first opening closed by a first film and a second compartment containing a second composition and having a second opening closed by a second film, wherein the first film and the second film have different water dissolution characteristics.

[0014] The present invention also provides a process for preparing a container as defined above which comprises forming the container comprising at least two compartments by injection-moulding, filling each compartment a composition and sealing each compartment with a film, wherein at least two sealing films have different water dissolution characteristics.

[0015] The containers of the present invention overcome some or all of the above disadvantages.

[0016] Firstly, because the containers are generally rigid and self-supporting, they have an attractive, uniform appearance which does not vary between different containers. Furthermore, the containers can easily have various elements incorporated which are considered to be pleasing to the eye but which are impossible to incorporate in the flexible containers discussed above.

[0017] Secondly, because the containers are generally rigid, it is possible to introduce two or more compartments, or have larger compartments separated by walls, to separate mutually incompatible ingredients. The containers can also hold part of the composition on an external surface, for example in an indentation. Since the films sealing the different compartments of the container have different dissolution characteristics, the contents of the compartments are released at, for example, different times or under different external conditions. Furthermore the container can be moulded in almost any shape that might be useful. In particular it can be given raised or lowered areas. Thirdly, it

is possible to control the release profile of the contents of the container. Since the container is generally rigid it is possible to adapt the thicknesses of some or all of the walls of the container as well as to have sealing films with different water dissolution characteristics to control both the rate of release of the composition as well as the start of release, although the start of release will generally be controlled by the films sealing the compartments.

[0018] For example one or more walls may be made thin in order to have an early release of the composition. Alternatively some or all of the walls may be thick in order to ensure that there is a delayed release of the composition. The rate of release of the composition may be controlled by ensuring that only part of the container has thin walls which are dissolved or dispersed before the remainder of the container or by ensuring that the film seals a compartment with a narrow opening which restricts the flow of the contents of the compartment out into the environment. Different walls or parts of walls of the container may be prepared from different water-soluble polymers which have different dissolution characteristics. For example a first component may be fully enclosed by a polymer which dissolves at a higher or lower temperature than the polymer enclosing a second component. Thus different components can be released at different times.

[0019] In a feature of the invention which comprises a single container with two openings each sealed with a different film it is understood that a formulation is provided in at least part of the container which is only released upon opening of the second film. This can be achieved by use of, for example, a solid or semi-solid formulation that is not released by the opening of the first film.

[0020] If the container holds a composition which does not flow, for example a solid or gelled composition, it is not even necessary for the container to fully enclose the composition. A part may be left exposed so that it immediately begins to dissolve when the container is added to water.

[0021] Fourthly, since the containers are generally rigid and self-supporting, they can be easily filled on a production line using normal filling equipment. Such equipment is easily capable of filling at least 1,500 containers per minute.

[0022] In all embodiments of this invention, the container is, for example, not a container comprising a member, for example, a member formed by injection moulding, having at least two openings positioned on different sides of the member, each opening being closed by a film, which container comprises at least two compartments, each compartment having an opening closed by a film, wherein the film over each opening has different water dissolution characteristics.

[0023] Similarly in all embodiments of this invention, the container is, for example, not a container comprising a member having at least two openings positioned on different sides of the member, each opening being closed by a film, each film having different water dissolution characteristics allowing the container to release different compositions at different temperatures.

[0024] Desirably the walls of the container consist essentially of, or consist of, the injection-moulded polymer composition. It is possible for suitable additives such as plasti-

cisers, lubricants and colouring agents to be added. Components which modify the properties of the polymer may also be added. Plasticisers are generally used in an amount of up to 20 wt %, for example from 15 to 20 wt %. Lubricants are generally used in an amount of 0.5 to 5 wt %. The polymer is therefore generally used in an amount of from 75 to 84.5 wt %, based on the total amount of the moulding composition. Suitable plasticisers are, for example, pentaerythritols such as depentaerythritol, sorbitol, mannitol, glycerine and glycols such as glycerol, ethylene glycol and polyethylene glycol. Solids such as talc, stearic acid, magnesium stearate, silicon dioxide, zinc stearate or colloidal silica may also be used.

[0025] It is also possible to include one or more particulate solids in the moulding composition in order to accelerate the rate of dissolution of the container. This solid may also be present in the contents of the container. Dissolution of the solid in water is sufficient to cause an acceleration in the break-up of the container, particularly if a gas is generated, when the physical agitation caused may, for example, result in the virtually immediate release of the contents from the container.

[0026] Examples of such solids are alkali or alkaline earth metal, such as sodium, potassium, magnesium or calcium, bicarbonate or carbonate, in conjunction with an acid.

[0027] Suitable acids are, for example acidic substances having carboxylic or sulfonic acid groups or salts thereof. Examples are cinnamic, tartaric, mandelic, fumaric, maleic, malic, palmoic, citric and naphthalene disulfonic acids.

[0028] Any water-soluble polymer (which term is taken to include water-dispersible) may be used to form the compartments. Examples of water-soluble polymers are poly(vinyl alcohol) (PVOH), cellulose derivatives such as hydroxypropyl methyl cellulose (HPMC) and gelatin. An example of a preferred PVOH is ethoxylated PVOH. The PVOH may be partially or fully alcoholised or hydrolysed. For example it may be from 40 to 100%, preferably from 70 to 92%, more preferably about 88% or about 92%, alcoholised or hydrolysed. The degree of hydrolysis is known to influence the temperature at which the PVOH starts to dissolve in water. 88% hydrolysis corresponds to a film soluble in cold (ie room temperature) water, whereas 92% hydrolysis corresponds to a film soluble in warm water. A preferred PVOH which is already in a form suitable for injection moulding is sold in the form of granules under the name CP1210T05 by Soltec Developpement SA of Paris, France.

[0029] Thus by choosing an appropriate polymer it is possible to ensure that the walls of the container dissolve at a desired temperature. Thus they may be cold water (20° C.) soluble, but may be insoluble in cold water and only become soluble in warm or hot water having a temperature of, for example, 30° C., 40° C., 50° C. or even 60° C.

[0030] The container walls generally have a thickness such that the container is rigid. For example, the outside walls and any inside walls may independently have a thickness of greater than 1001 μm , for example greater than 150 μm or greater than 200 μm , 300 μm , 400 μm , 500 μm , 750 μm or 1 mm. Typically the thicknesses are from 200 μm to 1,500 μm , preferably 300 μm to 800 μm . If different compartments having different wall dissolution times are

required, different wall thicknesses for each compartment may be used. A thickness difference of from 100 μm to 500 μm , preferably 250 μm to 350 μm , would give a suitable difference in dissolution times.

[0031] The container may have any shape, but suitably is generally cuboid. The top wall may be formed by the sealing film and the side walls, inside walls and base wall may be formed by the injection moulded part of the container, hereinafter sometimes referred to as the receptacle part.

[0032] The receptacle part contains one or more compartments. For example it can contain 2, 3, 4, 5 or 6 or more compartments. At least one or two, and preferable all, of the compartments have openings on the outside of the container. The openings may independently be on any side of the container. Thus, for example, all of the openings may be on one side of the container. Alternatively, one side of the container may have one or more openings and at least one other side of the container may have one or more openings. For example, for a container with two openings, the openings may both be on the same or different sides of the container. If they are on different sides, the sides may be, for example, adjacent to, spaced apart from or opposite each other, preferably the openings are spaced apart from or opposite each other. As a further example, for a container with three openings, the openings may all be on one side of the container, the openings may all be on different sides of the container, or the container may have one opening on one side and two openings on another side. These openings may be, for example, on adjacent, spaced apart or opposite sides of the container. As a yet further example, for a container with four openings, the openings may all be on one side of the container, the openings may all be on different sides of the container, or the container may have two openings on one side and two openings on another side, or the container may have two openings on one side and one opening on each of two other sides. These openings may be, for example, on adjacent, spaced apart or opposite sides of the container.

[0033] Desirably, and especially when all of the openings are on one side of the container, the openings extend substantially across all of the face of the container except for that part of the face which is required as a surface for sealing the films to the container. Said part may be, for example, an inward or outward flange. However, the openings may independently only extend across part of a surface of a container. For example they may extend over from 10 to 90% or 30 to 70% of the area of a side.

[0034] The dividing wall or walls of the container preferably terminate at the top of the receptacle part, i.e. in the same plane as the top edges of the side walls, such that when the receptacle part is closed by the sealing part the contents of the compartments cannot mix.

[0035] The container may be formed with an opening, for example a depression, formed in a side wall or in the base wall, and preferably being open in the outward direction. That is to say, it does not form part of the main volume defined by the container. Preferably the opening is adapted to receive, in a press-fit manner, a solid block, for example a tablet or ball, of a composition useful in a washing process. The opening may also receive a non-compressed composition, for example a gel, which is allowed to set in the opening. A composition held in such an opening may be released before the contents of the container are released.

[0036] The polymer may be injection moulded at any suitable temperature. A suitable moulding temperature, especially for PVOH, is from 180° C. to 220° C., depending upon the formulation selected and the melt flow required.

[0037] Each container may be individually moulded. It is also possible to mould the containers a conjoined line or a two dimensional array. The containers are then filled with the desired compositions. Before or after the filling step it is possible, if desired, to separate individual containers if more than one container has been moulded together.

[0038] Since the containers have more than one compartment, each compartment is filled with a composition. The compositions in each compartment may be the same or different. Each compartment may be filled simultaneously or at different times. If all of the compartments have openings on the same side, the compartments may all be filled at the same time.

[0039] However, if the compartments have openings on different sides, they may need to be filled at different times, with the orientation of the container being changed in between the filling operations. It may also be necessary to seal the opening of the filled compartment before the orientation of the container is changed. For example, in order to fill a container, especially one in the form of a cuboid, consisting of two compartments separated by an internal wall and having openings on opposite sides, the container is initially positioned with one opening upperwards, the compartment with the uppermost opening is filled and the opening is then sealed with a first film. The container is then turned upside down, and the operation repeated to fill the other compartment with a composition and then seal it with a second film.

[0040] At least one, and preferably all, of the films dissolve or disperse to release the contents of the compartments which they seal before the walls of the container dissolve.

[0041] If all of the compartments have openings on the same side of the container one film or a plurality of films may be used to seal the openings. However, if a single film is used to seal all the openings, or if the same film is used to seal all the openings at different times, at least part of the film must be treated or otherwise modified in order to ensure that at least two compartments are sealed with films having different dissolution characteristics.

[0042] When at least two different films are used to seal different openings, the films may have different dissolution characteristics from each other at the time of sealing, or the characteristics may be modified after the compartments have been sealed.

[0043] In order to ensure that films have different dissolution characteristics, the films may be chosen to dissolve at different temperatures. For example, the films may comprise PVOH polymers having different degrees of hydrolysis. The films may also be chosen to dissolve at different pHs. It is also possible to ensure that the films take different times to dissolve to achieve a sequential release of compositions from different compartments, even when the external environment of the containers has not changed. This may be achieved, for example, by using films which are of the same or different composition but which are of different thicknesses. It is also possible to treat one or more of the films after they have sealed the openings. For example, one or

more of the films may be covered by another film. If this is the same film it will simply retard dissolution of the film by increasing the effective thickness of the film layer. If is a different film, it may alter other dissolution properties. For example covering a cold water soluble film with a warm water soluble film will ensure that the resultant composite film will only dissolve in warm water. Other means for treating the film include increasing cross-linking by exposure to a cross-linking inducing chemical, such as boronic acid, or exposure to an electromagnetic stimulus such as UV light. Another technique is to coat the film with a compound or composition which can repel or attract water. Compounds may be applied to the film by any suitable technique, convenient techniques for applying thin layers of compound onto the film include techniques used in the printing industry, such as flexography, letterpress, gravure and silkscreen. Other techniques include transfer coating, roller coating or otherwise spray coating.

[0044] If a single film is used, it is possible to treat at least part of the surface before or after it seals the openings of the container. Any of the above treatments may be used, alone or in combination.

[0045] It is possible to use the same film for two compartments and then rely on one of the compositions in one of the compartments to modify the film closing that compartment. Examples of such an effect can be achieved by the addition of plasticisers in the composition or cross-linking agents, such as boronic acid.

[0046] The films may be sealed to close the openings by any means. The two parts may be sealed, for example, by means of an adhesive. A suitable adhesive is water or a solution of PVOH. The adhesive can be applied to the sides of the openings or to the films by spraying, transfer coating, roller coating or otherwise coating, or the films can be passed through a mist of the adhesive. The parts can also be made tacky such that they adhere to each other without the need for a separate adhesive. Thus they can be heated, such that they adhere to each other when they touch.

[0047] The container may also be wrapped in the film. If it is desired to have an attractive appearance with a smooth film, the film can be shrink-wrapped around the container. This can be done by pre-stretching the film, for example by biaxial orientation, and then heating it to shrink it around the container. The film may also be thermoformed around part of the container by placing the container in a pocket of the film held in a thermoforming mould. An opening in the remaining part of the container can then be sealed with another film.

[0048] The parts may also be sealed by heat sealing or infra-red, radio frequency, ultrasonic, laser, solvent, vibration, electromagnetic, hot gas, hot plate, insert bonding friction sealing or by spin welding. Ultrasonic or laser sealing is preferably used. The seal desirably is water-soluble.

[0049] If heat sealing is used, a suitable sealing temperature is, for example, 120 to 195° C., for example 140 to 150° C. A suitable sealing pressure is, for example, from 250 to 600 kPa. Examples of sealing pressures are 276 to 552 kPa (40 to 80 p.s.i.), especially 345 to 483 kPa (50 to 70 p.s.i.) or 400 to 800 kPa (4 to 8 bar), especially 500 to 700 kPa (5 to 7 bar) depending on the heat sealing machine used. Suitable sealing dwell times are at least 0.4 seconds, for example 0.4 to 2.5 seconds.

[0050] The sealing films generally dissolve in water before the receptacle part of the container. The films therefore generally have thicknesses which are less than the wall thickness of the receptacle part. In general, at least one of the films dissolves in water (at least to the extent of allowing the composition in the receptacle part to be partly or completely dissolved by the water) at 40° C. in less than 5 minutes, preferably less than 2 minutes.

[0051] It is possible for one or more of the sealing films to have incorporated therein a composition. Thus, for example, one or more of the films can themselves contain compositions formed in the films by a previous operation such as thermoforming or vertical form fill sealing.

[0052] The containers of the present invention contain two or more compositions, and can have a particularly attractive appearance since the compositions, which may be identical or different, are held in a fixed position in relation to each other. The compositions can be easily differentiated to accentuate their difference. For example, the compositions can have a different physical appearance, or can be coloured differently.

[0053] FIG. 1 of the accompanying drawings illustrates a container which is split into two compartments. The container consists of a cuboid with solid faces **1** and two openings **2** on opposite sides of the member. FIG. 2 illustrates a cross-section of the member of container **1** taken along the line II of FIG. 1. One compartment can be filled with a composition and the opening closed by a film. The container can then be turned upside down and the process repeated to fill and seal the other compartment with a film having different water dissolution characteristics.

[0054] The composition(s) which can be held in each compartment of the containers of the present invention may independently be a fabric care, surface care or dishwashing composition. Thus, for example, they may be a dishwashing, water-softening, laundry or detergent composition, or a rinse aid. Such compositions may be suitable for use in a domestic washing machine. The compositions may also independently be a disinfectant, antibacterial or antiseptic composition, or a refill composition for a trigger-type spray. Such compositions are generally packaged in total amounts of from 5 to 100 g, especially from 15 to 40 g. For example, a laundry composition may weigh from 15 to 40 g, a dishwashing composition may weigh from 15 to 30 g and a water-softening composition may weigh from 15 to 40 g.

[0055] If the composition is an aqueous liquid having a relatively high water content, for example above 5 wt % water, it may be necessary to take steps to ensure that the liquid does not attack the water-soluble polymer if it is soluble in cold water, or water up to a temperature of, say, 35° C. Steps may be taken to treat the inside surfaces of the container, for example by coating it with agents such as PVdC (poly(vinylidene dichloride)) or PTFE (polytetrafluoroethylene), or to adapt the composition to ensure it does not dissolve the polymer. For example, it has been found that ensuring the composition has a high ionic strength or contains an agent which minimises water loss through the walls of the container will prevent the composition from dissolving the polymer from the inside. This is described in more detail in EP-A-518689 and WO 97/27743.

[0056] The compartments may be completely filled or only partially filled. Each composition independently may

be a solid. For example, it may be a particulate or granulated solid, or a tablet. Each composition may also independently be a liquid, which may be thickened or gelled if desired. The liquid composition may be non-aqueous or aqueous, for example comprising less than or more than 5% or less than or more than 10 wt % total or free water. Desirably the compositions contain less than 80 wt % water.

[0057] Each composition may have more than one phase. For example each composition may comprise an aqueous composition and a liquid composition which is immiscible with the aqueous composition. Each composition may also comprise a liquid composition and a separate solid composition, for example in the form of a ball, pill or speckles.

[0058] Thus the composition within the container, or an individual compartment, need not be uniform. For example, during manufacture the container or compartment could first be fed with a settable composition, for example, a gel, and then with a different composition. The first composition could dissolve slowly in the washing process so as to deliver its charge over a long period within the washing process. This might be useful, for example, to provide an immediate, delayed or sustained delivery of an component such as a softening agent.

[0059] The compositions in each compartment may be the same or different. If they are different, they may, nevertheless, have one or more individual components in common.

[0060] The containers of the present invention may have any desired shape. For example the container can have an irregular or regular geometrical shape such as a cube, cuboid, pyramid, dodecahedron or cylinder. The cylinder may have any desired cross-section, such as a circular, triangular or square cross-section.

[0061] The individual compartments in the container need not necessarily be regular or identical. For example, if the final container has a cuboid shape, the individual compartments may have different sizes to accommodate different quantities of compositions.

[0062] The compartments may have the same or different size and/or shape. In general, if it is desired to have compartments containing different quantities of components, the compartments have volume ratios of from 2:1 to 20:1, especially from 4:1 to 10:1.

[0063] The container may also have a hook portion so that it can be hung, for example, from an appropriate place inside a dishwashing machine.

[0064] The containers produced by the process of the present invention may, if desired, have a maximum dimension of 5 cm, excluding any flanges. For example, a container may have a length of 1 to 5 cm, especially 3.5 to 4.5 cm, a width of 1.5 to 3.5 cm, especially 2 to 3 cm, and a height of 1 to 2 cm, especially 1.25 to 1.75 cm.

[0065] If more than one composition is present, the compositions may be appropriately chosen depending on the desired use of the article.

[0066] If the article is for use in laundry washing, the primary composition may comprise, for example, a detergent, and the secondary composition may comprise a bleach, stain remover, water-softener, enzyme or fabric conditioner. The article is adapted to release the compositions at different

times during the laundry wash. For example, a bleach or fabric conditioner is generally released at the end of a wash, and a water-softener is generally released at the start of a wash. An enzyme may be released at the start or the end of a wash.

[0067] If the article is for use as a fabric conditioner, the primary composition may comprise a fabric conditioner and the secondary component may comprise an enzyme which is released before or after the fabric conditioner in a rinse cycle.

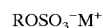
[0068] If the article is for use in dish washing the primary composition may comprise a detergent and the secondary composition may comprise a water-softener, salt, enzyme, rinse aid, bleach or bleach activator. The article is adapted to release the compositions at different times during the laundry wash. For example, a rinse aid, bleach or bleach activator is generally released at the end of a wash, and a water-softener, salt or enzyme is generally released at the start of a wash. The article may also have more than two compartments adapted to release compositions at different times. For example a three compartment container may contain a bleach, a bleach activator and an enzyme in different compartments. A four compartment container may also contain a salt in a fourth compartment.

[0069] Examples of surface care compositions are those used in the field of surface care, for example to clean, treat or polish a surface. Suitable surfaces are, for example, household surfaces such as worktops, as well as surfaces of sanitary ware, such as sinks, basins and lavatories.

[0070] The ingredients of each composition depend on the use of the composition. Thus, for example, the composition may contain surface active agents such as an anionic, nonionic, cationic, amphoteric or zwitterionic surface active agents or mixtures thereof.

[0071] Examples of anionic surfactants are straight-chained or branched alkyl sulfates and alkyl polyalkoxylated sulfates, also known as alkyl ether sulfates. Such surfactants may be produced by the sulfation of higher C₈-C₂₀ fatty alcohols.

[0072] Examples of primary alkyl sulfate surfactants are those of formula:



[0073] wherein R is a linear C₈-C₂₀ hydrocarbyl group and M is a water-solubilising cation. Preferably R is C₁₀-C₁₆ alkyl, for example C₁₂-C₁₄, and M is alkali metal such as lithium, sodium or potassium.

[0074] Examples of secondary alkyl sulfate surfactants are those which have the sulfate moiety on a "backbone" of the molecule, for example those of formula:



[0075] wherein m and n are independently 2 or more, the sum of m+n typically being 6 to 20, for example 9 to 15, and M is a water-solubilising cation such as lithium, sodium or potassium.

[0076] Especially preferred secondary alkyl sulfates are the (2,3) alkyl sulfate surfactants of formulae:



[0077] for the 2-sulfate and 3-sulfate, respectively. In these formulae x is at least 4, for example 6 to 20, preferably 10 to 16. M is cation, such as an alkali metal, for example lithium, sodium or potassium.

[0078] Examples of alkoxyated alkyl sulfates are ethoxyated alkyl sulfates of the formula:



[0079] wherein R is a C_8 - C_{20} alkyl group, preferably C_{10} - C_{18} such as a C_{12} - C_{16} , n is at least 1, for example from 1 to 20, preferably 1 to 15, especially 1 to 6, and M is a salt-forming cation such as lithium, sodium, potassium, ammonium, alkylammonium or alkanolammonium. These compounds can provide especially desirable fabric cleaning performance benefits when used in combination with alkyl sulfates.

[0080] The alkyl sulfates and alkyl ether sulfates will generally be used in the form of mixtures comprising varying alkyl chain lengths and, if present, varying degrees of alkoxylation.

[0081] Other anionic surfactants which may be employed are salts of fatty acids, for example C_8 - C_{18} fatty acids, especially the sodium or potassium salts, and alkyl, for example C_8 - C_{18} , benzene sulfonates.

[0082] Examples of nonionic surfactants are fatty acid alkoxyates, such as fatty acid ethoxyates, especially those of formula:



[0083] wherein R is a straight or branched C_8 - C_{16} alkyl group, preferably a C_9 - C_{15} for example C_{10} - C_{14} , alkyl group and n is at least 1, for example from 1 to 16, preferably 2 to 12, more preferably 3 to 10.

[0084] The alkoxyated fatty alcohol nonionic surfactant will frequently have a hydrophilic-lipophilic balance (HLB) which ranges from 3 to 17, more preferably from 6 to 15, most preferably from 10 to 15.

[0085] Examples of fatty alcohol ethoxyates are those made from alcohols of 12 to 15 carbon atoms and which contain about 7 moles of ethylene oxide. Such materials are commercially marketed under the trademarks Neodol 25-7 and Neodol 23-6.5 by Shell Chemical Company. Other useful Neodols include Neodol 1-5, an ethoxyated fatty alcohol averaging 11 carbon atoms in its alkyl chain with about 5 moles of ethylene oxide; Neodol 23-9, an ethoxyated primary C_{12} - C_{13} alcohol having about 9 moles of ethylene oxide; and Neodol 91-10, an ethoxyated C_9 - C_{11} primary alcohol having about 10 moles of ethylene oxide.

[0086] Alcohol ethoxyates of this type have also been marketed by Shell Chemical Company under the Dobanol trademark. Dobanol 91-5 is an ethoxyated C_9 - C_{11} fatty alcohol with an average of 5 moles ethylene oxide and Dobanol 25-7 is an ethoxyated C_{12} - C_{15} fatty alcohol with an average of 7 moles of ethylene oxide per mole of fatty alcohol.

[0087] Other examples of suitable ethoxyated alcohol nonionic surfactants include Tergitol 15-S-7 and Tergitol 15-S-9, both of which are linear secondary alcohol ethoxyates available from Union Carbide Corporation. Tergitol 15-S-7 is a mixed ethoxyated product of a C_{11} - C_{15} linear

secondary alkanol with 7 moles of ethylene oxide and Tergitol 15-S-9 is the same but with 9 moles of ethylene oxide.

[0088] Other suitable alcohol ethoxyated nonionic surfactants are Neodol 45-11, which is a similar ethylene oxide condensation products of a fatty alcohol having 14-15 carbon atoms and the number of ethylene oxide groups per mole being about 11. Such products are also available from Shell Chemical Company.

[0089] Further nonionic surfactants are, for example, C_{10} - C_{18} alkyl polyglycosides, such as C_{12} - C_{16} alkyl polyglycosides, especially the polyglucosides. These are especially useful when high foaming compositions are desired. Further surfactants are polyhydroxy fatty acid amides, such as C_{10} - C_{18} N-(3-methoxypropyl) glycamides and ethylene oxide-propylene oxide block polymers of the Pluronic type.

[0090] Examples of cationic surfactants are those of the quaternary ammonium type.

[0091] The total content of surfactants in the composition is desirably 60 to 95 wt %, especially 75 to 90 wt %. Desirably an anionic surfactant is present in an amount of 50 to 75 wt %, the nonionic surfactant is present in an amount of 5 to 50 wt %, and/or the cationic surfactant is present in an amount of from 0 to 20 wt %. The amounts are based on the total solids content of the composition, i.e. excluding any solvent which may be present.

[0092] The compositions, particularly when used as laundry washing or dishwashing compositions, may also independently comprise enzymes, such as protease, lipase, amylase, cellulase and peroxidase enzymes. Such enzymes are commercially available and sold, for example, under the registered trade marks Esperase, Alcalase and Savinase by Nova Industries A/S and Maxatase by International Biosynthetics, Inc. Desirably the enzymes are independently present in the compositions in an amount of from 0.5 to 3 wt %, especially 1 to 2 wt %, when added as commercial preparations they are not pure and this represents an equivalent amount of 0.005 to 0.5 wt % of pure enzyme.

[0093] The compositions may, if desired, independently comprise a thickening agent or gelling agent. Suitable thickeners are polyacrylate polymers such as those sold under the trade mark CARBOPOL, or the trade mark ACUSOL by Rohm and Haas Company. Other suitable thickeners are xanthan gums. The thickener, if present, is generally present in an amount of from 0.2 to 4 wt %, especially 0.5 to 2 wt %.

[0094] Compositions used in dishwashing independently usually comprise a detergency builder. The builders counteract the effects of calcium, or other ion, water hardness. Examples of such materials are citrate, succinate, malonate, carboxymethyl succinate, carboxylate, polycarboxylate and polyacetyl carboxylate salts, for example with alkali metal or alkaline earth metal cations, or the corresponding free acids. Specific examples are sodium, potassium and lithium salts of oxydisuccinic acid, mellitic acid, benzene polycarboxylic acids, C_{10} - C_{22} fatty acids and citric acid. Other examples are organic phosphonate type sequestering agents such as those sold by Monsanto under the trade mark Dequest and alkylhydroxy phosphonates. Citrate salts and C_{12} - C_{18} fatty acid soaps are preferred. Further builders are; phosphates such as sodium, potassium or ammonium salts of

mono-, di- or tri-poly or oligo-phosphates; zeolites; silicates, amorphous or structured, such as sodium, potassium or ammonium salts.

[0095] Other suitable builders are polymers and copolymers known to have builder properties. For example, such materials include appropriate polyacrylic acid, polymaleic acid, and polyacrylic/polymaleic and copolymers and their salts, such as those sold by BASF under the trade mark Sokalan. The builder is desirably present in an amount of up to 90 wt %, preferably 15 to 90 wt %, more preferably 15 to 75 wt %, relative to the total weight of the composition. Further details of suitable components are given in, for example, EP-A-694,059, EP-A-518,720 and WO 99/06522.

[0096] The compositions can also optionally comprise one or more additional ingredients. These include conventional detergent composition components such as further surfactants, bleaches, bleach enhancing agents, builders, suds boosters or suds suppressors, anti-tarnish and anti-corrosion agents, organic solvents, co-solvents, phase stabilisers, emulsifying agents, preservatives, soil suspending agents, soil release agents, germicides, pH adjusting agents or buffers, non-builder alkalinity sources, chelating agents, clays such as smectite clays, enzyme stabilizers, anti-limescale agents, colourants, dyes, hydrotropes, dye transfer inhibiting agents, brighteners, and perfumes. If used, such optional ingredients will generally constitute no more than 10 wt %, for example from 1 to 6 wt %, the total weight of the compositions.

[0097] Compositions which comprise an enzyme may optionally contain materials which maintain the stability of the enzyme. Such enzyme stabilizers include, for example, polyols such as propylene glycol, boric acid and borax. Combinations of these enzyme stabilizers may also be employed. If utilized, the enzyme stabilizers generally constitute from 0.1 to 1 wt % of the compositions.

[0098] The compositions may optionally comprise materials which serve as phase stabilizers and/or co-solvents. Examples are C₁-C₃ alcohols such as methanol, ethanol and propanol. C₁-C₃ alkanolamines such as mono-, di- and triethanolamines can also be used, by themselves or in combination with the alcohols. The phase stabilizers and/or co-solvents can, for example, constitute 0 to 1 wt %, preferably 0.1 to 0.5 wt %, of the composition.

[0099] The compositions may optionally comprise components which adjust or maintain the pH of the compositions at optimum levels. The pH may be from, for example, 1 to 13, such as 8 to 11 depending on the nature of the composition. For example a dishwashing composition desirably has a pH of 8 to 11, a laundry composition desirable has a pH of 7 to 9, and a water-softening composition desirably has a pH of 7 to 9. Examples of pH adjusting agents are NaOH and citric acid.

[0100] The above examples may be used for dish or fabric washing. In particular dish washing formulations are preferred which are adapted to be used in automatic dish washing machines. Due to their specific requirements specialised formulation is required and these are illustrated below

[0101] Amounts of the ingredients can vary within wide ranges, however preferred automatic dishwashing detergent compositions herein (which typically have a 1% aqueous

solution pH of above 8, more preferably from 9.5 to 12, most preferably from 9.5 to 10.5) are those wherein there is present: from 5% to 90%, preferably from 5% to 75%, of builder; from 0.1% to 40%, preferably from 0.5% to 30%, of bleaching agent; from 0.1% to 15%, preferably from 0.2% to 10%, of the surfactant system; from 0.0001% to 1%, preferably from 0.001% to 0.05%, of a metal-containing bleach catalyst; and from 0.1% to 40%, preferably from 0.1% to 20% of a water-soluble silicate. Such fully-formulated embodiments typically further comprise from 0.1% to 15% of a polymeric dispersant, from 0.01% to 10% of a chelant, and from 0.00001% to 10% of a detergent enzyme, though further additional or adjunct ingredients may be present. Detergent compositions herein in granular form typically limit water content, for example to less than 7% free water, for better storage stability.

[0102] Non-ionic surfactants useful in ADW (Automatic Dish Washing) compositions of the present invention desirably include surfactant(s) at levels of from 2% to 60% of the composition. In general, bleach-stable surfactants are preferred. Non-ionic surfactants generally are well known, being described in more detail in Kirk Othmer's Encyclopedia of Chemical Technology, 3rd Ed., Vol. 22, pp. 360-379, "Surfactants and Detergent Systems", incorporated by reference herein.

[0103] Preferably the ADW composition comprises at least one non-ionic surfactant. One class of non-ionics are ethoxylated non-ionic surfactants prepared by the reaction of a monohydroxy alkanol or alkylphenol with 6 to 20 carbon atoms with preferably at least 12 moles particularly preferred at least 16 moles, and still more preferred at least 20 moles of ethylene oxide per mole of alcohol or alkylphenol.

[0104] Particularly preferred non-ionic surfactants are the non-ionic from a linear chain fatty alcohol with 16-20 carbon atoms and at least 12 moles particularly preferred at least 16 and still more preferred at least 20 moles of ethylene oxide per mole of alcohol.

[0105] According to one preferred embodiment the non-ionic surfactant additionally comprise propylene oxide units in the molecule. Preferably this PO units constitute up to 25% by weight, preferably up to 20% by weight and still more preferably up to 15% by weight of the overall molecular weight of the non-ionic surfactant. Particularly preferred surfactants are ethoxylated mono-hydroxy alkanols or alkylphenols, which additionally comprises polyoxyethylene-polyoxypropylene block copolymer units. The alcohol or alkylphenol portion of such surfactants constitutes more than 30%, preferably more than 50%, more preferably more than 70% by weight of the overall molecular weight of the non-ionic surfactant.

[0106] Another class of non-ionic surfactants includes reverse block copolymers of polyoxyethylene and polyoxypropylene and block copolymers of polyoxyethylene and polyoxypropylene initiated with trimethylolpropane.

[0107] Another preferred non-ionic surfactant can be described by the formula:



[0108] wherein R¹ represents a linear or branched chain aliphatic hydrocarbon group with 4-18 carbon atoms or mixtures thereof, R² represents a linear or branched chain

aliphatic hydrocarbon rest with 2-26 carbon atoms or mixtures thereof, x is a value between 0.5 and 1.5 and y is a value of at least 15.

[0109] Another group of preferred nonionic surfactants are the end-capped polyoxyalkylated non-ionics of formula:



[0110] wherein R^1 and R^2 represent linear or branched chain, saturated or unsaturated, aliphatic or aromatic hydrocarbon groups with 1-30 carbon atoms, R^3 represents a hydrogen atom or a methyl, ethyl, n-propyl, iso-propyl, n-butyl, 2-butyl or 2-methyl-2-butyl group, x is a value between 1 and 30 and, k and j are values between 1 and 12, preferably between 1 and 5. When the value of x is ≥ 2 each R^3 in the formula above can be different. R^1 and R^2 are preferably linear or branched chain, saturated or unsaturated, aliphatic or aromatic hydrocarbon groups with 6-22 carbon atoms, where group with 8 to 18 carbon atoms are particularly preferred. For the group R^3H , methyl or ethyl are particularly preferred. Particularly preferred values for x are comprised between 1 and 20, preferably between 6 and 15.

[0111] As described above, in case $x \geq 2$, each R^3 in the formula can be different. For instance, when $x=3$, the group R^3 could be chosen to build ethylene oxide ($R^3=H$) or propylene oxide (R^3 =methyl) units which can be used in every single order for instance (PO) (EO)(EO), (EO) (PO) (EO), (EO)(EO)(PO), (EO) (EO) (EO), (PO) (EO) (PO), (PO) (PO) (EO) and (PO) (PO) (PO). The value 3 for x is only an example and bigger values can be chosen whereby a higher number of variations of (EO) or (PO) units would arise.

[0112] Particularly preferred end-capped polyoxyalkylated alcohols of the above formula are those where $k=1$ and $j=1$ originating molecules of simplified formula:



[0113] The use of mixtures of different non-ionic surfactants is particularly preferred in ADW formulations for example mixtures of alkoxyated alcohols and hydroxy group containing alkoxyated alcohols.

[0114] The containers may themselves be packaged in outer containers if desired, for example non-water soluble containers which are removed before the water-soluble containers are used.

[0115] In use the container are simply added to water where they dissolve. Thus they may be added in the usual way to a dishwasher or laundry machine, especially in the dishwashing compartment or a drum. They may also be added to a quantity of water, for example in a bucket or trigger-type spray.

1. A water-soluble, injection-moulded container comprising at least two compartments, a first compartment containing a first composition and having a first opening closed by a first film and a second compartment containing a second composition and having a second opening closed by a second film, wherein the first film and the second film have different water dissolution characteristics.

2. A container according to claim 1 wherein the first film and the second film dissolve in water before the injection-moulded walls of the container.

3. A container according to claim 1 or 2 wherein the first opening and the second opening are on different sides of the container.

4. A container according to claim 1 or 2 wherein the first opening and the second opening are on the same side of the container.

5. A container according to any one of the preceding claims wherein the container walls comprise a poly(vinyl alcohol).

6. A container according to any one of the preceding claims wherein at least one of the first film and the second film comprises a poly(vinyl alcohol).

7. A container according to any one of the preceding claims wherein the first film and the second film start to dissolve in water having different temperatures.

8. A container according to any one of the preceding claims wherein the first film and the second film start to dissolve in water having different pHs.

9. A container according to any one of the preceding claims wherein the first film and the second film comprise different base polymers.

10. A container according to any one of claims 1 to 7 wherein the first film and the second film comprise poly(vinyl alcohol)s having different degrees of hydrolysis.

11. A container according to any one of claims 1 to 7 wherein the first film and the second film have different thicknesses.

12. A container according to any one of claims 1 to 7 wherein at least one of the first film and the second film comprises a coating to modify its dissolution characteristics.

13. A container according to any one of the preceding claims wherein the first film and the second film are sealed to the container by laser or ultrasonic sealing.

14. A container according to any one of claims 1 to 12 wherein the first film and/or the second film is thermoformed around the container.

15. A container according to any one of claims 1 to 12 wherein the first film and/or the second film is wrapped around the container.

16. A container according to any one of the preceding claims wherein the first film and the second film are different films.

17. A container according to any one of claims 1 to 15 wherein the first film and the second film are in the form of a single film in which different parts have different water dissolution characteristics.

18. A container according to any one of the preceding claims wherein the first compartment and the second compartment each contains a fabric care, surface care or dishwashing composition.

19. A container according to claim 18 wherein each composition is a dishwashing, water-softening, laundry, detergent or rinse aid composition.

20. A container according to any one of claims 1 to 18 which encases a disinfectant, antibacterial or antiseptic composition.

21. A container according to any one of the preceding claims which encases a refill composition for a trigger-type spray.

22. A process for preparing a container as defined in any one of the preceding claims which comprises forming the container comprising at least two compartments by injection

tion-moulding, filling each compartment with a composition and sealing each opening with a film, wherein at least two sealing films have different water dissolution characteristics.

23. A process according to claim 22 wherein the two sealing films have different water dissolution characteristics at the time they seal each compartment.

24. A process according to claim 22 wherein the two sealing films have the same water dissolution characteristics at the time they seal each compartment and the water dissolution characteristic of at least one film is subsequently modified.

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