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(54) **HYDROGEL CONTACT LENSES AND PACKAGE SYSTEMS AND PRODUCTION METHODS FOR SAME**

HYDROGEL-KONTAKTLINSEN UND VERPACKUNGSSYSTEME UND HERSTELLUNGSVERFAHREN DAFÜR

LENTILLES DE CONTACT A BASE D'HYDROGEL, SYSTEMES D'EMBALLAGE ET PROCEDES DE PRODUCTION ASSOCIES

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Description

[0001] The present invention relates to hydrogel-containing contact lenses, packaging systems including same and methods of producing same. More particularly the invention relates to hydrogel-containing contact lenses, for example, disposable contact lenses, including water soluble polymer components, and packaging systems for use with same and methods of producing same.

Background of the Invention

[0002] In the recent past, a method for producing hydrogel-containing contact lenses has been developed which is more economical than either lathe cutting or spin casting, and provides better control over the final shape of the hydrated lens. This method involves direct molding of a monomer mixture wherein said mixture is dissolved in a non-aqueous, displaceable solvent. The mixture is placed in a mold having the precise shape of the final desired hydrogel (i.e., water-swollen) lens, and the monomer/solvent mixture is subjected to conditions whereby the monomer(s) polymerize, to thereby produce a polymer/solvent mixture in the shape of the final desired hydrogel lens.

[0003] After the polymerization is complete, the solvent is displaced with water to produce a hydrated lens whose final size and shape are quite similar to the size and shape of the original molded polymer/solvent article.

[0004] Such direct molding of hydrogel contact lenses is disclosed in Larsen, U.S. Pat. No. 4,495,313 and in Larsen et al., U.S. Pat. Nos. 4, 680336, 4, 889, 664 and 5, 039, 459. In addition, other patents to be considered include Larson U.S. Pat. No. 4,565,348; Okkada et al U.S. Pat. No. 4,347,198; Shepherd U.S. Pat. No. 4,208,364; Mueller et al EP-A-0493,320A2; and Wichterle et al U.S. Pat. No. RE 27,401 (U.S. Pat. No. 3,220,960). WO 00/02937 discloses contact lenses that include an interpenetrating network of a hydrophilic polymer material and a polymeric interpenetrating network agent. WO 98/55155 discloses contact lens packing solutions and methods for improving the comfort of disposable contact lenses. It would be advantageous to provide new and beneficial hydrogel-containing contact lenses, packaging systems for such lenses and methods of producing such contact lenses.

Summary of the Invention

[0005] New hydrogel-containing contact lenses, packaging systems for use with such lenses and methods of producing such lenses have been discovered. The present hydrogel-containing lenses take advantage of the economies and shape control benefits of direct molding of hydrogel-containing contact lenses. In addition, by properly selecting the diluent or material included in the mold during lens formation, in particular by employing one or more water soluble polymer components, such diluent or material may remain with/in the lens ready for use in an eye. Thus, the present methods of making hydrogel-containing contact lenses are even less complex and more economical, for example, by eliminating the solvent displacing step, relative to prior art direct molding processes discussed elsewhere herein. The present packaging systems advantageously maintain the diluent or material in the contact lenses prior to use in an eye. In addition, the hydrogel-containing lenses advantageously have increased modulus or strength when first placed in an eye. Over time, for example, over a one day use period, the diluent or material is removed from the lens and replaced by water or tear fluid in the eye. When the lens is removed from the eye, it has less strength and provides an indication to the wearer that the lens should be disposed of and replaced. In addition, should the wearer use the lens again, the lens would be less comfortable to wear, for example, due to the loss of the diluent or material. This reduced comfort feature provides an indication to the wearer that the lens should be disposed of and replaced. The present lenses are particularly advantageous when provided as disposable lenses, for example, lenses suitable or structured for one time usage.

[0006] In one broad aspect, the present invention is directed to a packaging system comprising: a contact lens body ready for use in the eye; a liquid medium; and a container holding the contact lens and the liquid medium, wherein the contact lens body comprises a hydrophilic polymeric material and a water soluble polymeric material selected from the group consisting of polyalkylene glycols, polyvinyl pyrrolidone, polymethacrylic acid, polyvinyl alcohol and mixtures thereof, characterised in that the liquid medium comprises an amount of water soluble polymeric material selected from the group consisting of polyalkylene glycols, polyvinyl pyrrolidone, polymethacrylic acid, polyvinyl alcohol and mixtures thereof, in addition to that present in the contact lens body. The contact lens bodies comprise a hydrophilic polymeric material and a water soluble polymer component (WSPC). Such contact lens bodies are ready for use in an eye. In one embodiment, the WSPC is in intimate admixture with the hydrophilic polymeric material.

[0007] In a very useful embodiment, the WSPC is derived from a diluent material used during polymerization of the hydrophilic polymeric material. The WSPC advantageously is derived from a diluent material, for example, is at least a portion of the diluent material, used during solution polymerization of a hydrophilic polymeric material.

[0008] In one embodiment, the contact lens body is produced using wet cast molding.

[0009] As noted above, the present contact lenses advantageously are structured to be disposed of after a single use

in the eye.

[0010] The present contact lens bodies including the WSPCs preferably have increased modulus relative to identical lens bodies in which the WSPC is replaced with water.

[0011] The WSPC advantageously is physically immobilized by the hydrophilic polymeric material in the present contact lens bodies. For example, the WSPC and the hydrophilic polymeric material may form an interpenetrating network or a psuedo interpenetrating network, preferably a psuedo interpenetrating network, in the lens body.

[0012] The present contact lens bodies preferably are configured or structured so that at least a portion of the WSPC leaves or is removed from the contact lens body during use of the contact lens body in an eye.

[0013] The hydrophilic polymeric material preferably is obtained by polymerization of at least one monomeric component, for example, by the polymerization of at least one hydrophilic monomeric component and at least one cross-linking monomeric component.

[0014] The hydrophilic monomeric component may be selected from any suitable such component. In a very useful embodiment, the hydrophilic monomeric component is selected from hydroxyalkyl acrylates, hydroxyalkyl methacrylates, N-vinyl pyrrolidone, acrylamides, vinyl alcohol, hydrophilic polyurethane precursors, glycerol acrylates, glycerol methacrylates, acrylates, methacrylates, substituted counterparts thereof and the like and mixtures thereof.

[0015] As used herein, the term "substituted counterparts thereof" refers to entities, e.g., compounds, which include one or more substituents and are effective to function in the present invention substantially like the unsubstituted entities, for example, the compounds listed herein.

[0016] Any suitable WSPC may be employed provided that it is effective in the present contact lenses, as described herein.

[0017] In one embodiment, the monomeric components from which the WSPCs are derived, for example, at least one ethylenically unsaturated hydrophilic monomeric component, are polymerizable to form linear or branched chain water soluble polymers or copolymers.

[0018] Hydrophilic monomeric components suitable for production of the WSPCs include, but are not limited to, hydrophilic vinylic monomers, such as vinyl (C_4-C_{45})alkyl ethers, vinyl (C_7-C_{49}) alkenoic acids and the like and mixtures thereof; hydroxy substituted (C_5-C_{45}) alkyl, alkoxy-alkyl and polyalkoxy-alkyl and mono- or bi-cycloaliphatic fumarates, maleates, acrylates, methacrylates, acrylamides and methacrylamides, and the like and mixtures thereof; acrylic acid, methacrylic acid, the corresponding amino or mono- and di-(lower alkyl) amino substituted acrylic monomers and the like and mixtures thereof; and vinyl-lactams and the like and mixtures thereof. Typical monomers include, but are not limited to, 2-hydroxyethyl, 2-hydroxypropyl, and 3-hydroxypropyl acrylates and methacrylates; N-vinylpyrrolidone; N,N-dimethylaminoethyl methacrylate; methoxyethyl-, ethoxyethyl, methoxy-ethoxyethyl and ethoxy-ethoxyethyl acrylates and methacrylates; (meth)acrylamides like N,N-dimethyl, N,N-diethyl, 2-hydroxyethyl-, 2-hydroxypropyl-, and 3-hydroxypropyl acrylamides and methacrylamides; vinyl sulfonic acid; styrene sulfonic acid; 2-methacrylamide-2-methyl propanesulfonic acid and the like and mixtures thereof.

[0019] In one embodiment, the WSPC preferably includes units derived from one or more of acrylic acid, hydrophilic derivatives of acrylic acid, methacrylic acid, hydrophilic derivatives of methacrylic acid, cationic/anionic pairs of monomeric components, cationic monomeric components, anionic monomeric components, nonionic monomeric components, hydrophilic vinylic monomeric components, salts thereof and mixtures thereof.

[0020] The WSPC is selected from polyalkylene glycols, for example, polyethylene glycols, polypropylene glycols and the like, polyvinyl pyrrolidone, polymethacrylic acid, polyvinyl alcohol, and the like and mixtures thereof.

[0021] The liquid medium that comprises an amount of the WSPC in addition to that present in the contact lens body, is preferably an aqueous liquid medium.

[0022] The liquid medium preferably includes the WSPC prior to the liquid medium being placed in the container, for example, in contact, with the contact lens.

[0023] Advantageously, the container is sealed, for example, using any suitable conventional container seal assembly, such as a conventional container seal assembly, and preferably sterilized to protect, preserve and maintain sterilized the contact lens and the liquid medium during shipment and storage.

[0024] Methods for producing the contact lenses included in the packaging systems of the invention may comprise polymerizing at least one hydrophilic monomeric component in the presence of a WSPC to form a contact lens body comprising a hydrophilic polymeric material and the WSPC. Advantageously, an effective amount of at least one cross-linking monomeric component is then present during the polymerizing step. The contact lens body is placed in a packaging container.

[0025] Advantageously the polymerizing step is a solution polymerizing step. The WSPC preferably is included in a diluent used during the polymerizing step. The polymerizing step preferably occurs in a contact lens mold, for example, a conventional contact lens mold, such as a conventional thermoplastic contact lens mold.

[0026] The liquid medium, preferably an aqueous liquid medium, is also placed in the packaging container. This liquid medium includes an amount of the WSPC in addition to that present in the contact lens body. The WSPC and the liquid medium preferably are ophthalmically acceptable.

[0027] In addition, the present methods preferably further comprise sealing the container with a contact lens body, and preferably the liquid medium, included therein.

[0028] Each and every feature described herein, and each and every combination of two or more of such features, is included within the scope of the present invention provided that the features included in such a combination are not mutually inconsistent.

[0029] These and other aspects of the present invention are set forth in the following detailed description, examples and claims, particularly when considered in conjunction with the accompanying drawings in which like parts bear like reference numerals.

Brief Description of the Drawings

[0030] Fig. 1 is a schematic illustration of a packaging system in accordance with the present invention.

Detailed Description of the Invention

[0031] The present invention is directed to package systems for contact lenses, for example, the present contact lenses. Such package systems comprise a contact lens ready for use in an eye, a liquid medium, preferably an aqueous liquid medium, and a container holding the contact lens and the liquid medium. The contact lens comprises a contact lens body comprising a hydrophilic polymeric material and a WSPC, as described elsewhere herein.

[0032] The contact lenses comprise a contact lens body comprising a hydrophilic polymeric material and a WSPC, preferably an effective amount of the WSPC, for example, to increase the modulus or strength of the contact lens and/or to provide enhanced lubrication to the eye wearing the contact lens and/or to increase the comfort to the lens wearer of wearing the contact lens. Such benefits, e.g., increases and/or enhancements, are relative to an identical contact lens without the WSPC.

[0033] The hydrophilic polymeric materials useful in the present contact lenses may be selected from any suitable such materials. Preferably, such hydrophilic polymeric materials are such as to take on or absorb sufficient water so as to expand or swell. Such water-swellable materials are often referred to as hydrogels. A number of hydrophilic polymeric materials are conventionally used in contact lenses, and such conventionally used materials may be employed in the present contact lenses. Specific examples, without limitation, of useful hydrophilic polymeric materials are identified elsewhere herein.

[0034] An important feature of the present invention is the inclusion of WSPCs in the present contact lenses.

[0035] The WSPCs useful in the present invention may be chosen from any suitable such components. The presently useful WSPCs advantageously are ophthalmically acceptable and substantially not cytotoxic.

[0036] In a very useful embodiment, the WSPC is effective to provide at least one benefit to the contact lens and/or to the wearing of the contact lens and/or to the wearer of the contact lens. For example, the WSPC advantageously is present in an amount effective to increase the modulus or strength of the contact lens relative to an identical contact lens in which the WSPC is replaced by water. The WSPC may be selected, and present in the contact lens in an amount, so as to be effective as a lubricant or lubricity agent as the WSPC dissolves into the tear fluid while the contact lens is in use in an eye. Thus, the lens wearer's eye, for example, cornea and/or eyelids, is more effectively lubricated when wearing the present contact lenses, which enhances the comfort of wearing the lenses, relative to an identical contact lens in which the WSPC is replaced by water.

[0037] The WSPC may be selected to have substantially no detrimental effect on the optical clarity and/or optical power of the contact lens while in use.

[0038] Specific examples, without limitation, of useful WSCPs are identified elsewhere herein. The WSPC may be included in the present contact lenses in any suitable amount effective to provide the desired result. Such amounts may be in a range of about 1% or about 5% or about 10% or about 15% to about 20% or about 30% or about 40% or about 50% or more of the hydrophilic polymeric material present in the contact lens.

[0039] One very useful class of WSPCs include polyethylene glycols. Polyethylene glycols are compounds that can be represented by the following formula:

$$HO\text{-}(CH_2\text{-}CH_2O)_n\text{-}H$$

wherein n represents a number such that the molecular weight of the polyethylene glycol is within the range of from about 300 to about 10,000 and preferably from about 400 to about 2000 or about 5000. Such polyethylene glycols are commercially available products.

[0040] The WSPCs employed are ultimately water-displaceable. That is, after placing the contact lens including the hydrophilic polymeric material and the WSPC in the eye, the WSPC is ultimately at least partially, and even substantially completely, replaced with water in the eye.

[0041] However, it is advantageous to provide the WSPCs in the present contact lenses so that the hydrophilic polymeric material physically immobilizes the WSPC, at least to a limited extent. For example, the hydrophilic polymeric material may immobilize the WSPC in the contact lens sufficiently so that the WSPC is replaced by water substantially only after the lens is placed in an eye. In one useful embodiment, the WSPC is present in the present contact lenses in an interpenetrating network or pseudo penetrating network with the hydrophilic polymeric material, for example, to provide the desired degree of physical immobilization of the WSPC.

[0042] The replacement, for example, controlled replacement, of the WSPC by water in the eye, can allow the WSPC, in the eye, to provide added lubrication and comfort to the lens wearer. In addition, the removal of the WSPC from the contact lens in the eye may reduce the modulus or strength of the lens. Thus, after the lens wearer removes the WSPC-depleted lens from his/her eye, the lens will have different strength properties than before it was placed in the eye. These different properties provide an indication to the wearer that the lens is to be disposed of, rather than to be reused. In other words, the replacement of the WSPC in the contact lens with water in the eye, advantageously facilitates lens wearer compliance with proper usage of disposable contact lenses. The present lenses preferably are structured to be disposed of after a single use in the eye.

[0043] Mixtures of two or more WSPCs may be included in a single contact lens in accordance with the present invention.

[0044] The hydrophilic polymeric material employed in the present contact lenses may be derived from any suitable monomer or mixture of monomers. In one embodiment, a monomer mixture used which contains a major proportion of at least one hydrophilic monomer such as 2-hydroxyethyl methacrylate ("HEMA") as the major component, one or more cross-linking monomers, and optionally small amounts of other monomers such as methacrylic acid. HEMA is one preferred hydrophilic monomer. Other hydrophilic monomers that can be employed include, without limitation, 2-hydroxyethyl acrylate, 2-hydroxypropyl methacrylate, 2-hydroxypropyl acrylate, 3-hydroxypropyl methacrylate, N-vinyl pyrrolidone, glycerol monomethacrylate, glycerol mono-acrylate, and the like and mixtures thereof.

[0045] The cross-linking monomers that can be employed, either singly or in combination, include, without limitation, ethylene glycol dimethacrylate ("EGDMA"), trimethylolpropane trimethacrylate ("TMPTMA"), glycerol trimethacrylate, polyethylene glycol dimethacrylate (wherein the polyethylene glycol has a molecular weight up to, for example, about 5000), other polyacrylate and polymethacrylate esters, end-capped polyoxyethylene polyols containing two or more terminal methacrylate moieties and the like and mixtures thereof. The cross-linking monomer is used in the usual amounts, e.g., from about 0.01% or less to about 0.5% or more, by weight of the reactive monomer mixture. The cross-linking monomer can be a hydrophilic monomer.

[0046] Other monomers that can be used include methacrylic acid, which is used to influence the amount of water that the hydrophilic polymeric material absorbs at equilibrium. Methacrylic acid is usually employed in amounts of from about 0.2 to about 8 parts, by weight, per 100 parts of hydrophilic monomer. Other monomers that can be present in the polymerization mixture include methoxyethyl methacrylate, acrylic acid, ultra-violet absorbing monomers, and the like and mixtures thereof.

[0047] A polymerization catalyst is included in the monomer mixture. The polymerization catalyst can be a compound such as lauroyl peroxide, benzoyl peroxide, isopropyl percarbonate, azobisiso-butyronitrile, and the like and mixtures thereof, that generates free radicals at moderately elevated temperatures, or the polymerization catalyst can be a photoinitiator system such as an aromatic α-hydroxy ketone or a tertiary amine plus a diketone. Illustrative examples of photoinitiator systems are 2-hydroxy-2-methyl-1-phenyl-propan-1-one and a combination of camphorquinone and ethyl 4-(N,N-dimethyl-amino)benzoate. The catalyst is used in the polymerization reaction mixture in catalytically effective amounts, e.g., from about 0.1 to about 2 parts by weight per 100 parts of hydrophilic monomer.

[0048] The presently useful WSPCs preferably are included in the contact lenses during polymerization, for example, solution polymerization, to produce the hydrophilic polymeric material. In a particularly useful embodiment, the WSPC in the contact lens is derived from a diluent material used during such polymerization of the hydrophilic polymeric material.

[0049] Methods of producing contact lenses present in the packaging system of the invention may comprise polymerizing, preferably solution polymerizing at least one hydrophilic monomeric component in the presence of a WSPC to form a contact lens body comprising a hydrophilic polymeric material and the WSPC. The WSPC preferably is included in a diluent used during the polymerizing step. The contact lens body is ready for use in the eye and is advantageously placed in a packaging container, for example, for shipment and/or storage.

[0050] The polymerizing step advantageously occurs in a contact lens mold, for example, a conventional contact lens mold. The polymerizing step may take place in a manner substantially similar or analogous to the corresponding step in the conventional wet cast molding process for making hydrophilic contact lenses. The polymerization reaction conditions useful in the present methods are substantially the same as those used in conventional wet cast molding processes for producing hydrophilic contact lenses and, therefor, are not detailed herein.

[0051] The resulting contact lens body preferably includes an interpenetrating network or a pseudo interpenetrating network of the hydrophilic polymeric material and the WSPC. One important feature of the present methods is that the WSPC is not replaced, for example, with water, prior to the contact lens being placed into a packaging container or into an eye. As described elsewhere herein, the WSPC in the contact lens in the eye produces one or more benefits.

[0052] The liquid medium comprises an amount of the WSPC in addition to the WSPC present in the contact lens body. Although the WSPC in the liquid medium need not be the same as the WSPC in the lens body, preferably it is substantially the same WSPC as that present in the lens body. Advantageously, the liquid medium includes the WSPC prior to the liquid medium being placed in contact with the lens body. The presence of the WSPC in the liquid medium preferably is effective to inhibit migration of the WSPC in the lens body from the lens body. Thus, the amount or concentration of the WSPC in the lens body is substantially maintained in the
packaging system, and is available for providing one or more benefits, as described elsewhere herein, after the contact lens is placed in an eye. The concentration of the WSPC in the liquid medium may be about equal to, or somewhat more or less than, that present in the lens body prior to the lens body being placed in contact with the liquid medium. The liquid medium, other than the WSPC, may have a composition substantially similar or analogous to liquid medium used in package systems for conventional hydrophilic contact lenses. Saline solutions, buffered saline solutions, other aqueous solutions and the like, together with the WSPC, may be employed.

[0053] The container advantageously is sealed, after placing the contact lens and liquid medium in the container, to preserve these components during shipment and storage. The container and seal may be substantially similar or analogous to a conventional blister pack which is used for packaging conventional hydrophilic contact lenses.

[0054] Referring now to Fig. 1, a package system in accordance with the present invention is shown at 10. Package system 10 includes a container 12, a contact lens 14, including a contact lens body including a hydrophilic polymeric material and a WSPC, a liquid medium 16, comprising an aqueous saline solution containing a separate amount of the WSPC present in the contact lens, and a removable seal 18.

[0055] The container 12 and seal 18 are similar to the container and seal used in a conventional blister pack used with conventional hydrophilic contact lenses.

[0056] With the container 12 unsealed, the liquid medium 16 and the contact lens 14, directly from the contact lens mold, are placed therein. The seal 18 is placed over, and secured to the top of container 12, thereby sealing the compartment 20 containing the contact lens 14 in contact with the liquid medium 16.

[0057] The contact lens 14 can be used by opening seal 18 (as shown by the shadow lines in Fig. 1), removing lens 14 from compartment 20 and placing the lens into one's eye. The container 12, liquid medium 16 and seal 18 can then be properly disposed of.

[0058] The following non-limiting examples illustrate certain aspects of the present invention:

EXAMPLE 1

[0059] A one day disposable, hydrogel-containing contact lens is wet cast molded in a polypropylene mold as follows. A monomer mixture of 98% by weight of 2-hydroxyethyl methacrylate, 1.6% by weight methacrylic acid and 0.4% by weight of ethylene glycol dimethacrylate is formed together with an effective amount of a conventional thermal initiator. This monomer is diluted by 20% by weight with water soluble polyethylene glycol having a molecular weight of about 1000. The diluted solution is added to a polypropylene contact lens mold and is cured using thermal curing. If desired, an ultraviolet light initiator can be included in place of the thermal initiator, and the solution can be cured using ultraviolet light curing. After curing, the lens is removed from the mold and placed in a packaging system similar to a conventional blister pack and hydrated with saline solution. The hydrated lens is formed to have mechanical properties similar to a dry cast molded lens.

EXAMPLE 1A

[0060] Alternately, and advantageously, the saline solution used in the package is altered to include about 20% of the polyethylene glycol, which is at substantial equilibrium with both the contact lens and the saline solution in the package. The use of this polyethylene glycol in the saline solution is effective to reduce, or even substantially eliminate, the polyethylene glycol from diffusing out of the contact lens during storage in the package.

EXAMPLE 2

[0061] A one day disposable, hydrogel-containing contact lens is wet cast molded in a polypropylene mold as follows. A monomer mixture of 98% by weight of 2-hydroxyethyl methacrylate, 1.6% by weight methacrylic acid and 0.4% by weight of ethylene glycol dimethacrylate is formed together with an effective amount of a conventional thermal initiator. This monomer is diluted by 30% by weight with water soluble polyethylene glycol having a molecular weight of about 1000. The diluted solution is added to a polypropylene contact lens mold and is cured using thermal curing. If desired, an ultraviolet light initiator can be included in place of the thermal initiator, and the solution can be cured using ultraviolet light curing. After curing, the lens is removed from the mold and placed in a packaging system similar to a conventional blister pack and hydrated with saline solution. The hydrated lens is formed to have mechanical properties similar to a

dry cast molded lens.

EXAMPLE 2A

[0062] Alternately, and advantageously, the saline solution used in the package is altered to include about 30% of the polyethylene glycol, which is at substantial equilibrium with both the contact lens and the saline solution in the package. The use of this polyethylene glycol in the saline solution is effective to reduce, or even substantially eliminate, the polyethylene glycol from diffusing out of the contact lens during storage in the package.

EXAMPLE 3

[0063] A one day disposable hydrogel-containing contact lens is wet cast molded in a polypropylene mold as follows. A monomer mixture of 98% by weight of 2-hydroxyethyl methacrylate, 1.6% by weight methacrylic acid and 0.4% by weight of ethylene glycol dimethacrylate is formed together with an effective amount of a conventional thermal initiator. This monomer is diluted by 40% by weight with water soluble polyethylene glycol having a molecular weight of about 1000. The diluted solution is added to a polypropylene contact lens mold and is cured using thermal curing. If desired, an ultraviolet light initiator can be included in place of the thermal initiator, and the solution can be cured using ultraviolet light curing. After curing, the lens is removed from the mold and placed in a packaging system similar to a conventional blister pack and hydrated with saline solution. The hydrated lens is formed to have mechanical properties similar to a dry cast molded lens.

EXAMPLE 3A

[0064] Alternately, and advantageously, the saline solution used in the package is altered to include about 40% of the polyethylene glycol, which is at substantial equilibrium with both the contact lens and the saline solution in the package. The use of this polyethylene glycol in the saline solution is effective to reduce, or even substantially eliminate, the polyethylene glycol from diffusing out of the contact lens during storage in the package.

EXAMPLE 4

[0065] A one day disposable hydrogel-containing contact lens is wet cast molded in a polypropylene mold as follows. A monomer mixture of 98% by weight of 2-hydroxyethyl methacrylate, 1.6% by weight methacrylic acid and 0.4% by weight of ethylene glycol dimethacrylate is formed together with an effective amount of a conventional thermal initiator. This monomer is diluted by 50% by weight with water soluble polyethylene glycol having a molecular weight of about 1000. The diluted solution is added to a polypropylene contact lens mold and is cured using thermal curing. If desired, an ultraviolet light initiator can be included in place of the thermal initiator, and the solution can be cured using ultraviolet light curing. After curing, the lens is removed from the mold and placed in a packaging system similar to a conventional blister pack and hydrated with saline solution. The hydrated lens is formed to have mechanical properties similar to a dry cast molded lens.

EXAMPLE 4A

[0066] Alternately, and advantageously, the saline solution used in the package is altered to include about 50% of the polyethylene glycol, which is at substantial equilibrium with both the contact lens and the saline solution in the package. The use of this polyethylene glycol in the saline solution is effective to reduce, or even substantially eliminate, the polyethylene glycol from diffusing out of the contact lens during storage in the package.

EXAMPLE 5

[0067] A one day disposable hydrogel-containing contact lens is wet cast molded in a polypropylene mold as follows. A mixture of 48.8% by weight of 2-hydroxyethyl methacrylate, 0.5% by weight methacrylic acid, 0.7% by weight of a cross-linking component sold under the tradename Craynor 435 and 50% by weight of methyl terminated polyethylene glycol having a molecular weight of about 350 (PEGME-350) is formed together with an effective amount of a conventional thermal initiator. This mixture is added to a polypropylene contact lens mold and is cured using thermal curing. If desired, an ultraviolet light initiator can be included in place of the thermal initiator, and the mixture can be cured using ultraviolet light curing. After curing, the lens is removed from the mold and placed in a packaging system similar to a conventional blister pack and hydrated with saline solution. The hydrated lens is formed to have mechanical properties similar to a dry cast molded lens.

EXAMPLE 5A

[0068] Alternately, and advantageously, the saline solution used in the package is altered to include about 50% of the PEGME-350, which is at substantial equilibrium with both the contact lens and the saline solution in the package. The use of this methyl terminated polyethylene glycol in the saline solution is effective to reduce, or even substantially eliminate, the methyl terminated polyethylene glycol from diffusing out of the contact lens during storage in the package.

EXAMPLE 6

[0069] A one day disposable hydrogel-containing contact lens is wet cast molded in a polypropylene mold as follows. A mixture of 37.3% by weight of 2-hydroxyethyl methacrylate, 0.6% by weight methacrylic acid, 0.2% by weight of ethylene glycol dimethacrylate, 30.8% by weight of polyethylene glycol having a molecular weight of about 300 and 31.1% by weight of deionized water is formed together with an effective amount of a conventional thermal initiator. The mixture is added to a polypropylene contact lens mold and is cured using thermal curing. If desired, an ultraviolet light initiator can be included in place of the thermal initiator, and the mixture can be cured using ultraviolet light curing. After curing, the lens is removed from the mold and placed in a packaging system similar to a conventional blister pack and hydrated with saline solution. The hydrated lens is formed to have mechanical properties similar to a dry cast molded lens.

EXAMPLE 6A

[0070] Alternately, and advantageously, the saline solution used in the package is altered to include about 30.8% of the polyethylene glycol, which is at substantial equilibrium with both the contact lens and the saline solution in the package. The use of this polyethylene glycol in the saline solution is effective to reduce, or even substantially eliminate, the polyethylene glycol from diffusing out of the contact lens during storage in the package.

EXAMPLE 7 TO 18

[0071] Each of twelve (12) patients removes a different one of the lenses produced in accordance with Examples 1 to 6 and 1A to 6A from the solution and places it on his/her eye. In each case, while the lens is on the patient's eye, the polyethylene glycol or methyl terminated polyethylene glycol diffuses out of the lens and into the eye, thereby advantageously increasing the lubrication of the cornea and the eyelid of the eye.

[0072] If the patient was to remove the lens, place it into a saline solution and wear it again the next day, the lens would be significantly less comfortable to wear due to the loss of the polyethylene glycol, or methyl terminated polyethylene glycol and the loss of lubrication. In addition, because of the loss of the polyethylene glycol, or methyl terminated polyethylene glycol, the lens has less modulus or strength and appears more "floppy" after the lens is worn in the eye. In effect, the loss of the polyethylene glycol, or methyl terminated polyethylene glycol from the contact lens creates a trigger mechanism and/or provides an indication to the patient to be compliant with the one day disposable modality.

[0073] While this invention has been described with respect to various specific examples and embodiments, it is to be understood that the invention is not limited thereto and that it can be variously practiced within the scope of the following claims.

Claims

1. A packaging system comprising a contact lens body ready for use in the eye, a liquid medium, and a container holding the contact lens and the liquid medium,
   wherein the contact lens body comprises a hydrophilic polymeric material and a water soluble polymeric material selected from the group consisting of polyalkylene glycols, polyvinyl pyrrolidone, polymethacrylic acid, polyvinyl alcohol and mixtures thereof,
   characterised in that the liquid medium comprises, in addition to the water soluble polymeric material present in the contact lens body, an amount of water soluble polymeric material selected from the group consisting of polyalkylene glycols, polyvinyl pyrrolidone, polymethacrylic acid, polyvinyl alcohol and mixtures thereof.

2. The packaging system of claim 1 wherein the water soluble polymer component is in intimate admixture with the hydrophilic polymeric material.

3. The packaging system of claim 1 wherein the water soluble polymer component is ophthalmically acceptable.

4. The packaging system of claim 1 wherein the water soluble polymer component is derived from a diluent material used during polymerization of the hydrophilic polymeric material.

5. The packaging system of claim 1 wherein the water soluble polymer component is derived from a diluent material used during solution polymerization of the hydrophilic polymeric material.

6. The packaging system of claim 4 wherein the contact lens body is produced using wet cast molding.

7. The packaging system of claim 1 wherein the contact lens is structured to be disposed of after a single use in an eye.

8. The packaging system of claim 1 wherein the contact lens body has an increased modulus relative to an identical lens body in which the water soluble polymer component is replaced with water.

9. The packaging system of claim 1 wherein the water soluble polymer component is physically immobilized by the hydrophilic polymeric material.

10. The packaging system of claim 1 wherein the contact lens body is configured so that at least a portion of the water soluble polymer component leaves the contact lens body during use of the contact lens body in an eye.

11. The packaging system of claim 1 wherein the water soluble polymer component and the hydrophilic polymeric material form an interpenetrating network or a psuedo interpenetrating network.

12. The packaging system of claim 1 wherein the water soluble polymer component and the hydrophilic polymeric material form a psuedo interpenetrating network.

13. The packaging system of claim 1 wherein the hydrophilic polymeric material is obtained by polymerization of at least one hydrophilic monomeric component.

14. The packaging system of claim 13 wherein the hydrophilic polymeric material is obtained by polymerization of at least one hydrophilic monomeric component and at least one cross-linking monomeric component.

15. The packaging system of claim 14 wherein the hydrophilic monomeric component is selected from the group consisting of hydroxyalkyl acrylates, hydroxyalkyl methacrylates, N-vinyl pyrrolidone, acrylamides, vinyl alcohol, hydrophilic polyurethane precursors, glycerol acrylates, glycerol methacrylates, acrylates, methacrylates, substituted counterparts thereof and the like and mixtures thereof.

16. The packaging system of claim 1 wherein the water soluble polymer component is selected from the group consisting of hydrophillic vinylic monomers, such as vinyl (C_4-C_{45}) alkyl ethers, vinyl (C_7-C_{49}) alkenoic acids and the like and mixtures thereof; hydroxy substituted (C_5-C_{45}) alkyl, alkoxy-alkyl and polyalkoxy-alkyl and mono- or bi-cycloaliphatic fumarates, maleates, acrylates, methacrylates, acrylamides and methacrylamides, and the like and mixtures thereof; acrylic acid, methacrylic acid, the corresponding amino or mono- and di-(lower alkyl) amino substituted acrylic monomers and the like and mixtures thereof; and vinyl-lactams and the like and mixtures thereof.

17. The packaging system of any preceding claim wherein the water soluble polymer is a polyethylene glycol.

18. The packaging system of any preceding claim wherein the water soluble polymer in the liquid is the same as that present in the lens body.

19. The packaging system of any preceding claim wherein the container is structured to hold the contact lens in contact with the liquid medium and the liquid medium includes the water soluble polymer component prior to the liquid medium being placed in contact with the contact lens.

20. The packaging system of claim 1 wherein the container is sealed.

21. A method of producing a packaging system as set forth in claims 1 to 20, the method comprising
polymerizing at least one hydrophilic monomeric component in the presence of a water soluble polymer component to form a contact lens body comprising a hydrophilic polymeric material and the water soluble polymer component; and placing the contact lens body in a packaging container.

22. The method of claim 21 wherein the polymerizing step is a solution polymerization step.

23. The method of claim 21 wherein the water soluble polymer component is included in a diluent used during the polymerizing step.

24. The method of claim 21 wherein the polymerizing step occurs in a contact lens mold.

25. The method of claim 21 wherein an effective amount of at least one cross-linking monomeric component is present during the polymerizing step.

Patentansprüche

1. Verpackungssystem, das einen Kontaktlinsenkörper, der zur Verwendung in einem Auge bereit ist, ein flüssiges Medium, und einen Behälter, in dem die Kontaktlinse und das flüssige Medium aufgenommen sind, umfasst, wobei der Kontaktlinsenkörper ein hydrophiles polymeres Material und ein wasserlösliches polymeres Material, ausgewählt aus der Gruppe, bestehend aus Polyalkylenglycolen, Polyvinylpyrrolidon, Polymethacrylsäure, Polyvinylalkohol und Mischungen derselben, umfasst,
dadurch gekennzeichnet, dass das flüssige Medium zusätzlich zu dem wasserlöslichen polymeren Material, das in dem Kontaktlinsenkörper vorhanden ist, eine Menge von einem wasserlöslichen polymeren Material, das aus der Gruppe ausgewählt ist, die aus Polyalkylenglycolen, Polyvinylpyrrolidon, Polymethacrylsäure, Polyvinylalkohol und Mischungen derselben besteht, umfasst.

2. Das Verpackungssystem nach Anspruch 1, wobei die wasserlösliche Polymerkomponente in inniger Mischung mit dem hydrophilen polymeren Material vorliegt.

3. Das Verpackungssystem nach Anspruch 1, wobei die wasserlösliche Polymerkomponente ophthalmisch akzeptabel ist.

4. Das Verpackungssystem nach Anspruch 1, wobei die wasserlösliche Polymerkomponente aus einem Material stammt, welches während der Polymerisation des hydrophilen polymeren Materials als ein Verdünnungsmittel verwendet wird.

5. Das Verpackungssystem nach Anspruch 1, wobei die wasserlösliche Polymerkomponente aus einem Material stammt, das während der Lösungspolymerisation des hydrophilen polymeren Materials als ein Verdünnungsmittel verwendet wird.

6. Das Verpackungssystem nach Anspruch 4, wobei der Kontaktlinsenkörper unter Verwendung von Nassgussformung hergestellt wird.

7. Das Verpackungssystem nach Anspruch 1, wobei die Kontaktlinse so strukturiert ist, dass sie nach einer einmaligen Verwendung in einem Auge entsorgt wird.

8. Das Verpackungssystem nach Anspruch 1, wobei der Kontaktlinsenkörper gegenüber einem identischen Linsenkörper, in dem die wasserlösliche Polymerkomponente durch Wasser ersetzt ist, ein erhöhtes Modul aufweist.

9. Das Verpackungssystem nach Anspruch 1, wobei die wasserlösliche Polymerkomponente mit Hilfe des hydrophilen polymeren Materials physikalisch immobilisiert ist.

10. Das Verpackungssystem nach Anspruch 1, wobei der Kontaktlinsenkörper so konfiguriert ist, dass mindestens ein Teil der wasserlöslichen Polymerkomponente den Kontaktlinsenkörper während der Verwendung des Kontaktlinsenkörpers in einem Auge verlässt.

11. Das Verpackungssystem nach Anspruch 1, wobei die wasserlösliche Polymerkomponente und das hydrophile polymere Material ein sich gegenseitig durchdringendes Netzwerk oder ein pseudo-interpenetrierendes Netzwerk bilden.

12. Das Verpackungssystem nach Anspruch 1, wobei die wasserlösliche Polymerkomponente und das hydrophile po-

lymere Material ein pseudo-interpenetrierendes Netzwerk bilden.

13. Das Verpackungssystem nach Anspruch 1, wobei das hydrophile polymere Material durch Polymerisation von mindestens einer hydrophilen monomeren Komponente erhalten wird.

14. Das Verpackungssystem nach Anspruch 13, wobei das hydrophile polymere Material durch Polymerisation von mindestens einer hydrophilen monomeren Komponente und mindestens einer vernetzenden monomeren Komponente erhalten wird.

15. Das Verpackungssystem nach Anspruch 14, wobei die hydrophile monomere Komponente aus der Gruppe ausgewählt wird, die aus Hydroxyalkylacrylaten, Hydroxyalkylmethacrylaten, N-Vinylpyrrolidon, Acrylamiden, Vinylalkohol, hydrophilen Polyurethanvorläufern, Glycerinacrylaten, Glycerinmethacrylaten, Acrylaten, Methacrylaten, substituierten Gegenstücken derselben und dergleichen sowie Mischungen derselben besteht.

16. Das Verpackungssystem nach Anspruch 1, wobei die wasserlösliche Polymerkomponente aus der Gruppe ausgewählt wird, die aus hydrophilen vinylischen Monomeren, wie, zum Besipiel, Vinyl- (C_4-C_{45})alkylethern, Vinyl-(C_7-C_{49})alkensäuren und dergleichen sowie Mischungen derselben; Hydroxy- substitutierten (C_5-C_{45}) Alkyl-, Alkoxyalkyl- und Polyalkoxyalkyl- sowie Mono- oder Bi-cycloaliphatischen Fumaraten, Maleaten, Acrylaten, Methacrylaten, Acrylamiden und Methacrylamiden, und dergleichen sowie Mischungen derselben; Acrylsäure, Methacrylsäure, den entsprechenden Amino-substituierten Acrylmonomeren oder mono- und di-(Niederalkyl)-substituierten Amino-Acrylmonomeren und dergleichen sowie Mischungen derselben; und Vinyllactamen und dergleichen sowie Mischungen derselben besteht.

17. Das Verpackungssystem nach einem der vorhergehenden Ansprüche, wobei das wasserlösliche Polymer ein Polyethylenglycol ist.

18. Das Verpackungssystem nach einem der vorhergehenden Ansprüche, wobei das wasserlösliche Polymer in der Flüssigkeit das gleiche ist wie jenes, das in dem Linsenkörper vorhanden ist.

19. Das Verpackungssystem nach einem der vorhergehenden Ansprüche, wobei der Behälter so strukturiert ist, dass er die Kontaktlinse in Kontakt mit dem flüssigen Medium hält, und das flüssige Medium die wasserlösliche Polymerkomponente enthält, bevor das flüssige Medium in Kontakt mit der Kontaktlinse gebracht wird.

20. Das Verpackungssystem nach Anspruch 1, wobei der Behälter verschlossen ist.

21. Verfahren zur Herstellung eines Verpackungssystems gemäß einem der Ansprüche 1 bis 20, wobei das Verfahren umfasst:

    das Polymerisieren von mindestens einer hydrophilen monomeren Komponente in der Gegenwart von einer wasserlöslichen Polymerkomponente, um einen Kontaktlinsenkörper zu bilden, der ein hydrophiles polymeres Material und die wasserlösliche Polymerkomponente umfasst; und
    das Anordnen des Kontaktlinsenkörpers in einem Behälter zur Verpackung.

22. Das Verfahren nach Anspruch 21, wobei der Schritt der Polymerisierung ein Lösungspolymerisationsschritt ist.

23. Das Verfahren nach Anspruch 21, wobei die wasserlösliche Polymerkomponente in einem Verdünnungsmittel enthalten ist, welches während dem Polymerisationsschritt verwendet wird.

24. Das Verfahren nach Anspruch 21, wobei der Polymerisationsschritt in einem Formwerkzeug für Kontaktlinsen erfolgt.

25. Das Verfahren nach Anspruch 21, wobei eine wirksame Menge von mindestens einer vernetzenden monomeren Komponente während des Polymerisationsschrittes vorhanden ist.

Revendications

1. Système d'emballage comprenant un corps de lentille de contact prêt à l'emploi dans l'oeil, un milieu liquide, et un récipient contenant les lentilles de contact et le milieu liquide,

dans lequel le corps de lentille de contact comprend un composant polymère hydrophile et un composant polymère hydrosoluble choisi dans le groupe consistant en les glycols de polyoxyalkylène, la polyvinylpyrrolidone, l'acide polyméthacrylique, l'alcool polyvinylique, et des mélanges de ceux-ci,
caractérisé en ce que le milieu liquide comprend, en plus du composant polymère hydrosoluble présent dans le corps de lentille de contact, une quantité de composant polymère hydrosoluble choisi dans le groupe consistant en les glycols de polyoxyalkylène, la polyvinylpyrrolidone, l'acide polyméthacrylique, l'alcool polyvinylique, et des mélanges de ceux-ci.

2. Système d'emballage selon la revendication 1, dans lequel le composant polymère hydrosoluble est en mélange intime avec le composant polymère hydrophile.

3. Système d'emballage selon la revendication 1, dans lequel le composant polymère hydrosoluble est acceptable sur le plan ophtalmique.

4. Système d'emballage selon la revendication 1, dans lequel le composant polymère hydrosoluble est dérivé d'un agent diluant utilisé au cours de la polymérisation du composant polymère hydrophile.

5. Système d'emballage selon la revendication 1, dans lequel le composant polymère hydrosoluble est dérivé d'un agent diluant utilisé pendant la polymérisation en solution du composant polymère hydrophile.

6. Système d'emballage selon la revendication 4, dans lequel le corps de lentille de contact est fabriqué à l'aide d'un moulage par coulée en phase humide.

7. Système d'emballage selon la revendication 1, dans lequel la lentille de contact est structurée de manière à être jetée après un usage unique dans l'oeil.

8. Système d'emballage selon la revendication 1, dans lequel le corps de lentille de contact a un module augmenté par rapport à un corps de lentille identique dans lequel le composant polymère hydrosoluble est remplacé par de l'eau.

9. Système d'emballage selon la revendication 1, dans lequel le composant polymère hydrosoluble est physiquement immobilisé par le composant polymère hydrophile.

10. Système d'emballage selon la revendication 1, dans lequel le corps de lentille de contact est configuré de telle manière qu'au moins une partie du composant polymère hydrosoluble se retire du corps de lentille de contact pendant l'utilisation du corps de lentille de contact dans un oeil.

11. Système d'emballage selon la revendication 1, dans lequel le composant polymère hydrosoluble et le composant polymère hydrophile forment un réseau interpénétrant ou un pseudo-réseau interpénétrant.

12. Système d'emballage selon la revendication 1, dans lequel le composant polymère hydrosoluble et le composant polymère hydrophile forment un pseudo-réseau interpénétrant.

13. Système d'emballage selon la revendication 1, dans lequel le composant polymère hydrophile est obtenu par polymérisation d'au moins un composant monomère hydrophile.

14. Système d'emballage selon la revendication 13, dans lequel le composant polymère hydrophile est obtenu par polymérisation d'au moins un composant monomère hydrophile et d'au moins un composant monomère de réticulation.

15. Système d'emballage selon la revendication 14, dans lequel le composant polymère hydrophile est choisi dans le groupe consistant en les acrylates d'hydroxyalkyle, les méthacrylates d'hydroxyalkyle, la N-vinyl-pyrrolydone, les acrylamides, l'alcool vinylique, les précurseurs de polyuréthane hydrophiles, les acrylates de glycérol, les méthacrylates de glycérol, les acrylates, les méthacrylates, des homologues substitués de ceux-ci et similaires ainsi que des mélanges de ceux-ci.

16. Système d'emballage selon la revendication 1, dans lequel le composant polymère hydrosoluble est choisi dans le groupe consistant en les monomères vinyliques hydrophiles, tels que les éthers d'alkyle (C_4-C_{45}) de vinyle, les acides alcénoïques (C_7-C_{49}) de vinyle et similaires ainsi que des mélanges de ceux-ci, de l'alkyle (C_5-C_{45}) hydroxy-

substitué, de l'alkoxy-alkyle et du polyalkoxy-alkyle et des fumarates mono- ou bi-cycloaliphatiques, des maléates, des acrylates, des méthacrylates, des acrylamides et des méthacrylamides et similaires ainsi que des mélanges de ceux-ci, de l'acide acrylique, de l'acide méthacrylique, les monomères acryliques amino ou mono- et di-(alkyle inférieur) amino substitués et similaires ainsi que des mélanges de ceux-ci, et des vinyl-lactames et similaires ainsi que des mélanges de celles-ci.

17. Système d'emballage selon l'une quelconque des revendications précédentes, dans lequel le composant polymère hydrosoluble est un glycol de polyéthylène.

18. Système d'emballage selon l'une quelconque des revendications précédentes, dans lequel le polymère hydrosoluble dans le liquide est le même que celui qui est présent dans le corps de la lentille.

19. Système d'emballage selon l'une quelconque des revendications précédentes, dans lequel le récipient est structuré de manière à maintenir les lentilles de contact en contact avec le milieu liquide et le milieu liquide inclut le composant polymère hydrosoluble avant que le milieu liquide soit mis en contact avec les lentilles de contact.

20. Système d'emballage selon la revendication 1, dans lequel le récipient est fermé hermétiquement.

21. Procédé de fabrication d'un système d'emballage selon les revendications 1 à 20, ledit procédé comprenant :

la polymérisation d'au moins un composant polymère hydrophile en présence d'un composant polymère hydrosoluble afin de former un corps de lentille de contact comprenant un composant polymère hydrophile et le composant polymère hydrosoluble et
la mise en place du corps de lentille de contact dans un récipient d'emballage.

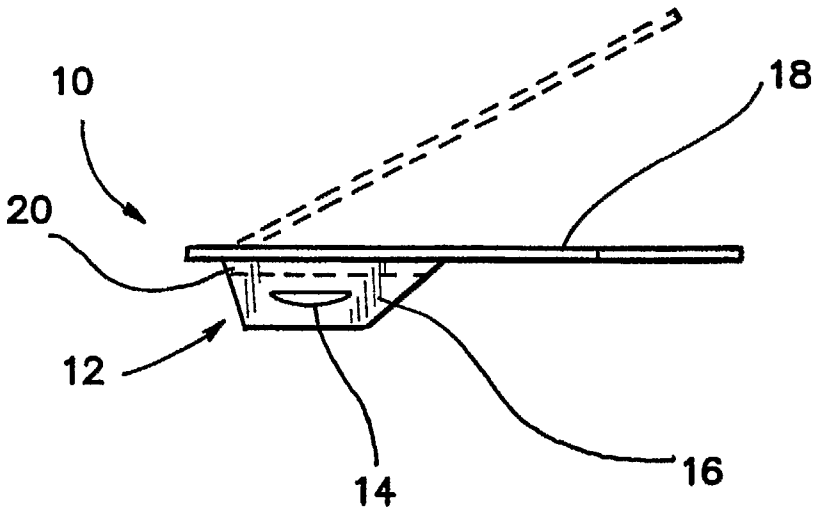
22. Procédé selon la revendication 21, dans lequel l'étape de polymérisation est une étape de polymérisation en solution.

23. Procédé selon la revendication 21, dans lequel le composant polymère hydrosoluble est inclus dans un diluant utilisé au cours de l'étape de polymérisation.

24. Procédé selon la revendication 21, dans lequel l'étape de polymérisation se produit dans un moule pour lentille de contact.

25. Procédé selon la revendication 21, dans lequel une quantité efficace d'au moins un composant monomère de réticulation est présente pendant l'étape de polymérisation.

FIG. 1



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Szabadalmi igénypontok

1. Csomagoló rendszer, amely tartalmaz a szemben való viselésre kész kontaktlencsét, folyékony közeget és tartályt, amely tartalmazza a kontaktlencsét és a folyékony közeget,
   amelyben a kontaktlencse test tartalmaz hidrofil polimer anyagot és vízben oldható polimer anyagot, amely polialkilénglikolok, polivinilpirrolidon, polimetakrilsav, polivinilalkohol, és ezek keverékei által alkotott csoportból van választva,
   azzal jellemezve, hogy a folyékony közeg tartalmaz a kontaktlencse testben jelen lévő, vízben oldható polimer anyagon kívül valamely mennyiségű vízben oldható polimer anyagot, amely polialkilénglikolok, polivinilpirrolidon, polimetakrilsav, polivinilalkohol, és ezek keverékei által alkotott csoportból van választva.

2. Az 1. igénypont szerinti csomagoló rendszer, amelyben a vízben oldható polimer összetevő a hidrofil polimer anyaggal bensőséges keveréket képez.

3. Az 1. igénypont szerinti csomagoló rendszer, amelyben a vízben oldható polimer összetevő oftalmikusan elfogadható.

4. Az 1. igénypont szerinti csomagoló rendszer, amelyben a vízben oldható polimer összetevő a hidrofil polimer anyag polimerizálása során használt hígító anyagból származik.

5. Az 1. igénypont szerinti csomagoló rendszer, amelyben a vízben oldható polimer összetevő a hidrofil polimer anyag oldószeres polimerizálása során használt hígító anyagból származik.

6. A 4. igénypont szerinti csomagoló rendszer, amelyben a kontaktlencse test nedves formaöntéssel készül.

7. Az 1. igénypont szerinti csomagoló rendszer, amelyben a kontaktlencse úgy van kialakítva, hogy a szemben való egyetlen használat után eldobásra kerüljön.

8. Az 1. igénypont szerinti csomagoló rendszer, amelyben a kontaktlencse testnek nagyobb modulusa van egy azonos lencse testhez képest, amelyben a vízben oldható polimer összetevő vízzel van helyettesítve.

9. Az 1. igénypont szerinti csomagoló rendszer, amelyben a vízben oldható polimer összetevő fizikailag immobilizálva van a hidrofil polimer anyag által.

10. Az 1. igénypont szerinti csomagoló rendszer, amelyben a kontaktlencse test úgy van kialakítva, hogy a vízben oldható polimer összetevő legalább egy része távozik a kontaktlencse testből a kontaktlencse test szemben való használata során.

11. Az 1. igénypont szerinti csomagoló rendszer, amelyben a vízben oldható polimer összetevő és a hidrofil polimer anyag interpenetráló térhálót vagy pszeudo interpenetráló térhálót képez.

12. Az 1. igénypont szerinti csomagoló rendszer, amelyben a vízben oldható polimer összetevő és a hidrofil polimer anyag pszeudo interpenetráló térhálót képez.

13. Az 1. igénypont szerinti csomagoló rendszer, amelyben a hidrofil polimer anyagot legalább egy hidrofil monomer összetevő polimerizálásával kapjuk.

14. A 13. igénypont szerinti csomagoló rendszer, amelyben a hidrofil polimer anyagot legalább egy hidrofil monomer összetevő és legalább egy térhálósító monomer összetevő polimerizálásával kapjuk.

15. A 14. igénypont szerinti csomagoló rendszer, amelyben a hidrofil monomer összetevő hidroxialkil-akrilátok, hidroxialkil-metakrilátok, N-vinil-pirrolidon, akrilamidok, vinilalkohol, hidrofil poliuretán elővegyületek, glicerin-akrilátok, glicerin-metakrilátok, akrilátok, metakrilátok, ezek helyettesített megfelelői és hasonlók, és ezek keverékei által alkotott csoportból van választva.

16. Az 1. igénypont szerinti csomagoló rendszer, amelyben a vízben oldható polimer összetevő hidrofil vinil-monomerek, mint amilyenek például a vinil-(C_4-C_{48})alkil-éterek, vinil-(C_7-C_{48})alkénsavak és hasonlók, és ezek keverékei; hidroxi-helyettesített (C_4-C_{48})alkil, alkoxi-alkil és polialkoxi-alkil, és mono- vagy biciklioalifás fumarátok, maleátok, akrilátok, metakrilátok, akrilamidok és metakrilamidok és hasonlók, és ezek keverékei; akrilsav, metakrilsav, a megfelelő amino- vagy mono- és di-(alacsony szénatomszámú alkil)-amino-helyettesített akril-monomerek és hasonlók, és ezek keverékei; és vinil-laktámok és hasonlók, és ezek keverékei által alkotott csoportból van választva.

17. Az előző igénypontok bármelyike szerinti csomagoló rendszer, amelyben a vízben oldható polimer polietilénglikol.

18. Az előző igénypontok bármelyike szerinti csomagoló rendszer, amelyben a folyadékban lévő vízben oldható polimer ugyanaz, mint ami a lencse testben van jelen.

19. Az előző igénypontok bármelyike szerinti csomagoló rendszer, amelyben a tartály úgy van kialakítva, hogy a kontaktlencsét érintkezésben tartja a folyékony közeggel, és a folyékony közeg tartalmazza a vízben oldható polimer összetevőt mielőtt a folyékony közeg érintkezésbe kerül a kontaktlencsével.

20. Az 1. igénypont szerinti csomagoló rendszer, amelyben a tartály le van zárva.

21. Eljárás az 1–20. igénypontokban meghatározott csomagoló rendszer gyártására, amely eljárás a következő lépéseket tartalmazza:

    polimerizálunk legalább egy hidrofil monomer összetevőt vízben oldható polimer összetevő jelenlétében, hogy olyan kontaktlencse testet alakítsunk ki, amely tartalmaz hidrofil polimer anyagot és vízben oldható polimer összetevőt; és

    behelyezzük a kontaktlencse testet egy csomagoló tartályba.

22. A 21. igénypont szerinti eljárás, amelyben a polimerizálási lépés oldószeres polimerizáló lépés.

23. A 21. igénypont szerinti eljárás, amelyben a vízben oldható polimer összetevőt magában foglalja egy oldószer, amelyet a polimerizálási lépés során használunk.

24. A 21. igénypont szerinti eljárás, amelyben a polimerizálási lépés egy kontaktlencse öntőformában történik.

25. A 21. igénypont szerinti eljárás, amelyben legalább egy térhálósító monomer összetevő hatásos mennyisége van jelen a polimerizálási lépés során.