Claims

1. A polyurethane polymer composition prepared by reacting a mixture comprising:

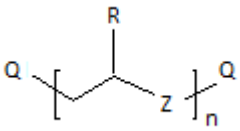
at least one poly(ethylene glycol) compound,

at least one block copolymer of ethylene oxide-propylene oxide-ethylene oxide, and/or at least one poly(ethylene glycol) - poly dimethyl siloxane diol - poly(ethylene glycol) (PEG-PDMS-PEG) copolymer diol,

at least one di- or poly isocyanate compound,

0.5 to 4 wt% of at least one polyfunctional compound having an average functionality greater than 2, or a mixture of such polyfunctional compounds,

0.5 to 20 wt% of a chain extender having the structure of Formula B:



where Q represents COOH, OH, SH or NH_2;

Z represents C, C=O, S or N;

R represents an alkyl group (generally a small alkyl group having a carbon backbone of 1 to 5 carbon atoms), and

n represents an integer from 1 to 25;

wherein the reactants are reacted under substantially anhydrous conditions.

2. The polymer as claimed in claim 1 wherein at least 90 wt% of the mixture is formed from the components specified in claim 1, typically at least 95 wt%.

3. The polymer as claimed in claim 1 wherein the chain extender is di-propylene glycol (DPG).

4. The polymer as claimed in claim 2 wherein the mixture comprises 0.5 to 10 wt% DPG.

5. The polymer as claimed in either one of claims 3 and 4 wherein the mixture comprises 1.5 to 10 wt% DPG.

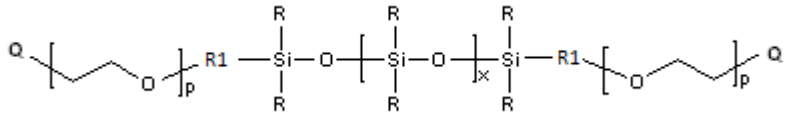
6.The polymer as claimed in any preceding claim wherein the mixture comprises 5 wt% or less of the sum of all compounds having an average functionality of greater than two.

7. The polymer of any preceding claim wherein the polyfunctional compound is a polyol having a number average molecular weight less than or equal to 1000.

8. The polymer of any preceding claim wherein the polyfunctional compound is TMP.

9. The polymer of any preceding claim wherein the mixture comprises at least 0.7 wt% polyfunctional compound.

10. The polymer of any preceding claim wherein the mixture comprises a PEG-PDMS-PEG copolymer diol having the structure of Formula A:



where each Q group independently represents a COOH, OH, SH, NH_2, NHR or NCO group; each R group independently represents a hydrocarbyl group, generally an alkyl group (suitably a small alkyl group such as a methyl, ethyl or propyl group), each R_1 group represents an alkyl group (generally a methyl group), each p is independently an integer from 0 to 110 (generally 1 to 100) and x is an integer from 1 to 324 (generally 1 to 100).

11. The polymer of any preceding claim wherein the mixture comprises one or more copolymers of ethylene oxide and propylene oxide having a number average molecular weight of less than 5000.

12. The polymer of claim 11 wherein the copolymer comprises two terminal poly(ethylene glycol) (PEG) units, and has the general structure PEG-PPG-PEG.

13. The polymer of any preceding claim wherein the mixture has an associated NCO:OH ratio of 0.8 to 1.2.

14. The polymer of claim 1 wherein the mixture comprises:

30 to 70 wt% of at least one poly (ethylene glycol) compound,

10 to 40 wt% of at least one block copolymer of ethylene oxide-propylene oxide-ethylene oxide,

10 to 30 wt% of at least one di- or poly isocyanate compound, generally at least one di-isocyanate compound,

0.5 to 4 wt% of at least one polyfunctional compound having an average functionality greater than 2, or a mixture of such polyfunctional compounds,

0.5 to 20 wt% di-propylene glycol (generally 1 to 10 wt% di-propylene glycol).

15. The polymer of claim 14 wherein the mixture comprises at least 50 wt% PEG compound and block copolymer of ethylene oxide-propylene oxide-ethylene oxide.

16. The polymer of claim 1 wherein the mixture comprises

10 to 30 wt% of at least one PEG compound (generally 15 to 25 wt% of at least one PEG compound),

30 to 70 wt% of at least one poly(ethylene glycol) - poly dimethyl siloxane diol - poly(ethylene glycol) (PEG-PDMS-PEG) copolymer diol,

10 to 30 wt% of at least one di- or poly isocyanate compound,

0.5 to 4 wt% of at least one polyfunctional compound having an average functionality greater than 2, or a mixture of such polyfunctional compounds,

0.5 to 20 wt%, di-propylene glycol (generally 1 to 10 wt% di-propylene glycol).

17. The polymer of claim 16 wherein the mixture comprises 40 to 60wt% of at least one PEG-PDMS-PEG copolymer diol, typically 45 to 55 wt% of at least one PEG-PDMS-PEG copolymer diol.

18. The polymer of either one of claims 16 and 17 wherein the mixture comprises at least 50 wt% PEG compound and PEG-PDMS-PEG copolymer diol, typically at least 60 wt%.

19. The polymer of any preceding claim in the form of an ophthalmic device such as a contact lens.

20. A polyurethane xerogel prepared from a mixture comprising:

i. at least one PEG compound;

ii. at least one block copolymer of ethylene oxide and propylene oxide;

iii. at least one di-isocyanate

iv. 0.5 to 4 wt% of a polyol, generally TMP;

v. 0.5 to 20 wt% DPG;

wherein the reactants are reacted under substantially anhydrous conditions.

21. A polyurethane xerogel prepared from a mixture comprising:

i) at least one PEG compound;

ii) at least one PEG-PDMS-PEG copolymer diol;

iii) at least one di-isocyanate;

iv) 0.5 to 4 wt% of a polyol, generally TMP;

v) 0.5 to 20 wt% DPG;

wherein the reactants are reacted under substantially anhydrous conditions.

22. A polyurethane xerogel prepared from a mixture comprising:

i) at least one PEG compound;

ii) at least one di-isocyanate;

iii) 0.5 to 4 wt% of a polyol, generally TMP

iv) Optionally 0.5 to 2 wt% monofunctional PEG compound, generally PEGMe

v) An antioxidant 0.1 to 2 wt%, generally BHA

23. A process for preparing a polyurethane hydrogel, said process comprising:

(i) preparing a mixture as recited in claim 1;

(ii) curing the mixture formed in step (i) directly to form a polyurethane xerogel;

(iii) hydrating the xerogel using an aqueous medium to form a hydrogel.

24. A process for preparing a polyurethane xerogel in the form of a moulded article, said process comprising the steps of:

(i) preparing a mixture as recited in claim 1;

(ii) reacting the mixture formed in step (i) using substantially anhydrous materials to form a polyurethane xerogel;

(iii) reaction cast moulding the polyurethane xerogel to form a moulded article.

25. A process for preparing a contact lens comprising the steps of:

1. preparing a mixture as recited in claim 1;
2. dispensing the reaction mixture formed in step i) into a contact lens mold;
3. allowing the reaction mixture to react and cure (generally with the assistance of energy, in particular thermal energy or other means of radiation);
4. removing the contact lens from the mould; and hydrating the contact lens, in an aqueous fluid, optionally comprising a non-ionic surface active agent.