Preferred (B) is a divalent residue of an oligo- or polysiloxane of the formula

$$-[Ak\text{-}O]_q\text{-}Ak\text{-}Si(R_2)\text{-}[O\text{-}Si(R_2)]_p\text{-}O\text{-}Si(R_2)\text{-}Ak\text{-}[O\text{-}Ak]_{q'}\text{-} \qquad (IV)$$

wherein Ak stands for C_2-C_4alkylene, R stands for C_1-C_4alkyl, and each of p, q and q' independently is a number selected from the range 0-50. In more preferred moieties (B) of formula (IV), p ranges from 1 to 50, especially from 2 to 50.

Preferred (C) is a diphenyl sulfone monomer or linear oligomer or polymer block containing 1-50 moieties phenyl-SO_2-phenyl, and optionally further 1-50 further moieties Ar, which moieties are, in case of the oligomer or polymer, linked together by means selected from direct bonds and spacers Sp;
Ar is selected from -Ph-Ph- and –Ph-Sp-Ph-;
Ph is phenyl or phenyl substituted by C_1-C_4alkyl;
where the spacers Sp independently are –O- or C_1-C_3alkylene.

End groups in the oligomer or polymer (marked by asterisks * in formula I) mainly are mono-reacted constituents of the polyurethane (e.g. free OH from the diol component, or mono-reacted diisocyanate [–CO-NH-A-NCO], attached to (B) or (C) on the right side of formula I; or mono-reacted diol component HO-(B)- or HO-(C) attached on the left side of formula I). Chain termination may also be effected by including a certain amount (e.g. up to 20 mol-%) of monofunctional constituents, e.g. monoalcohols R'-(B)-OH or R'-(C)-OH where R' is alkyl (auch as C_1-C_4alkyl), Ar or especially H; R' (appropriately attached to (B) or (C)) thus forming one or both end group(s). In accordance, the present oligo- and polyurethanes are essentially free of typical silane end groups like $Si(R'')_3$, where R'' is any of H, alkyl, alkoxy.

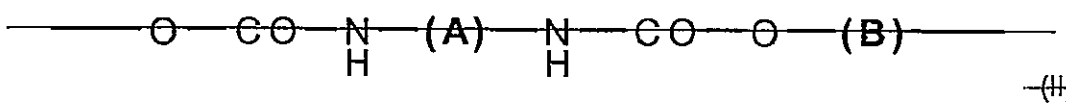
The invention further pertains to a membrane, especially semipermeable membrane, comprising the above polymer composition. The membrane of the invention generally shows an at least 8-fold enrichment of silicon, especially an 8- to 25-fold enrichment of silicon, in the section 2-10 nm from the membrane surface over the membrane's average silicon content. The invention includes the use of this membrane as a filter membrane in a water treatment, water separation or gas separation process.

~~Further, it has been found that, surprisingly, polysulfone moieties are not necessarily required in copolymers used as additives in water filtration membranes, thus still providing a good enrichment of silicone on the membrane surface, and good membrane operating properties such as antiadhesion and flux recovery effect in the aqueous environment. The invention thus further pertains to, in a second aspect, to a water filtration membrane comprising an oligo- and polyurethane comprising abovesaid components (A) and (B), but not (C) or any other sulfone moiety, of the formula (X)n~~

~~wherein n ranges from 2 to 100, especially from 2 to 50,~~

~~where~~

~~(X) is a block of formula~~



~~(II)~~

~~(A) is a residue of an aliphatic or aromatic diisocyanate linker,~~

~~(B) is a residue of a linear oligo- or polysiloxane, especially containing 3 or more Si-atoms, and containing alkanol end groups, and optionally further containing one or more aliphatic ether moieties.~~

Further constituents of the membrane generally comprise (as component b) one or more further organic polymers selected from the group consisting of polyvinyl pyrolidone, polyvinyl acetates, cellulose acetates, polyacrylonitriles, polyamides, polyolefines, polyesters, polysulfones, polyethersulfones, polycarbonates, polyether ketones, sulfonated polyether ketones, polyamide sulfones, polyvinylidene fluorides, polyvinylchlorides, polystyrenes and polytetrafluorethylenes, copolymers thereof, and mixtures thereof; preferably selected from the group consisting of polysulfones, polyethersulfones, polyvinylidene fluorides, polyamides, cellulose acetate and mixtures thereof.

End groups in the sulfone-free oligo- or polyurethane mainly are mono-reacted constituents of the polyurethane (e.g. free OH from the diol component, or mono-reacted diisocyanate [–CO-NH-A-NCO]. In accordance, the present oligo- and polyurethanes are essentially free of typical silane end groups like $Si(R'')_3$, where R" is any of H, alkyl, alkoxy.

Preferred meanings for (A) and (B) are as defined for copolymers of formula I above; specifically, the molecular weight (Mn) of the polyurethane is preferably from the range 1500 to 100000;

(A) preferably is a divalent residue selected from C_2-C_{12}alkylene and Ar;

(B) preferably is a divalent residue of an oligo- or polysiloxane of the formula

$$-[Ak\text{-}O]_q\text{-}Ak\text{-}Si(R_2)\text{-}[O\text{-}Si(R_2)]_p\text{-}O\text{-}Si(R_2)\text{-}Ak\text{-}[O\text{-}Ak]_{q'}\text{-} \qquad (IV)$$

wherein Ak stands for C_2-C_4alkylene, R stands for C_1-C_4alkyl, and each of q and q' independently is a number selected from the range 0-50, and p ranges from 1 to 50, especially from 2 to 50;

Ar is –Ph-Sp-Ph-;

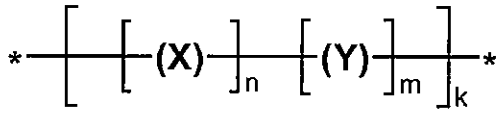
Ph is phenyl or phenyl substituted by C_1-C_4alkyl; and

Sp independently is selected from direct bond, –O-, C_1-C_3alkylene.

The water filtration membrane (semipermeable membrane) preferably consists essentially of a polymer composition comprising abovesaid oligo- or polyurethane in an amount of 0.1 to 25 % by weight of the total polymer composition, especially in a homogenous phase or within the same phase enriched at the surface. It may further

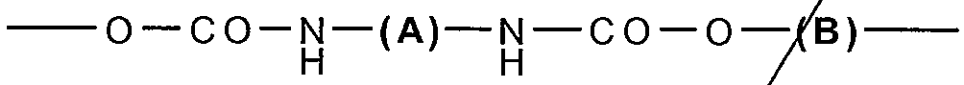
Claims

1. Polymer composition comprising
a) an oligo- or polyurethane of the formula I



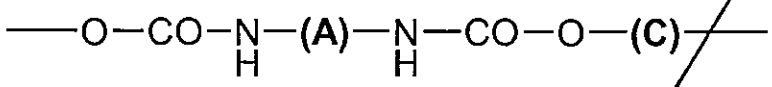
(I)

wherein k and n independently are numbers from 1 to 100,
m is from the range 1-100,
(X) is a block of formula



(II)

and (Y) is a block of the formula



(III),

(A) is a residue of an aliphatic or aromatic diisocyanate linker,
(B) is a residue of a linear oligo- or polysiloxane containing alkanol end groups, and optionally further containing one or more aliphatic ether moieties, and
(C) is an aromatic oligo- or polysulfone block;
or a mixture of such oligo- or polyurethanes; and

b) one or more further organic polymers selected from the group consisting of polyvinyl pyrolidone, polyvinyl acetates, cellulose acetates, polyacrylonitriles, polyamides, polyolefines, polyesters, polysulfones, polyethersulfones, polycarbonates, polyether ketones, sulfonated polyether ketones, polyamide sulfones, polyvinylidene fluorides, polyvinylchlorides, polystyrenes and polytetrafluorethylenes, copolymers thereof, and mixtures thereof; preferably selected from the group consisting of polysulfones, polyethersulfones, polyvinylidene fluorides, polyamides, cellulose acetate and mixtures thereof.

2. Polymer composition according to claim 1, wherein the molecular weight (Mn) of the compound of formula I is from the range 1500 to 100000, wherein n and m each are from the range 1 to 50, and k is from range 1 to 20.

3. Polymer composition according to any of claims 1 or 2, where in the oligo- or polyurethane of the formula I
(A) is a divalent residue selected from C_2-C_{12}alkylene and Ar;
(B) is a divalent residue of an oligo- or polysiloxane of the formula

$$-[Ak\text{-}O]_q\text{-}Ak\text{-}Si(R_2)\text{-}[O\text{-}Si(R_2)]_p\text{-}O\text{-}Si(R_2)\text{-}Ak\text{-}[O\text{-}Ak]_{q'}- \qquad (IV)$$

wherein Ak stands for C_2-C_4alkylene, R stands for C_1-C_4alkyl, and each of p, q and q' independently is a number selected from the range 0-50;

(C) is a diphenyl sulfone monomer or linear oligomer or polymer block containing 1-50 moieties phenyl-SO_2-phenyl, and optionally further 1-50 further moieties Ar, which moieties are, in case of the oligomer or polymer, linked together by spacers Sp;

Ar is –Ph-Sp-Ph-;

Ph is phenyl or phenyl substituted by C_1-C_4alkyl; and

Sp independently is selected from direct bond, –O-, C_1-C_3alkylene.

4. Polymer composition according to any of claims 1 to 3, comprising the oligo- or polyurethane of formula I in an amount of 0.1 to 25 % by weight of the total polymer composition, especially in a homogenous phase or within the same phase enriched at the surface.

5. Polymer composition according to any of claims 1 to 4, further comprising one or more antimicrobial or bacteriostatic agents, especially silver in ionic and/or metallic form such as silver colloid, silver glass, silver zeolite, silver salts, elemental silver in form of powder, microparticle, nanoparticle or cluster.

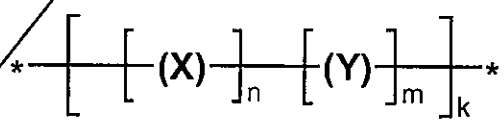
6. Membrane, especially semipermeable membrane, comprising a polymer composition of any of claims 1 to 5.

7. Membrane of claim 6, showing an at least 8-fold enrichment of silicon, especially an 8- to 25-fold enrichment of silicon, in the section 2-10 nm from the membrane surface over the membrane's average silicon content.

8. Process for the preparation of a membrane, especially a semipermeable membrane for water treatment or and gas separation purposes, which process comprises incorporation of a polymer composition according to any of claims 1 to 5 into the membrane material.

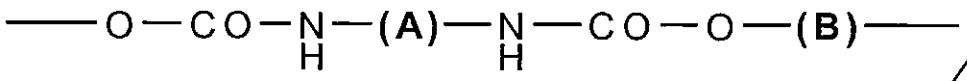
9. Use of the polymer composition according to any of claims 1 to 5 for the preparation of an antimicrobial membrane, especially for water separation or gas separation purposes.

10. Oligo- or polyurethane compound of the formula I



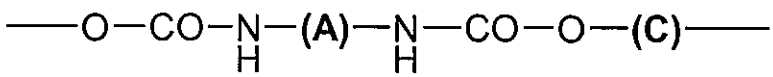
(I)

wherein k and n independently are numbers from 1 to 100,
m is from the range 1-100,
(X) is a block of formula



(II)

and (Y) is a block of the formula



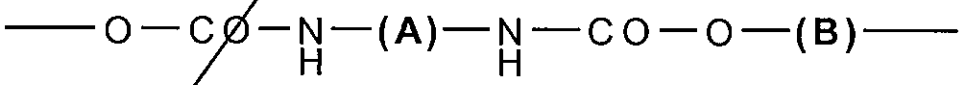
(III),

(A) is a residue of an aliphatic or aromatic diisocyanate linker,
(B) is a residue of a linear oligo- or polysiloxane containing alkanol end groups, and optionally further containing one or more aliphatic ether moieties, and
(C) is an aromatic oligo- or polysulfone block;
especially for use as an antimicrobial or anti-bioadhesive additive.

11. Compound according to claim 10, the molecular weight (Mn) of the compound of formula I being from the range 1500 to 100000, especially from the range 4000 to 25000, wherein n and m are from the range 1 to 50, and k is from range 1 to 20.

12. Use of an oligo- or polyurethane according of formula I as described in any of claims 1 to 5 or 10 to 11 as an additive imparting antiadhesive or bacteriostatic properties to a polymer composition, especially to a polymer membrane.

13. Water filtration membrane comprising an oligo- and polyurethane of the formula
$-(X)_n-$
wherein n ranges from 2 to 100, especially from 2 to 50, where
(X) is a block of formula



(II)

(A) is a residue of an aliphatic or aromatic diisocyanate linker,
(B) is a residue of a linear oligo- or polysiloxane, especially containing 3 or more Si atoms, and containing alkanol end groups, and optionally further containing one or more aliphatic ether moieties.

14. Water filtration membrane according to claim 13, further comprising one or more organic polymers selected from the group consisting of polyvinyl pyrolidone, polyvinyl acetates, cellulose acetates, polyacrylonitriles, polyamides, polyolefines, polyesters, polysulfones, polyethersulfones, polycarbonates, polyether ketones, sulfonated polyether ketones, polyamide sulfones, polyvinylidene fluorides, polyvinylchlorides, polystyrenes and polytetrafluorethylenes, copolymers thereof, and mixtures thereof; preferably

selected from the group consisting of polysulfones, polyethersulfones, polyvinylidene fluorides, polyamides, cellulose acetate and mixtures thereof.

15. Water filtration membrane according to claim 13 or 14, wherein
(A) is a divalent residue selected from C_2-C_{12}alkylene and Ar;
(B) is a divalent residue of an oligo- or polysiloxane of the formula

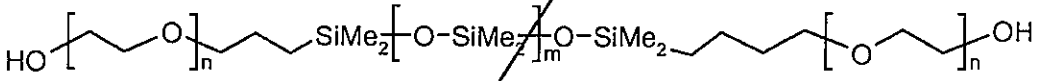
$$-[Ak\text{-}O]_q\text{-}Ak\text{-}Si(R_2)\text{-}[O\text{-}Si(R_2)]_p\text{-}O\text{-}Si(R_2)\text{-}Ak\text{-}[O\text{-}Ak]_{q'}\text{-} \qquad (IV)$$

wherein Ak stands for C_2-C_4alkylene, R stands for C_1-C_4alkyl, and each of q and q' independently is a number selected from the range 0-50, and p ranges from 1 to 50, especially from 2 to 50;
Ar is –Ph-Sp-Ph-;
Ph is phenyl or phenyl substituted by C_1-C_4alkyl; and
Sp independently is selected from direct bond, –O-, C_1-C_3alkylene.

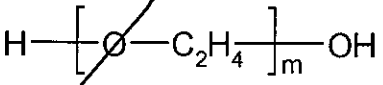
16. Use of an oligo- or polyurethane of the formula $-(X)_n-$ as described in any of claims 13 to 15 as an additive imparting antiadhesive or bacteriostatic properties to a water filtration membrane.

17. Compound, especially according to any of claims 10 or 11, which is selected from

a) poly(polydimethylsiloxane-block-co-polyethylenoxid)urethane derived from



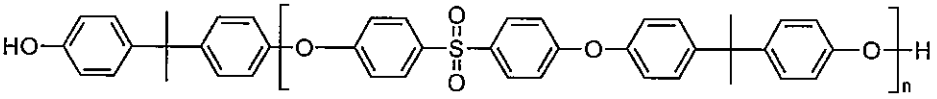
where n is from the range 0-100 (especially 5 to 80) and m is from the range 1-100 (especially from the range 5 to 80), and 1,6-hexamethylene diisocyanate as linker;

b) poly(polydimethylsiloxane-block-co-polyether)urethane derived from polyethylene-glycol of formula  and polydimethylsiloxane of formula



in a molar ratio ranging from 1:2 to 2:1, where m in both formulas is from the range 5 to 80, and 1,6-hexamethylene diisocyanate as linker;

c) poly(polydimethylsiloxane-block-co-polyethersulfonyl)urethane derived from a polyethersulfone of formula

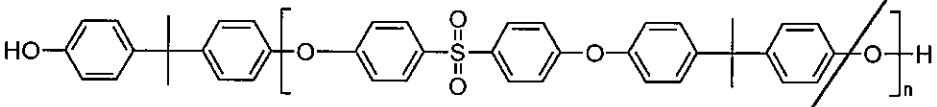


and polydimethylsiloxane of formula

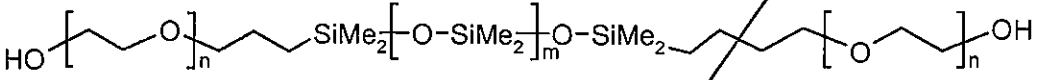


in a molar ratio ranging from 3:1 to 1:1, where m in both formulas is from the range 5 to 80, and 1,6-hexamethylene diisocyanate as linker;

d) poly(polydimethylsiloxane-block-co-polyethylenoxid-block-co-polyethersulfonyl)urethane derived from a polyethersulfone of formula

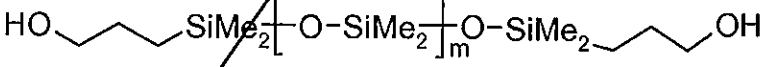


and polydimethylsiloxane of formula

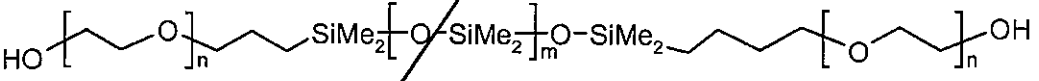


in a molar ratio ranging from 3:1 to 1:1, wherein n and m are from the range 5 to 80, and hexamethylene diisocyanate as linker;

e) poly(polydimethylsiloxane-block-co-polyethylenoxid-block-polydimethylsiloxane)-urethane derived from



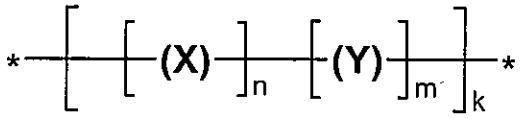
and



in a molar ratio ranging from 1:2 to 2:1, where n and m in both formulas are from the range 5 to 80, and 1,6-hexamethylene diisocyanate as linker.

Claims:

1. Polymer composition comprising
a) an oligo- or polyurethane of the formula I



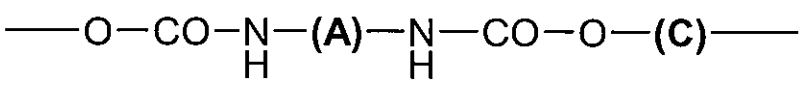
(I)

wherein k and n independently are numbers from 1 to 100,
m is from the range 1-100,
(X) is a block of formula



(II)

and (Y) is a block of the formula



(III),

(A) is a residue of an aliphatic or aromatic diisocyanate linker,
(B) is a residue of a linear oligo- or polysiloxane containing alkanol end groups, and optionally further containing one or more aliphatic ether moieties, and
(C) is an aromatic oligo- or polysulfone block;
or a mixture of such oligo- or polyurethanes; and

b) one or more further organic polymers selected from the group consisting of polyvinyl pyrolidone, polyvinyl acetates, cellulose acetates, polyacrylonitriles, polyamides, polyolefines, polyesters, polysulfones, polyethersulfones, polycarbonates, polyether ketones, sulfonated polyether ketones, polyamide sulfones, polyvinylidene fluorides, polyvinylchlorides, polystyrenes and polytetrafluorethylenes, copolymers thereof, and mixtures thereof; preferably selected from the group consisting of polysulfones, polyethersulfones, polyvinylidene fluorides, polyamides, cellulose acetate and mixtures thereof.

2. Polymer composition according to claim 1, wherein the molecular weight (Mn) of the compound of formula I is from the range 1500 to 100000, wherein n and m each are from the range 1 to 50, and k is from range 1 to 20.

3. Polymer composition according to any of claims 1 or 2, where in the oligo- or polyurethane of the formula I
(A) is a divalent residue selected from C_2-C_{12}alkylene and Ar;
(B) is a divalent residue of an oligo- or polysiloxane of the formula

$$-[Ak\text{-}O]_q\text{-}Ak\text{-}Si(R_2)\text{-}[O\text{-}Si(R_2)]_p\text{-}O\text{-}Si(R_2)\text{-}Ak\text{-}[O\text{-}Ak]_{q'}\text{-} \qquad (IV)$$

wherein Ak stands for C_2-C_4alkylene, R stands for C_1-C_4alkyl, and each of p, q and q' independently is a number selected from the range 0-50;
(C) is a diphenyl sulfone monomer or linear oligomer or polymer block containing 1-50 moieties phenyl-SO_2-phenyl, and optionally further 1-50 further moieties Ar, which moieties are, in case of the oligomer or polymer, linked together by spacers Sp;
Ar is –Ph-Sp-Ph-;
Ph is phenyl or phenyl substituted by C_1-C_4alkyl; and
Sp independently is selected from direct bond, –O-, C_1-C_3alkylene.

4. Polymer composition according to any of claims 1 to 3, comprising the oligo- or polyurethane of formula I in an amount of 0.1 to 25 % by weight of the total polymer composition, especially in a homogenous phase or within the same phase enriched at the surface.

5. Polymer composition according to any of claims 1 to 4, further comprising one or more antimicrobial or bacteriostatic agents, especially silver in ionic and/or metallic form such as silver colloid, silver glass, silver zeolite, silver salts, elemental silver in form of powder, microparticle, nanoparticle or cluster.

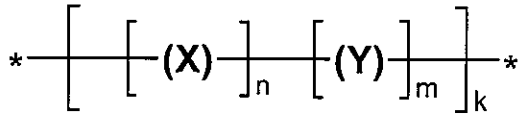
6. Membrane, especially semipermeable membrane, comprising a polymer composition of any of claims 1 to 5.

7. Membrane of claim 6, showing an at least 8-fold enrichment of silicon, especially an 8- to 25-fold enrichment of silicon, in the section 2-10 nm from the membrane surface over the membrane's average silicon content.

8. Process for the preparation of a membrane, especially a semipermeable membrane for water treatment or and gas separation purposes, which process comprises incorporation of a polymer composition according to any of claims 1 to 5 into the membrane material.

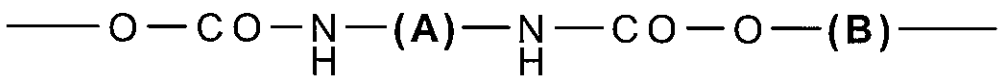
9. Use of the polymer composition according to any of claims 1 to 5 for the preparation of an antimicrobial membrane, especially for water separation or gas separation purposes.

10. Oligo- or polyurethane compound of the formula I



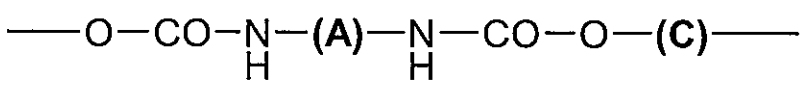
(I)

wherein k and n independently are numbers from 1 to 100,
m is from the range 1-100,
(X) is a block of formula



(II)

and (Y) is a block of the formula



(III),

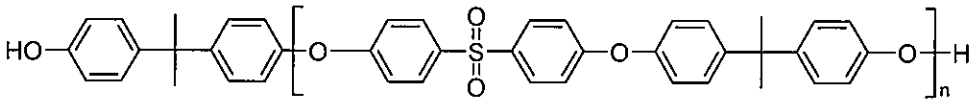
(A) is a residue of an aliphatic or aromatic diisocyanate linker,
(B) is a residue of a linear oligo- or polysiloxane containing alkanol end groups, and optionally further containing one or more aliphatic ether moieties, and
(C) is an aromatic oligo- or polysulfone block;
especially for use as an antimicrobial or anti-bioadhesive additive.

11. Compound according to claim 10, the molecular weight (Mn) of the compound of formula I being from the range 1500 to 100000, especially from the range 4000 to 25000, wherein n and m are from the range 1 to 50, and k is from range 1 to 20.

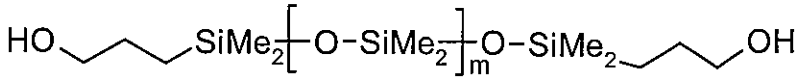
12. Use of an oligo- or polyurethane according of formula I as described in any of claims 1 to 5 or 10 to 11 as an additive imparting antiadhesive or bacteriostatic properties to a polymer composition, especially to a polymer membrane.

13. Compound, especially according to claim 10, which is selected from

a) poly(polydimethylsiloxane-block-co-polyethersulfonyl)urethane derived from a polyethersulfone of formula

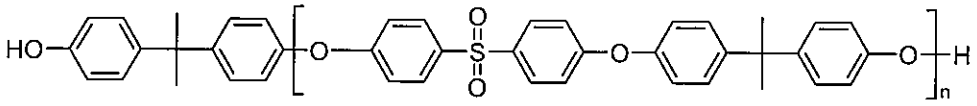


and polydimethylsiloxane of formula

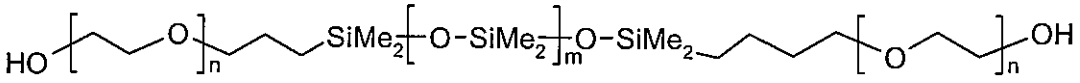


in a molar ratio ranging from 3:1 to 1:1, where m in both formulas is from the range 5 to 80, and 1,6-hexamethylene diisocyanate as linker;

b) poly(polydimethylsiloxane-block-co-polyethylenoxid-block-co-polyethersulfonyl)urethane derived from a polyethersulfone of formula



and polydimethylsiloxane of formula



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in a molar ratio ranging from 3:1 to 1:1, wherein n and m are from the range 5 to 80,
5 and hexamethylene diisocyanate as linker.