MULTI-ARM HYDROPHILIC URETHANE POLYMERS, METHODS OF MAKING THEM, AND COMPOSITIONS AND PROCESSES EMPLOYING THEM

RELATED APPLICATIONS

[001] This application claims priority to U.S. Provisional Application No. 61472503 filed on April 6, 2011, with the title "Multi-Arm Hydrophilic Urethane Polymers, Methods of Making Them, And Compositions and Processes Employing Them," the contents of which are incorporated by reference in their entirety.

BACKGROUND OF THE INVENTION

[002] The present technology, in general, relates to water-dispersible or water-soluble multi-arm polymers which contain at least one urethane bond and compositions thereof; methods of manufacture; and the various applications or processes that use them.

[003] In particular, these polymers are designed to be water-dispersible and/or soluble. The literature is replete with examples of urethane polymers that are designed to provide structural properties for furniture foam, contact lenses, wound dressings, adhesives, curable coatings and the like. The polymers of this invention are different in that they are designed to be incorporated into aqueous cleaning compositions to provide surface wetting and/or sustained foaming benefits. This requires properties very different than the prior art urethane polymers, which are generally only water swellable, if not water insoluble.

BRIEF SUMMARY OF THE INVENTION

[004] In one aspect, the present technology provides a water-dispersible or water-soluble composition comprising one or more water-dispersible or water-soluble urethane polymers, wherein the one or more polymers comprise:

(a) a core comprising C1-6 linear, branched, or cyclic hydrocarbon having at least two reactive group;

(b) two or more arms radiating out from the core, each arm having the following Formula 1:

$$-[O-C(=O)-N(H)-R1-N(H)-C(=O)-O-(CH2CH2-O)_n]-H$$

wherein n=4-12, R1 is the same or different and is dicyclohexylmethane, diphenylmethane, or toluene.

[004a] Also disclosed is a star polymer, wherein the star polymer comprises:

a core comprising a C1-6 linear, branched, cyclic or other hydrocarbon organic molecules having at least one functional group,

one or more arms bonded to the core group wherein each arm has the following Formula 1:

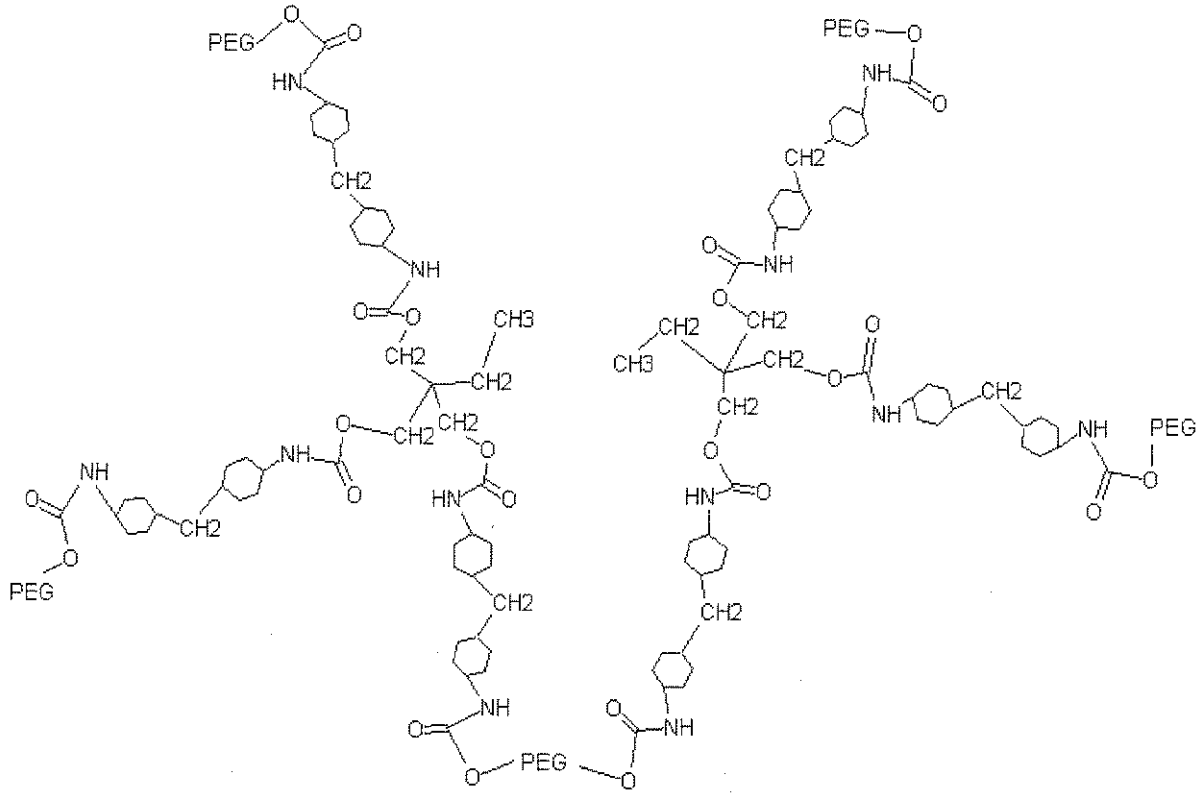
-[O-C(=O)-N(H)-R1-N(H)-C(=O)-O-(CH2CH2-O)$_n$]-H

where n=4-12, and R1 is the same or different and can be dicyclohexylmethane, diphenylmethane, or toluene. In further ~~embodiments~~examples, at least some of the arms of the star polymer are crosslinked via bonds formed between the diisocyanate groups at the free-end of each arm and at least one hydrophilizing molecule that possesses at least two hydrophilic groups per molecule. In some ~~aspects~~examples, the star polymer has from 1 to 6 arms. In other ~~aspects~~examples, the hydrophilizing molecule is polyethylene glycol that reacts across the diisocyanates attached to different core groups lightly crosslinking the star polymers to provide the water-soluble and/or water-dispersible polymers of the present technology.

The compositions of the present technology are best described by the combination of materials that make them and the process used. Numerous structures are present, all of which will contain the urethane bond, and also which contain the hydrophilizing polyol. Below are depicted two embodiments of the present technology, one example of the un-crosslinked star polymer (Formula 2) of the present technology, and one example of the cross-linked star polymer (Formula 3) of the present technology:

Formula 2, where the components are trimethylolpropane, Desmodur® W, and polyethylene glycol (PEG), e.g. PEG-400.

Formula 3, where the components are the same as formula 2, but a crosslink has occurred:



[005] Also disclosed is~~Another aspect of the present technology provides~~ at least one composition manufactured via the reaction of at least one C1-6 polyol with at least one diisocyanate, followed by reaction with at least one low molecular weight polyethylene glycol.

[006] In ~~yet~~ another ~~aspect~~example, the technology provides at least one composition with the above described polymers dispersed or dissolved in water to provide a detergent composition.

[007] In other aspects of the present technology, there is provided a cleaning composition comprising about 0.01% to about 50% by weight of at least one water-dispersible or water-soluble composition, wherein the water-dispersible or water soluble composition comprises one or more water-dispersible or water-soluble star polymers, wherein the one or more star polymers comprises:

(a) a core comprising C1-6 linear, branched, or cyclic hydrocarbon having at least one reactive group;

(b) one or more arms radiating out from the core, each arm having the following Formula 1:

-[O-C(=O)-N(H)-R1-N(H)-C(=O)-O-(CH2CH2-O)n]-H

wherein n=4-12, R1 is the same or different and is dicyclohexylmethane, diphenylmethane, or toluene.

[007a] Also disclosed is at least one cleaning composition containing the above-described polymer combined with a surfactant.

[007b] In another aspect, the present technology provides a light duty liquid detergent composition comprising about 0.01% to about 10% of the water-dispersible or water-soluble composition, wherein the water-dispersible or water soluble composition comprises one or more water-dispersible or water-soluble star polymers, wherein the one or more star polymers comprises:

(a) a core comprising C1-6 linear, branched, or cyclic hydrocarbon having at least one reactive group;

(b) one or more arms radiating out from the core, each arm having the following Formula 1:

-[O-C(=O)-N(H)-R1-N(H)-C(=O)-O-(CH2CH2-O)n]-H

wherein n=4-12, R1 is the same or different and is dicyclohexylmethane, diphenylmethane, or toluene.

[008] Also disclosed is~~A further aspect of the present technology provides~~ at least one foaming liquid detergent composition including from about 0.01% to about 1.0% of the above-described polymer.

[009] Also disclosed is~~In another aspect, the present technology provides~~ a hard surface cleaner composition comprising from about 0.01% to about 1.0% of the above-described polymer.

[010] In another aspect, the present technology provides a glass cleaner composition comprising about 0.01% to about 0.1% of the water-dispersible or water soluble composition, wherein the water-dispersible or water soluble composition comprises one or more water-dispersible or water-soluble star polymers, wherein the one or more star polymers comprises:

(a) a core comprising C1-6 linear, branched, or cyclic hydrocarbon having at least one reactive group;

(b) one or more arms radiating out from the core, each arm having the following Formula 1:

-[O-C(=O)-N(H)-R1-N(H)-C(=O)-O-(CH2CH2-O)n]-H

wherein n=4-12, R1 is the same or different and is dicyclohexylmethane, diphenylmethane, or toluene.

[010a] Also disclosed is a glass cleaner composition comprising from about 0.01% to about 1.0% of the polymer of the present technology.

[011] Also disclosed is~~In another aspect, the present technology provides~~ a cleaning composition comprising from about 0.01% to about 1.0% of the above-described polymer which leaves the surface more water-wettable after cleaning.

BRIEF DESCRIPTION OF THE DRAWINGS

[012] Figure 1 is a graph of surface tension vs. concentration for an aqueous solution containing the polymer of the present technology.

DETAILED DESCRIPTION OF THE INVENTION

[013] The present technology generally relates to water-dispersible and/or water-soluble polymers manufactured from a polyhydroxy core molecule reacted with a diisocyanate, followed by reaction with a hydrophilic diol or polyol to create a multi-arm, hydrophilic, urethane based molecular polymer structure that can provide wetting of surfaces and/or structural longevity to aqueous foaming systems. The materials and method of manufacture create polymers with arms that emanate from a core, with the possibility of minimal levels of crosslinking. The materials and processes of the present technology are chosen to ensure the number average molecular weight of the polymer is 10,000 or less, and that the polymer is at least dispersible into water as well as being soluble. The materials and method of manufacture are chosen to ensure at least one nitrogen, preferable at least two or more nitrogen atoms are present in each arm of the polymer. In one embodiment of the present technology, the at least one nitrogen, preferably at least two nitrogen atoms form urethane links within each polymer arm. The materials and method of manufacture are chosen to ensure the presence of sufficient –CH2CH2-O- or other hydrophilic molecular groups to render the polymer hydrophilic and therefore water-dispersible and/or water-soluble. Additional components may be added that are consistent with the above requirements. An