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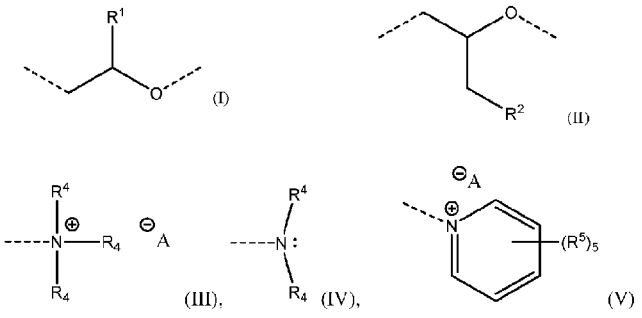
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(54) Title: A DEPOSITION AID POLYMER FOR LAUNDRY

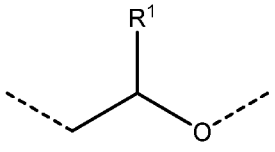


(57) Abstract: A deposition aid polymer for laundry is provided, comprising >50 to 99 wt% of structural units of formula (I) wherein R^1 is selected from hydrogen, -C_{1-4} alkyl and -CH_2OR^3; wherein R^3 is selected from -C_{1-12} alkyl and phenyl; and 1 to < 50 wt% of structural units of formula (II) wherein R^2 is selected from a moiety of Formula (III), a moiety of Formula (IV) and a moiety of Formula (V) wherein A^- is a counter anion balancing the cationic charge on the N; wherein R^4 is selected from hydrogen, -C_{1-12} alkyl and phenyl; and wherein R^5 is selected from hydrogen and -C_{1-8} alkyl; wherein the deposition aid polymer has a weight average molecular weight of < 100,000 Daltons; and with the proviso that the deposition aid polymer has an average of at least two structural units of formula (II) per molecule.

WO 2021/061773 A1

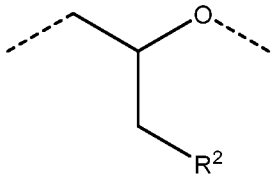
A DEPOSITION AID POLYMER FOR LAUNDRY

[0001] The present invention relates to a deposition aid polymer for laundry. In particular, the present invention relates to a deposition aid polymer for laundry, comprising >50 to 99 wt%, based on weight of the deposition aid polymer, of structural units of formula (I)



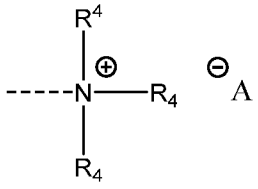
(I)

wherein R^1 is selected from hydrogen, -C_{1-4} alkyl and -CH_2OR^3; wherein R^3 is selected from -C_{1-12} alkyl and phenyl; and 1 to < 50 wt%, based on weight of the deposition aid polymer, of structural units of formula (II)

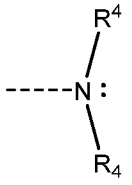


(II)

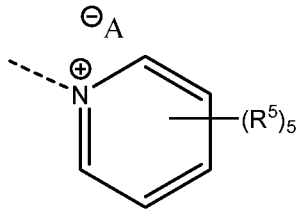
wherein R^2 is selected from a moiety of Formula (III), a moiety of Formula (IV) and a moiety of Formula (V)



(III),



(IV), and



(V)

wherein A^- is a counter anion balancing the cationic charge on the N; wherein R^4 is selected from hydrogen, -C_{1-12} alkyl and phenyl; and wherein R^5 is selected from hydrogen and -C_{1-8} alkyl; wherein the deposition aid polymer has a weight average molecular weight of < 100,000 Daltons; and with the proviso that the deposition aid polymer has an average of at least two structural units of formula (II) per molecule.

[0002] Cleaning of fabrics via laundering is useful for removing stains, odors and soils. Notwithstanding, the laundering process tends to induce mechanical and chemical damage to the textiles which results in wrinkles, color fading, pills, fuzz, dye transfer, stiffness, fabric wear, fiber deterioration and other issues consumer's find undesirable. Accordingly, laundry products (e.g., detergents, fabric softeners) are frequently formulated to include fabric care benefit agents to reduce some of the undesirable laundering issues.

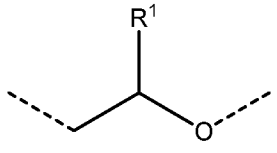
[0003] Many fabric care benefit agents have been found to provide only limited benefits due to inadequate delivery efficiency to fabrics during the laundering process. The affinity between the fabric care benefit agents and the fabrics is typically impaired by a lack of

natural attractive forces between the fabric care benefit agents and the fabrics. This derives from most fabric care benefit agents being anionic or nonionic to avoid undesirable interaction with anionic surfactants typically contained in the laundry product formulations which may lead to cleaning negatives. Given that most fibers used in fabric (e.g., cotton, wool, silk and nylon) carry a slightly anionic charge in the laundry solution, there exist repulsive forces between the fabric care benefit agents and the fabric leading to the noted poor delivery efficiency.

[0004] One approach for enhancing the delivery of a fabric care benefit agent is described by Wang et al in U.S. Patent No. 7,056,879. Wang et al disclose a laundry product composition comprising a stable mixture of: a) from about 0.1% to about 10%, by weight of the composition, of at least one water insoluble silicone derivative fabric care benefit agent, wherein the silicone derivative fabric care benefit agent has a particle size of from about 1 nm to 100 microns; b) from about 0.01% to about 5%, by weight of the composition, of at least one cationic cellulose delivery enhancing agent; c) from about 1% to about 80%, by weight of the composition, of a surfactant; d) from about 3.96% to about 80%, by weight of the composition, of a builder; and e) from about 0.001% to about 5%, by weight of the composition, of a compatible enzyme selected from lipase enzymes, protease enzymes or mixtures thereof; wherein the ratio of the delivery enhancing agent to the fabric care benefit agent is from about 1:50 to about 1:1.

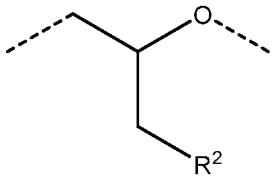
[0005] Notwithstanding, there remains a continuing need for deposition aids for improving the delivery efficiency of fabric care benefit agents incorporated into laundry products.

[0006] The present invention provides a deposition aid polymer for laundry, comprising: (a) >50 to 99 wt%, based on weight of the deposition aid polymer, of structural units of formula (I)



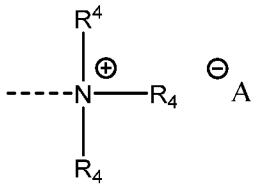
(I)

wherein each R^1 is independently selected from the group consisting of a hydrogen, a -C_{1-4} alkyl group and a -CH_2OR^3 group; wherein each R^3 is independently selected from the group consisting of a -C_{1-12} alkyl group and a phenyl group; and (b) 1 to < 50 wt%, based on weight of the deposition aid polymer, of structural units of formula (II)

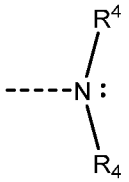


(II)

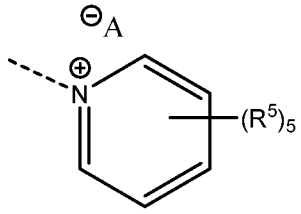
wherein each R^2 is independently selected from the group consisting of a moiety of Formula (III), a moiety of Formula (IV) and a moiety of Formula (V)



(III),



(IV), and



(V)

wherein A^- is a counter anion balancing the cationic charge on the N; wherein each R^4 is independently selected from the group consisting of a hydrogen, a -C_{1-12} alkyl group and a phenyl group; and wherein each R^5 is independently selected from the group consisting of a hydrogen and a -C_{1-8} alkyl group; wherein the deposition aid polymer has a weight average molecular weight of < 100,000 Daltons; and with the proviso that the deposition aid polymer has an average of at least two structural units of formula (II) per molecule.

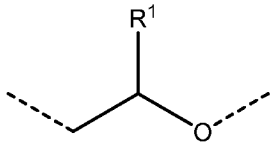
DETAILED DESCRIPTION

[0007] It has been surprisingly found that the deposition aid polymers as described herein having a weight average molecular weight of < 100,000 Daltons are effective at significantly increasing the deposition efficiency of fabric care benefit agents (e.g., hydrophobic poly(dimethylsiloxane) fabric conditioning agents).

[0008] Unless otherwise indicated, ratios, percentages, parts, and the like are by weight. Weight percentages (or wt%) in the composition are percentages of dry weight, i.e., excluding any water that may be present in the composition.

[0009] As used herein, unless otherwise indicated, the terms "weight average molecular weight" and "M_w" are used interchangeably to refer to the weight average molecular weight as measured in a conventional manner with gel permeation chromatography (GPC) and conventional standards, such as polystyrene standards. GPC techniques are discussed in detail in Modern Size Exclusion Liquid Chromatography: Practice of Gel Permeation and Gel Filtration Chromatography, Second Edition, Striegel, et al., John Wiley & Sons, 2009. Weight average molecular weights are reported herein in units of Daltons.

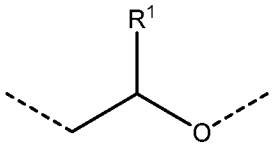
[0010] The term "structural units" as used herein and in the appended claims refers to the remnant of a given raw material; thus a structural unit of ethyleneoxide is illustrated:



(I)

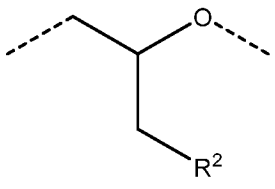
wherein the dotted lines represent the points of attachment to the polymer backbone and where R^1 is a hydrogen.

[0011] Preferably, the deposition aid polymer for laundry of the present invention comprises: (a) >50 to 99 wt% (preferably, 60 to 98 wt%; more preferably, 75 to 97 wt%; still more preferably, 82 to 96 wt%; most preferably, 90 to 95 wt%), based on weight of the deposition aid polymer, of structural units of formula (I)



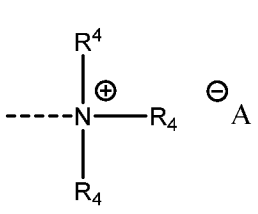
(I)

wherein each R^1 is independently selected from the group consisting of a hydrogen, a -C_{1-4} alkyl group and a -CH_2OR^3 group (preferably, a hydrogen, a -C_{1-4} alkyl group and a mixture thereof; more preferably, a hydrogen, a -C_{1-2} alkyl group and a mixture thereof; still more preferably, a hydrogen, a methyl group and a mixture thereof; most preferably, a hydrogen); wherein each R^3 is independently selected from the group consisting of a -C_{1-12} alkyl group and a phenyl group; and (b) 1 to < 50 wt% (preferably, 2 to 40 wt%; more preferably, 3 to 25 wt%; still more preferably, 4 to 18 wt%; most preferably, 5 to 10 wt%), based on weight of the deposition aid polymer, of structural units of formula (II)

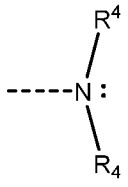


(II)

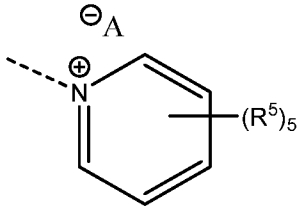
wherein each R^2 is independently selected from the group consisting of a moiety of Formula (III), a moiety of Formula (IV) and a moiety of Formula (V)



(III),



(IV), and



(V)

wherein A^- is a counter anion balancing the cationic charge on the N; wherein each R^4 is independently selected from the group consisting of a hydrogen, a -C_{1-12} alkyl group and a phenyl group (preferably, a hydrogen and a -C_{1-12} alkyl group; more preferably, a hydrogen

and a -C_{1-4} alkyl group; still more preferably, a hydrogen and a -C_{1-2} alkyl group; most preferably, a hydrogen and a methyl group); and wherein each R^5 is independently selected from the group consisting of a hydrogen and a -C_{1-8} alkyl group (preferably, a hydrogen and a -C_{1-4} alkyl group; more preferably, a hydrogen and a methyl group; most preferably, a hydrogen); wherein the deposition aid polymer has a weight average molecular weight of < 100,000 Daltons; and with the proviso that the deposition aid polymer has an average of at least two (preferably, 2.5 to 300; more preferably, 3 to 50; still more preferably, 3 to 20; most preferably, 3.5 to 15) structural units of formula (II) per molecule.

[0012] Preferably, the deposition aid polymer for laundry of the present invention has a weight average molecular weight, M_W, of < 100,000 Daltons. More preferably, the deposition aid polymer for laundry of the present invention has a weight average molecular weight of 2,000 to 90,000 Daltons. Still more preferably, the deposition aid polymer for laundry of the present invention has a weight average molecular weight of 2,500 to 75,000 Daltons. Yet still more preferably, the deposition aid polymer for laundry of the present invention has a weight average molecular weight of 3,000 to 50,000 Daltons. Most preferably, the deposition aid polymer for laundry of the present invention has a weight average molecular weight of 12,000 to 30,000 Daltons.

[0013] Preferably, the deposition aid polymer for laundry of the present invention comprises >50 to 99 wt% (preferably, 60 to 98 wt%; more preferably, 75 to 97 wt%; still more preferably, 82 to 96 wt%; most preferably, 90 to 95 wt%), based on weight of the deposition aid polymer, of structural units of formula (I), wherein each R^1 is independently selected from the group consisting of a hydrogen, a -C_{1-4} alkyl group and a -CH_2OR^3 group; wherein each R^3 is independently selected from the group consisting of a -C_{1-12} alkyl group and a phenyl group. More preferably, the deposition aid polymer for laundry of the present invention comprises >50 to 99 wt% (preferably, 60 to 98 wt%; more preferably, 75 to 97 wt%; still more preferably, 82 to 96 wt%; most preferably, 90 to 95 wt%), based on weight of the deposition aid polymer, of structural units of formula (I), wherein each R^1 is independently selected from the group consisting of a hydrogen, a -C_{1-4} alkyl group and a mixture thereof. Still more preferably, the deposition aid polymer for laundry of the present invention comprises >50 to 99 wt% (preferably, 60 to 98 wt%; more preferably, 75 to 97 wt%; still more preferably, 82 to 96 wt%; most preferably, 90 to 95 wt%), based on weight of the deposition aid polymer, of structural units of formula (I), wherein each R^1 is independently selected from the group consisting of a hydrogen, a -C_{1-2} alkyl group and a mixture thereof. Yet more preferably, the deposition aid polymer for laundry of the present

invention comprises >50 to 99 wt% (preferably, 60 to 98 wt%; more preferably, 75 to 97 wt%; still more preferably, 82 to 96 wt%; most preferably, 90 to 95 wt%), based on weight of the deposition aid polymer, of structural units of formula (I), wherein each R^1 is independently selected from the group consisting of a hydrogen, a methyl group and a mixture thereof. Most preferably, the deposition aid polymer for laundry of the present invention comprises >50 to 99 wt% (preferably, 60 to 98 wt%; more preferably, 75 to 97 wt%; still more preferably, 82 to 96 wt%; most preferably, 90 to 95 wt%), based on weight of the deposition aid polymer, of structural units of formula (I), wherein each R^1 is independently selected from the group consisting of a hydrogen.

[0014] Preferably, the deposition aid polymer for laundry of the present invention comprises 1 to < 50 wt% (preferably, 2 to 40 wt%; more preferably, 3 to 25 wt%; still more preferably, 4 to 18 wt%; most preferably, 5 to 10 wt%), based on weight of the deposition aid polymer, of structural units of formula (II), wherein each R^2 is independently selected from the group consisting of a moiety of Formula (III), a moiety of Formula (IV) and a moiety of Formula (V); wherein A^- is a counter anion balancing the cationic charge on the N (preferably, wherein A^- is selected from the group consisting of Cl^-, F^-, Br^- and I^-; more preferably, Cl^- and Br^-; most preferably, Cl^-); wherein each R^4 is independently selected from the group consisting of a hydrogen, a -C_{1-12} alkyl group and a phenyl group (preferably, a hydrogen and a -C_{1-12} alkyl group; more preferably, a hydrogen and a -C_{1-4} alkyl group; still more preferably, a hydrogen and a -C_{1-2} alkyl group; most preferably, a hydrogen and a methyl group); and wherein each R^5 is independently selected from the group consisting of a hydrogen and a -C_{1-8} alkyl group (preferably, a hydrogen and a -C_{1-4} alkyl group; more preferably, a hydrogen and a methyl group; most preferably, a hydrogen); and with the proviso that the deposition aid polymer has an average of at least two (preferably, 2.5 to 300; more preferably, 3 to 50; still more preferably, 3 to 20; most preferably, 3.5 to 15) structural units of formula (II) per molecule. More preferably, the deposition aid polymer for laundry of the present invention comprises 1 to < 50 wt% (preferably, 2 to 40 wt%; more preferably, 3 to 25 wt%; still more preferably, 4 to 18 wt%; most preferably, 5 to 10 wt%), based on weight of the deposition aid polymer, of structural units of formula (II), wherein each R^2 is independently selected from the group consisting of a moiety of Formula (III) and a Moiety of Formula (IV); wherein each R^4 is independently selected from the group consisting of a hydrogen, a -C_{1-12} alkyl group (preferably, a -C_{1-8} alkyl group; more preferably, a -C_{1-4} alkyl group; most preferably, a methyl group) and a phenyl group; and with the proviso that the deposition aid polymer has

an average of at least two (preferably, 2.5 to 300; more preferably, 3 to 50; still more preferably, 3 to 20; most preferably, 3.5 to 15) structural units of formula (II) per molecule. Preferably, when R^2 is a moiety of Formula (III), at least one (preferably, at least two; more preferably, all three) of the R^4 groups is a -C_{1-12} alkyl group (preferably, a -C_{1-4} alkyl group; more preferably, a -C_{1-2} alkyl group; most preferably, a methyl group). Preferably, when R^2 is a moiety of Formula (IV), at least one (preferably, both) of the R^4 groups is a -C_{1-12} alkyl group (preferably, a -C_{1-4} alkyl group; more preferably, a -C_{1-2} alkyl group; most preferably, a methyl group). Most preferably, the deposition aid polymer for laundry of the present invention comprises 1 to < 50 wt% (preferably, 2 to 40 wt%; more preferably, 3 to 25 wt%; still more preferably, 4 to 18 wt%; most preferably, 5 to 10 wt%), based on weight of the deposition aid polymer, of structural units of formula (II), wherein each R^2 is a moiety of Formula (IV); wherein at least one (preferably, both) of the R^4 groups is a -C_{1-12} alkyl group (preferably, a -C_{1-4} alkyl group; more preferably, a -C_{1-2} alkyl group; most preferably, a methyl group); and with the proviso that the deposition aid polymer has an average of at least two (preferably, 2.5 to 300; more preferably, 3 to 50; still more preferably, 3 to 20; most preferably, 3.5 to 15) structural units of formula (II) per molecule.

[0015] Preferably, the deposition aid polymer for laundry of the present invention comprises ≤ 1 wt%, based on weight of the deposition aid polymer, of active moieties capable of forming covalent bonds with cellulose (e.g., azetidinium groups, epoxide groups, halomethyl groups (e.g., chloromethyl moieties, fluoromethyl moieties)). More preferably, the deposition aid polymer for laundry of the present invention comprises ≤ 0.5 wt%, based on weight of the deposition aid polymer, of active moieties capable of forming covalent bonds with cellulose (e.g., azetidinium groups, epoxide groups, halomethyl groups (e.g., chloromethyl moieties, fluoromethyl moieties)). Still more preferably, the deposition aid polymer for laundry of the present invention comprises ≤ 0.2 wt%, based on weight of the deposition aid polymer, of active moieties capable of forming covalent bonds with cellulose (e.g., azetidinium groups, epoxide groups, halomethyl groups (e.g., chloromethyl moieties, fluoromethyl moieties)). Yet more preferably, the deposition aid polymer for laundry of the present invention comprises ≤ 0.1 wt%, based on weight of the deposition aid polymer, of active moieties capable of forming covalent bonds with cellulose (e.g., azetidinium groups, epoxide groups, halomethyl groups (e.g., chloromethyl moieties, fluoromethyl moieties)). Still yet more preferably, the deposition aid polymer for laundry of the present invention comprises ≤ 0.01 wt%, based on weight of the deposition aid polymer, of active moieties capable of forming covalent bonds with cellulose (e.g., azetidinium groups, epoxide groups,

halomethyl groups (e.g., chloromethyl moieties, fluoromethyl moieties)). Most preferably, the deposition aid polymer for laundry of the present invention comprises < the detectable limit of active moieties capable of forming covalent bonds with cellulose (e.g., azetidinium groups, epoxide groups, halomethyl groups (e.g., chloromethyl moieties, fluoromethyl moieties)).

[0016] Preferably, the deposition aid polymer for laundry of the present invention comprises ≤ 1 wt%, based on weight of the deposition aid polymer, of carboxylic acid moieties. More preferably, the deposition aid polymer for laundry of the present invention comprises ≤ 0.5 wt%, based on weight of the deposition aid polymer, of carboxylic acid moieties. Still more preferably, the deposition aid polymer for laundry of the present invention comprises ≤ 0.2 wt%, based on weight of the deposition aid polymer, of carboxylic acid moieties. Yet more preferably, the deposition aid polymer for laundry of the present invention comprises ≤ 0.1 wt%, based on weight of the deposition aid polymer, of carboxylic acid moieties. Still yet more preferably, the deposition aid polymer for laundry of the present invention comprises ≤ 0.01 wt%, based on weight of the deposition aid polymer, of carboxylic acid moieties. Most preferably, the deposition aid polymer for laundry of the present invention comprises < the detectable limit of carboxylic acid moieties.

[0017] Preferably, the deposition aid polymer for laundry of the present invention comprises ≤ 1 wt%, based on weight of the deposition aid polymer, of carbonyl moieties. More preferably, the deposition aid polymer for laundry of the present invention comprises ≤ 0.5 wt%, based on weight of the deposition aid polymer, of carbonyl moieties. Still more preferably, the deposition aid polymer for laundry of the present invention comprises ≤ 0.2 wt%, based on weight of the deposition aid polymer, of carbonyl moieties. Yet more preferably, the deposition aid polymer for laundry of the present invention comprises ≤ 0.1 wt%, based on weight of the deposition aid polymer, of carbonyl moieties. Still yet more preferably, the deposition aid polymer for laundry of the present invention comprises ≤ 0.01 wt%, based on weight of the deposition aid polymer, of carbonyl moieties. Most preferably, the deposition aid polymer for laundry of the present invention comprises < the detectable limit of carbonyl moieties.

[0018] Preferably, the deposition aid polymer for laundry of the present invention comprises: (a) 82 to 96 wt%, based on weight of the deposition aid polymer, of structural units of formula (I), wherein each R^1 is independently selected from a hydrogen and a -C_{1-4} alkyl group; and (b) 4 to 18 wt%, based on weight of the deposition aid polymer, of

structural units of formula (II), wherein each R^2 is independently selected from the group consisting of a moiety of Formula (III) and a moiety of Formula (IV); wherein each R^4 is independently selected from the group consisting of a hydrogen and a -C_{1-8} alkyl group; wherein the deposition aid polymer contains less than the detectable limit of azetidinium moieties, carboxylic acid moieties, carbonyl moieties and halomethyl moieties (e.g., chloromethyl moieties, fluoromethyl moieties); wherein the deposition aid polymer has a weight average molecular weight of 5,000 to 30,000 Daltons; and with the proviso that the deposition aid polymer has an average of at least two (preferably, 2.5 to 300; more preferably, 3 to 50; still more preferably, 3 to 20; most preferably, 3.5 to 15) structural units of formula (II) per molecule. More preferably, the deposition aid polymer for laundry of the present invention comprises: (a) 82 to 96 wt%, based on weight of the deposition aid polymer, of structural units of formula (I), wherein each R^1 is independently selected from a hydrogen and a methyl group; and (b) 4 to 18 wt%, based on weight of the deposition aid polymer, of structural units of formula (II), wherein each R^2 is independently selected from the group consisting of a moiety of Formula (III) and a moiety of Formula (IV); wherein each R^4 is a methyl group; wherein the deposition aid polymer contains less than the detectable limit of azetidinium moieties, carboxylic acid moieties, carbonyl moieties and halomethyl moieties (e.g., chloromethyl moieties, fluoromethyl moieties); wherein the deposition aid polymer has a weight average molecular weight of 5,000 to 30,000 Daltons; and with the proviso that the deposition aid polymer has an average of at least two (preferably, 2.5 to 300; more preferably, 3 to 50; still more preferably, 3 to 20; most preferably, 3.5 to 15) structural units of formula (II) per molecule. Most preferably, the deposition aid polymer for laundry of the present invention comprises: (a) 82 to 96 wt%, based on weight of the deposition aid polymer, of structural units of formula (I), wherein each R^1 is a hydrogen; and (b) 4 to 18 wt%, based on weight of the deposition aid polymer, of structural units of formula (II), wherein each R^2 is a moiety of Formula (IV); wherein each R^4 is a methyl group; wherein the deposition aid polymer contains less than the detectable limit of azetidinium moieties, carboxylic acid moieties, carbonyl moieties and halomethyl moieties (e.g., chloromethyl moieties, fluoromethyl moieties); wherein the deposition aid polymer has a weight average molecular weight of 5,000 to 30,000 Daltons; and with the proviso that the deposition aid polymer has an average of at least two (preferably, 2.5 to 300; more preferably, 3 to 50; still more preferably, 3 to 20; most preferably, 3.5 to 15) structural units of formula (II) per molecule.

[0019] Some embodiments of the present invention will now be described in detail in the following **Examples**.

[0020] The abbreviations listed in the following table are used in the examples.

Abbreviation	Meaning
ECH	Epichlorohydrin
EDTA-4Na	Ethylenediamine-N,N,N',N'-tetraacetic acid, tetrasodium salt
EO	Ethylene oxide
MEA	Monoethanolamine
M_n	Number average molecular weight
M_w	Weight average molecular weight
PO	Propylene oxide
PTFE	Poly(tetrafluoroethylene)
RT	Room temperature
SEC	Size exclusion chromatography
SLES	Lauryl alcohol ethoxylate, sodium salt
THF	Tetrahydrofuran
TiBA	Triisobutylaluminum
XPS	X-ray photoelectron spectroscopy

Analytical methods:

Molecular weight analysis of epichlorohydrin copolymers:

Sample Prep:	2 mg/mL in THF; solutions were filtered with 0.45 µm nylon syringe filter into autosampler vials before injection
Pump:	Waters Model e2695 at a nominal flow rate of 1.0 mL/min
Eluent:	0.2 M sodium nitrate and 0.02% sodium azide in water
Injector:	Waters Model e2695 set to inject 100 µL
Columns:	Two Tosoh GMPWXL columns, held at 35 °C
Detection:	Shodex RI-201 differential refractive index (DRI)
Data system:	PL Cirrus, version 3.3
Calibration:	12 narrow poly(ethylene oxide) standards from Polymer labs, fit to a 1st order polynomial curve over the range of 863.5 kg/mol to 0.610 kg/mol.

Molecular weight analysis of amine-functionalized copolymers:

[0021] All samples were prepared in the GPC mobile phase at 5 mg/mL. The accurate concentration of each sample was recorded. The samples were shaken for at least 2 hrs on a horizontal shaker at ambient temperature to expedite the dissolution process. Prepared samples were then filtered using 45 µm nylon syringe filter into autosampler vials before injection. No resistance was observed during the filtration process for any of the exemplified amine-functionalized polymers.

[0022] The GPC instrument setup used consisted of a Waters Alliance 2690 Separation Module (degasser, pump, autosampler and column oven) and Wyatt Optilab UT-rEX refractive index detector (RI). A waters e-SAT/IN module was used to translate analog

signals from the RI detector to digital signals for data collection. Empower 3 was used for data acquisition and process.

[0023] GPC conditions:

Columns:	TOSOH TSKgel G5000PWxl-CP and G5000PWxl-CP columns (7.8 mm ID x 300 mm L)
Mobile phase:	100 mM ammonium formate pH 3
Flow rate:	0.5 mL/min
Sample solvent:	Same as mobile phase
Sample concentration:	5 mg/mL
Injected volume of sample solution:	50 µL
Concentration detection:	Refractive index detector
Column calibration standards:	Easivial PEG/PEO premixed poly(ethylene oxide) molecular weight standards from Agilent Technology
Calibration curve:	3rd order fit for the PEO standards with peak molecular weight of 1,378,000; 942,000; 542,500; 122,200; 64,850; 29,420; 16,100; 3,860; 1,450; 610; 194; 104 g/mol
Integration limit:	End at around 38.5 min

NMR analysis of ECH copolymers:

[0024] All samples were prepared in the GPC mobile phase at 5 mg/mL. The accurate concentration of each sample was recorded. The samples were shaken for at least 2 hrs on a horizontal shaker at ambient temperature to expedite the dissolution process. Prepared samples were then filtered using 45 µm nylon syringe filter into autosampler vials before injection. No resistance was observed during the filtration process for any of the exemplified amine-functionalized polymers.

Molecular weight analysis of amine-functionalized copolymers:

[0025] Sample preparation: 500 mg of sample dissolved in 2.2 mL acetone-d_6 containing 5 mM relaxation agent to form a homogeneous solution that was then transferred to a 10 mm NMR tube. Quantitative ^{13}C NMR spectroscopy was conducted on a Bruker 600 MHz spectrometer equipped with a 10 mm cryogenic probe using the following parameters. Pulsed-field-gradient NMR allowed diffusion measurement to quantify molecular weight using a 0.1 wt% solution in $CDCl_3$ containing 2 mM relaxation agent. Diffusion measurement was conducted on a 400 MHz instrument equipped with a 5 mm BBO probe. Repetition time: 7 s; number of scans: 128; 90° pulse: 12 µs; T: 25 °C; spectrum width: 240 ppm; spectrum center: 90 ppm.

XPS analysis of cotton fabric:

Instrument:	Thermo K-alpha XPS
X-ray source:	Monochromatic Al Kα 72 Watts (12 kV, 6 mA)
Analyzer Pass Energy:	200 eV (survey spectra: 50 msec, 1 eV/step, 5 scans; 80 eV (quantitation scans: 50 msec, 0.15 eV/step, 5 scans); 20 eV (high resolution carbon spectra: 50 msec, 0.1 eV/step, 15 scans)
Take-Off Angle:	400 µm
Auto height:	on
Analysis Area:	400 µm oval
Flood gun:	on
Data processing:	Thermo Advantage software with Thermo's modified XPS sensitivity factors.
Minimum of 4 areas analyzed per sheet with 2 sheets analyzed per formulation tested	

Example P1: EO-ECH Polymer

[0026] Syringes were charged under an inert atmosphere with ECH (4.63 mL) and toluene (150 mL), capped with sealed GC vials and then added to a 300 mL stainless steel pressure reactor equipped with a stirrer utilizing a gas entrainment impeller blade. Temperature was controlled with a mantle through resistive heating and cooling water fed through an internal cooling loop using a research control valve. The reactor had been dried at 100 °C and thoroughly purged with nitrogen. The reactor was pressurized with ~15 psig nitrogen followed by the addition of EO (8.85 mL) using the Camille reactor control system. The reaction mixture was heated to 40 °C. The catalyst mixture in toluene (6 mL) was prepared in a glove box from TiBA (25 % in toluene, 2.48 g) and triethylamine (79 mg), taken up in a syringe, capped and removed from the box. The catalyst mixture was added to the shot tank and charged into the reactor.

[0027] An immediate exotherm was observed of ~4 °C and an additional ~9 mL of EO was added to maintain pressure over about 1 h. The mixture was then quenched by addition of ethanol (6 mL) through the shot tank. After cooling to RT, purging with nitrogen, the mixture was removed from the reactor, and concentrated on a rotovap. The mixture was transferred to a jar and dried further at 50 °C using the glove box vacuum pump. The product polymer (12.2 g) was isolated. The ECH content of the polymer was found by quantitative ^{13}C NMR to be 16 wt %. The polymer M_w and M_n by GPC were 11.9 and 2.9 kDa, respectively.

Example P2: EO-ECH Polymer

[0028] Syringes were charged under an inert atmosphere with ECH (1.54 mL) and toluene (150 mL), capped with sealed GC vials and then added to a 300 mL stainless steel pressure reactor equipped with a stirrer utilizing a gas entrainment impeller blade. Temperature was controlled with a mantle through resistive heating and cooling water fed through an internal cooling loop using a research control valve. The reactor had been dried at 100 °C and thoroughly purged with nitrogen. The reactor was pressurized with ~15 psig nitrogen followed by the addition of EO (8.85 mL) using the Camille reactor control system. The reaction mixture was heated to 40 °C. The catalyst mixture in toluene (8 mL) was prepared in a glove box from TiBA (25 % in toluene, 1.86 g) and tetraoctylammonium bromide (427 mg), taken up in a syringe, capped and removed from the box. The catalyst mixture was added to the shot tank and charged into the reactor.

[0029] An immediate exotherm was observed of ~3 °C and an additional ~9 mL of EO was added to maintain pressure over about 1 h. The mixture was then quenched by addition of ethanol (6 mL) through the shot tank. After cooling to RT, purging with nitrogen, the mixture was removed from the reactor, and concentrated on a rotovap. The mixture was transferred to a jar and dried further at 50 °C using the glove box vacuum pump. The product polymer (14.0 g) was isolated. The ECH content of the polymer was found by quantitative ^{13}C NMR to be 6.4 wt %. The polymer M_w and M_n by GPC were 25.6 and 9.3 kDa, respectively.

Example P3: EO-ECH Polymer

[0030] Syringes were charged under an inert atmosphere with ECH (3.09 mL) and toluene (150 mL), capped with sealed GC vials and then added to a 300 mL stainless steel pressure reactor equipped with a stirrer utilizing a gas entrainment impeller blade. Temperature was controlled with a mantle through resistive heating and cooling water fed through an internal cooling loop using a research control valve. The reactor had been dried at 100 °C and thoroughly purged with nitrogen. The reactor was pressurized with ~15 psig nitrogen followed by the addition of EO (8.85 mL) using the Camille reactor control system. The reaction mixture was heated to 40 °C. The catalyst mixture in toluene (8 mL) was prepared in a glove box from TiBA (25 % in toluene, 3.71 g) and tetraoctylammonium bromide (853 mg), taken up in a syringe, capped and removed from the box. The catalyst mixture was added to the shot tank and charged into the reactor.

[0031] An immediate exotherm was observed of ~3 °C and an additional ~9 mL of EO was added to maintain pressure over about 1 h. The mixture was then quenched by addition of

ethanol (6 mL) through the shot tank. After cooling to RT, purging with nitrogen, the mixture was removed from the reactor, and concentrated on a rotovap. The mixture was transferred to a jar and dried further at 50 °C using the glove box vacuum pump. The product polymer (7.4 g) was isolated. The ECH content of the polymer was found by quantitative ^{13}C NMR to be 10.6 wt %. The polymer M_w and M_n by GPC were 9.9 and 3.1 kDa, respectively.

Example P4: EO-ECH Polymer

[0032] Syringes were charged under an inert atmosphere with ECH (9.26 mL) and toluene (150 mL), capped with sealed GC vials and then added to a 300 mL stainless steel pressure reactor equipped with a stirrer utilizing a gas entrainment impeller blade. Temperature was controlled with a mantle through resistive heating and cooling water fed through an internal cooling loop using a research control valve. The reactor had been dried at 100 °C and thoroughly purged with nitrogen. The reactor was pressurized with ~15 psig nitrogen followed by the addition of EO (8.85 mL) using the Camille reactor control system. The reaction mixture was heated to 40 °C. The catalyst mixture in toluene (8 mL) was prepared in a glove box from TiBA (25 % in toluene, 3.71 g) and tetraoctylammonium bromide (853 mg), taken up in a syringe, capped and removed from the box. The catalyst mixture was added to the shot tank and charged into the reactor.

[0033] An immediate exotherm was observed of ~3 °C and an additional ~9 mL of EO was added to maintain pressure over about 1 h. The mixture was then quenched by addition of ethanol (6 mL) through the shot tank. After cooling to RT, purging with nitrogen, the mixture was removed from the reactor, and concentrated on a rotovap. The mixture was transferred to a jar and dried further at 50 °C using the glove box vacuum pump. The product polymer (19.2 g) was isolated. The ECH content of the polymer was found by quantitative ^{13}C NMR to be 27.8 wt %.

Example P5: EO-PO-ECH Polymer

[0034] Syringes were charged under an inert atmosphere with ECH (3.09 mL), PO (8.26 mL) and toluene (150 mL), capped with sealed GC vials and then added to a 300 mL stainless steel pressure reactor equipped with a stirrer utilizing a gas entrainment impeller blade. Temperature was controlled with a mantle through resistive heating and cooling water fed through an internal cooling loop using a research control valve. The reactor had been dried at 100 °C and thoroughly purged with nitrogen. The reactor was pressurized with ~15 psig nitrogen followed by the addition of EO (8.85 mL) using the Camille reactor control system. The reaction mixture was heated to 40 °C. The catalyst mixture in toluene

(8 mL) was prepared in a glove box from TiBA (25 % in toluene, 3.71 g) and tetraoctylammonium bromide (853 mg), taken up in a syringe, capped and removed from the box. The catalyst mixture was added to the shot tank and charged into the reactor.

[0035] No exotherm was observed and reactor pressure stayed constant. The mixture was heated to 60 °C and held for 72 hours. The mixture was cooled, vented and purged with nitrogen. The mixture was transferred to a jar and dried further at 60 °C using the glove box vacuum pump. The product polymer (12.0 g) was isolated.

Example P6: Amine reacted EO-ECH Polymer

[0036] A Fisher Porter tube containing a PTFE-covered magnetic stirbar was charged with 8.64 g of copolymer prepared according to **Example P1** and 7.81 mL of a 45 wt% solution of trimethylamine. The solution was stirred and 20 mL distilled water was added to adjust the concentartion of polymer . The Fisher Porter tube was sealed and the mixture was stirred at 125 °C for 16 hours. The solution was then cooled to room temperature and the pressure tube was vented. Nitrogen was bubbled through the solution for 1 hour to remove excess amine. The solvent was evaporated under reduced pressure and the crude polymer taken up in a minimal amount of methanol. The solution was added to diethyl ether (10x volume of methanol) with vigorous stirring to precipitate the polymer. The polymer was isolated as a brown oil (9.55 g). By quantitative ^{13}C NMR, the copolymer contained 77 wt% EO and 23 wt% N,N,N-trimethyl-2-oxiranemethanaminium chloride.

Example P7: Amine reacted EO-ECH Polymer

[0037] A Fisher Porter tube containing a PTFE-covered magnetic stirbar was charged with 5.00 g of copolymer prepared according to **Example P2** and 3.25 mL of a 45 wt% solution of trimethylamine. The solution was stirred and 15 mL distilled water was added to adjust the concentartion of polymer . The Fisher Porter tube was sealed and the mixture was stirred at 125 °C for 16 hours. The solution was then cooled to room temperature and the pressure tube was vented. Nitrogen was bubbled through the solution for 1 hour to remove excess amine. The solvent was evaporated under reduced pressure and the crude polymer taken up in a minimal amount of methanol. The solution was added to diethyl ether (10x volume of methanol) with vigorous stirring to precipitate the polymer. The polymer was isolated as an off white powder (4.44 g). The polymer M_w and M_n by SEC were 25.9 and 13.5 kDa, respectively. The By quantitative ^{13}C NMR, the copolymer contained 93 wt% EO and 7 wt% N,N,N-trimethyl-2-oxiranemethanaminium chloride.

Example P8: Amine reacted EO-ECH Polymer

[0038] A Fisher Porter tube containing a PTFE-covered magnetic stirbar was charged with 5.00 g of copolymer prepared according to **Example P2** and 2.72 mL of a 45 wt% solution of trimethylamine. The solution was stirred and 15 mL distilled water was added to adjust the concentartion of polymer . The Fisher Porter tube was sealed and the mixture was stirred at 125 °C for 16 hours. The solution was then cooled to room temperature and the pressure tube was vented. Nitrogen was bubbled through the solution for 1 hour to remove excess amine. The solvent was evaporated under reduced pressure and the crude polymer taken up in a minimal amount of methanol. The solution was added to diethyl ether (10x volume of methanol) with vigorous stirring to precipitate the polymer. The polymer was isolated as an off white powder (4.77 g). The polymer M_w and M_n by SEC were 37.4 and 17.9 kDa, respectively. The By quantitative ^{13}C NMR, the copolymer contained 92 wt% EO and 8 wt% N,N-dimethyl-2-oxiranemethanaminium chloride.

Example P9: Amine reacted EO-ECH Polymer

[0039] A Fisher Porter tube containing a PTFE-covered magnetic stirbar was charged with 5.32 g of copolymer prepared according to **Example P3** and 5.67 mL of a 45 wt% solution of trimethylamine. The solution was stirred and 15 mL distilled water was added to adjust the concentartion of polymer . The Fisher Porter tube was sealed and the mixture was stirred at 125 °C for 16 hours. The solution was then cooled to room temperature and the pressure tube was vented. Nitrogen was bubbled through the solution for 1 hour to remove excess amine. The solvent was evaporated under reduced pressure and the crude polymer taken up in a minimal amount of methanol. The solution was added to diethyl ether (10x volume of methanol) with vigorous stirring to precipitate the polymer. The polymer was isolated as a light brown oil (5.12 g). The polymer M_w and M_n by SEC were 14.9 and 7.7 kDa, respectively. The By quantitative ^{13}C NMR, the copolymer contained 83 wt% EO and 17 wt% N,N,N-trimethyl-2-oxiranemethanaminium chloride.

Example P10: Amine reacted EO-ECH Polymer

[0040] A Fisher Porter tube containing a PTFE-covered magnetic stirbar was charged with 5.56 g of copolymer prepared according to **Example P4** and 15.5 mL of a 45 wt% solution of trimethylamine. The solution was stirred and 10 mL distilled water was added to adjust the concentartion of polymer . The Fisher Porter tube was sealed and the mixture was stirred at 125 °C for 16 hours. The solution was then cooled to room temperature and the pressure tube was vented. Nitrogen was bubbled through the solution for 1 hour to remove excess amine. The solvent was evaporated under reduced pressure and the crude polymer

taken up in a minimal amount of methanol. The solution was added to diethyl ether (10x volume of methanol) with vigorous stirring to precipitate the polymer. The polymer was isolated as a light brown oil (6.01 g). The polymer M_w and M_n by SEC were 16.9 and 6.9 kDa, respectively. The By quantitative ^{13}C NMR, the copolymer contained 62 wt% EO and 38 wt% N,N,N-trimethyl-2-oxiranemethanaminium chloride.

Example P11: Amine reacted EO-ECH Polymer

[0041] A Fisher Porter tube containing a PTFE-covered magnetic stirbar was charged with 5.50 g of terpolymer prepared according to **Example P5** and 10.5 mL of a 45 wt% solution of trimethylamine. The solution was stirred and 15 mL distilled water was added to adjust the concentartion of polymer . The Fisher Porter tube was sealed and the mixture was stirred at 125 °C for 16 hours. The solution was then cooled to room temperature and the pressure tube was vented. Nitrogen was bubbled through the solution for 1 hour to remove excess amine. The solvent was evaporated under reduced pressure and the crude polymer taken up in a minimal amount of methanol. The solution was added to diethyl ether (10x volume of methanol) with vigorous stirring to precipitate the polymer. The polymer was isolated as a light brown oil (6.13 g). The polymer M_w and M_n by SEC were 2.1 and 1.5 kDa, respectively. The By quantitative ^{13}C NMR, the copolymer contained 62 wt% EO, 13 wt% PO and 25 wt% N,N,N-trimethyl-2-oxiranemethanaminium chloride.

Comparative Example C1 and Examples 1-4: Liquid Laundry Detergent

[0042] The liquid laundry detergent formulations used in the deposition tests in the subsequent Examples were prepared having the generic formulation as described in **TABLE 1** with the deposition aid polymer as noted in **TABLE 2** and were prepared by standard liquid laundry formulation preparation procedures.

TABLE 1

Ingredient	Commercial Name	wt%
Linear alkyl benzene sulfonate	Nacconal 90G*	12.0
Sodium lauryl ethoxysulfate	Steol CS-460*	4.0
Ethanol	--	2.0
Propylene glycol	--	5.0
Non-ionic surfactant	Biosoft N25-7*	6.0
Sodium citrate	--	5.0
Deposition aid polymer	as noted in **TABLE 2**	2.5
Silicone emulsion	DOWSIL™ By 22-840[a]	5.0
Deionized water	--	QS to 100
* available from Stepan Company [a] available from The Dow Chemical Company		

TABLE 2

Example	Deposition Aid Polymer
Comparative Example C1	None
1	**Example P6**
2	**Example P7**
3	**Example P8**
4	**Example P9**

Silicone Deposition

[0043] The silicone deposition for the liquid laundry detergent formulations of **Comparative Example C1** and **Examples 1-4** were assessed in a Terg-o-tometer Model TOM-52-A available from SR Lab Instruments (6 x 1 L wells) agitated at 90 cycles per minute with the conditions noted in **TABLE 3**.

TABLE 3

Parameter	Setting
Temperature	ambient
Water hardness	200 ppm, Ca/Mg = 2/1
Fabric Types (6 in each well)	Cotton 400
Wash time	16 minutes
Rinse time	3 minutes
Liquid laundry detergent dosage	1 g/L

[0044] The fabric swatches were then dried and analyzed by X-ray photoelectron spectroscopy (XPS) for quantification of surface deposited silicone. The XPS results for Si, wt% deposition are provided in **TABLE 4**.

[0045] Friction measurements were then obtained for the fabric swatches using a tribometer apparatus described in Kalihari et al., *Rev. Sci. Instrum.* 2013, 84, 035104. The fabric swatches were adhered to glass substrates using double sided tape and secured on a unidirectional sliding deck. A 3/8" rigid nylon sphere was placed in contact with the fabric surface at an applied normal force, and the lateral force was measured as the cloth covered glass substrate was drawn unilaterally across the sphere surface. The process was performed at three forces with multiple replicates. The coefficient of friction was determined by calculating the slope between the measured lateral force and the applied normal force. The results are reported in **TABLE 4**.

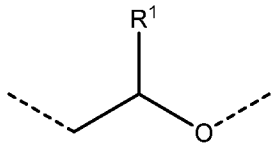
TABLE 4

Example	Deposition aid polymer	Si (wt%)	Coeff of Friction
C1	None	1.3 ± 0.6	0.156 ± 0.006
1	Example P6	3.8 ± 0.6	0.118 ± 0.004
2	Example P7	4.8 ± 0.9	0.110 ± 0.017
3	Example P8	5.0 ± 0.2	0.117 ± 0.012
4	Example P9	4.3 ± 0.2	0.121 ± 0.004

We claim:

1. A deposition aid polymer for laundry, comprising:

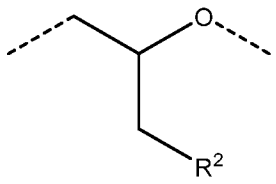
(a) >50 to 99 wt%, based on weight of the deposition aid polymer, of structural units of formula (I)



(I)

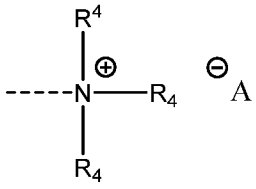
wherein each R^1 is independently selected from the group consisting of a hydrogen, a -C_{1-4} alkyl group and a -CH_2OR^3 group; wherein each R^3 is independently selected from the group consisting of a -C_{1-12} alkyl group and a phenyl group; and

(b) 1 to < 50 wt%, based on weight of the deposition aid polymer, of structural units of formula (II)

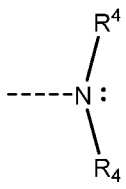


(II)

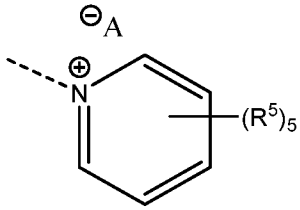
wherein each R^2 is independently selected from the group consisting of a moiety of Formula (III), a moiety of Formula (IV) and a moiety of Formula (V)



(III),



(IV), and



(V)

wherein A^- is a counter anion balancing the cationic charge on the N; wherein each R^4 is independently selected from the group consisting of a hydrogen, a -C_{1-12} alkyl group and a phenyl group; and wherein each R^5 is independently selected from the group consisting of a hydrogen and a -C_{1-8} alkyl group;

wherein the deposition aid polymer has a weight average molecular weight of < 100,000 Daltons; and

with the proviso that the deposition aid polymer has an average of at least two structural units of formula (II) per molecule.

2. The deposition aid polymer of claim 1, wherein the deposition aid polymer contains less than the detectable limit of azetidinium moieties.

3. The deposition aid polymer of claim 2, wherein the deposition aid polymer contains less than the detectable limit of epoxide moieties.

4. The deposition aid polymer of claim 3, wherein the deposition aid polymer contains less than the detectable limit of halomethyl moieties.

5. The deposition aid polymer of claim 4, wherein the deposition aid polymer contains less than the detectable limit of carboxylic acid moieties.

6. The deposition aid polymer of claim 5, wherein the deposition aid polymer contains less than the detectable limit of carbonyl moieties.

7. The deposition aid polymer of claim 6, wherein the deposition aid polymer has a weight average molecular weight of 5,000 to 30,000 Daltons.

8. The deposition aid polymer of claim 7, wherein the deposition aid polymer has

(a) 82 to 96 wt%, based on weight of the deposition aid polymer, of structural units of formula (I), wherein each R^1 is independently selected from a hydrogen and a -C_{1-4} alkyl group; and

(b) 4 to 18 wt%, based on weight of the deposition aid polymer, of structural units of formula (II), wherein each R^2 is independently selected from the group consisting of a moiety of Formula (III) and a moiety of Formula (IV).

9. The deposition aid polymer of claim 8,

wherein each R^1 is independently selected from a hydrogen and a methyl group; and

wherein each R^4 is a -CH_3 group.

10. The deposition aid polymer of claim 9,

wherein each R^1 is a hydrogen; and

wherein each R^2 is a moiety of Formula (IV).

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2020/052217

A. CLASSIFICATION OF SUBJECT MATTER
INV. C11D3/37 C11D11/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C11D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2009/065738 A2 (HENKEL AG & CO KGAA [DE]; SCHMIDT ANDREAS [DE] ET AL.) 28 May 2009 (2009-05-28)	1-8
A	claims 1, 5, 6; example 1	9,10

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
15 January 2021	25/01/2021

Name and mailing address of the ISA/	Authorized officer
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1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2009065738 A2	28-05-2009	DE 102007056525 A1	08-10-2009
		WO 2009065738 A2	28-05-2009