from the group consisting of an aliphatic alcohol having 1-18 carbon atoms, an aromatic alcohol having 7 to 18 carbon atoms, and a polyvinyl alcohol with a weight-average molecular weight of about 1,000 ~ about 50,000. Alternatively, the component B alcohol can also be a ploy ol described in US application 2009/0043055A1, ~~which is incorporated herein by reference~~.

More preferably, the component B alcohol is at least one selected from the group consisting of methanol, ethanol, n-propanol, i-propanol, n-butanol, i-butanol, t-butanol, n-pentanol, i-pentanol, pentaerythritol, n-hexanol, i-hexanol, heptanol, octanol, decanol, dodecanol, cetyl alcohol, stearyl alcohol, ethylene glycol, propylene glycol, glycerol, cyclohexanol, benzyl alcohol, 2-phenyl ethanol, a polyvinyl alcohol with a weight-average molecular weight of about 5,000 ~ about 40,000, 1,2-ethanediol, 1,2-propanediol, 1,3-propanediol, 2,3-dimethyl-2,3-butanediol, 2,2-dimethyl-1,3-propanediol, 1,2-butanediol, 1,3-butanediol, 1,4-butanediol, 2,3-butanediol, 1,2-pentanediol, 1,3-pentanediol, 1,4-pentanediol, 1,5-pentanediol, 2,3-pentanediol, 2,4-pentanediol, 1,2-hexanediol, 1,5-hexanediol, 1,6-hexanediol, 2,5-hexanediol, diethylene glycol, triethylene glycol, dipropylene glycol, diethanolamine, N-n-butyldiethanolamine, N-t-butyldiethanolamine, 3-diisopropylamino-1,2-propanediol, 1,2-cyclopentanediol, 1,3-cyclopentanediol, 1,2-cyclohexanediol, 1,3-cyclohexanediol, 1,4-cyclohexanediol, 3-methoxy-1,2-propanediol, catechol, 2-hydroxymethyl-1,3-propanediol, 1,2,4-butanetriol, 1,1,1-tris (hydroxymethyl)ethane, 1,2,6-hexanetriol, 1,1,1-tris(hydroxymethyl)propane, 1,2,3-heptanetriol, 1,3,5-cyclohexanetriol, pyrogallol, triethanolamine, triisopropanolamine, 1-[N,N-bis(2-hydroxyethyl)amino]-2-propanol, 2-deoxyribose, erythritol, threitol, 1,3-dihydroxyacetone dimer, glyceraldehyde dimer, fucose, 2-deoxy-galactose, 2-deoxy-glucose, glucose, allose, arabinose, lyxose, ribose, xylose, xylulose, galactose, mannose, tagatose, fructose, melibiose, arabitol, hexahydroxycyclohexane, xylitol, mannitol, and sorbitol.

CLAIMS

1. An additive for terminating polymerization and/or reducing viscosity of polymer solution, comprising:

A. a carboxylic acid, wherein the component A carboxylic acid is at least one selected from the group consisting of a saturated aliphatic acid having 6-26 carbon atoms, an unsaturated aliphatic acid having 6-26 carbon atoms, and an aromatic acid having 7-26 carbon atoms,

B. an alcohol,

C. an salt which is selected from the group consisting of an alkali metal salt, an alkaline earth metal salt, an ammonium salt and a mixture thereof; and

E. optionally, water.

2. The additive according to claim 1, further comprising

D. at least one selected from the group consisting of an amine, a phenol, and an ester.

3. The additive according to claim 2, wherein the contents of the components A, B, C, D, and E in the additive are respectively about 5%~about 50%, about 5%~about 45%, about 2%~about 40%, about 2%~about 25% and 0~about 60%, on the basis of the total weight of the additive; and preferably the contents of the components A, B, C, D, and E in the additive are respectively about 8%~about 48%, about 8%~about 43%, about 4%~about 38%, about 4%~about 20% and about 0~about 55%, on the basis of the total weight of the additive.

~~4. The additive according to any of claims 1-3, wherein the component A carboxylic acid is at least one selected from the group consisting of a saturated aliphatic acid having 6-26 carbon atoms, an unsaturated aliphatic acid having 6-26 carbon atoms, and an aromatic acid having 7-26 carbon atoms.~~

54. The additive according to claim 41, wherein the component A carboxylic acid is at least one selected from the group consisting of a saturated aliphatic acid having 10-20 carbon atoms, an unsaturated aliphatic acid having 10-20 carbon atoms, and an aromatic acid having 7-20 carbon atoms; preferably the component A carboxylic acid is at least one selected from the group consisting of decanoic acid, undecanoic acid, dodecoic acid, tridecanoic acid, myristic acid, pentadecanoic acid, palmitic acid, heptadecanoic acid, stearic acid, hexadecenoic acid, octadecenoic acid, octadecadienoic acid, octadecatrienoic acid, eicosatetraenoic acid, ricinoleic acid, epoxy oleic acid, sebacic acid, dodecanedioic acid, tridecanedioic acid, benzoic acid, methyl benzoic acid, ethyl benzoic acid, propyl benzoic acid, butyl benzoic acid, pentyl benzoic acid, hexyl benzoic acid, phenylacetic acid, phenylpropionic acid, 2,4,6-trimethyl phenylacetic acid, phthalic acid, and phenylene diacetic acid.

65. The additive according to any of claims 1-3, wherein the component B alcohol is at least one selected from the group consisting of an aliphatic alcohol having 1-18 carbon atoms, an aromatic alcohol having 7 to 18 carbon atoms, and a polyvinyl alcohol with a weight-average molecular weight of about 1,000 ~ about 50,000.

76. The additive according to claim 65, wherein the component B is at least one selected from the group consisting of methanol, ethanol, n-propanol, i-propanol, n-butanol, i-butanol, t-butanol, n-pentanol, i-pentanol, pentaerythritol, n-hexanol, i-hexanol, heptanol, octanol, decanol, dodecanol, cetyl alcohol, stearyl alcohol, ethylene glycol, propylene glycol, glycerol, cyclohexanol, benzyl alcohol, 2-phenyl ethanol, a polyvinyl alcohol with a weight-average molecular weight of about 5,000 ~ about 40,000, 1,2-ethanediol, 1,2-propanediol, 1,3-propanediol, 2,3-dimethyl-2,3-butanediol, 2,2-dimethyl-1,3-propanediol,

1,2-butanediol, 1,3-butanediol, 1,4-butanediol, 2,3-butanediol, 1,2-pentanediol, 1,3-pentanediol, 1,4-pentanediol, 1,5-pentanediol, 2,3-pentanediol, 2,4-pentanediol, 1,2-hexanediol, 1,5-hexanediol, 1,6-hexanediol, 2,5-hexanediol, diethylene glycol, triethylene glycol, dipropylene glycol, diethanolamine, N-n-butyldiethanolamine, N-t-butyldiethanolamine, 3-diisopropylamino-1,2-propanediol, 1,2-cyclopentanediol, 1,3-cyclopentanediol, 1,2-cyclohexanediol, 1,3-cyclohexanediol, 1,4-cyclohexanediol, 3-methoxy-1,2-propanediol, catechol, 2-hydroxymethyl-1,3-propanediol, 1,2,4-butanetriol, 1,1,1-tris (hydroxymethyl)ethane, 1,2,6-hexanetriol, 1,1,1-tris(hydroxymethyl)propane, 1,2,3-heptanetriol, 1,3,5-cyclohexanetriol, pyrogallol, triethanolamine, triisopropanolamine, 1-[N,N-bis(2-hydroxyethyl)amino]-2-propanol, 2-deoxyribose, erythritol, threitol, 1,3-dihydroxyacetone dimer, glyceraldehyde dimer, fucose, 2-deoxy-galactose, 2-deoxy-glucose, glucose, allose, arabinose, lyxose, ribose, xylose, xylulose, galactose, mannose, tagatose, fructose, melibiose, arabitol, hexahydroxycyclohexane, xylitol, mannitol, and sorbitol.

~~8~~7. The additive according to any of claims 1-3, wherein the alkali metal salt and alkaline earth metal salt of component C salt are respectively a carboxylate, a sulfonate, a sulfate, or a phosphate; and wherein the ammonium salt is a primary ammonium salt, a secondary ammonium salt, a tertiary ammonium salt or a quaternary ammonium salt, preferably an alkyl-substituted primary ammonium salt, an alkyl-substituted secondary ammonium salt, an alkyl-substituted tertiary ammonium salt or an alkyl-substituted quaternary ammonium salt.

~~9~~8. The additive according to claim ~~8~~7, wherein the component C is at least one selected from the group consisting of sodium stearate, calcium stearate, sodium oleate, calcium oleate, potassium

stearate, sodium laurate, calcium laurate, potassium laurate, sodium dodecyl benzene sulfonate, sodium tetradecyl sulfonate, sodium hexadecyl sulfonate, bis(2-ethylhexyl) sulfosuccinate sodium salt, sodium dibutyl naphthalene sulfonate, sodium lauryl sulfate, sodium polycarboxylate, octadecyl ammonium chloride, dioctadecyl ammonium chloride, octadecyl dimethyl ammonium chloride, octadecyl dimethyl benzyl ammonium chloride, polycarboxylic acid sodium salt with a weight-average molecular weight of about 1,000 ~ about 20,000, and polycarboxylic acid ammonium salt with a weight-average molecular weight of about 1,000 ~ about 20,000.

~~10~~9. The additive according to claim 2 or 3, wherein the amine of component D is selected from aromatic amine, the phenol of component D is selected from hindered phenol, and the ester of component D is selected from carboxylate ester and phosphite.

~~11~~10. The additive according to claim ~~10~~9, wherein

the aromatic amine is at least one selected from the group consisting of diphenyl amines, p-phenylene diamines, dihydroquinolines and derivatives of dihydroquinoline, preferably is at least one selected from N-isopropyl-N'-phenyl- p-phenylene diamine, N-(1,3-dimethylbutyl)- N'-phenyl- p-phenylene diamine, N,N'-diphenyl- p-phenylene diamine, octylated diphenylamine, 4,4'- (a,a-dimethylbenzyl) diphenylamine, 2,2,4-trimethyl-1,2-dihydroquinoline and 6-ethoxy-2,2,4-trimethyl-1,2-dihydroquinoline;

the hindered phenol is at least one selected from the group consisting of 2,6-di-tert-butyl -4-methyl phenol, 2,2'-methylene-bis(4-methyl-6-tert-butyl-phenol), 2,2'-methylene-bis(4-ethyl-6- tert-butyl-phenol), 4,4'-butylidenebis(3-methyl-6-tert-butyl-phenol), 4,4'-thio-bis(3-methyl-6-t-butyl-phenol) and

2,4-bis(n-octylthiomethyl)-6-methylphenol; and

the ester is at least one selected from the group consisting of stearyl β-(3,5-di-tert-butyl-4-hydroxyphenyl)propionate, dilauryl thiodipropionate,dimyristyl thiodipropionate, distearyl thiodipropionate, trioctyl phosphite, tri(decyl) phosphite, trilauryl phosphite and tri(hexadecyl) phosphite.

~~12~~11. A method for terminating polymerization and/or reducing viscosity of polymer solution, including adding the additive according to any one of claims 1-~~11~~10 into a polymer solution and then mixing the resulting mixture for about 0.5 – about 30 min at a mixing temperature of about -100 °C to about 110 °C; wherein the additive is added in an amount of about 0.4 wt% to about 7.5wt%, preferably about 0.7 wt% to about 6.0wt%, based on the total weight of the polymer in the polymer solution.

~~13~~12. The method according to claim ~~12~~11, wherein the polymer solution contains living polymer chains.

~~14~~13. The method according to claim ~~12~~11 or ~~13~~12, wherein the polymer solution is obtained from a solution polymerization or a bulk polymerization, or the polymer solution is obtained by dissolving a polymer in a solvent.

~~15~~14. Use of the additive according to any one of claims 1-~~11~~10 for terminating polymerization and/or reducing viscosity of polymer solution.

from the group consisting of an aliphatic alcohol having 1-18 carbon atoms, an aromatic alcohol having 7 to 18 carbon atoms, and a polyvinyl alcohol with a weight-average molecular weight of about 1,000 ~ about 50,000. Alternatively, the component B alcohol can also be a ploy ol described in US application 2009/0043055A1.

More preferably, the component B alcohol is at least one selected from the group consisting of methanol, ethanol, n-propanol, i-propanol, n-butanol, i-butanol, t-butanol, n-pentanol, i-pentanol, pentaerythritol, n-hexanol, i-hexanol, heptanol, octanol, decanol, dodecanol, cetyl alcohol, stearyl alcohol, ethylene glycol, propylene glycol, glycerol, cyclohexanol, benzyl alcohol, 2-phenyl ethanol, a polyvinyl alcohol with a weight-average molecular weight of about 5,000 ~ about 40,000, 1,2-ethanediol, 1,2-propanediol, 1,3-propanediol, 2,3-dimethyl-2,3-butanediol, 2,2-dimethyl-1,3-propanediol, 1,2-butanediol, 1,3-butanediol, 1,4-butanediol, 2,3-butanediol, 1,2-pentanediol, 1,3-pentanediol, 1,4-pentanediol, 1,5-pentanediol, 2,3-pentanediol, 2,4-pentanediol, 1,2-hexanediol, 1,5-hexanediol, 1,6-hexanediol, 2,5-hexanediol, diethylene glycol, triethylene glycol, dipropylene glycol, diethanolamine, N-n-butyldiethanolamine, N-t-butyldiethanolamine, 3-diisopropylamino-1,2-propanediol, 1,2-cyclopentanediol, 1,3-cyclopentanediol, 1,2-cyclohexanediol, 1,3-cyclohexanediol, 1,4-cyclohexanediol, 3-methoxy-1,2-propanediol, catechol, 2-hydroxymethyl-1,3-propanediol, 1,2,4-butanetriol, 1,1,1-tris (hydroxymethyl)ethane, 1,2,6-hexanetriol, 1,1,1-tris(hydroxymethyl)propane, 1,2,3-heptanetriol, 1,3,5-cyclohexanetriol, pyrogallol, triethanolamine, triisopropanolamine, 1-[N,N-bis(2-hydroxyethyl)amino]-2-propanol, 2-deoxyribose, erythritol, threitol, 1,3-dihydroxyacetone dimer, glyceraldehyde dimer, fucose, 2-deoxy-galactose, 2-deoxy-glucose, glucose, allose, arabinose, lyxose, ribose, xylose, xylulose, galactose, mannose, tagatose, fructose, melibiose, arabitol, hexahydroxycyclohexane, xylitol, mannitol, and sorbitol.

CLAIMS

1. An additive for terminating polymerization and/or reducing viscosity of polymer solution, comprising:

A. a carboxylic acid, wherein the component A carboxylic acid is at least one selected from the group consisting of a saturated aliphatic acid having 6-26 carbon atoms, an unsaturated aliphatic acid having 6-26 carbon atoms, and an aromatic acid having 7-26 carbon atoms,

B. an alcohol,

C. an salt which is selected from the group consisting of an alkali metal salt, an alkaline earth metal salt, an ammonium salt and a mixture thereof; and

E. optionally, water.

2. The additive according to claim 1, further comprising

D. at least one selected from the group consisting of an amine, a phenol, and an ester.

3. The additive according to claim 2, wherein the contents of the components A, B, C, D, and E in the additive are respectively about 5%~about 50%, about 5%~about 45%, about 2%~about 40%, about 2%~about 25% and 0~about 60%, on the basis of the total weight of the additive; and preferably the contents of the components A, B, C, D, and E in the additive are respectively about 8%~about 48%, about 8%~about 43%, about 4%~about 38%, about 4%~about 20% and about 0~about 55%, on the basis of the total weight of the additive.

4. The additive according to claim 1, wherein the component A carboxylic acid is at least one selected from the group consisting of a saturated aliphatic acid having 10-20 carbon atoms, an unsaturated aliphatic acid having 10-20 carbon atoms, and an aromatic acid having 7-20 carbon atoms; preferably the component

A carboxylic acid is at least one selected from the group consisting of decanoic acid, undecanoic acid, dodecoic acid, tridecanoic acid, myristic acid, pentadecanoic acid, palmitic acid, heptadecanoic acid, stearic acid, hexadecenoic acid, octadecenoic acid, octadecadienoic acid, octadecatrienoic acid, eicosatetraenoic acid, ricinoleic acid, epoxy oleic acid, sebacic acid, dodecanedioic acid, tridecanedioic acid, benzoic acid, methyl benzoic acid, ethyl benzoic acid, propyl benzoic acid, butyl benzoic acid, pentyl benzoic acid, hexyl benzoic acid, phenylacetic acid, phenylpropionic acid, 2,4,6-trimethyl phenylacetic acid, phthalic acid, and phenylene diacetic acid.

5. The additive according to any of claims 1-3, wherein the component B alcohol is at least one selected from the group consisting of an aliphatic alcohol having 1-18 carbon atoms, an aromatic alcohol having 7 to 18 carbon atoms, and a polyvinyl alcohol with a weight-average molecular weight of about 1,000 ~ about 50,000.

6. The additive according to claim 5, wherein the component B is at least one selected from the group consisting of methanol, ethanol, n-propanol, i-propanol, n-butanol, i-butanol, t-butanol, n-pentanol, i-pentanol, pentaerythritol, n-hexanol, i-hexanol, heptanol, octanol, decanol, dodecanol, cetyl alcohol, stearyl alcohol, ethylene glycol, propylene glycol, glycerol, cyclohexanol, benzyl alcohol, 2-phenyl ethanol, a polyvinyl alcohol with a weight-average molecular weight of about 5,000 ~ about 40,000, 1,2-ethanediol, 1,2-propanediol, 1,3-propanediol, 2,3-dimethyl-2,3-butanediol, 2,2-dimethyl-1,3-propanediol, 1,2-butanediol, 1,3-butanediol, 1,4-butanediol, 2,3-butanediol, 1,2-pentanediol, 1,3-pentanediol, 1,4-pentanediol, 1,5-pentanediol, 2,3-pentanediol, 2,4-pentanediol, 1,2-hexanediol, 1,5-hexanediol, 1,6-hexanediol, 2,5-hexanediol, diethylene glycol, triethylene glycol, dipropylene glycol, diethanolamine,

N-n-butyldiethanolamine, N-t-butyldiethanolamine, 3-diisopropylamino-1,2-propanediol, 1,2-cyclopentanediol, 1,3-cyclopentanediol, 1,2-cyclohexanediol, 1,3-cyclohexanediol, 1,4-cyclohexanediol, 3-methoxy-1,2-propanediol, catechol, 2-hydroxymethyl-1,3-propanediol, 1,2,4-butanetriol, 1,1,1-tris (hydroxymethyl)ethane, 1,2,6-hexanetriol, 1,1,1-tris(hydroxymethyl)propane, 1,2,3-heptanetriol, 1,3,5-cyclohexanetriol, pyrogallol, triethanolamine, triisopropanolamine, 1-[N,N-bis(2-hydroxyethyl)amino]-2-propanol, 2-deoxyribose, erythritol, threitol, 1,3-dihydroxyacetone dimer, glyceraldehyde dimer, fucose, 2-deoxy-galactose, 2-deoxy-glucose, glucose, allose, arabinose, lyxose, ribose, xylose, xylulose, galactose, mannose, tagatose, fructose, melibiose, arabitol, hexahydroxycyclohexane, xylitol, mannitol, and sorbitol.

7. The additive according to any of claims 1-3, wherein the alkali metal salt and alkaline earth metal salt of component C salt are respectively a carboxylate, a sulfonate, a sulfate, or a phosphate; and wherein the ammonium salt is a primary ammonium salt, a secondary ammonium salt, a tertiary ammonium salt or a quaternary ammonium salt, preferably an alkyl-substituted primary ammonium salt, an alkyl-substituted secondary ammonium salt, an alkyl-substituted tertiary ammonium salt or an alkyl-substituted quaternary ammonium salt.

8. The additive according to claim 7, wherein the component C is at least one selected from the group consisting of sodium stearate, calcium stearate, sodium oleate, calcium oleate, potassium stearate, sodium laurate, calcium laurate, potassium laurate, sodium dodecyl benzene sulfonate, sodium tetradecyl sulfonate, sodium hexadecyl sulfonate, bis(2-ethylhexyl) sulfosuccinate sodium salt, sodium dibutyl naphthalene sulfonate, sodium lauryl sulfate, sodium polycarboxylate, octadecyl ammonium chloride, dioctadecyl

ammonium chloride, octadecyl dimethyl ammonium chloride, octadecyl dimethyl benzyl ammonium chloride, polycarboxylic acid sodium salt with a weight-average molecular weight of about 1,000 ~ about 20,000, and polycarboxylic acid ammonium salt with a weight-average molecular weight of about 1,000 ~ about 20,000.

9. The additive according to claim 2 or 3, wherein the amine of component D is selected from aromatic amine, the phenol of component D is selected from hindered phenol, and the ester of component D is selected from carboxylate ester and phosphite.

10. The additive according to claim 9, wherein

the aromatic amine is at least one selected from the group consisting of diphenyl amines, p-phenylene diamines, dihydroquinolines and derivatives of dihydroquinoline, preferably is at least one selected from N-isopropyl-N'-phenyl- p-phenylene diamine, N-(1,3-dimethylbutyl)- N'-phenyl- p-phenylene diamine, N,N'-diphenyl- p-phenylene diamine, octylated diphenylamine, 4,4'- (a,a-dimethylbenzyl) diphenylamine, 2,2,4-trimethyl-1,2-dihydroquinoline and 6-ethoxy-2,2,4-trimethyl-1,2-dihydroquinoline;

the hindered phenol is at least one selected from the group consisting of 2,6-di-tert-butyl -4-methyl phenol, 2,2'-methylene-bis(4-methyl-6-tert-butyl-phenol), 2,2'-methylene-bis(4-ethyl-6- tert-butyl-phenol), 4,4'-butylidenebis(3-methyl-6-tert-butyl-phenol), 4,4'-thio-bis(3-methyl-6-t-butyl-phenol) and 2,4-bis(n-octylthiomethyl)-6-methylphenol; and

the ester is at least one selected from the group consisting of stearyl β-(3,5-di-tert-butyl-4-hydroxyphenyl)propionate, dilauryl thiodipropionate,dimyristyl thiodipropionate, distearyl thiodipropionate, trioctyl phosphite, tri(decyl) phosphite, trilauryl phosphite and tri(hexadecyl) phosphite.

11. A method for terminating polymerization and/or reducing viscosity of polymer solution, including adding the additive according to any one of claims 1-10 into a polymer solution and then mixing the resulting mixture for about 0.5 – about 30 min at a mixing temperature of about -100 °C to about 110 °C; wherein the additive is added in an amount of about 0.4 wt% to about 7.5wt%, preferably about 0.7 wt% to about 6.0wt%, based on the total weight of the polymer in the polymer solution.

12. The method according to claim 11, wherein the polymer solution contains living polymer chains.

13. The method according to claim 11 or 12, wherein the polymer solution is obtained from a solution polymerization or a bulk polymerization, or the polymer solution is obtained by dissolving a polymer in a solvent.

14. Use of the additive according to any one of claims 1-10 for terminating polymerization and/or reducing viscosity of polymer solution.