slurry feed line becomes clogged, the entire operation needs to be shut down, the feed lines need to be taken off line, and subsequently cleaned with the acid. In certain processes, these steps must be repeated, sometimes as frequently as once a week, thereby greatly increasing the total time needed to achieve the intended goal of the overall process, such as hydrocarbon production. Therefore, there is a need for chemical treatments that will reduce or inhibit lime and magnesium oxide deposits in slurry feed lines so the feed lines do not need to be taken off line and cleaned.

BRIEF SUMMARY OF THE INVENTION

[0005] Rheology modifying agents and methods of modifying the rheology of slurries are disclosed herein. In one aspect, a method of modifying the rheology of a lime slurry is disclosed. The method comprises the steps of providing a lime slurry; and adding a rheology modifying agent to the lime slurry, wherein the rheology modifying agent comprises a member selected from the group consisting of a low molecular weight anionic polymer, a high molecular weight polymer, a mixture of a low molecular weight anionic polymer and a high molecular weight polymer, a mixture of a chelating agent and a high molecular weight polymer, and a mixture of a chelating agent, a high molecular weight polymer, and a low molecular weight anionic polymer, and wherein the amount of the rheology modifying agent added to the lime slurry is about 2 ppm to about 70 ppm.

[0006] In an additional aspect, a method of modifying the rheology of a magnesium oxide slurry is disclosed. The method comprises the steps of providing a magnesium oxide slurry; and adding a rheology modifying agent to the magnesium oxide slurry, wherein the rheology modifying agent comprises a member selected from the group consisting of a low molecular weight anionic polymer, a mixture of a low molecular weight anionic polymer and a high molecular weight polymer, and a mixture of a chelating agent, a high molecular weight polymer, and a low molecular weight anionic polymer, wherein the amount of the rheology modifying agent added to the magnesium oxide slurry is selected from the group consisting of about 10 ppm to about 300 ppm and about 30 ppm to about 250 ppm.

[0007] In another aspect, a method of preventing fouling during a hydrocarbon production process is disclosed. The method comprises the steps of providing a lime slurry; adding a rheology modifying agent to the

lime slurry to form a mixture, wherein the rheology modifying agent comprises a member selected from the group consisting of a low molecular weight anionic polymer, a high molecular weight polymer, a mixture of a low molecular weight anionic polymer and a high molecular weight polymer, a mixture of a chelating agent and a high molecular weight polymer, and a mixture of a chelating agent, a high molecular weight polymer, and a low molecular weight anionic polymer, and wherein the amount of the rheology modifying agent added to the lime slurry is about 2 ppm to about 70 ppm; transporting the mixture through a feed line to a warm lime softener; and preventing fouling in the feed line.

[0008] In yet a further aspect, an alternate method of preventing fouling during a hydrocarbon production process is disclosed. The method comprises the steps of providing a magnesium oxide slurry; adding a rheology modifying agent to the magnesium oxide slurry to form a mixture, wherein the rheology modifying agent comprises a member selected from the group consisting of a low molecular weight anionic polymer, a mixture of a low molecular weight anionic polymer and a high molecular weight polymer, and a mixture of a chelating agent, a high molecular weight polymer, and a low molecular weight anionic polymer, and wherein the amount of the rheology modifying agent added to the magnesium oxide slurry is selected from the group consisting of about 10 ppm to about 300 ppm and about 30 ppm to about 250 ppm; transporting the mixture through a feed line to a piece of equipment; and preventing fouling in the pipeline.

[0009] The foregoing has outlined rather broadly the features and technical advantages of the present disclosure in order that the detailed description that follows may be better understood. Additional features and advantages of the disclosure will be described hereinafter that form the subject of the claims of this application. It should be appreciated by those skilled in the art that the conception and the specific embodiments disclosed may be readily utilized as a basis for modifying or designing other embodiments for carrying out the same purposes of the present disclosure. It should also be realized by those skilled in the art that such equivalent embodiments do not depart from the spirit and scope of the disclosure as set forth in the appended claims.

CLAIMS

What is claimed is:

1. A method of modifying the rheology of a lime slurry comprising the steps of:

providing a lime slurry; and

adding a rheology modifying agent to the lime slurry, wherein the rheology modifying agent comprises a member selected from the group consisting of a low molecular weight anionic polymer, a high molecular weight polymer, a mixture of a low molecular weight anionic polymer and a high molecular weight polymer, a mixture of a chelating agent and a high molecular weight polymer, and a mixture of a chelating agent, a high molecular weight polymer, and a low molecular weight anionic polymer, and wherein the amount of the rheology modifying agent added to the lime slurry is about 2 ppm to about 70 ppm.

~~2. The method of claim 1, wherein the amount of the rheology modifying agent added to the lime slurry is selected from the group consisting of about 0.1 ppm to about 300 ppm, about 1 to about 100 ppm, and about 2 ppm to about 70 ppm.~~

~~3~~2. The method of claim 1, wherein the rheology modifying agent is selected from the group consisting of a mixture of a hydrolyzed polyacrylamide with a chelating agent, a high molecular weight copolymer of acrylic acid and acrylamide, a low molecular weight poly acrylic acid, a terpolymer comprising acrylic acid : acrylamide : sulfonated acrylamide, and a polymaleic acid polymer.

~~4~~3. The method of claim 1, wherein the high molecular weight polymer has a molecular weight of greater than 1,000,000 and the low molecular weight anionic polymer has a molecular weight of less than about 20,000.

54. The method of claim 1, wherein the rheology modifying agent is selected from the group consisting of a composition comprising about 2% hydrolyzed polyacrylamide and about .5% ethylenediaminetetraacetic acid, an acrylic acid polymer having a molecular weight less than about 5,000, and a terpolymer comprising about 40% acrylic acid, about 20% acrylamide, and about 40% sulfonated acrylamide.

65. The method of claim 1, wherein the chelating agent is selected from the group consisting of ethylenediaminetetraacetic acid, citric acid, lingo sulfonates, dimercaprol (2,3-dimercapto-1-propanol), prophine, and any combination thereof.

76. A method of modifying the rheology of a magnesium oxide slurry comprising the steps of:

providing a magnesium oxide slurry; and

adding a rheology modifying agent to the magnesium oxide slurry, wherein the rheology modifying agent comprises a member selected from the group consisting of a low molecular weight anionic polymer, a mixture of a low molecular weight anionic polymer and a high molecular weight polymer, and a mixture of a chelating agent, a high molecular weight polymer, and a low molecular weight anionic polymer, wherein the amount of the rheology modifying agent added to the magnesium oxide slurry is selected from the group consisting of about 10 ppm to about 300 ppm and about 30 ppm to about 250 ppm.

~~8. The method of claim 7, wherein the amount of the rheology modifying agent added to the magnesium oxide slurry is selected from the group consisting of about 10 ppm to about 300 ppm and about 30 ppm to about 250 ppm.~~

97. The method of claim 76, wherein the rheology modifying agent is selected from the group consisting of a composition comprising hydrolyzed polyacrylamide, a chelating agent, polymaleic acid, and an AA/AMPS copolymer, a low molecular weight poly acrylic acid, a terpolymer

comprising acrylic acid : acrylamide : sulfonated acrylamide, a blend of polymaleic acid with an AA/AMPS copolymer, and an AA/AMPS copolymer.

~~10~~8. The method of claim 7, wherein the high molecular weight polymer has a molecular weight of greater than 1,000,000 and the low molecular weight anionic polymer has a molecular weight of less than about 20,000.

~~11~~9. A method of preventing fouling during a hydrocarbon production process comprising the steps of:

providing a lime slurry;

adding a rheology modifying agent to the lime slurry to form a mixture, wherein the rheology modifying agent comprises:

a) a member selected from the group consisting of a low molecular weight anionic polymer, a high molecular weight polymer, a mixture of a low molecular weight anionic polymer and a high molecular weight polymer, a mixture of a chelating agent and a high molecular weight polymer, and a mixture of a chelating agent, a high molecular weight polymer, and a low molecular weight anionic polymer, and wherein the amount of the rheology modifying agent added to the lime slurry is about 2 ppm to about 70 ppm;

transporting the mixture through a feed line to a warm lime softener; and

preventing fouling in the feed line.

~~12. The method of claim 11, wherein the amount of the rheology modifying agent added to the lime slurry is selected from the group consisting of about 0.1 ppm to about 300 ppm, about 1 to about 100 ppm, and about 2 ppm to about 70 ppm.~~

~~13~~10. The method of claim ~~11~~9, wherein the rheology modifying agent is selected from the group consisting of a mixture of a hydrolyzed polyacrylamide with a chelating agent, a high molecular weight copolymer of acrylic acid and acrylamide, a low molecular weight poly acrylic acid, a

terpolymer comprising acrylic acid : acrylamide : sulfonated acrylamide, and a polymaleic acid polymer.

1411. The method of claim 119, wherein the high molecular weight polymer has a molecular weight of greater than 1,000,000 and the low molecular weight anionic polymer has a molecular weight of less than about 20,000.

1512. The method of claim 119, wherein the rheology modifying agent is selected from the group consisting of a composition comprising about 2% hydrolyzed polyacrylamide and about .5% ethylenediaminetetraacetic acid, an acrylic acid polymer having a molecular weight less than about 5,000, and a terpolymer comprising about 40% acrylic acid, about 20% acrylamide, and about 40% sulfonated acrylamide

1613. The method of claim 119, wherein the chelating agent is selected from the group consisting of ethylenediaminetetraacetic acid, citric acid, lingo sulfonates, dimercaprol (2,3-dimercapto-1-propanol), prophine, and any combination thereof.

1714. A method of preventing fouling during a hydrocarbon production process comprising the steps of:

providing a magnesium oxide slurry;

adding a rheology modifying agent to the magnesium oxide slurry to form a mixture, wherein the rheology modifying agent comprises:

a) a member selected from the group consisting of a low molecular weight anionic polymer, a mixture of a low molecular weight anionic polymer and a high molecular weight polymer, and a mixture of a chelating agent, a high molecular weight polymer, and a low molecular weight anionic polymer, and wherein the amount of the rheology modifying agent added to the magnesium oxide slurry is selected from the group consisting of about 10 ppm to about 300 ppm and about 30 ppm to about 250 ppm;

transporting the mixture through a feed line to a piece of equipment; and

preventing fouling in the pipeline.

~~18~~15. The method of claim ~~17~~14, wherein the piece of equipment is selected from the group consisting of a warm lime softener, a heat exchanger, and an evaporator.

~~19. The method of claim 17, wherein the amount of the rheology modifying agent added to the magnesium oxide slurry is selected from the group consisting of about 10 ppm to about 300 ppm and about 30 ppm to about 250 ppm.~~

~~20~~16. The method of claim ~~17~~14, wherein the rheology modifying agent is selected from the group consisting of a composition comprising hydrolyzed polyacrylamide, a chelating agent, polymaleic acid, and an AA/AMPS copolymer, a low molecular weight poly acrylic acid, a terpolymer comprising acrylic acid : acrylamide : sulfonated acrylamide, a blend of polymaleic acid with an AA/AMPS copolymer, and an AA/AMPS copolymer.