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(54) COMPOSITIONS USEFUL FOR BLEACHING AND METHODS OF PREPARATION AND USE THEREOF

(57) The present disclosure includes bleaching compositions and methods of their preparation. The methods may comprise, for example, preparing a composition by combining a basic solution with a first slurry comprising an alkaline earth metal hydroxide and a dispersant. The basic solution may comprise from about 30% by weight to about 50% by weight of an alkali hydroxide and/or the first slurry may comprise from about 30% by weight to about 65% by weight of the alkaline earth metal hydroxide. The composition may have a Brookfield viscosity below about 1000 MPa·s at least 24 hours after adding the basic solution to the first slurry. The composition may be in the form of a second slurry, e.g., used for bleaching in a pulp processing or papermaking process.

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Description

TECHNICAL FIELD

[0001] Embodiments of the present disclosure relate generally to compositions useful for bleaching and methods of preparation and uses thereof.

BACKGROUND

[0002] Bleaching compositions are generally introduced into pulp derived from wood or other lignocellulosic material during pulp processing to increase the brightness and/or whiteness of the pulp, and to remove lignin and other undesired materials. Bleaching compositions may be used to treat mechanical pulp, e.g. wood pulp, or chemical pulps. Bleaching is typically conducted with hydrogen peroxide under alkaline conditions. However, certain bleaching conditions are associated with negative effects such as high chemical oxygen demand (COD) and biochemical oxygen demand (BOD), e.g., given the causticity of chemicals used during bleaching.

[0003] Typically, chemicals used in the bleaching process are stored separately and only combined, sometimes after dilution, during pulp processing. One reason for such handling and processing is to avoid negative rheological properties when ingredients are combined. However, the separate transportation, handling, and storage of materials increases costs, logistic complexity and reduces efficiency.

SUMMARY OF THE DISCLOSURE

[0004] The present disclosure includes compositions useful in bleaching applications, including pulp processing, and methods of use thereof. For example, the present disclosure includes a method for preparing a composition by combining a basic solution with a first slurry comprising an alkaline earth metal hydroxide and a dispersant; wherein the basic solution comprises from about 30% by weight to about 50% by weight, or from about 40% by weight to about 50% by weight of an alkali hydroxide; wherein the first slurry comprises from about 30% by weight to about 65% by weight, from about 35% by weight to about 55% by weight, or from about 35% by weight to about 45 % by weight of the alkaline earth metal hydroxide; and/or wherein the composition is in the form of a second slurry having a Brookfield viscosity below about 1000 mPa·s at least 24 hours after adding the basic solution to the first slurry.

[0005] According to some aspects of the present disclosure, the alkaline earth metal hydroxide may comprise $Mg(OH)_2$, $Ca(OH)_2$, or a mixture thereof. In some cases, the alkali hydroxide may comprise NaOH, KOH, or a mixture thereof. In some aspects of the present disclosure, the weight ratio of alkaline earth metal hydroxide to alkali hydroxide in the composition may range from about 5:1 to about 20:1, from about 6:1 to about 12:1, or from about 8:1 to about 10:1. Additionally or alternatively, the basic solution may comprise from about 45% to about 50% by weight NaOH, and the first slurry may comprise from about 35% to about 45% by weight $Mg(OH)_2$.

[0006] In some examples, the first slurry may comprise from about 0.5% by weight to about 2.5% by weight, or from about 1.0% by weight to about 1.5% by weight of the dispersant. An exemplary dispersant may comprise a polyether carboxylate, maleic acid-acrylic acid copolymer, or mixture thereof.

[0007] In some aspects of the present disclosure, the basic solution may be added to the first slurry over period of time ranging from about 0.005 g alkali hydroxide/min per g alkaline earth metal hydroxide to about 0.250 g alkali hydroxide/min per g alkaline earth metal hydroxide. Additionally or alternatively, the basic solution may be added to the first slurry over a period of time of greater than about 1 minute, greater than about 2 minutes, greater than about 3 minutes, greater than about 5 minutes, or a period of time ranging from about 1 minute to about 10 minutes or from about 5 minutes to about 10 minutes.

[0008] According to some aspects of the present disclosure, the composition may be a second slurry having a total solids content ranging from about 40% to about 60% by weight. In some examples, the composition may have a Ford cup emptying time of less than about 40 seconds, less than about 35 seconds, or less than about 30 seconds at least 24 hours after adding the basic solution to the slurry. According to some examples, the Brookfield viscosity of the composition may change by less than about 20% within 24 hours of adding the basic solution to the slurry. In some aspects of the present disclosure, the pH of the composition may range from about 12.0 to about 14.0, or from about 13.0 to about 13.5.

[0009] The present disclosure may also include a composition prepared according to any of the methods described above, or elsewhere herein. For example, the composition may comprise water, a dispersant, $Mg(OH)_2$, and NaOH, wherein the composition has a total solids content ranging from about 40.0% to about 60.0% by weight. The composition may be in the form of a slurry. In some examples, the composition may have a Brookfield viscosity below about 1000 mPa·s. Additionally or alternatively, the Brookfield viscosity of the composition may range from about 500 mPa·s to about 800 mPa·s. In at least one example, the Brookfield viscosity of the composition may change by less than about 20%

within 24 hours.

[0010] In some examples, the weight ratio of $Mg(OH)_2$ to NaOH in the composition may range from about 6:1 to about 12:1, or from about 8:1 to about 10:1. According to some examples, the composition may have a Ford emptying time of less than about 40 seconds, less than about 35 seconds, or less than about 30 seconds. In some aspects of the present disclosure, the composition may have a pH ranging from about 12.0 to about 14.0.

[0011] The present disclosure may also include use of the composition described above, or elsewhere herein, in a pulp bleaching process.

DETAILED DESCRIPTION

[0012] Particular aspects of the present disclosure are described in greater detail below. The terms and definitions provided herein control, if in conflict with terms and/or definitions incorporated by reference.

[0013] As used herein, the terms "comprises," "comprising," or any other variation thereof are intended to cover a non-exclusive inclusion, such that a process, method, composition, article, or apparatus that comprises a list of elements does not include only those elements, but may include other elements not expressly listed or inherent to such process, method, composition, article, or apparatus. The term "exemplary" is used in the sense of "example" rather than "ideal."

[0014] As used herein, the singular forms "a," "an," and "the" include plural reference unless the context dictates otherwise. The terms "approximately" and "about" refer to being nearly the same as a referenced number or value. As used herein, the terms "approximately" and "about" should be understood to encompass ± 5% of a specified amount or value.

[0015] The present disclosure includes compositions useful for bleaching applications including, e.g. compositions comprising an alkaline slurry. The compositions herein may help to brighten and/or whiten pulp from wood or other lignocellulosic material during pulp processing. Also provided herein are methods for preparation of such compositions, e.g., having a relatively high solids content and a viscosity and stability suitable for use in pulp processing. The compositions herein may be in the form of an aqueous slurry.

[0016] Compositions according to the disclosure may be alkaline. For example, the compositions herein may be prepared from a basic solution. In some examples, the basic solution may comprise a strong base. According to some examples of the disclosure, the basic solution may comprise an alkali hydroxide, such as, e.g., NaOH, KOH, LiOH, or a mixture thereof.

[0017] In some examples, the basic solution may comprise from about 25% by weight to about 50% by weight of at least one alkali hydroxide, such as from about 35% by weight to about 45% by weight, or from about 40% by weight to about 50% by weight of the alkali hydroxide. For example, the basic solution may have a concentration ranging from about 5.5 M to about 19.0 M, such as from about 7.0 M to about 15.0 M, from about 12.0 M to about 17.0 M, or from about 12.0 M to about 19.0 M. According to some aspects of the present disclosure, the basic solution comprises NaOH having a concentration ranging from about 10.0 M to about 19.0 M, from about 6.5 M to about 12.0 M, from about 7.0 M to about 11 M, from about 8.0 M to about 12.0 M, from about 10.0 M to about 16.0 M, or from about 10.0 M to about 12.5 M. According to some aspects, the basic solution comprises KOH having a concentration ranging from about 5.5 M to about 12.0 M, from about 7.0 M to about 10.0 M, or from about 10.0 M to about 12.0 M. In at least one example, the basic solution is free from sodium silicate.

[0018] The composition may further comprise an alkaline earth metal hydroxide and/or an alkaline earth metal oxide, which may be present as an aqueous slurry. For example, the basic solution may be combined with a first slurry comprising the alkaline earth metal hydroxide and/or oxide to produce a composition in the form of a second slurry having a pH higher than the first slurry.

[0019] The first slurry (comprising alkaline earth metal(s)) may have a relatively high solids content. In some aspects, for example, the amount of alkaline earth metal hydroxide and/or oxide in the first slurry may range from about 30% by weight to about 65% by weight, from about 35% by weight to about 55% by weight, or from about 35% by weight to about 45 % by weight of the first slurry. Exemplary alkaline earth metal hydroxides and oxides include, but are not limited to, $Mg(OH)_2$, $Ca(OH)_2$, MgO, CaO, and mixtures thereof. In at least one example, the first slurry is an aqueous slurry comprising from about 30% to about 65% by weight $Mg(OH)_2$.

[0020] The first slurry may further comprise at least one dispersant. In some aspects of the present disclosure, the dispersant may be cationic, anionic, or nonionic. Exemplary dispersants include, but are not limited to, polyether carboxylates, polyether polycarboxylates, and acrylate polymers and copolymers (e.g., maleic acid-acrylic acid copolymers, maleic acid copolymers, etc.). In some examples, the first slurry may comprise from about 0.5% by weight to about 2.5% by weight of the at least one dispersant, such as, e.g., from about 0.75% by weight to about 1.75% by weight, or from about 1.0% by weight to about 1.5% by weight of the dispersant(s). In at least one example, the first slurry comprises $Mg(OH)_2$ and a dispersant chosen from a polyether carboxylate or maleic acid acrylic acid copolymer.

[0021] The compositions herein may be prepared by adding, or otherwise combining, the first slurry (comprising alkaline earth metal(s)) with the basic solution to produce a second slurry. Due to the relatively high solids content of the first slurry, the manner in which the basic solution and the first slurry are combined can result in mixtures with different rheological properties. In some cases, the resulting rheological properties of the mixture may be unsuitable for bleaching, such as mixtures having the consistency of a gel rather than a liquid.

[0022] According to the present disclosure, the basic solution may be combined with the first slurry at a controlled rate, e.g., to avoid gelling of the liquid. The rate at which the basic solution is added may be selected based at least partially on the concentration of the first slurry, the concentration of the basic solution, or both. For example, the basic solution may be added more slowly to slurries with a relatively higher solids content. In at least one example, the rate may be generally described as "very fast" when the full volume of basic solution is added in less than 10 seconds, "fast" when the full volume of basic solution is added in a time period ranging from 10 seconds to 30 seconds, "slow" when the full volume of basic solution is added in a time period ranging from 30 seconds to 2 minutes, and "very slow" when the full volume of basic solution is added over a period of time greater than about 2 minutes, or greater than about 3 minutes, or greater than about 5 minutes, or greater than about 10 minutes.

[0023] In at least one example, the basic solution may be added to the first slurry at a rate ranging from about 0.1 g alkali hydroxide/min to about 5.0 g alkali hydroxide/min, such as from about 0.5 g alkali hydroxide/min to about 4.0 g alkali hydroxide/min, from about 1.5 g alkali hydroxide/min to about 3.0 g/min, or from about 0.8 g alkali hydroxide/min to about 4.0 g alkali hydroxide/min. For example, 16 g of a 50% by weight solution of NaOH may be added to a slurry comprising 30-60% $Mg(OH)_2$ by weight over a period of time ranging from about 30 seconds to about 10 minutes at a rate of about 1.6-32.0 g NaOH solution/min.

[0024] In some aspects of the present disclosure, the basic solution may be added to the first slurry at a rate at least partially dependent on the amount of alkaline earth metal hydroxide in the first slurry. For example, the basic solution may be added to the first slurry at a rate ranging from about 0.005 g to about 0.250 g alkali hydroxide/min per g alkaline earth metal hydroxide in the first slurry, such as from about 0.010 g to about 0.200 g alkali hydroxide/min per g alkaline earth metal hydroxide, from about 0.050 g to about 0.150 g alkali hydroxide/min per g alkaline earth metal hydroxide, or from about 0.010 g to about 0.050 g alkali hydroxide/min per g alkaline earth metal hydroxide in the first slurry. Further, for example, the basic solution may be added at a rate ranging from about 0.010 g alkali hydroxide/min per g alkaline earth metal hydroxide in the first slurry to about 0.100 g alkali hydroxide/min per g alkaline earth metal hydroxide in the first slurry, from about 0.011 g alkali hydroxide/min per g alkaline earth metal hydroxide in the first slurry to about 0.070 g alkali hydroxide/min per g alkaline earth metal hydroxide in the first slurry, from about 0.012 g alkali hydroxide/min per g alkaline earth metal hydroxide in the first slurry to about 0.060 g alkali hydroxide/min per g alkaline earth metal hydroxide in the first slurry, from about 0.014 g alkali hydroxide/min per g alkaline earth metal hydroxide in the first slurry to about 0.056 g alkali hydroxide/min per g alkaline earth metal hydroxide in the first slurry, from about 0.016 g alkali hydroxide/min per g alkaline earth metal hydroxide in the first slurry to about 0.037 g alkali hydroxide/min per g alkaline earth metal hydroxide in the first slurry, from about 0.010 g alkali hydroxide/min per g alkaline earth metal hydroxide in the first slurry to about 0.028 g alkali hydroxide/min per g alkaline earth metal hydroxide in the first slurry, or from about 0.011 g alkali hydroxide/min per g alkaline earth metal hydroxide in the first slurry to about 0.056 g alkali hydroxide/min per g alkaline earth metal hydroxide in the first slurry. In some examples, the rate of adding the basic solution may be slower than 0.005 g alkali hydroxide/min per g alkaline earth metal hydroxide in the first slurry.

[0025] In some examples, the basic solution may be added to the first slurry at a rate based on the content of the produced composition (e.g., a second slurry). For example, the second slurry may comprise from about 5% by weight to about 15% by weight of alkali hydroxide, such as, e.g., from about 7% by weight to about 13% by weight, from about 8% by weight to about 12% by weight, or from about 9% by weight to 11% by weight of alkali hydroxide. Thus, for example, the basic solution may be added to the first slurry over a period of time ranging from about 30 seconds to about 10 minutes, from about 40 seconds to about 9 minutes, from about 1 minute to about 7 minutes, from about 2 minutes to about 5 minutes, or from about 2 minutes to about 10 minutes. In some examples, the basic solution may be added to the first slurry over a period of time greater than 1 minute, e.g. greater than 2 minutes, greater than 3 minutes, greater than 5 minutes, or greater than 10 minutes until the composition comprises from about 5% by weight to about 15% by weight of alkali hydroxide, e.g., from about 7% by weight to about 13% by weight, from about 8% by weight to about 12% by weight, or from about 9% by weight to 11% by weight of alkali hydroxide.

[0026] Additionally or alternatively, the basic solution may be added to the first slurry over a certain period of time. For example, the basic solution may be added to the first slurry over a period of time ranging from about 30 seconds to about 10 minutes, from about 40 seconds to about 9 minutes, from about 1 minute to about 7 minutes, from about 2 minutes to about 5 minutes, or from about 2 minutes to about 10 minutes. In some examples, the basic solution may be added to the first slurry over a period of time greater than 1 minute, e.g. greater than 2 minutes, greater than 3 minutes, greater than 5 minutes, or greater than 10 minutes.

[0027] Without intending to be bound by theory, it is generally believed that controlling the rate at which the basic solution and the slurry of alkaline earth metal hydroxide and/or oxide are combined may assist in maintaining rheological properties suitable for bleaching processes. By adding the basic solution at a relatively slow, controlled rate, the resulting composition may maintain a viscosity suitable for combination with other agents (e.g., oxidizing/bleaching agents) during bleaching. For example, by adding the basic solution to the first slurry at a rate of 10% per minute or less, the Brookfield viscosity of the resulting composition (second slurry) may be less than or equal to 1000 MPa·s, e.g., the composition having a sufficiently liquid-like consistency for use in a bleaching process. Such compositions may be beneficial in efficiently producing paper with a desired brightness.

[0028] Agitation may be used to incorporate the basic solution and the first slurry. For example, the first slurry may be stirred, e.g., with a stirrer bar or other suitable agitation, during the addition of the basic solution. The basic solution and first slurry may be combined at a temperature ranging from about 10°C to about 35°C, such as at or near room temperature (e.g., from about 20°C to about 25°C).

[0029] Adding the basic solution to the first slurry may raise the pH of the first slurry such that the resulting composition (second slurry) exhibits a pH above 10.2. For example, the pH of the second slurry may range from about 12.0 to about 14.0, from about 12.2 to about 13.8, from about 12.5 to about 13.7, or from about 13.0 to about 13.5. Without intending to be bound by theory, it is generally believed that the higher pH may result in a faster bleaching process and consequently also in improved brightness/whiteness as compared to a pH of 10.2 or less.

[0030] According to some examples of the present disclosure, the weight ratio of alkaline earth metal hydroxide to alkali hydroxide in the composition (e.g., second slurry) may range from about 5:1 to about 20:1, such as from about 6:1 to about 12:1, or from about 8:1 to about 10:1. For example, the composition may comprise NaOH and $Mg(OH)_2$ having a weight ratio of $Mg(OH)_2$ to NaOH ranging from about 6:1 to about 12:1, or from about 8:1 to about 10:1. In some examples, the composition may have a total solids content ranging from about 30% by weight to about 65% by weight, about 40% by weight to about 60% by weight, or about 45% by weight to about 55% by weight. The composition may optionally comprise one or more additives such as, e.g., pH buffering agents, bleaching agents, chelating agents, and/or surfactants. In some examples, the composition does not include stabilizing agents such as silicate. In at least one example, the composition does not comprise sodium silicate.

[0031] The rheological properties of the composition may be characterized by its Brookfield viscosity and Ford cup emptying time. Brookfield viscosity may be determined according to ISO 2884-2: 2003. For example, the composition may be allowed to stabilize at room temperature and then poured into a glass cell with a spindle. Then a Brookfield viscometer may rotate the spindle at 100 rpm within the second slurry to measure a maximum torque. The maximum torque may be used to calculated the Brookfield viscosity. In some examples, the composition may have a Brookfield viscosity less than or equal to about 1000 mPa·s at least 24 hours after adding the basic solution to the first slurry. For example, the Brookfield viscosity may range from about 450 mPa·s to about 900 mPa·s, from about 500 mPa·s to about 800 mPa·s, or from about 650 mPa·s to about 750 mPa·s at least 24 hours after adding the basic solution to the first slurry.

[0032] The Brookfield viscosity of the composition may be steady or change relatively little over time. In some examples, the Brookfield viscosity of the composition changes by less than about 25%, less than about 20%, or less than about 15% within 24 hours of adding the basic solution to the first slurry. In certain examples, the Brookfield viscosity of the composition may increase or decrease by less than about 20%, less than about 15%, or less than about 10% within 24 hours of adding the basic solution to the first slurry. In at least one example, the Brookfield viscosity of the composition does not increase within 24 hours of adding the basic solution to the first slurry.

[0033] The Ford cup emptying time provides another indication of the viscosity of the composition and may be measured according to ASTM D1200. In this test, the composition is added to a Ford cup No. 4, having an opening in the bottom of the cup that allows the composition to flow out of the cup under the force of gravity. According to some aspects of the present disclosure, the composition may have a Ford cup emptying time of less than 40 seconds, less than 35 seconds, or less than 30 seconds at least 24 hours after adding the basic solution to the first slurry. For example, the composition may have a Ford cup emptying time ranging from 5 seconds to 40 seconds, from 5 seconds to 25 seconds, or from 10 seconds to 15 seconds.

[0034] In some aspects of the present disclosure, the composition may be an aqueous slurry having a solids content of at least 30% that is prepared and stored in a container before use in a bleaching process. For example, the composition may be stored in a container ranging from 1 L to 200 L in volume, e.g., from about 1 L to about 10 L, or from about 25 L to about 200 L. In further examples, the composition may be stored in intermediate bulk containers (IBL's) or bulk containers of 500 L or more, e.g., ranging from about 500 L to about 2000 L, or from about 1000 L to about 1250 L in volume. In additional or alternative aspects, the composition may be stored in shipping containers; e.g. tank cars, sea containers, or other intermodal containers.

[0035] The compositions herein may be useful for a number of applications, including the pulp bleaching and the papermaking process. For example, the compositions herein may fully or partially replace other alkaline agents as part of the bleaching process.

[0036] Aspects of the present disclosure are further illustrated by reference to the following, non-limiting numbered paragraphs describing exemplary embodiments.

1. A method comprising preparing a composition by combining a basic solution with a first slurry comprising an alkaline earth metal hydroxide and a dispersant; wherein the basic solution comprises from about 30% by weight

to about 50% by weight, or from about 40% by weight to about 50% by weight of an alkali hydroxide; wherein the first slurry comprises from about 30% by weight to about 65% by weight, from about 35% by weight to about 55% by weight, or from about 35% by weight to about 45 % by weight of the alkaline earth metal hydroxide; and wherein the composition is in the form of a second slurry having a Brookfield viscosity below about 1000 mPa·s at least 24 hours after adding the basic solution to the first slurry.

2. The method according to paragraph 1, wherein the alkaline earth metal hydroxide comprises $Mg(OH)_2$, $Ca(OH)_2$, or a mixture thereof.

3. The method according to paragraph 1 or 2, wherein the alkali hydroxide comprises NaOH, KOH, or a mixture thereof.

4. The method according to any one of paragraphs 1-3, wherein the first slurry comprises from about 0.5% by weight to about 2.5% by weight, or from about 1.0% by weight to about 1.5% by weight of the dispersant.

5. The method according to any one of paragraphs 1-4, wherein the dispersant comprises a polyether carboxylate, maleic acid-acrylic acid copolymer, or mixture thereof.

6. The method according to any one of paragraphs 1-5, wherein the composition has a Ford cup emptying time of less than about 40 seconds, less than about 35 seconds, or less than about 30 seconds at least 24 hours after adding the basic solution to the first slurry.

7. The method according to any one of paragraphs 1-6, wherein the weight ratio of alkaline earth metal hydroxide to alkali hydroxide in the composition ranges from about 5:1 to about 20:1, from about 6:1 to about 12:1, or from about 8:1 to about 10:1.

8. The method according to any one of paragraphs 1-7, wherein the basic solution is added to the first slurry at a rate from about 0.005 g alkali hydroxide/min per g alkaline earth metal hydroxide to about 0.250 g alkali hydroxide/min per g alkaline earth metal hydroxide and/or wherein the basic solution is added to the first slurry over a period of time ranging from greater than about 1 minute, or greater than about 2 minutes, or greater than about 3 minutes, or greater than about 5 minutes, or from about 1 minute to about 10 minutes.

9. The method according to any of one of paragraphs 1-8, wherein the pH of the composition ranges from about 12.0 to about 14.0, or from about 13.0 to about 13.5.

10. The method according to any one of paragraphs 1-9, wherein the basic solution comprises from about 45% to about 50% by weight NaOH, and the first slurry comprises from about 35% to about 45% by weight $Mg(OH)_2$.

11. The method according to any one of paragraphs 1-10, wherein the composition has a total solids content ranging from about 40% to about 60% by weight.

12. The method according to any one of paragraphs 1-11, wherein the Brookfield viscosity of the composition changes by less than about 20% within 24 hours of adding the basic solution to the first slurry.

13. The composition prepared according to any one of paragraphs 1-12.

14. A composition comprising water, a dispersant, $Mg(OH)_2$, and NaOH, wherein the composition has a total solids content ranging from about 40.0% to about 60.0% by weight; and wherein the composition has a Brookfield viscosity below about 1000 mPa·s.

15. The composition according to paragraph 14, wherein the weight ratio of $Mg(OH)_2$ to NaOH ranges from about 6:1 to about 12:1, or from about 8:1 to about 10:1.

16. The composition according to paragraph 14 or 15, wherein the Brookfield viscosity of the composition ranges from about 500 mPa·s to about 800 mPa·s.

17. The composition according to any one of paragraphs 14-16, wherein the composition has a Ford emptying time of less than about 40 seconds, less than about 35 seconds, or less than about 30 seconds.

18. The composition according to any one of paragraphs 14-17, wherein the Brookfield viscosity of the composition changes by less than about 20% within 24 hours.

19. The composition according to any one of paragraphs 14-18, wherein the composition has a pH ranging from about 12.0 to about 14.0.

20. Use of the composition according to any one of paragraphs 13-19 in a pulp bleaching process.

[0037] Other aspects and embodiments of the present disclosure will be apparent to those skilled in the art from consideration of the specification and practice of the embodiments disclosed herein.

EXAMPLES

[0038] The following examples are intended to illustrate the present disclosure without, however, being limiting in nature. It is understood that the present disclosure encompasses additional aspects and embodiments consistent with the foregoing description and following examples.

Example 1

[0039] Studies were performed to prepare and characterize various aqueous slurry compositions (A-F) for suitability in bleaching processes.

[0040] Compositions A, B, and C were prepared from a slurry comprising $Mg(OH)_2$ and a dispersant that was combined with NaOH solution as summarized in Table 1. For composition A, a stock slurry comprising 53% by weight $Mg(OH)_2$ and about 1% polyether-polycarboxalate dispersant was used. For compositions B and C, the stock slurry was diluted to a concentration of 39.1% by weight $Mg(OH)_2$ with water. In each case, NaOH solution (12.5% or 50% by weight) was added to each slurry in a beaker over a certain period of time (greater than 2 minutes or less than 1 minute) to produce the respective compositions.

Table 1

Composition	A	B	c
$Mg(OH)_2$ slurry			
$Mg(OH)_2$ (% wt)	53.0%	39.1%	39.1%
Total $Mg(OH)_2$ (g)	72	72	72
Total weight (g)	135.8	184.0	184.0
NaOH solution			
NaOH (% wt)	12.5%	50%	50%
Total NaOH (g)	8	8	8
Total weight (g)	64.2	16.0	16.0
Time of NaOH addition	> 2 min	> 2 min	~10-30 sec
Rate of NaOH addition (g NaOH/g $Mg(OH)_2$/min)	< 0.056	< 0.056	> 0.22
Total composition weight (g)	200	200	200
Total composition water (g)	120	120	120
Total composition solids (g)	80	80	80

[0041] Compositions D, E, and F, were then prepared to test the effects of dilution. These compositions were prepared as discussed above with respect to compositions A-C, except for compositions D and E, water was added after mixing the slurry and NaOH solution, and for composition F, water was added to the slurry before adding NaOH. See Table 2 below.

Table 2

Composition	D	E	F
$Mg(OH)_2$ slurry			
$Mg(OH)_2$ (% wt)	53%	53%	53%
Total $Mg(OH)_2$ (g)	72	216	68
Total weight (g)	135.8	407.5	128.3
NaOH solution			
NaOH (% wt)	50%	50%	50%
Total NaOH (g)	8	24	12
Total weight (g)	16	48	24
Time of NaOH addition	> 2 min	> 2 min	> 2 min
Rate of NaOH addition (g NaOH/g $Mg(OH)_2$/min)	< 0.05	< 0.05	< 0.08

(continued)

Composition	D	E	F
Water added for dilution (g)	48.2	144.5	47.7
Total composition weight (g)	200	600	200
Total composition water (g)	120	360	120
Total composition solids (g)	80	240	80

[0042] The Brookfield viscosity of each of compositions A-F was tested according to ISO 2884-2: 2003 directly after preparation, and then again after allowing the compositions to sit undisturbed for 24 hours. The Ford cup emptying time of each composition was measured according to ASTM D1200, 24 hours after preparation. Results are shown in Table 3 below.

Table 3

Composition	A	B	C	D	E	F
Brookfield viscosity after preparation (mPa·s)	700	650	840	1100	1400	1800
Brookfield viscosity after 24 hours (mPa·s)	750	650	920	750	700	1500
Ford Cup No. 4 emptying time after 24 hours (s)	30	27	36	34	29	*
*not measured						

[0043] The viscosities reported in Table 3 for compositions A-E were sufficiently liquid-like (as opposed to gel-like) for use in bleaching applications, e.g., exhibiting viscosities less than 1000 mPa·s. While compositions D and E initially had a higher viscosity, the respective values decreased over the 24-hour period following preparation. Composition F had the highest viscosity, and likely would not be suitable for use in a bleaching process or cause problems in handling the slurry such as pumping or stirring. Moreover, comparison of compositions B and C, which had the same amounts of NaOH and $Mg(OH)_2$, suggests that the rate at which NaOH is added to $Mg(OH)_2$ has an effect since NaOH was added at a slower rate for composition B. Composition B exhibited a lower viscosity than composition C, and the viscosity of composition B did not increase within the 24-hour period. Further compositions A-C maintained relatively stable viscosities over time as compared to compositions D-F prepared with a dilution step.

Example 2

[0044] Compositions G, H and I are prepared with MgO in place of, or in addition to, $Mg(OH)_2$. In each case, MgO is added to water in a beaker and mixed to form a slurry. MgO is slightly soluble in water (~0.009 g per 100 mL water) to produce $Mg(OH)_2$. For composition I, $Mg(OH)_2$ is also added to form the slurry. Next, a 50% by weight NaOH solution is slowly added with agitation. Compositions G, H, and I are summarized in Table 4 below.

Table 4

Composition	G	H	I
MgO/$Mg(OH)_2$ slurry			
MgO (g)	50.4	23.8	24.0
Total $Mg(OH)_2$ (g)	--	--	64.1
Water (g)	133.6	64.2	87.9
Total weight (g)	184	88	176
NaOH solution			
NaOH (% wt)	50%	50%	50%

(continued)

Composition	G	H	I
Total NaOH (g)	8	6	12
Total weight (g)	16	12	24
Total composition weight (g)	200	100	200
Total composition water added* (g)	142	70	164
Total composition solids (g)	58	30	36
* Water will partly react with MgO so final water in the slurry is less			

[0045] Other aspects and embodiments of the present disclosure will be apparent to those skilled in the art from consideration of the specification and practice of the embodiments disclosed herein.

[0046] It is intended that the specification and examples therein be considered as exemplary only, with a true scope and spirit of the present disclosure being indicated by the following claims.

Claims

1. A method comprising:

   preparing a composition by combining a basic solution with a first slurry comprising an alkaline earth metal hydroxide and a dispersant;
   wherein the basic solution comprises from about 30% by weight to about 50% by weight, or from about 40% by weight to about 50% by weight of an alkali hydroxide;
   wherein the first slurry comprises from about 30% by weight to about 65% by weight, from about 35% by weight to about 55% by weight, or from about 35% by weight to about 45 % by weight of the alkaline earth metal hydroxide; and
   wherein the composition is in the form of a second slurry and has a Brookfield viscosity below about 1000 mPa·s at least 24 hours after adding the basic solution to the first slurry.

2. The method according to claim 1, wherein the alkaline earth metal hydroxide comprises $Mg(OH)_2$, $Ca(OH)_2$, or a mixture thereof and/or wherein the alkali hydroxide comprises NaOH, KOH, or a mixture thereof.

3. The method according to any of the preceding claims, wherein the first slurry comprises from about 0.5% by weight to about 2.5% by weight, or from about 1.0% by weight to about 1.5% by weight of the dispersant.

4. The method according to any of the preceding claims, wherein the dispersant comprises a polyether carboxylate, maleic acid-acrylic acid copolymer, or mixture thereof.

5. The method according to any of the preceding claims, wherein the composition has a Ford cup emptying time of less than about 40 seconds, less than about 35 seconds, or less than about 30 seconds at least 24 hours after adding the basic solution to the first slurry.

6. The method according to any of the preceding claims, wherein the weight ratio of alkaline earth metal hydroxide to alkali hydroxide in the composition ranges from about 5:1 to about 20:1, from about 6:1 to about 12:1, or from about 8:1 to about 10:1.

7. The method according to any of the preceding claims, wherein the basic solution is added to the first slurry at a rate from about 0.005 g alkali hydroxide/min per g alkaline earth metal hydroxide to about 0.250 g alkali hydroxide/min per g alkaline earth metal hydroxide and/or wherein the basic solution is added to the first slurry over a period of time ranging from greater than about 1 minute, or greater than about 2 minutes, or greater than about 3 minutes, or greater than about 5 minutes, or from about 1 minute to about 10 minutes.

8. The method according to any of the preceding claims, wherein the pH of the composition ranges from about 12.0 to about 14.0, or from about 13.0 to about 13.5.

9. The method according to any of the preceding claims, wherein the basic solution comprises from about 45% to about 50% by weight NaOH, and the first slurry comprises from about 35% to about 45% by weight $Mg(OH)_2$.

10. The method according to any of the preceding claims, wherein the composition has a total solids content ranging from about 40% to about 60% by weight.

11. The method according to any of the preceding claims, wherein the Brookfield viscosity of the composition changes by less than about 20% within 24 hours of adding the basic solution to the first slurry.

12. The composition obtained by or obtainable by a method of any of the preceding claims.

13. A composition comprising water, a dispersant, $Mg(OH)_2$, and NaOH, wherein:

the composition has a total solids content ranging from about 40.0% to about 60.0% by weight; and
the composition has a Brookfield viscosity below about 1000 mPa·s.

14. The composition of claim 12 or 13, wherein the Brookfield viscosity of the composition ranges from about 500 mPa·s to about 800 mPa·s.

15. Use of the composition according to any one of claims 12-14 in a pulp bleaching process.

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EUROPEAN SEARCH REPORT

Application Number
EP 18 30 5577

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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	29 October 2018	Koegler-Hoffmann, S

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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