SUMMARY

In an aspect of the present disclosure, there is provided a method for producing a solution of ammonium carbamate comprising:

providing an aqueous solution of ammonium hydroxide;

providing sodium bicarbonate; and

mixing said solution of ammonium hydroxide with said sodium bicarbonate to produce said solution of ammonium carbamate.

The present disclosure seeks to provide a method for producing a solution of ammonium carbamate.

There is thus provided in accordance with a preferred example of the present disclosure a method for producing a solution of ammonium carbamate including: providing an aqueous solution of ammonium hydroxide; providing sodium bicarbonate; and mixing the solution of ammonium hydroxide with the sodium bicarbonate to produce the solution of ammonium carbamate. Preferably, the solution of ammonium hydroxide has a concentration of about 25-28% (as ammonia).

In accordance with one preferred example of the present disclosure, the sodium bicarbonate is added as a solid to the solution of ammonium hydroxide. In accordance with an alternative preferred example of the present disclosure, the solution of ammonium hydroxide is added to an aqueous slurry of the sodium bicarbonate. In one example, the slurry further includes ammonium carbamate. Preferably, the weight ratio of the ammonium carbamate to the sodium bicarbonate prior to adding the ammonium hydroxide is from 1:10 to 1:1, more preferably from 1:2.5 to 1:1.5.

In a preferred example, ammonium carbamate does not crystallize from the solution of ammonium carbamate when stored at 0 ^{o}C. In another preferred example, ammonium carbamate does not crystallize from the solution of ammonium carbamate when stored at -5 ^{o}C. In a further preferred example, ammonium carbamate does not crystallize from the solution of ammonium carbamate when stored at -10 ^{o}C.

Preferably, the method further includes monitoring the conductivity of the solution of ammonium carbamate during the mixing. In a preferred

example, the method further includes monitoring the temperature of the solution of ammonium carbamate during the mixing. Preferably, the method further includes monitoring the pH of the solution of ammonium carbamate during the mixing.

In accordance with a preferred example of the present disclosure, the concentration of the solution of ammonium carbamate at the end of the mixing is from about 15% to about 25%, preferably about 20%. Preferably, the pH of the solution of

ammonium carbamate at the end of the mixing is at least 10.0, more preferably at least 10.4, and most preferably at least 10.68. In accordance with a preferred example of the present disclosure, the conductivity of the solution of ammonium carbamate at the end of the mixing is between about 70 and about 130 mS/cm, more preferably between about 80 and about 120 mS/cm, and most preferably between about 90 and about 110 mS/cm.

Preferably, the method further includes producing a biocide by mixing the solution of ammonium carbamate with a solution of a hypochlorite oxidant. In accordance with a preferred example of the present disclosure, the hypochlorite oxidant is sodium hypochlorite. Preferably, the solution of a hypochlorite oxidant has a concentration from about 1000 to about 20,000 ppm, more preferably from about 3000 to about 10,000 ppm, and most preferably from about 3500 to about 7000 ppm.

In accordance with a preferred example of the present disclosure, the mixing the solution of ammonium carbamate with the solution of a hypochlorite oxidant includes: diluting the solution of ammonium carbamate with water or with a portion of the solution of a hypochlorite oxidant to form an ammonium carbamate dilution; and adding the remaining portion of the solution of a hypochlorite oxidant to the ammonium carbamate dilution. Preferably, the ammonium carbamate dilution has an ammonium carbamate concentration from about 1,000 to about 50,000 ppm, more preferably from about 12,000 to about 30,000 ppm. In accordance with a preferred example of the present disclosure, the method further includes monitoring the conductivity of the biocide during the adding.

CLAIMS

1. A method for producing a solution of ammonium carbamate comprising:

providing an aqueous solution of ammonium hydroxide;

providing sodium bicarbonate; and

mixing said solution of ammonium hydroxide with said sodium bicarbonate to produce said solution of ammonium carbamate.

2. The method according to claim 1, wherein said sodium bicarbonate is added as a solid to said solution of ammonium hydroxide.

3. The method according to claim 1, wherein said solution of ammonium hydroxide is added to an aqueous slurry of said sodium bicarbonate.

4. The method according to claim 3, wherein said slurry further comprises ammonium carbamate.

5. The method according to claim 4, wherein the weight ratio of said ammonium carbamate to said sodium bicarbonate prior to adding said ammonium hydroxide is from 1:10 to 1:1.

6. The method according to claim 4 or claim 5, wherein the weight ratio of said ammonium carbamate to said sodium bicarbonate prior to adding said ammonium hydroxide is from 1:2.5 to 1:1.5.

7. The method according to any one of claims 4 to 6, wherein ammonium carbamate does not crystallize from said solution of ammonium carbamate when stored at 0 ^{o}C.

8. The method according to any one of claims 4 to 7, wherein ammonium carbamate does not crystallize from said solution of ammonium carbamate when stored at -5 ^{o}C.

9. The method according to any one of claims 4 to 8, wherein ammonium carbamate does not crystallize from said solution of ammonium carbamate when stored at -10 ^{o}C.

10. The method according to any one of claims 1 to 9, further comprising monitoring at least one of the conductivity, the temperature and the pH of said solution of ammonium carbamate during said mixing.

11. The method according to any one of claims 1 to 10, wherein the concentration of said solution of ammonium carbamate at the end of said mixing is from about 15% to about 25%.

12. The method according to any one of claims 1 to 11, wherein the pH of said solution of ammonium carbamate at the end of said mixing is at least 10.0.

13. The method according to any one of claims 1 to 12, wherein the conductivity of said solution of ammonium carbamate at the end of said mixing is between about 70 and about 130 mS/cm.

14. The method according to any one of claims 1 to 13, further comprising producing a biocide by mixing said solution of ammonium carbamate with a solution of a hypochlorite oxidant.

15. The method according to claim 14, wherein said hypochlorite oxidant is sodium hypochlorite.

16. The method according to claim 14 or claim 15, wherein said solution of a hypochlorite oxidant has a concentration from about 1000 to about 20,000 ppm.

17. The method according to any one of claims 14 to 16, wherein said solution of a hypochlorite oxidant has a concentration from about 3000 to about 10,000 ppm.

18. The method according to any one of claims 14 to 17, wherein said mixing said solution of ammonium carbamate with said solution of a hypochlorite oxidant comprises:

diluting said solution of ammonium carbamate with water or with a portion of said solution of a hypochlorite oxidant to form an ammonium carbamate dilution; and

adding a portion of said solution of a hypochlorite oxidant to said ammonium carbamate dilution.

19. The method according to claim 18, wherein said ammonium carbamate dilution has an ammonium carbamate concentration from about 1,000 to about 50,000 ppm.

20. The method according to claim 18 or claim 19, further comprising monitoring the conductivity of the biocide during said adding.