Summary of the Invention

The Applicant has developed novel and inventive phase change compositions containing sodium acetate trihydrate as a phase change material.

Accordingly the present invention provides compositions containing sodium acetate trihydrate as a phase change material comprising:

(a) sodium acetate trihydrate or sodium acetate anhydrous;

(b) at least one suitable alkali soluble polymer;

(c) at least one suitable nucleation promoter; and

(d) water;

wherein said one or more alkali soluble polymers is independently selected from: the copolymer of methacrylic acid and methyl methacrylate, poly(methacrylic acid co-methyl methacrylate) having a molecular weight of from about 500,000 to about 1,000,000, or a sodium, potassium or zinc salt thereof; poly(methacrylic acid) having an average molecular weight of about 10,000, or the sodium salt thereof; or a mixture thereof.

As demonstrated in the Examples hereinafter the Applicant has surprisingly found that the compositions of the present disclosure which contain sodium acetate trihydrate as a phase change material display unprecedented improvements in homogeneity and thermodynamic stability properties than previously achievable using sodium acetate trihydrate as a PCM. In particular the Applicant has found that the compositions of the present disclosure which contain sodium acetate trihydrate as a phase change material are resistant to the nucleation of crystalline sodium acetate on heating and cooling.

According to a further embodiment the present disclosure provides for the use of the compositions according to the disclosure as phase change materials suitable for use in phase change systems.

In one aspect, the present invention also provides the use of a composition as disclosed herein, or a composition obtainable via the process disclosed herein as a phase change material.

The Applicant has also developed a novel process for the preparation of the compositions according to the disclosure. According to a further embodiment the present disclosure provides a process for the preparation of compositions containing sodium acetate trihydrate as a phase change material which comprises:

(a) mixing an aqueous solution comprising sodium acetate anhydrous with at least one suitable alkali soluble polymer; and at least one nucleation promoter;

(b) heating the resultant mixture to provide a 58°C phase change material containing sodium acetate trihydrate.

When sodium acetate trihydrate is used, the following steps are followed:

(a) heating the sodium acetate trihydrate to a temperature above 58°C; and

(b) mixing the sodium acetate trihydrate with at least one suitable alkali soluble polymer; and at least one nucleation promoter.

In another aspect, the present invention also provides a process for the preparation of compositions as disclosed herein containing sodium acetate trihydrate as a phase change material which comprises:

(a) mixing an aqueous solution comprising sodium acetate anhydrous with at least one suitable alkali soluble polymer; and at least one nucleation promoter;

(b) heating the resultant mixture to provide a 58°C phase change material containing sodium acetate trihydrate; and

wherein said aqueous solution may optionally contain an agent for modifying the melting point of sodium acetate.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings:

Figure 1 is a phase diagram of sodium acetate and water, showing the solubility limit of sodium acetate in water, at about 58°C, is at about 58.0%, whereas the corresponding

Claims

1. A composition containing sodium acetate trihydrate as a phase change material comprising:
   (a) sodium acetate trihydrate or sodium acetate anhydrous;
   (b) one or more suitable alkali soluble polymers;
   (c) one or more suitable nucleation promoters; and
   (d) water.

2. A composition according to claim 1, wherein the sodium acetate trihydrate is present at a level of from about 80% to about 100% by weight of the composition.

3. A composition according to claim 1, wherein the sodium acetate anhydrous is present at a level of from about 45% to about 60% by weight of the composition.

4. A composition according to claim 1 or 3, wherein said one or more alkali soluble polymers may be independently present at levels of from about 0.1% to about 10% by weight of the composition.

5. A composition according to any of claims 1 to 4, wherein said one or more alkali soluble polymers is a polymer having general formula I.

6. A composition according to any of the preceding claims wherein said one or more alkali soluble polymers is independently selected from: the copolymer of methacrylic acid and methyl methacrylate, poly(methacrylic acid co-methyl methacrylate) having a molecular weight of from about 500,000 to about 1,000,000, or a sodium, potassium or zinc salt thereof; poly(methacrylic acid) having an average molecular weight of about 10,000, or the sodium salt thereof; or a mixture thereof.

7. A composition according to any of the preceding claims wherein said one or more suitable nucleation promoters are each independently present at a level of from about 0.1% to about 5% by weight of the composition.

8. A composition according to any of the preceding claims wherein said one or more suitable nucleation promoters are independently selected from: disodium hydrogen phosphate (DSP) and hydrated forms thereof; tetrasodium pyrophosphate (TSPP) and hydrated forms thereof; and mixtures thereof.

9. A composition according to any of the preceding claims wherein said the nucleation promoters are disodium hydrogen phosphate dihydrate and tetrasodium pyrophosphate decahydrate present at a total combined level of from about 0.5% to about 5% by weight of the composition.

10. A composition according to any of the preceding claims additionally comprising an agent for modifying the melting point of sodium acetate trihydrate at a level of from about 1% to about 95% by weight of the composition.

11. A composition according to claim 10 wherein said agent is lithium acetate dihydrate.

12. A composition according to claim 10 wherein said agent is lithium acetate anhydrous.

13. A process for the preparation of compositions according to any of the preceding claims containing sodium acetate trihydrate as a phase change material which comprises:

(a) mixing an aqueous solution comprising sodium acetate anhydrous with at least one suitable alkali soluble polymer; and at least one nucleation promoter;

(b) heating the resultant mixture to provide a 58°C phase change material containing sodium acetate trihydrate; and

wherein said aqueous solution may optionally contain an agent for modifying the melting point of sodium acetate.

14. A process according to claim 13 wherein the aqueous solution comprises: from about 40% to about 60% of sodium acetate anhydrous; from about 0.1% to about 10% of at least one suitable alkali soluble polymer; from about 0.1% to about 5% of at least one suitable nucleation promoter; from about 1% to about 25% of an optional melting point depressing agent; and water to balance.

15. Use of a composition according to any of claims 1 to 10, or a composition obtainable via the process of claims 11 or 12 as a phase change material.

Claims

1. A composition containing sodium acetate trihydrate as a phase change material comprising:

   (a) sodium acetate trihydrate or sodium acetate anhydrous;
   (b) one or more suitable alkali soluble polymers;
   (c) one or more suitable nucleation promoters; and
   (d) water;

   wherein said one or more alkali soluble polymers is independently selected from: the copolymer of methacrylic acid and methyl methacrylate, poly(methacrylic acid co-methyl methacrylate) having a molecular weight of from about 500,000 to about 1,000,000, or a sodium, potassium or zinc salt thereof; poly(methacrylic acid) having an average molecular weight of about 10,000, or the sodium salt thereof; or a mixture thereof.

2. A composition according to claim 1, wherein the sodium acetate trihydrate is present at a level of from about 80% to about 100% by weight of the composition.

3. A composition according to claim 1, wherein the sodium acetate anhydrous is present at a level of from about 45% to about 60% by weight of the composition.

4. A composition according to claim 1 or 3, wherein said one or more alkali soluble polymers may be independently present at levels of from about 0.1% to about 10% by weight of the composition.

5. A composition according to any of claims 1 to 4, wherein said one or more alkali soluble polymers is a polymer having general formula I;

$$. -\{[X]_n-[Y]_m\}_z-$$

I

and salts thereof

wherein z is 10 to 1,000;

n = 1 to 10 to 1,000; and wherein m = 0 to 1,000

wherein the ratio of n : m is in the range of from about X: Y and wherein the molecular weight of the polymer is in the range of from about P to about Q,

X is independently selected from groups based on the following monomers: ethylene, acrylic acid, methyl methacrylate, acrylamide, ethyl methacrylate, ethacrylic acid, ethyl oxide, diallyldimethylammonium chloride, vinylpyrrolidone, N-isopropylacrylamide, styrene, maleic acid and mixtures thereof,

Y is independently selected from groups based on the following monomers: ethylene, acrylic acid, methyl methacrylate, acrylamide, ethyl methacrylate, ethacrylic acid, ethyl oxide, diallyldimethylammonium chloride, vinylpyrrolidone, N-isopropylacrylamide, styrene, maleic acid and mixtures thereof,

6. A composition according to any of the preceding claims wherein said one or more suitable nucleation promoters are each independently present at a level of from about 0.1% to about 5% by weight of the composition.

7. A composition according to any of the preceding claims wherein said one or more suitable nucleation promoters are independently selected from: disodium hydrogen phosphate (DSP) and hydrated forms thereof; tetrasodium pyrophosphate (TSPP) and hydrated forms thereof; and mixtures thereof.

8. A composition according to any of the preceding claims wherein said the nucleation promoters are disodium hydrogen phosphate dihydrate and tetrasodium pyrophosphate decahydrate present at a total combined level of from about 0.5% to about 5% by weight of the composition.

9. A composition according to any of the preceding claims additionally comprising an agent for modifying the melting point of sodium acetate trihydrate at a level of from about 1% to about 25% by weight of the composition.

10. A composition according to claim 9 wherein said agent is lithium acetate dihydrate.

11. A composition according to claim 9 wherein said agent is lithium acetate anhydrous.

12. A process for the preparation of compositions according to any of the preceding claims containing sodium acetate trihydrate as a phase change material which comprises:

(a) mixing an aqueous solution comprising sodium acetate anhydrous with at least one suitable alkali soluble polymer; and at least one nucleation promoter;

(b) heating the resultant mixture to provide a 58°C phase change material containing sodium acetate trihydrate; and

wherein said aqueous solution may optionally contain an agent for modifying the melting point of sodium acetate.

13. A process according to claim 12 wherein the aqueous solution comprises: from about 40% to about 60% of sodium acetate anhydrous; from about 0.1% to about 10% of at least one suitable alkali soluble polymer; from about 0.1% to about 5% of at least one suitable nucleation promoter; from about 1% to about 25% of an optional melting point depressing agent; and water to balance.

14. Use of a composition according to any of claims 1 to 9, or a composition obtainable via the process of claims 10 or 11 as a phase change material.