In another aspect, there is provided a process for producing and purifying alkanesulfonic anhydride comprising:

(i) feeding a material stream comprising alkanesulfonic acid, high boilers and residual low boilers as a first stream and sulfur trioxide as a second stream into a reaction stage (41; 43) where the alkanesulfonic acid reacts with the sulfur trioxide forming alkanesulfonic anhydride, and

(ii) purifying the alkanesulfonic anhydride in a process as defined above.

In another aspect, there is provided a process for producing anhydrous alkanesulfonic acid, comprising:

- purifying alkanesulfonic anhydride as defined above or producing and purifying alkanesulfonic anhydride as defined above,

- solving the crystals in a water-containing alkanesulfonic acid, wherein the water of the water-containing alkanesulfonic acid reacts with the alkanesulfonic anhydride forming alkanesulfonic acid or mixing equimolar amounts of the alkanesulfonic anhydride and water wherein the water reacts with the alkanesulfonic anhydride forming alkanesulfonic acid.

In another aspect, there is provided a process for producing peroxoalkanesulfonic acid, comprising:

- purifying alkanesulfonic anhydride as defined above or producing and purifying alkanesulfonic anhydride as defined above,

- adding the purified alkanesulfonic anhydride to a mixture comprising water and hydrogen peroxide, wherein the hydrogen peroxide reacts with the alkanesulfonic anhydride forming peroxoalkanesulfonic acid and the water reacts with the alkanesulfonic anhydride forming alkanesulfonic acid.

Claims

1. A process for purifying alkanesulfonic anhydride which comprises the following steps of:

   (a) feeding a stream comprising alkanesulfonic anhydride, sulfuric acid, high boilers and residual low boilers into a melt crystallization (25) to form crystals of the alkanesulfonic anhydride suspended in mother liquor,

   (b) performing a solid-liquid separation to remove the crystals from the mother liquor,

   (c) optionally washing the crystals to remove mother liquor adhering to the crystals.

2. The process according to claim 1, wherein before feeding the stream comprising alkanesulfonic anhydride, sulfuric acid, high boilers and residual low boilers into the melt crystallization (25), a distillation (23) for removing low boilers is carried out.

3. The process according to claim 2, wherein a crude product stream is fed into a distillation apparatus (23), the crude product stream comprising alkanesulfonic anhydride, sulfuric acid, high boilers and low boilers.

4. The process according to any of claims 1 to 3, wherein the mother liquor after removal of the crystals in step (b) and/or the mother liquor generated in step (a) is at least partly recycled into the melt crystallization (25).

5. The process according to any of claims 1 to 4, wherein the low boilers comprise sulfur trioxide.

6. The process according to any of claims 1 to 5, wherein the melt crystallization is carried out at a temperature in the range from 0 to 70°C.

7. The process according to any of claims 1 to 6, wherein the crystals are washed with molten crystallizate in step (c).

8. The process according to claim 7, wherein the molten crystallizate for washing the crystals has a temperature 0.1°C to 15°C above the solidification temperature of the alkanesulfonic-anhydride-containing crystallizate.

9. The process according to any of claims 1 to 8, wherein the alkanesulfonic anhydride is methanesulfonic anhydride.

10. A process for producing and purifying alkanesulfonic anhydride comprising:

(i) feeding a material stream comprising alkanesulfonic acid, high boilers and residual low boilers as a first stream and sulfur trioxide as a second stream into a reaction stage (41; 43) where the alkanesulfonic acid reacts with the sulfur trioxide forming alkanesulfonic anhydride, and

(ii) purifying the alkanesulfonic anhydride in a process according to any of claims 1 to 9.

11. The process according to claim 10, further comprising distilling a melt comprising crude alkanesulfonic acid to completely or partly remove low boilers to obtain the material stream comprising alkanesulfonic acid, high boilers and residual low boilers.

12. The process according to claim 10 or 11, wherein the low boilers comprise sulfur trioxide.

13. A process for producing anhydrous alkanesulfonic acid, comprising:

- purifying alkanesulfonic anhydride according to any of claims 1 to 9 or producing and purifying alkanesulfonic anhydride according to any of claims 10 to 12,

- solving the crystals in a water-containing alkanesulfonic acid, wherein the water of the water-containing alkanesulfonic acid reacts with the alkanesulfonic anhydride forming alkanesulfonic acid or mixing equimolar amounts of the alkanesulfonic anhydride and water wherein the water reacts with the alkanesulfonic anhydride forming alkanesulfonic acid.

14. The process according to claim 13, wherein the water-containing alkanesulfonic acid is alkanesulfonic acid hydrate.

15. A process for producing peroxoalkanesulfonic acid, comprising:

- purifying alkanesulfonic anhydride according to any of claims 1 to 9 or producing and purifying alkanesulfonic anhydride according to any of claims 10 to 12,

- adding the purified alkanesulfonic anhydride to a mixture comprising water and hydrogen peroxide, wherein the hydrogen peroxide reacts with the alkanesulfonic anhydride forming peroxoalkanesulfonic acid and the water reacts with the alkanesulfonic anhydride forming alkanesulfonic acid.

16. A process for producing alkanesulfonic acid, comprising:

- purifying alkanesulfonic anhydride according to any of claims 1 to 9 or producing and purifying alkanesulfonic anhydride according to any of claims 10 to 12,

- adding the purified alkanesulfonic acid to a mixture comprising sulfuric acid, wherein the sulfuric acid reacts with the alkanesulfonic anhydride forming alkanesulfonic acid and sulfur trioxide.

17. The process according to claim 16, wherein the sulfur trioxide is recycled into a process for producing crude alkanesulfonic acid or into a process for producing alkanesulfonic anhydride.

18. The process according to any of claims 13 to 17, wherein the alkanesulfonic acid is methanesulfonic acid.

19. The process according to claim 15, wherein the peroxoalkansulfonic acid is added as an initiator to sulphur trioxide and alkane to start a radical chain reaction for producing alkanesulfonic acid or alkanesulfonic anhydride.