CLAIMS

1. An integrated process for the production of methyl acetate and methanol which process comprises:

(i) feeding synthesis gas and dimethyl ether into a carbonylation reaction zone and reacting therein the synthesis gas and dimethyl ether in the presence of a carbonylation catalyst to form a gaseous carbonylation reaction product comprising methyl acetate and synthesis gas enriched in hydrogen relative to the hydrogen content of the feed synthesis gas and wherein the carbonylation catalyst is an aluminosilicate zeolite which comprises at least one channel which is defined by an 8-membered ring;

(ii) withdrawing carbonylation reaction product from the carbonylation reaction zone and recovering therefrom a methyl acetate-rich liquid stream and a synthesis gas stream comprising residual amounts of methyl acetate; and wherein the synthesis gas is split into a major portion and a minor portion;

(iii) scrubbing in a scrubbing zone the minor portion of the synthesis gas recovered from the carbonylation reaction product with a liquid scrubbing solvent to reduce the content of the methyl acetate in the synthesis gas and to obtain a scrubbed synthesis gas depleted in methyl acetate and a liquid solvent stream comprising methyl acetate;

(iv) passing scrubbed synthesis gas to a methanol synthesis zone and contacting it therein with a methanol synthesis catalyst to form a methanol synthesis product comprising methanol and unconverted synthesis gas; and wherein the major portion of the synthesis gas recovered from the carbonylation reaction product is recycled to the carbonylation reaction zone.

2. A process according to claim 1 which further comprises the steps of

(v) withdrawing methanol synthesis product from the methanol synthesis zone and recovering therefrom a methanol-rich liquid stream and a synthesis gas stream; and

(vi) recycling at least a portion of the synthesis gas stream recovered from the methanol synthesis product to the methanol synthesis zone.

3. A process according to claim 1 wherein the scrubbed synthesis gas is passed to the methanol synthesis zone as a combined feed with at least a portion of synthesis gas recovered from the methanol synthesis product.

4. A process according to claim 1 wherein the synthesis gas fed to the carbonylation reaction zone is fresh synthesis gas having a stoichiometric number SN and SN=$(H_2—CO_2)/(CO+CO_2)$ in the range 0.9 to 1.3.

5. A process according to claim 4 wherein the stoichiometric number of the fresh synthesis gas is lower than the stoichiometric number of the scrubbed synthesis gas passed to the methanol synthesis zone.

6. A process according to claim 1 wherein the scrubbed synthesis gas has a stoichiometric number in the range 1.5 to 2.5.

7. A process according to claim 6 wherein the stoichiometric number is in the range 2.0 to 2.1.

8. A process according to claim 1 wherein the synthesis gas feed to the carbonylation reaction zone is fresh synthesis gas or a mixture of fresh and recycle synthesis gas.

9. A process according to claim 1 wherein the synthesis gas feed (including any recycles) to the carbonylation reaction zone comprises carbon dioxide.

10. A process according to claim 9 wherein carbon dioxide is present in the synthesis gas in an amount in the range 0.5 to 12 mol %.

11. A process according to claim 1 wherein the aluminosilicate zeolite has a framework structure type selected from MOR, FER, OFF and GME.

12. A process according to claim 11 wherein the zeolite has a framework structure type MOR and is a mordenite.

13. A process according to claim 1 wherein the synthesis gas and dimethyl ether are reacted in the carbonylation reaction zone under conditions of a temperature in the range 250°C to 350°C and a total pressure in the range 50 to 100 barg (5000 kPa to 10,000 kPa).

14. A process according to claim 1 wherein the major portion is 70 to 80 mol % of the synthesis gas recovered from the carbonylation reaction product.

15. A process according to claim 1 wherein synthesis gas recovered from the carbonylation reaction product comprises methyl acetate in an amount in the range 0.1 to 5 mol %.

16. A process according to claim 1 wherein the scrubbing solvent comprises methanol.

17. A process according to claim 16 wherein the scrubbing solvent further comprises one or more of water and dimethyl ether.

18. A process according to claim 1 wherein synthesis gas recovered from the carbonylation reaction product is subjected to multiple scrubbings.

19. A process according to claim 18 wherein the multiple scrubbings are conducted in one scrubbing unit.

20. A process according to claim 2 wherein the scrubbing solvent is at least a portion of the methanol-rich liquid stream recovered from the methanol synthesis product.

21. A process according to claim 1 wherein the scrubbed synthesis gas has a stoichiometric number in the range 1.5 to 2.5.

22. A process according to claim 1 wherein the methanol synthesis catalyst comprises copper.

23. A process according to claim 1 wherein synthesis gas is contacted with the methanol synthesis catalyst under conditions of a temperature of from 210°C to 270°C and a total pressure in the range 50 to 100 barg (5000 kPa to 10,000 kPa).

24. A process according to claim 1 wherein methanol is recovered from one or more of the methanol synthesis product withdrawn from the methanol synthesis zone and liquid solvent streams comprising methanol obtained from scrubbing of synthesis gas recovered from the carbonylation reaction product.

25. A process according to claim 2 wherein methanol is recovered from the methanol-rich liquid stream recovered from the methanol synthesis product.

26. A process according to claim 2 wherein methyl acetate is recovered from at least a portion of the methyl acetate-rich liquid stream and the recovered methyl acetate is converted to acetic acid.

27. A process according to claim 1 wherein recovered methyl acetate is converted to acetic acid by hydrolysis.

28. A process according to claim 1 wherein a portion of the synthesis gas recovered from the methanol synthesis product is vented as a purge stream.

29. A process according to claim 1 wherein in each of the carbonylation reaction zone and the methanol synthesis zone the reaction is conducted as a heterogeneous vapour phase reaction.

30. A process according to claim 1 wherein the process is operated as a continuous process.

Claims:

1. An integrated process for the production of methyl acetate and methanol which process comprises:

(i) feeding synthesis gas and dimethyl ether into a carbonylation reaction zone and reacting therein the synthesis gas and dimethyl ether in the presence of a carbonylation catalyst to form a gaseous carbonylation reaction product comprising methyl acetate and synthesis gas enriched in hydrogen;

(ii) withdrawing carbonylation reaction product from the carbonylation reaction zone and recovering therefrom a methyl acetate-rich liquid stream and a synthesis gas stream comprising residual amounts of methyl acetate;

(iii) scrubbing in a scrubbing zone at least a portion of the synthesis gas recovered from the carbonylation reaction product with a liquid scrubbing solvent to reduce the content of the methyl acetate in the synthesis gas and to obtain a scrubbed synthesis gas depleted in methyl acetate and a liquid solvent stream comprising methyl acetate;

(iv) passing scrubbed synthesis gas to a methanol synthesis zone and contacting it therein with a methanol synthesis catalyst to form a methanol synthesis product comprising methanol and unconverted synthesis gas.

2. A process according to claim 1 which further comprises the steps of

(v) withdrawing methanol synthesis product from the methanol synthesis zone and recovering therefrom a methanol-rich liquid stream and a synthesis gas stream; and

(vi) recycling at least a portion of the synthesis gas stream recovered from the methanol synthesis product to the methanol synthesis zone.

3. A process according to claim 2 wherein the scrubbed synthesis gas is passed to the methanol synthesis zone as a combined feed with at least a portion of the synthesis gas recovered from the methanol synthesis product.

4. A process according to any one of claims 1 to 3 wherein the synthesis gas fed to the carbonylation reaction zone which is fresh synthesis gas having a stoichiometric number SN and $SN = (H_2-CO_2)/(CO+CO_2)$ in the range 0.9 to 1.3

5. A process according to claim 4 wherein the stoichiometric number of the fresh synthesis gas is lower than the stoichiometric number of the scrubbed synthesis gas passed to the methanol synthesis zone.

6. A process according to any one of claims 1 to 5 wherein the scrubbed synthesis gas has a stoichiometric number in the range 1.5 to 2.5.

7. A process according to claim 6 wherein the stoichiometric number is in the range 2.0 to 2.1.

8. A process according to any one of claims 1 to 7 wherein the synthesis gas feed to the carbonylation reaction zone is fresh synthesis gas or a mixture of fresh and recycle synthesis gas.

9. A process according to any one of claims 1 to 8 wherein the synthesis gas feed (including any recycles) to the carbonylation reaction zone comprises carbon dioxide.

10. A process according to claim 9 wherein carbon dioxide is present in the synthesis gas in an amount in the range 0.5 to 12 mol%.

11. A process according to any one of claims 1 to 10 wherein water and methanol are introduced into the carbonylation reaction zone in a combined amount in the range 0 to 0.5 mol%.

12. A process according to any one of claims 1 to 11 wherein the carbonylation catalyst is an aluminosilicate zeolite which comprises at least one channel which is defined by an 8-membered ring,

13. A process according to claim 12 wherein the aluminosilicate zeolite has a framework structure type selected from MOR, FER, OFF and GME.

14. A process according to claim 13 wherein the zeolite has a framework structure type MOR and is a mordenite.

15. A process according to any one of claims 1 to 14 wherein the synthesis gas and dimethyl ether are reacted in the carbonylation reaction zone under conditions of a temperature in the range 250 °C to 350 °C and a total pressure in the range 50 to 100 barg (5000kPa to 10,000kPa).

16. A process according to any one of claims 1 to 15 wherein the synthesis gas recovered from the carbonylation reaction product is split into a major and minor portion wherein the major portion is recycled to the carbonylation reaction zone and the minor portion is scrubbed.

17. A process according to claim 16 wherein the major portion is 70 to 80 mol% of the synthesis gas recovered from the carbonylation reaction product.

18. A process according to any one of claims 1 to 17 wherein the synthesis gas recovered from the carbonylation reaction product comprises methyl acetate in an amount in the range 0.1 to 5 mol%.

19. A process according to claim 18 wherein the synthesis gas recovered from the carbonylation reaction product comprises methyl acetate in an amount in the range 0.5 to 2 mol%.

20. A process according to any one of claims 1 to 19 wherein the scrubbing zone comprises two or more scrubbing units.

21. A process according to any one of claims 1 to 20 wherein the scrubbing solvent comprises methanol.

22. A process according to claim 21 wherein the scrubbing solvent further comprises one or more of water and dimethyl ether.

23. A process according to any one of claims 1 to 22 wherein synthesis gas recovered from the carbonylation reaction product is subjected to multiple scrubbing treatments.

24. A process according to claim 23 wherein the multiple scrubbing treatments are conducted in one scrubbing unit.

25. A process according to any one of claims 2 to 24 wherein the scrubbing solvent comprises at least a portion of the methanol-rich liquid stream recovered from the methanol synthesis product.

26. A process according to any one of claims 1 to 25 wherein the scrubbed synthesis gas has a stoichiometric number in the range 1.5 to 2.5.

27. A process according to claims 1 to 26 wherein the scrubbed synthesis gas comprises methyl acetate in an amount of 0 to 1 mol%.

28. A process according to any one of claims 1 to 27 wherein the methanol synthesis catalyst comprises copper.

29. A process according to claim 28 wherein the catalyst is a Katalco™ methanol synthesis catalyst.

30. A process according to any one of claims 1 to 29 wherein synthesis gas is contacted with the methanol synthesis catalyst under conditions of a temperature of from 210 °C to 270 °C and a total pressure in the range 50 to 100 barg (5000kPa to 10,000kPa).

31. A process according to any one of claims 1 to 30 wherein methanol is recovered from one or more of the methanol synthesis product withdrawn from the methanol

synthesis zone and liquid solvent streams comprising methanol obtained from scrubbing of synthesis gas recovered from the carbonylation reaction product.

32. A process according to any one of claims 2 to 31 wherein methanol is recovered from the methanol-rich liquid stream recovered from the methanol synthesis product.

33. A process according to any one of claims 1 to 32 wherein methyl acetate is recovered from at least a portion of the methyl acetate-rich liquid stream and the recovered methyl acetate is converted to acetic acid.

34. A process according to claim 33 wherein recovered methyl acetate is converted to acetic acid by hydrolysis.

35. A process according to any one of claims 2 to 34 wherein a portion of the synthesis recovered from the methanol synthesis product is vented as a purge stream.

36. A process according to any one of claims 1 to 35 wherein in each of the carbonylation reaction zone and the methanol synthesis zone, the reaction is conducted as a heterogeneous vapour phase reaction

37. A process according to any one of claims 1 to 36 wherein the process is operated as a continuous process.