c. separating a fragmentation product stream comprising the C_1-C_3 oxygenates from the stream of cooled heat carrying particles; and then

d. recovering the composition comprising C_1-C_3 oxygenates from the fragmentation product stream

wherein the number of acid sites on the surface of the heat carrying particles is less than 1 μmol/g as measured by NH_3-TPD.

According to an example of the present disclosure a process is provided for thermolytic fragmentation of a sugar into a composition comprising C_1-C_3 oxygenates, the process comprising:

a. Providing a circulating, fluidized stream of heat carrying particles, wherein the heat carrying particles are circulated to a heating zone to produce heated heat carrying particles, and then the heated heat carrying particles are circulated from the heating zone to a fragmentation zone to provide heat to the fragmentation zone and producing cooled heat carrying particles, and then the cooled heat carrying particles are circulated back to the heating zone for reheating.

Claims

1. A process for thermolytic fragmentation of a sugar into a composition comprising C_1-C_3 oxygenates, the process comprising:
    a. Providing a circulating, fluidized stream of heat carrying particles, wherein the heat carrying particles are circulated to a heating zone to produce heated heat carrying particles, and then the heated heat carrying particles are circulated from the heating zone to a fragmentation zone to provide heat to the fragmentation zone and producing cooled heat carrying particles, and then the cooled heat carrying particles are circulated back to the heating zone for reheating.
    b. introducing a feedstock solution comprising the sugar into the fragmentation zone of the circulating, fluidized stream of heat carrying particles to absorb heat and convert the sugar by thermolytic fragmentation into the C_1-C_3 oxygenates;
    c. separating a fragmentation product stream comprising the C_1-C_3 oxygenates from the stream of cooled heat carrying particles; and then
    d. recovering the composition comprising C_1-C_3 oxygenates from the fragmentation product stream

    wherein the number of acid sites on the surface of the heat carrying particles is less than 1 µmol/g as measured by NH_3-TPD.

2. The process according to claim 1, wherein the particle surface area of the heat carrying particles is below 3 square meters per g, such as below 1, 0.5, 0.2 or 0.15.

3. The process according to claim 1 or 2, wherein at least 90% by weight of the heat carrying particles consist of silicium, aluminium and oxygen and the mass ratio of silicium to aluminium is from 0.25 to 1.

4. The process according to any one of the preceding claims, wherein the number of acid sites on the surface of the heat carrying particles is less than 0.5 µmol/g as measured by NH_3-TPD, such as less than 0.1µmol/g.

5. The process according to any one of the preceding claims, wherein the number of basic sites on the surface of the heat carrying particles is less than 1 µmol/g as measured by CO_2-TPD.

6. The process according to any one of the preceding claims, wherein the fluidization index of the heat carrying particles is above 1.

7. The process according to any one of the preceding claims, wherein 90-100%, such as 95-99.9% or 98-99.8% by weight of the heat carrying particles consist of silicium, aluminium and oxygen and the mass ratio of silicium to aluminium is of from 0.25 to 1, such as from 0.4 to 0.8 or 0.45 to 0.55.

8. The process according to any one of the preceding claims, wherein at least 50% by weight, such as at least 60%, 70%, 80%, 50-99%, 60-95% or 65-90%, of the heat carrying particles consist of mullite.

9. The process according to any one of the preceding claims, wherein the heat carrying particles have been calcined at a temperature of at least 1000 ^{O}C, such as in the range of from 1200 to 2000 ^{O}C, from 1400-1800 ^{O}C or from 1500 to 1700 ^{O}C.

10. The process according to any one of the preceding claims, wherein the heat carrying particles has a melting point above 1100 °C, such as in the range of 1100 to 3000°C.

11. The process according to any one of the preceding claims, wherein the particle density of the heat carrying particles is below 3.5 g/ml, such as in the range of from 2-3 g/ml, as measured by Hg porosimetry.

12. The process according to any one of the preceding claims, wherein the Sauter mean diameter of the heat carrying particles is from 50-150 µm.

13. The process according to any one of the preceding claims, wherein the feedstock solution comprising the sugar is fed directly into the fragmentation zone.

14. The process according to any one of the preceding claims, wherein the sugar is a mono- and/or di-saccharide.

15. The process according to any one of the preceding claims, wherein the feedstock solution comprises an aqueous solution of a sugar selected from the group consisting of sucrose, lactose, xylose, arabinose, ribose, mannose, tagatose, galactose, glucose and fructose; or mixtures thereof.

16. The process according to any one of the preceding claims, wherein the concentration of sugar in the feedstock solution is between 10 and 90% by weight.

17. The process according to any one of the preceding claims, wherein the composition comprising the C_1-C_3 oxygenates comprises one or more of glycolaldehyde, glyoxal, pyruvaldehyde, acetol and formaldehyde.

18. The process according to any one of the preceding claims, wherein the fragmentation zone has a fragmentation temperature in the range of from 250 - 900 °C, such as from 300-750, 350-650, or 400-550 °C.

19. The process according to any one of the preceding claims, wherein the heated heat carrying particles have a temperature in the range of from 300-950 °C, such as from 350-800, 400-700 or 450-650 °C as measured when the heated heat carrying particles leave the heating zone.

20. The process according to any one of the preceding claims, wherein the cooled heat carrying particles have a temperature in the range of from 200-850 °C, such as from 250-700, 300-600, or 350-550 °C as measured when the cooled heat carrying particles leave the fragmentation zone.

21. The process according to any one of the preceding claims, wherein the fragmentation zone is delimited by a riser suitable for conducting thermolytic fragmentation of a feedstock solution comprising a sugar and suitable for fluidizing the stream of heat carrying particles.

22. The process according to any one of the preceding claims, wherein the heating zone is delimited by a riser suitable for heating and suitable for fluidizing the stream of heat carrying particles.

23. The process according to any one of the preceding claims, wherein the fragmentation product stream is separated from the stream of cooled heat carrying particles by inertial separation.

24. The process according to any one of the preceding claims, wherein the composition comprising the C_1-C_3 oxygenates is recovered by quench cooling of the fragmentation product stream.

25. The process according to any one of the preceding claims, wherein the ratio of the mass flow rate of heat carrying particles per mass flow rate of feedstock is between 12:1 and 200:1.

26. The process according to any one of the preceding claims, wherein step d) of recovering the composition comprising C_1-C_3 oxygenates comprises collecting the fragmentation product stream and conveying it to a hydrogenation unit to convert the C_1-C_3 oxygenates into the corresponding poly-alcohols.