

between one and ten carbon atoms, including cyclic sulfones in which R₁ and R₂ form part of a cyclic polymethylene ring.

5. The method according to claim 1 wherein the polar organic liquid comprises tetramethylene sulfone.

6. The method according to any one of the preceding claims wherein the acid is chosen from orthophosphoric acid, sulfuric acid, methanesulfonic acid, trifluoromethanesulfonic acid, hydrohalic acids, nitric acid and formic acid.

7. The method according to any one of the preceding claims wherein the acid comprises, 0.1% to 10% by weight of the catalyst composition.

8. The method according to any one of the preceding claims wherein the weight of the catalyst composition in the mixture is one to ten times the weight of the particulate lignocellulosic material.

9. The method according to any one of the preceding claims wherein the heating of the mixture is carried out in a rotating screw reactor having an inlet for the mixture and an outlet for char in which the pressure is maintained within the range 50 to 150 millibar with temperature in the reactor being controlled along the reactor's length such that the temperature of the reactor increases from a lower temperature closer to the inlet to a higher temperature closer to the outlet.

10. The method according to any one of the preceding claims wherein the volatile organic compounds comprise levoglucosenone.

~~11. Levoglucosenone when produced by the method of any one of the preceding claims.~~

~~12.~~ Apparatus for converting lignocellulosic materials into volatile organic liquids and char comprising,

a mixing and comminution station for mixing the lignocellulosic material with a catalyst composition and comminuting the lignocellulosic material,

an elongate tubular reactor arranged to receive mixture from the mixing and comminution station through an inlet and to discharge char from an outlet located downstream of the inlet,

an evacuation pump arranged to reduce pressure in the reactor to below 900 millibar,

a screw feeder arranged to subject the mixture to shearing and compression and to move the mixture from the inlet to the outlet so as to discharge char from the outlet,

a heating assembly for heating the mixture in the reactor to a temperature in the range 190°C to 500°C as it travels through the reactor,

a steam assembly arranged to inject steam into the reactor at at least one location downstream of the inlet, and

a volatiles condensation assembly arranged to recover catalyst and separate volatile chemical products from the reactor.

~~13.~~ The apparatus according to claim ~~12~~ comprising a gas-solid separation system and a fractional distillation system.

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5. The method according to claim 1 wherein the polar organic liquid comprises tetramethylene sulfone.

6. The method according to any one of the preceding claims wherein the acid is chosen from orthophosphoric acid, sulfuric acid, methanesulfonic acid, trifluoromethanesulfonic acid, hydrohalic acids, nitric acid and formic acid.

7. The method according to any one of the preceding claims wherein the acid comprises, 0.1% to 10% by weight of the catalyst composition.

8. The method according to any one of the preceding claims wherein the weight of the catalyst composition in the mixture is one to ten times the weight of the particulate lignocellulosic material.

9. The method according to any one of the preceding claims wherein the heating of the mixture is carried out in a rotating screw reactor having an inlet for the mixture and an outlet for char in which the pressure is maintained within the range 50 to 150 millibar with temperature in the reactor being controlled along the reactor's length such that the temperature of the reactor increases from a lower temperature closer to the inlet to a higher temperature closer to the outlet.

10. The method according to any one of the preceding claims wherein the volatile organic compounds comprise levoglucosenone.

11. Apparatus for converting lignocellulosic materials into volatile organic liquids and char comprising,

a mixing and comminution station for mixing the lignocellulosic material with a catalyst composition and comminuting the lignocellulosic material,

an elongate tubular reactor arranged to receive mixture from the mixing and comminution station through an inlet and to discharge char from an outlet located downstream of the inlet,

an evacuation pump arranged to reduce pressure in the reactor to below 900 millibar,

a screw feeder arranged to subject the mixture to shearing and compression and to move the mixture from the inlet to the outlet so as to discharge char from the outlet,

a heating assembly for heating the mixture in the reactor to a temperature in the range 190°C to 500°C as it travels through the reactor,

a steam assembly arranged to inject steam into the reactor at at least one location downstream of the inlet, and

a volatiles condensation assembly arranged to recover catalyst and separate volatile chemical products from the reactor.

12. The apparatus according to claim 11 comprising a gas-solid separation system and a fractional distillation system.