

Claims

1. A retort chamber comprising:
 - a) a top,
 - b) a bottom,
 - c) a heater at or near the bottom of the retort chamber capable of heating the bottom to a temperature between about 900 and 1300°C,
 - d) two or more inlet ports located at or near the bottom of the retort chamber,
 - e) one or more outlet ports located at or near the top of the retort chamber,
 - f) temperature monitors at or near the top and bottom of the retort chamber,
 - g) a temperature monitor located at a position between about 30 and about 70% of the distance between the top and the bottom of the retort chamber, and
 - h) a vacuum line or aspirator located in the upper third of the retort chamber.
2. The retort chamber of Claim 1, wherein the heater is a burner placed on a carriage, which carriage is adapted to allow the burner to move along the bottom of the retort chamber.
3. The retort chamber of Claim 1, wherein the bottom of the retort chamber comprises a plurality of registers, which registers are spaced so as to provide substantially equal pressure along the entire bottom of the retort, wherein substantially equal means that the pressure along the bottom of the retort chamber does not vary by more than 20%.
4. The retort chamber of Claim 1, wherein one or more of the inlet ports is adapted to receive a supply of water to be introduced into the retort chamber.
5. The retort chamber of Claim 1, further comprising one or more of the inlet ports at or near the top of the retort chamber, which inlet ports are adapted to receive a supply of water to be introduced into the retort chamber.
6. The retort chamber of Claim 1, wherein one or more of the inlet ports is adapted to receive a supply of air or oxygen to be introduced into the retort chamber.

7. The retort chamber of Claim 1, wherein the bottom is hinged, and, when open, allows for material to be removed from the retort chamber.

8. The retort chamber of Claim 1, wherein the top is hinged, and, when open, allows for material to be inserted into or removed from, the retort chamber.

9. The retort chamber of Claim 8, further comprising a hinge with a horizontal axis, adapted to allow the retort chamber to rotate, allowing for material to be removed from the retort chamber when the lid is open and the retort chamber is rotated such that the top of the retort chamber is lower than the bottom of the retort chamber.

10. The retort chamber of Claim 1, further comprising a desulfurization unit attached to one of the outlet ports.

11. The retort chamber of Claim 1, further comprising a cyclone unit attached to one of the outlet ports, wherein the cyclone unit is adapted to remove particulates from a gaseous product stream exiting the outlet port.

12. The retort chamber of Claim 1, further comprising a chilling or condensation unit attached to one of the outlet ports, which chilling or condensation unit is adapted to receive and cool a product stream that is in the gas phase at the temperature at which it enters the chilling or condensation unit, and, when cooled, at least a portion of the product stream is in the liquid phase.

13. The retort chamber of Claim 1, further comprising a vacuum line or aspirator.

14. The retort chamber of Claim 12, further comprising a vacuum line or aspirator, wherein the vacuum line or aspirator is attached to the chilling or condensation unit.

15. A process for thermally de-manufacturing tires and/or other materials, comprising:

a) loading the retort chamber of Claim 1 with tires and/or other materials,

b) purging the retort chamber of volatiles and air, such that a vacuum in the range of between approximately -0.8 and -200 millibars is present in the retort chamber,

c) heating a portion of the tires and/or other materials at or near the bottom of the retort chamber to a temperature between about 900 and 1300°C, and

d) thermally depolymerizing the tires and/or other materials to form a product stream which exits the retort chamber through an outlet port, which product stream is in the gas phase while exiting the retort chamber,

while maintaining the temperature in the zone where the products leave the retort chamber at a temperature between about 100 and 280°C.

16. The process of Claim 15, wherein the pressure is between about -6 and -8 millibars.

17. The process of Claim 15, wherein the temperature is maintained by adding water and/or air or oxygen through two or more inlet ports.

18. The process of Claim 15, wherein the material to be thermally de-manufactured comprises steel-belted tires, and wherein water reacts with the steel in the steel-belted tires at a temperature between about 900 and 1300°C to form hydrogen.

19. The process of Claim 18, wherein the tires comprise vulcanized rubber which comprises sulfur-sulfur and/or sulfur-carbon linkages, and the hydrogen breaks the sulfur-sulfur and/or sulfur-carbon linkages in the vulcanized rubber.

20. The process of Claim 15, further comprising subjecting the product stream to desulfurization conditions.

21. The process of Claim 15, further comprising subjecting the product stream to a cyclone to remove particulates.

22. The process of Claim 15, wherein the product stream comprises one or more products which are liquid at room temperature and atmospheric pressure, and one or more products which are gaseous at room temperature and atmospheric pressure,

further comprising subjecting the product stream to a chiller or condenser unit, so as to condense a portion of the products which are liquid at room temperature and atmospheric pressure.

23. The process of Claim 15, wherein the tires and/or other material being thermally de-manufactured undergo a thermal depolymerization reaction in that part of the reactor between where the temperature is between about 900 and about 1300°C, and where the temperature is between about 100 and about 280°C.

24. The process of Claim 23, wherein the material being thermally de-manufactured comprises tires, and tires being burned at or near the bottom of the reactor provide heat energy for the thermal depolymerization step.

25. The process of Claim 23, wherein the product composition varies as the temperature of the product stream varies from about 100 to about 280°C, with relatively more of the product composition having a relatively low molecular weight as the temperature is relatively higher, and relatively more of the product composition having a relatively high molecular weight as the temperature is relatively lower.

26. The process of Claim 25, wherein the temperature of the thermal depolymerization step, and, accordingly, the product composition, is controlled by adjusting the amount of water and/or air or oxygen through two or more inlet ports.

27. The process of Claim 15, wherein, after the thermal depolymerization step is complete, the retort chamber is cooled by introducing water into the retort chamber through an inlet port at or near the top of the retort chamber and/or an inlet port at or near the bottom of the retort chamber.