Amended claims (clean)

1. Method for depolymerising polymers into one or more monomers, comprising:
   (a) providing a fluidised reactor system comprising a pyrolysis chamber (2), a combustion chamber (12), and bed material that circulates from the combustion chamber (12) to the pyrolysis chamber (2) via a transport zone (30); and
   (b) inputting a feedstock comprising 60% or more polymers by weight of the feedstock into the pyrolysis chamber (2) and executing a pyrolysis process at a temperature in the range of from 450 to 650°C in the bed material to obtain a depolymerised polymer product gas comprising the monomers; wherein upon circulating the bed material sufficient heat is transferred from the combustion chamber (12) to the pyrolysis chamber (2) to execute the pyrolysis process.

2. The method according to claim 1, wherein the feedstock comprises predominately one or more of polystyrene, polyvinylchloride, polymethyl methacrylate or polytetrafluorethylene.

3. The method according to claim 1, wherein the feedstock comprises 60 – 100 % polystyrene, by weight of the total polymers in the feedstock.

4. The method according to any preceding claim, wherein:
   - in the combustion chamber a combustion process is executed at a temperature in the range of from 30 to 130°C higher than the pyrolysis process, preferably 30 to 70°C; and/or
   - the temperature difference between the combustion chamber (12) and the pyrolysis chamber (2) is increased by decreasing the circulation rate of the bed material, and wherein the temperature difference between the combustion chamber (12) and the pyrolysis chamber (2) is decreased by increasing the circulation rate of the bed material, preferably wherein the circulation rate of the bed material is from 10 to 100 kg bed material circulated per kg feedstock, more preferably 20 to 60 kg per kg.

5. The method according to any preceding claim, wherein fluidisation gas is transferred into the transport zone (30), typically from a product recovery unit (40) of the fluidised reactor system, to control the circulation rate of the bed material, optionally at more than one region, preferably wherein the temperature difference between the combustion chamber (12) and the pyrolysis chamber (2) is increased or decreased by changing the ratio of fluidisation gas transferred into a first region of the transport zone relative to a second region of the transport zone.

6. The method according to any preceding claim, wherein the transport zone (30) comprises a first region (32) to allow the downflow of bed material from the combustion chamber (12) and a second region (34) to allow the upflow of bed material to the pyrolysis chamber (2),

preferably wherein fluidisation gas is transferred into an upstream portion (36) of the second region (34) and into a downstream portion (35) of the second region (34), preferably wherein the velocity of the fluidisation gas in the upstream portion (36) and/or downstream portion (35) is from 0.5 to 3 m/s, preferably from 1 to 2.5 m/s, even more preferably 2 m/s.

7. The method according to claim 5 or 6, wherein the velocity of the fluidisation gas in the transport zone (30) is from 0.5 to 3 m/s, preferably from 1 to 2.5 m/s.

8. The method according to any preceding claim, wherein fluidisation gas is transferred into the pyrolysis chamber (2), typically from a product recovery unit (40) of the fluidised reactor system, to control the circulation rate of the bed material, preferably wherein the velocity of the fluidisation gas in the pyrolysis chamber (2) is from 3 to 7 m/s, preferably from 4 to 6 m/s.

9. The method according to any preceding claim, further comprising (c) transferring the depolymerised polymer product gas into a product recovery unit (40) and isolating the one or more monomers, optionally wherein one or more of the following applies:
   - non-condensable gas and/or an energy source is isolated from the depolymerised polymer product gas;
   - at least a portion of the non-condensable gas and/or energy source that is isolated from the depolymerised polymer product gas is transferred to the combustion chamber (12);
   - flue gas from the combustion chamber (12) and at least a portion of the non-condensable gas and/or the energy source that is isolated from the depolymerised polymer product gas is transferred from the product recovery unit (40) to a heat recovery system, wherein the heat recovery system comprises an afterburner (58), preferably wherein from 40 to 75% of the non-condensable gas by weight of the total non-condensable gas is transferred to the heat recovery system, preferably 60 to 70%;
   - at least a portion of the non-condensable gas and/or the energy source that is isolated from the depolymerised polymer product gas is transferred to the pyrolysis chamber (2) to fluidise the pyrolysis chamber, preferably wherein olefins present in the non-condensable gas and/or the energy source are hydrogenated prior to being transferred to the pyrolysis chamber (2);
   - at least a portion of the non-condensable gas and/or the energy source that is isolated from the depolymerised polymer product gas is used for the production of chemicals, preferably hydrogen and/or olefins;
   - dimers and trimers are isolated from the depolymerised polymer product gas and transferred the dimers and trimers to the pyrolysis chamber (2).

10. The method according to any preceding claim, wherein non-condensable gas and/or an energy source is isolated from the depolymerised polymer product gas, and wherein flue gas from the combustion chamber (12) and 40 to 75%, preferably 60 to 70%, of the non-

condensable gas and/or the energy source, by weight of the total non-condensable gas and/or the energy source from the product recovery unit (40) to a heat recovery system, wherein the heat recovery system comprises an afterburner (58).

11. The method according to any preceding claim, wherein the combustion chamber (12) is run sub-stoichiometrically.

12. The method according to any preceding claim, wherein the feedstock is provided as flakes with a thickness of from 0.25 to 3mm, and/or
wherein at least 50% of the feedstock is provided as flakes, preferably at least 75%, even more preferably at least 90%.

13. Use of a fluidised reactor system comprising a pyrolysis chamber (2), a combustion chamber (12), and bed material that circulates from the combustion chamber (12) to the pyrolysis chamber (2) via a transport zone (30), for depolymerising polymers in a feedstock comprising 60% or more polymers by weight of the feedstock into one or more monomers.

14. Use of the fluidised reactor system according to claim 13, wherein one or more of the following applies:
    - a pyrolysis process is executed at a temperature in the range of from 450 to 650°C in the bed material to obtain the depolymerised polymer product gas comprising the monomers;
    - a temperature difference between the combustion chamber and the pyrolysis chamber is regulated by changing the ratio of fluidisation gas transferred into a first region of the transport zone relative to a second region of the transport zone;
    - a temperature difference between the combustion chamber and the pyrolysis chamber is increased or decreased by changing the circulation rate of the bed material.