CLAIMS

1. A process for upgrading refinery heavy residues to petrochemicals, comprising the following steps of:

(a) separating a hydrocarbon feedstock in a distillation unit into an overhead stream and a bottom stream,

(b) feeding said bottom stream to a hydrocracking reaction area,

(c) separating reaction products, which are generated from said reaction area of step (b) into a stream rich in mono-aromatics and in a stream rich in poly-aromatics,

(d) feeding said stream rich in mono-aromatics to a gasoline hydrocracker (GHC) unit, wherein the process conditions prevailing in said gasoline hydrocracker (GHC) unit are a reaction temperature of 300-580 °C, a pressure of 0.3-5 MPa gauge and a Weight Hourly Space Velocity (WHSV) of 0.1-10 h-1, and separating reaction products of said GHC into an overhead gas stream, comprising C2-C4 paraffins, hydrogen and methane and a bottom stream comprising aromatic hydrocarbon compounds and non-aromatic hydrocarbon compounds,

(e) feeding said stream rich in poly-aromatics to a ring opening reaction area, wherein the process conditions prevailing in said reaction area for ring opening are a temperature from 100 ºC to 500 ºC and a pressure from 2 to 10 MPa together with from 50 to 300 kg of hydrogen per 1,000 kg of feedstock over an aromatic hydrogenation catalyst and passing the resulting stream to a ring cleavage unit at a temperature from 200 ºC to 600 ºC and a pressure from 1 to 12 MPa together with from 50 to 200 kg of hydrogen per 1,000 kg of said resulting stream over a ring cleavage catalyst,

(f) feeding the overhead stream from the gasoline hydrocracker (GHC) unit into a steam cracker unit.

2. The process as set forth in claim 1, further comprising pretreating said stream rich in poly-aromatics of step (b) in an aromatics extraction unit, from which aromatics extraction unit its bottom stream is fed into said reaction area for ring opening and its overhead stream is fed into said steam cracker unit.

3. The process as set forth in any one of claims 1-2 further comprising feeding the heavy fraction of reaction products formed in the reaction area for ring opening into the gasoline hydrocracker (GHC) unit.

4. The process as set forth in any one of claims 1-3, further comprising feeding the light fraction of reaction products formed in the reaction area for ring opening into said steam cracker unit.

5. The process as set forth in claim 2, wherein said aromatics extraction unit is of the type of a distillation unit.

6. The process as set forth in claim 2, wherein said aromatics extraction unit is of the type of a solvent extraction unit, especially wherein in said solvent extraction unit its overhead stream is washed for removal of solvent, wherein the thus recovered solvent is returned into said solvent extraction unit and the overhead stream thus washed being fed into said steam cracker unit.

7. The process as set forth in claim 2, wherein said aromatics extraction unit is of the molecular sieve type.

8. The process as set forth in any one of claims 1-7, further comprising pretreating said bottom stream from said distillation unit of step (a) in a vacuum distillation unit, in which vacuum distillation unit said feed is separated in an overhead stream and a bottom stream, and feeding said bottom stream into said hydrocracking area of step (b).

9. The process as set forth in claim 8, further comprising pretreating said stream rich in poly-aromatics of step (b) in an aromatics extraction unit, from which aromatics extraction unit its bottom stream is fed into said reaction area for ring opening and its overhead stream is fed into said steam cracker unit,

further comprising feeding said overhead stream from said vacuum distillation unit to said aromatics

extraction unit or to said reaction area for ring opening, or a combination thereof.

10. The process as set forth in any one of claims 1-9, further comprising feeding said overhead stream of said distillation unit of step (a) to a separation section, in which separation section said overhead stream being separated in a stream rich in aromatics and a stream rich in paraffins.

11. The process as set forth in claim 10, further comprising feeding said stream rich in paraffins to said steam cracker unit.

12. The process as set forth in claim 10, further comprising feeding said stream rich in aromatics to said gasoline hydrocracker (GHC) unit of step (c).

13. The process as set forth in any one of the claims 2-12, further comprising feeding the overhead stream from the aromatics extraction unit into an isomerization unit and feeding the thus isomerized stream to said steam cracking unit.

14. The process as set forth in any one of the claims 10-13, further comprising feeding said stream rich in paraffins coming from the separation section

into an isomerization unit and feeding the thus isomerized stream to said steam cracking unit.

15. The process as set forth in any one of the claims 1-14, further separating C2-C4 paraffins from the gaseous stream sent to the steam cracker unit and,

feeding said C2-C4 paraffins thus separated from the gaseous stream to the furnace section of a steam cracker unit.

16. The process according to claim 15, further comprising separating C2-C4 paraffins in individual streams, each stream predominantly comprising C2 paraffins, C3 paraffins and C4 paraffins, respectively, and feeding each individual stream to a specific furnace section of said steam cracker unit.

17. The process as set forth in any one of the claims 1-16, further comprising partly feeding the gaseous stream sent to the steam cracker unit to a dehydrogenation unit, wherein it is preferred to send only the C3-C4 fraction to the dehydrogenation unit, especially as separate C3 and C4 streams, more preferably as a combined C3 + C4 stream.

18. The process as set forth in any one of the claims 1-17, further comprising separating reaction products of said steam cracking in an overhead stream comprising C2 - C6 alkanes, a middle stream, comprising C2=, C3= and C4=, and a bottom stream, comprising aromatic hydrocarbon compounds, non-aromatic hydrocarbon compounds and C9+, especially further comprising separating said bottom stream into a stream comprising aromatic hydrocarbon compounds and non-aromatic hydrocarbon compounds and a stream comprising C9+, carbon black oil (CBO) and cracked distillates (CD).

19. The process as set forth in claim 18, further comprising returning said overhead stream to said steam cracking unit.

20. The process as set forth in claim 18, further comprising feeding said C9+, carbon black oil (CBO) and cracked distillates (CD) containing bottom stream into said reaction area for ring opening.

21. The process as set forth in claim 18, further comprising feeding said C9+, carbon black oil (CBO) and cracked distillates (CD) containing bottom stream into said hydrocracking reaction area.

22. The process as set forth in claim 18, further comprising feeding said bottom stream comprising aromatic hydrocarbon compounds and non-aromatic hydrocarbon compounds into said gasoline hydrocracker (GHC) unit.

23. The process as set forth in any one of claims 1-22, further comprising separating said bottom stream from reaction products of said gasoline hydrocracker (GHC) unit in a BTX rich fraction and in heavy fraction.

24. The process as set forth in any one of the claims 1-23, further comprising recovering hydrogen from the reaction products of said steam cracking unit and feeding the hydrogen thus recovered to said gasoline hydrocracker (GHC) unit, said hydrocracking reaction area and/or said reaction area for ring opening, especially further comprising partly feeding the gaseous stream sent to the steam cracker unit to a dehydrogenation unit and recovering hydrogen from said dehydrogenation unit and feeding the hydrogen thus recovered to said gasoline hydrocracker (GHC) unit, said hydrocracking reaction area and/or said reaction area for ring opening.

25. The process as set forth in any one or more of the claims 1-24, further comprising returning a high content poly aromatics stream from the reaction area for ring opening (e) to said hydrocracking area of step (b).

26. The process as set forth in any one or more of the claims 1-25, further comprising feeding a high content mono aromatics stream from the reaction area for ring opening to said gasoline hydrocracker (GHC) unit.

27. The process as set forth in any one of claims 1-26, wherein the process conditions prevailing in said gasoline hydrocracker (GHC) unit are a reaction temperature of 450-580 °C, preferable of 470-550 °C, a pressure of 0.6-3 MPa gauge, preferable at a pressure of 1-2 MPa gauge, most preferable at a pressure of 1.2-1.6 MPa gauge, a Weight Hourly Space Velocity (WHSV) of 0.2-6 h-1, preferable of 0.4-2 h-1.

28. The process as set forth in any one of claims 1-27, wherein the process conditions prevailing in said steam cracking unit are a reaction temperature around 750-900 °C, residence times of 50-1000 milliseconds and a pressure selected of atmospheric up to 175 kPa gauge.

29. The process as set forth in any one of claims 1-28, wherein the process conditions prevailing in said hydrocracking area of step (b) are a temperature of 300-580 °C, a pressure of 300-5000 kPa gauge and a Weight Hourly Space Velocity of 0.1-10 h-1, preferable a temperature of 300-450 °C, a pressure of 300-5000 kPa gauge and a Weight Hourly Space Velocity of 0.1-10 h-1, more preferable a

temperature of 300-400 °C, a pressure of 600-3000 kPa gauge and a Weight Hourly Space Velocity of 0.2-2 h-1.

30. The process as set forth in any one of claims 1-29, wherein the hydrocarbon feedstock of step (a) is chosen form the group crude oil, kerosene, diesel, atmospheric gas oil (AGO), gas condensates, waxes, crude contaminated naphtha, vacuum gas oil (VGO), vacuum residue, atmospheric residue, naphtha and pretreated naphtha, or a combination thereof.

31. The process as set forth in any one of claims 1-30, wherein the overhead stream from the distillation unit is sent to said steam cracker unit.

32. The process as set forth in any one of claims 1-31, wherein the overhead stream from the distillation unit is sent to said gasoline hydrocracker (GHC) unit.

33. The process as set forth in any one of claims 1-32, wherein a middle stream from the distillation unit is sent to said ring opening reaction area.