

CLAIMS

1. Process to prepare propylene from a mixture of hydrocarbons having an olefin content of between 5 and 50 wt.% and boiling for more than 90 vol.% between 35 and 280 °C or from a hydrocarbon feed comprising paraffins, naphthenics and/or aromatics and optionally up to 10 wt.% of olefins, wherein the process comprises the following steps:
 - (a) feeding the mixture of hydrocarbons optionally in admixture with a recycle stream and having a temperature between 450 and 750 °C to a reactor where the feed is contacted with a low acidic density cracking catalyst at a hydrocarbon partial pressure of below 3 bar and at a weight hourly space velocity of between 0.5 and 100 h⁻¹,
 - (b) isolating propylene and optionally other low boiling compounds from the effluent of step (a) wherein a first high boiling fractions remains,
 - (c) feeding all or part of the first high boiling fraction optionally in admixture with a recycle stream and having a temperature between 400 and 750 °C to a reactor where the first high boiling fraction is contacted with a high acidic density cracking catalyst at a hydrocarbon partial pressure of below 3 bar and at a weight hourly space velocity of between 0.5 and 100 h⁻¹ and wherein the temperature of the mixture of hydrocarbons optionally in admixture with a recycle stream as fed to the reactor in step (a) is lower than the temperature of the first high boiling fraction optionally in admixture with a recycle stream as fed to the reactor in step (c),
 - (d) isolating propylene and optionally other low boiling compounds from the effluent of step (c) wherein a second high boiling fractions remains, and
 - (e) recycling all or part of the second high boiling fraction to step (a) and/or to step (c) as the optional recycle stream.
2. Process according to claim 1, wherein the weight hourly space velocity in step (a) is greater than the weight hourly space velocity in step (c).
3. Process according to any one of claims 1-2, wherein part of the first high boiling fraction and/or all or part of the second high boiling fraction is contacted in a step (f) with hydrogen in the presence of an aromatic conversion catalyst as present in a reactor to obtain a fraction rich in aromatics and wherein all or part of the fraction rich in aromatics is recycled to step (c) as an optional recycle stream and/or to step (f).

4. Process according to claim 3, wherein contacting in step (f) takes place at a temperature of between 400 and 700 °C, at a weight hourly space velocity of between 0.1 and 50 h⁻¹, a hydrocarbon partial pressure below 10 bar and a hydrogen partial pressure below 10 bars.
5. Process according to any one of claims 3-4, wherein the aromatic conversion catalyst is a heterogenous catalyst comprising ZnO, a medium pore zeolite and a binder.
6. Process according to any one of claims 1-5, wherein the low acidic density catalyst is an amorphous catalyst.
7. Process according to any one of claims 1-5, wherein the low acidic density catalyst in step (a) is a heterogenous catalyst comprising a medium or large pore zeolite having a silica to alumina ratio of between 2 and 1000.
8. Process according to claim 7, wherein the heterogenous catalyst comprises up to 70 wt.% ZSM-5, between 1-20 wt.% P₂O₅ and a binder.
9. Process according to claim 8, wherein the heterogenous catalyst comprises between 25 and 80 wt.% ZSM-5.
10. Process according to any one of claims 1-8, wherein the weight hourly space velocity in step (a) is between 0.5 and 50 h⁻¹.
11. Process according to any one of claims 1-9, wherein the high acidic density catalyst in step (c) is a heterogenous catalyst comprising up to 80 wt.% ZSM-5 having a silica to alumina ratio of between 2 and 1000, between 1-20 wt.% P₂O₅ and a binder.
12. Process according to any one of claims 7-10 and claim 11, wherein the silica to alumina ratio of the high acidic density catalyst is lower than the silica alumina ratio of the low acidic density catalyst.
13. Process according to claim 12, wherein the heterogenous catalyst comprises between 35 and 50 wt.% ZSM-5.

14. Process according to any one of claims 1-13, wherein the weight hourly space velocity in step (c) is between 1 and 50 h⁻¹.
15. Process according to any one of claims 1-14, wherein the hydrocarbon partial pressure excluding aromatics in steps (a) and (c) is below 1 bar.
16. Process according to any one of claims 1-15, wherein the mixture of hydrocarbons comprises a fraction as isolated from the effluent of a Fluid Catalytic Cracking process and/or isolated from the effluent of a steam cracker process.
17. Process according to any one of claims 1-16, wherein the content of aromatic compounds in the hydrocarbon mixture including optional recycle streams as fed to the reactor in step (c) is between 10 and 80 wt. %.
18. Process according to any one of claims 1-17, wherein part of the second high boiling fraction as obtained in step (d) is recycled to step (c) as the recycle stream.
19. Process according to 18, wherein in step (d) propylene and other low boiling compounds are isolated from the effluent of step (c) in a debutanizer distillation column which is operated under partial vacuum and wherein the second high boiling fraction is obtained as a bottom product of the debutanizer distillation column.
20. Process to prepare propylene from a hydrocarbon starting feed comprising paraffins, naphthenics and/or aromatics and optionally up to 10 wt.% of olefins by adding aromatic compounds to the hydrocarbon starting feed resulting in an upgraded feed containing between 10 and 70 wt% and wherein the upgraded feed is catalytically cracked in the presence of an acidic cracking catalyst to propylene and other reaction products.
21. Process according to claim 20, wherein the upgraded feed contains between 20 and 50 wt% aromatic compounds.
22. Process to prepare propylene from a hydrocarbon feed comprising paraffins, naphthenics and/or aromatics and optionally up to 10 wt.% of olefins wherein the process comprises the following steps:

- (aa) feeding the feed in admixture with a recycle stream and having a temperature of between 450 and 700 °C to a continuously operated reactor comprising a high acidic density cracking catalyst where the mixture is contacted with a high acidic density cracking catalyst at a hydrocarbon partial pressure, excluding aromatics, of below 3 bar and at a weight hourly space velocity of between 1 and 30 h⁻¹,
- (bb) isolating propylene and optionally other low boiling compounds from the effluent of step (aa) wherein a high boiling fractions remains,
- (cc) recycling part of the high boiling fraction to the reactor of step (aa) wherein the total content of aromatics in the combined mixture as fed to the reactor in step (aa) is maintained at between 5 and 50 wt.%, optionally by additionally feeding an aromatic comprising further hydrocarbon mixture to the reactor.
23. Process according to 22, wherein in step (bb) propylene and other low boiling compounds are isolated from the effluent of step (aa) in a distillation column which is operated under partial vacuum and wherein the high boiling fraction is obtained as a bottom product of the distillation column.
24. Process according to any one of claims 22-23, wherein the high acidic density catalyst in step (aa) is a heterogenous catalyst comprising up to 80 wt.% ZSM-5 having a silica to alumina ratio of between 2 and 1000, between 1-20 wt.% P₂O₅ and a binder.
25. Process according to any one of claims 22-24, wherein part of the high boiling fraction is contacted in a step (dd) with hydrogen in the presence of an aromatic conversion catalyst as present in a reactor to obtain a fraction rich in aromatics and wherein all or part of the fraction rich in aromatics is recycled to step (aa) as the further hydrocarbon mixture.
26. Process according to claim 25, wherein contacting in step (dd) takes place at a temperature of between 400 and 550 °C, at a weight hourly space velocity of between 0.5 and 5 h⁻¹, a hydrocarbon partial pressure below 10 bar and a hydrogen partial pressure below 10 bars.
27. Process according to any one of claims 25-26, wherein the aromatic conversion catalyst is a heterogenous catalyst comprising ZnO, a medium pore zeolite and a binder.
28. Process configuration suited to prepare propylene from an olefin comprising hydrocarbon mixture comprising

- (i) one or more parallel operated first reactors comprising an amorphous heterogeneous cracking catalyst or a heterogeneous cracking catalyst comprising a medium or large pore zeolite having a silica to alumina ratio of between 1 and 1000,
 - (ii) first distillation and/or flash separation units fluidly connected to the outlet of the one or more first reactors having at least an outlet for a propylene comprising fraction and an outlet for high boiling compounds,
 - (iii) means to recycle the high boiling compounds from the outlet of the distillation and/or flash separation units to the inlet of the one or more parallel operated first reactors,
 - (iv) one or more parallel operated second reactors comprising a heterogeneous cracking catalyst comprising up to 80 wt.% ZSM-5 having a silica to alumina ratio of between 2 and 1000, between 1-20 wt.% P_2O_5 and a binder and wherein the inlet of the second reactors are fluidly connected to the outlet for high boiling compounds of the first distillation and/or flash separation unit,
 - (v) second distillation and/or flash separation units fluidly connected to the outlet of the one or more second reactors of (iv) having at least an outlet for a propylene comprising fraction and an outlet for high boiling compounds,
 - (vi) means to recycle the high boiling compounds from the outlet of the second distillation and/or flash separation units to the inlet of the one or more parallel operated first reactors and to the inlet of the one or more parallel operated second reactors.
29. Process configuration according to claim 28, further comprising inlet means (vii) for a further hydrocarbon feed fluidly connected to the inlet of the one or more parallel second reactors.
30. Process configuration according to any one of claims 28-29, further comprising (viii) one or more parallel operated aromatic conversion reactors fluidly connected to the outlet for high boiling compounds of the second distillation and/or flash separation units and means to recycle part of the effluent of the aromatic conversion reactors to the inlet of the one or more first reactors, to the inlet of the one or more second reactors and to the inlet of the aromatics conversion reactors.
31. Process configuration according to claim 30, wherein the aromatic conversion reactors have an inlet for hydrogen and have a bed of a heterogeneous catalyst comprising ZnO , a medium pore zeolite and a binder.