

CLAIMS

What is claimed is –

1. A process for making olefins, said process comprising:

5 (a) cracking a cracker feed stream comprising a recycle content pyrolysis oil composition (r-pyoil) and predominantly propane or predominantly ethane in a cracker furnace to provide an olefin-containing effluent; and

(b) separating at least a portion of said olefin-containing effluent stream to provide a product stream comprising butadiene,

10 wherein, when the cracker feed stream comprises predominantly propane, the weight ratio of butadiene to propane in said product stream is higher than if said cracker feed stream did not include r-pyoil but had the same mass flow rate, all other conditions being the same, and

15 wherein, when the cracker feed stream comprises predominantly ethane, the weight ratio of butadiene to ethane in said product stream is higher than if said cracker feed stream did not include r-pyoil but had the same mass flow rate, all other conditions being the same.

2. A process for making olefins, said process comprising:

20 cracking a cracker feed stream comprising a recycle content pyrolysis oil composition (r-pyoil) and a stream comprising a stream comprising predominantly propane or predominantly ethane in a cracker furnace to provide an olefin-containing effluent,

25 wherein the weight ratio of butadiene in said olefin-containing effluent to said cracker feed stream is higher than if said cracker feed stream did not include r-pyoil but had the same mass flow rate, all other conditions being the same.

3. A process for making olefins, said process comprising:

30 (a) cracking a cracker feed stream comprising a recycle content pyrolysis oil composition (r-pyoil) and a stream comprising predominantly propane or predominantly ethane in a cracker furnace to provide an olefin-containing effluent comprising a recycle content olefin composition (r-olefin); and

(b) separating a column feed stream comprising at least a portion of said olefin-containing effluent stream in a depropanizer column to form an overhead stream enriched in propane and lighter components and a bottoms stream depleted in propane and lighter components,

5 wherein at least one of the following criteria (i) through (v) are true:

 (i) the ratio of the mass flow rate of said bottoms stream to the mass flow rate of said column feed stream is at least 0.1% higher than if said cracker feed stream did not include r-pyoil, all other conditions being the same;

 (ii) the mid-range boiling point of said bottoms stream is at least 0.1%
10 lower than if said cracker feed stream did not include r-pyoil but had the same mass flow rate, all other conditions being the same;

 (iii) the volumetric or mass flow rate of the liquid within said depropanizer is at least 0.1% higher than if said cracker feed stream did not include r-pyoil but had the same mass flow rate, all other conditions being the same;
15 same;

 (iv) the pressure differential across said depropanizer is at least 0.1% higher than if said cracker feed stream did not include r-pyoil but had the same mass flow rate, all other conditions being the same; and

 (v) the total diene content of said bottoms stream is at least 0.1% higher
20 than if said cracker feed stream did not include r-pyoil but had the same mass flow rate, all other conditions being the same.

4. A process for separating a column feed stream into one or more streams, said process comprising:

25 (a) introducing a column feed stream into a depropanizer column, wherein said column feed stream comprises a recycle content olefin composition (r-olefin);

 (b) separating a column feed stream into an overhead stream enriched in propane and lighter components and a bottoms stream enriched in C4 and heavier components,

30 wherein at least one of the following criteria (i) through (vi) are true:

 (i) the ratio of the mass flow rate of said bottoms stream to the mass flow rate of said column feed stream is at least 0.1% higher than if said column feed

stream did not include r-olefin but had the same mass flow rate, all other conditions being the same;

(ii) the column bottoms liquid temperature is at least 0.1% lower than if said column feed stream did not include r-olefin but had the same mass flow rate, all other conditions being the same;

(iii) the volumetric or mass flow rate of liquid said depropanizer is at least 0.1% higher than if said column feed stream did not include r-olefin but had the same mass flow rate, all other conditions being the same;

(iv) the pressure differential across said depropanizer is at least 0.1% higher than if said column feed stream did not include r-olefin but had the same mass flow rate, all other conditions being the same;

(v) the total diene content of said bottoms stream is at least 0.1% higher than if said column feed stream did not include r-olefin but had the same mass flow rate, all other conditions being the same; and

(vi) the total propane content of said bottoms stream is at least 0.1% lower than if said column feed stream did not include r-olefin but had the same mass flow rate, all other conditions being the same.

5. A composition comprising a recycle content hydrocarbon composition (r-hydrocarbon) formed according to any of claims 1-4.

6. A depropanizer bottoms stream comprising a recycle content butadiene and heavier hydrocarbon composition (r-C4+) formed according to any of claims 1-4.

7. The process or composition of any of claims 1-4, wherein the weight ratio of butadiene in the product stream to propane in the cracker feed stream is at least 0.001.

8. The process or composition of any of claims 1-4, wherein the weight ratio of butadiene in the product stream to ethane in the cracker feed stream is at least 0.001.

9. The process or composition of any of claims 1-4, the weight ratio of butadiene in said olefin-containing effluent to propane in said cracker feed stream is at least 0.1% than if said cracker feed stream did not include r-pyoil but had the same mass flow rate, all other conditions being the same.

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10. The process or composition of any of claims 1-4, the weight ratio of butadiene in said olefin-containing effluent to ethane in said cracker feed stream is at least 0.1% than if said cracker feed stream did not include r-pyoil but had the same mass flow rate, all other conditions being the same.

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11. The process or composition of any of claims 1-4, wherein the C4 and heavier components are present in the bottoms stream in an amount of at least 5 weight percent and/or not more than 95 weight percent, based on the total weight of the stream.

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12. The process or composition of any of claims 1-4, wherein the C4 and heavier components are present in the overhead stream in an amount of at least 0.01 weight percent and/or not more than 10 weight percent, based on the total weight of the overhead stream.

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13. The process or composition of any of claims 1-4, wherein the propane and lighter components are present in the overhead stream in an amount of at least 5 weight percent and/or not more than 95 weight percent, based on the total weight of the stream.

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14. The process or composition of any of claims 1-4, wherein the propane and lighter components are present in the bottoms stream in an amount of at least 0.01 weight percent and/or not more than 10 weight percent, based on the total weight of the stream.

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15. The process or composition of any of claims 1-4, wherein the overhead stream comprises at least 50 percent by weight of the total amount of propane and lighter components introduced into the column in the feed stream.

16. The process or composition of any of claims 1-4, wherein the bottoms stream comprises at least 50 percent by weight of the total amount of C4 and heavier components introduced into the column in the feed stream.

5 17. The process or composition of any of claims 1-4, wherein the overhead stream comprises not more than 50 percent by weight of the total amount of C4 and heavier components introduced into the column in the feed stream.

10 18. The process or composition of any of claims 1-4, wherein the bottoms stream comprises not more than 50 percent by weight of the total amount of propane and lighter components introduced into the column in the feed stream.

15 19. The process or composition of any of claims 1-4, wherein said r-olefin composition comprises predominantly propylene.

20 20. The process or composition of any of claims 1-4, wherein said r-olefin composition comprises predominantly ethylene.

25 21. The process or composition of any of claims 1-4, wherein r-olefin composition is present in the feed stream in an amount of at least 5 and/or not more than 99 weight percent, based on the total weight of the feed stream.

30 22. The process or composition of any of claims 1-4, wherein at least a portion of the separating is carried out in a debutanizer, wherein the debutanizer separates a feed stream into an overhead stream enriched in butane and lighter components and a bottoms stream enriched in C5 and heavier components.

35 23. The process or composition of claim 22, wherein the C5 and heavier components are present in the bottoms stream in an amount of at least 5 weight percent and/or not more than 95, weight percent, based on the total weight of the stream.

24. The process or composition of any of claims 22 or 23, wherein the C5 and heavier components are present in the overhead stream in an amount of at least 0.01 weight percent and/or not more than 10 weight percent, based on the total weight of the overhead stream.

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25. The process or composition of any of claims 22-24, wherein the butane and lighter components are present in the overhead stream in an amount of at least 5 weight percent and/or not more than 95 weight percent, based on the total weight of the stream.

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26. The process or composition of any of claims 22-25, wherein the butane and lighter components are present in the bottoms stream in an amount of at least 0.01 weight percent and/or not more than 10 weight percent, based on the total weight of the stream.

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27. The process or composition of any of claims 22-26, wherein the overhead stream comprises at least 50 percent by weight of the total amount of butane and lighter components introduced into the column in the feed stream.

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28. The process or composition of any of claims 22-27, wherein the bottoms stream comprises at least 50 percent by weight of the total amount of C5 and heavier components introduced into the column in the feed stream.

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29. The process or composition of any of claims 22-28, wherein the overhead stream comprises not more than 50 percent by weight of the total amount of C5 and heavier components introduced into the column in the feed stream.

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30. The process or composition of any of claims 22-29, wherein the bottoms stream comprises not more than 50 percent by weight of the total amount of butane and lighter components introduced into the column in the feed stream.

31. The process or composition of any of claims 1-4, wherein the weight ratio of butadiene in said product stream to propane in said cracker feed stream is at least 0.1% higher than if said furnace feed stream did not include said r-pyoil but had the same mass flow rate, all other conditions being the same.

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32. The process or composition of any of claims 1-4, wherein the ratio of the mass flow rate of said bottoms stream to the mass flow rate of said column feed stream is at least 0.1% higher than if said cracker feed stream did not include r-pyoil but had the same mass flow rate, all other conditions being the same.

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33. The process or composition of any of claims 1-4, wherein the mid-range boiling point of said bottoms stream is at least 0.1% higher than if said cracker feed stream did not include r-pyoil but had the same mass flow rate, all other conditions being the same.

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34. The process or composition of any of claims 1-4, wherein the liquid volumetric or mass flow rate within said depropanizer is at least 0.1% higher than if said cracker feed stream did not include r-pyoil but had the same mass flow rate, all other conditions being the same.

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35. The process or composition of any of claims 1-4, wherein the pressure differential across said depropanizer is at least 0.1% higher than if said cracker feed stream did not include r-pyoil but had the same mass flow rate, all other conditions being the same.

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36. The process or composition of any of claims 1-4, wherein the total diene content of said bottoms stream is at least 0.1% higher than if said cracker feed stream did not include r-pyoil but had the same mass flow rate, all other conditions being the same.

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37. The process or composition of any of claims 1-4, wherein the ratio of the mass flow rate of said bottoms stream to the mass flow rate of said column feed

stream is at least 0.1% higher than if said column feed stream did not include r-C2 to C4 olefin but had the same mass flow rate, all other conditions being the same.

38. The process or composition of any of claims 1-4, wherein the column bottoms liquid temperature is at least 0.1% higher than if said column feed stream did not include r-olefin but had the same mass flow rate, all other conditions being the same.

39. The process or composition of any of claims 1-4, wherein the column bottoms liquid temperature of the depropanizer is at least at least 20, or at least 25, or at least 30, or at least 35, or at least 40, in each case °C and/or not more than 60, or not more than 65, or not more than 60, or not more than 55, or not more than 50, in each case °C.

40. The process or composition of any of claims 1-4, wherein the liquid flow rate within said depropanizer is at least 0.1% higher than if said column feed stream did not include r-olefin but had the same mass flow rate, all other conditions being the same.

41. The process or composition of any of claims 1-4, wherein the pressure differential across said depropanizer is at least 0.1% higher than if said column feed stream did not include r-olefin but had the same mass flow rate, all other conditions being the same.

42. The process or composition of any of claims 1-4, wherein the pressure differential across said depropanizer is at least 50 kPa.

43. The process or composition of any of claims 1-4, wherein the total diene content of said bottoms stream is at least 0.1% higher than if said column feed stream did not include r-olefin but had the same mass flow rate, all other conditions being the same.

44. The process or composition of any of claims 1-4, wherein the total content of cyclopentadiene and/or dicyclopentadiene said bottoms stream is at least 0.1 higher than if said column feed stream did not include r-olefin but had the same mass flow rate, all other conditions being the same.

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45. The process or composition of any of claims 1-4, wherein the total content of butadiene said bottoms stream is at least 0.1% higher than if said column feed stream did not include r-olefin but had the same mass flow rate, all other conditions being the same.

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46. The process or composition of any of claims 1-4, wherein the total dicyclopentadiene and/or cyclopentadiene content of said bottoms stream is at least 0.01 and/or not more than 1 weight percent, based on the total weight of the bottoms stream.

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47. The process or composition of any of claims 1-4, wherein the total butadiene content of said bottoms stream is at least 0.01 and/or not more than 1 weight percent, based on the total weight of the bottoms stream.

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48. The process or composition of any of claims 1-4, wherein the total amount of propane and lighter components in said bottoms stream is least 0.1% higher than if said column feed stream did not include r-olefin but had the same mass flow rate, all other conditions being the same.

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49. The process or composition of any of claims 1-4, wherein said furnace feed stream comprises predominantly propane.

50. The process or composition of claim 49, wherein said propane is non-recycle content propane.

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51. The process or composition of claim 49, wherein said propane comprises a recycle content propane composition (r-propane).

52. The process or composition of any of claims 1-4, wherein said furnace feed stream comprises predominantly ethane.

53. The process or composition of any of claims 1-4, wherein said propane is non-recycle content ethane.

54. The process or composition of any of claims 1-4, wherein said propane comprises a recycle content propane composition (r-ethane).

55. The process or composition of any of claims 1-4, wherein said furnace feed stream comprises predominantly C5 to C22 hydrocarbon composition.

56. The process or composition of any of claims 1-4, wherein said propane is non-recycle content C5 to C22.

57. The process or composition of any of claims 1-4, wherein said propane comprises a recycle content C5 to C22 composition (r-C5 to C22).

58. The process or composition of any of claims 1-4, prior to said cracking, introducing a first feed stream comprising a C2 to C4 hydrocarbon composition and a second feed stream comprising said r-pyol separately into the cracking furnace.

59. The process or composition of any of claims 1-4, wherein said introducing includes introducing said first cracker feed stream into a first coil of said cracker furnace and introducing said second cracker feed stream into a second coil of said cracker furnace, and separately cracking said first and second feed streams during said cracking.

60. The process or composition of any of claims 1-4, wherein said introducing includes combining said first and said second feed stream to form a combined cracker feed, and cracking said combined cracker feed during said cracking of step (b).