CLAIMS

What is claimed is:

1. A process for steam cracking a hydrocarbon material in a steam cracking furnace including a tube comprising a convection section, a cross-over section downstream of the convection section, and a heated radiant section downstream of the cross-over section, comprising:

feeding the hydrocarbon material and steam into the convection section to obtain a mixture comprising the hydrocarbon material and the steam;

heating the mixture comprising the hydrocarbon material and the steam in the convection section to obtain a first fluid stream at a temperature T1 at the end of the convection section;

passing the first fluid stream through the cross-over section to obtain a second fluid stream at the end of the cross-over section at a temperature T2;

passing the second fluid stream through the radiant section to obtain a cracked fluid mixture at the end of the radiant section at a temperature T3, wherein:

T3 is higher than T2 and T1; and

T1 and T2 are selected such that significant cracking reaction occurs at least in a portion of the convection section and at least a portion of the cross-over section;

the hydrocarbon material comprises one or more olefins at a total concentration of C0 mol% based on the total moles of the fluid species in the hydrocarbon material;

the second fluid stream comprises one or more olefins at a total concentration of C2 mol% based on the total moles of the fluid species therein; and

$C2 - C0$ is ≥ 5.

2. The process of claim 1, wherein:

the first fluid stream comprises one or more olefins at a total concentration of C1 mol% based on the total moles of the fluid species therein, and

$C1 - C0$ is ≥ 1.

3. The process of claim 2, wherein:

$C2 - C1$ is ≥ 1.

4. The process of claim 1, wherein the hydrocarbon material comprises ethane at a concentration of at least 50 mol% based on the total moles of hydrocarbons in the hydrocarbon material, and T1 is in a range from 1300°F to 1435°F .

5. The process of claim 4, wherein T2 is in a range from 1275°F to 1430°F .

6. The process of claim 4, wherein T3 is in a range from 1500°F to 1800°F .

7. The process of claim 4, wherein a total concentration of C5 and C6 olefins and benzene in the cracked fluid mixture is in a range from 1 mol% to 8 mol%, based on a total moles of species therein.

8. The process of claim 4, wherein an overall conversion of ethane in the steam cracking furnace is in a range from 60% to 75%.

9. The process of claim 1, wherein the hydrocarbon material comprises propane at a concentration of at least 50 mol% based on the total moles of hydrocarbons in the hydrocarbon material, and T1 is in a range from 1200°F to 1415°F.

10. The process of claim 9, wherein T2 is in a range from 1175°F to 1410°F.

11. The process of claim 9, wherein T3 is in a range from 1525°F to 1800°F.

12. The process of claim 9, wherein an overall conversion of propane in the steam cracking furnace is in a range from 80% to 96%.

13. The process of claim 1, wherein the hydrocarbon material comprises butane at a concentration of at least 50 mol% based on the total moles of hydrocarbons in the hydrocarbon material, and T1 is in a range from 1150°F to 1400°F.

14. The process of claim 13, wherein T2 is from 25°F to 150°F lower than T1.

15. The process of claim 13, wherein T3 is in a range from 1475°F to 1700°F.

16. The process of claim 13, having a severity index in the cracked fluid mixture in a range from 0.50 to 1.65.

17. The process of claim 1, wherein the hydrocarbon material comprises naphtha at a concentration of at least 50 mol% based on the total moles of the hydrocarbon material, and T1 is in a range from 1150°F to 1250°F.

18. The process of claim 17, wherein T2 is in a range from 1125°F to 1245°F.

19. The process of claim 17, wherein T3 is in a range from 1450°F to 1600°F.

20. The process of claim 17, having a severity index in the cracked fluid mixture in a range from 0.50 to 1.25.

21. The process of claim 1, wherein the hydrocarbon material comprises a gas oil at a concentration of at least 50 mol% based on the total moles of hydrocarbons in the hydrocarbon material, and T1 is in a range from 1060°F to 1160°F.

22. The process of claim 21, wherein T2 is in a range from 1035°F to 1155°F.

23. The process of claim 21, wherein T3 is in a range from 1375°F to 1525°F.

24. The process of claim 21, having a severity index in the cracked fluid mixture in a range from 0.8 to 2.4.

25. A process for steam cracking a hydrocarbon, comprising:

introducing a hydrocarbon and steam into a convection section of a steam cracking furnace to produce a mixture comprising the hydrocarbon and the steam, wherein the mixture comprising the hydrocarbon and the steam has a first concentration of olefins;

heating the mixture comprising the hydrocarbon and the steam in the convection section to produce a first cracked mixture having a second concentration of olefins;

heating the first cracked mixture in a cross-over section of the steam cracking furnace to produce a second cracked mixture having a third concentration of olefins; and

heating the second cracked mixture in a radiant section of the steam cracking furnace to produce a third cracked mixture having a fourth concentration of olefins, wherein:

the second concentration of olefins is greater than the first concentration of olefins,

the third concentration of olefins is greater than the second concentration of olefins,

the fourth concentration of olefins is greater than the third concentration of olefins, and

the third concentration of olefins is at least 5 mol% greater than the first concentration of olefins.