CLAIMS

What Is Claimed Is:

1. A method for treating gaseous effluent from a hydrocarbon pyrolysis unit, the method comprising:

(a) cooling said gaseous effluent at least to a temperature at which tar, formed by reaction among constituents of the effluent, condenses;

(b) passing the mixed gaseous and liquid effluent from step (a) through at least one vapor-liquid separator, where the condensed tar separates from the gaseous effluent;

(c) cooling the gaseous effluent from step (b) to condense a liquid effluent quench oil;

(d) passing at least a portion of the effluent from step (c) through at least one rectifier comprising a reflux inlet for introducing a pyrolysis gasoline fraction;

(e) cooling the gaseous effluent from step (d) to condense a liquid effluent comprising pyrolysis gasoline and water condensed from steam;

(f) treating the mixed gaseous and liquid effluent from step (e) to at least partially separate therefrom a liquid pyrolysis gasoline rich stream; and

(g) passing at least a portion of the liquid pyrolysis gasoline rich stream as reflux to said rectifier.

2. The method of claim 1, wherein the gaseous effluent is cooled in step (a) to a temperature of less than about 371°C (700°F), cooled in step (c) to a temperature of less than about 316°C (600°F), and cooled in step (e) to a temperature of less than about 104°C (220°F).

3. The method of claim 1, wherein the gaseous effluent is cooled in step (a) to a temperature ranging from about 232° to about 316°C (450 to 600°F), cooled in step (c) to a temperature ranging from about 93° to about 232°C (200° to 450°F), and cooled in step (e) to a temperature ranging from about 15° to about 93°C (60° to 200°F).

4. The method of claim 1, wherein the gaseous effluent is cooled in step (a) to a temperature ranging from about 249° to about 293°C (480° to 560°F), cooled in step (c) to a temperature ranging from about 121° to about 176°C (250° to 350°F), and

cooled in step (e) to a temperature ranging from about 32° to about 88°C (90° to 190°F).

5. The method of any of the preceding claims, wherein said liquid pyrolysis gasoline rich stream has an initial boiling point of less than about 66°C (150°F) and a final boiling point in excess of about 149°C (300°F).

6. The method of claim 5, wherein said liquid pyrolysis gasoline rich stream has a final boiling point ranging from about 177° to about 454°C (350° to 850°F).

7. The method of any of the preceding claims, wherein step (a) includes passing the effluent through a primary transfer line heat exchanger which provides steam having a temperature of at least about 254°C (489°F) and pressure greater than about 4240 kPa (600 psig).

8. The method of any of the preceding claims, wherein step (a) includes passing the effluent through a primary transfer line heat exchanger which provides steam having a temperature ranging from about 254° to about 677°C (489° to 1250°F) and pressure ranging from about 4240 to about 17340 kPa (600 to 2500 psig).

9. The method of any of claims 7 or 8, wherein step (a) includes passing the effluent from the primary transfer line heat exchanger to a secondary transfer line heat exchanger wherein at least a substantial portion of said tar is condensed.

10. The method of any of claims 7 through 9, wherein step (a) includes maintaining an outlet temperature for said primary transfer line heat exchanger above the dew point of its effluent.

11. The method of any of the preceding claims, wherein step (a) is at least partially effected by direct quench of the gaseous effluent with a liquid quench stream.

12. The method of claim 11, wherein said liquid quench stream is selected from water and oil.

13. The method of claim 12, wherein said liquid quench stream comprises condensed quench oil from step (d).

14. The method of any of claims 7 through 10, wherein step (a) comprises directly contacting the gaseous effluent with a quench liquid after passage of the effluent through said primary transfer line heat exchanger.

15. The method of claim 14, wherein said quench liquid is selected from water and oil.

16. The method of claim 15, wherein said quench liquid comprises condensed quench oil from step (d).

17. The method of any of the preceding claims, wherein the cooling step (c) is effected by indirect contact heat exchange.

18. The method of any of the preceding claims, wherein at least a portion of said condensed tar is recycled to said vapor-liquid separator.

19. The method of any of the preceding claims, wherein the gaseous effluent of step (a) is derived from pyrolysis of a naphtha feed.

20. The method of any of the preceding claims, wherein the gaseous effluent of step (a) is derived from pyrolysis of a feed heavier than naphtha.

21. The method of any of the preceding claims, wherein the cooled gaseous effluent, liquid pyrolysis gasoline and liquid water from step (e) are at least partially separated in a distillate drum from each other to form a gaseous effluent stream which is directed to a recovery train, a liquid pyrolysis gasoline rich stream and a liquid water rich stream.

22. The method of any of the preceding claims, wherein the liquid pyrolysis gasoline rich stream has a lower end point than a corresponding stream made from a corresponding method excluding step (d).

23. A method for treating gaseous effluent from a hydrocarbon pyrolysis unit, the method comprising:

(a) passing the gaseous effluent derived from pyrolysis of a feed heavier than naphtha through at least one primary heat exchanger, thereby cooling the gaseous effluent and generating super high pressure steam;

(b) passing a mixed gaseous and liquid effluent from step (a) through at least one vapor-liquid separator, where tar, formed by reaction among constituents of the effluent is condensed and separates from the gaseous effluent;

(c) cooling the gaseous effluent from step (b) to condense a liquid effluent quench oil;

(d) passing the mixed gaseous and liquid effluent from step (c) through at least one rectifier comprising distillation media selected from trays and packing and a reflux inlet for introducing a pyrolysis gasoline fraction, where condensed quench oil separates from the gaseous effluent;

(e) cooling the gaseous effluent from step (d) to condense a liquid effluent comprising pyrolysis gasoline and water condensed from steam;

(f) treating the gaseous and/or liquid effluent from step (e) to at least partially separate therefrom a liquid pyrolysis gasoline rich stream; and

(g) passing at least a portion of the liquid pyrolysis gasoline rich stream as reflux to said rectifier.

24. Hydrocarbon cracking apparatus comprising:

(a) a reactor for pyrolyzing a hydrocarbon feedstock, the reactor having an outlet through which gaseous pyrolysis effluent can exit the reactor;

(b) at least one of i) a heat exchanger connected to the reactor outlet and ii) a line for introducing quench oil downstream of the reactor outlet, for cooling the gaseous pyrolysis effluent;

(c) at least one vapor-liquid separator connected to and downstream of (b) for separating tar from the gaseous effluent;

(d) a cooling train connected to and downstream of the at least one vapor-liquid separator for further cooling the gaseous effluent;

(e) at least one rectifier comprising at least one theoretical stage, for receiving a mixed gaseous and liquid effluent from step (d), where condensed quench oil separates from the gaseous effluent;

(f) at least one cooling means selected from the group consisting of condenser and water quench tower for cooling the gaseous effluent from step (e) to condense a liquid effluent comprising pyrolysis gasoline and water condensed from steam;

(g) a separator for recovering a liquid pyrolysis gasoline rich stream from the gaseous and/or liquid effluent of step (f);

(h) a recovery train which recovers light olefins from the gaseous effluent from steps (f) and/or (g); and

(i) a line for recycling at least a portion of the liquid pyrolysis gasoline rich stream of step (g) to said rectifier.

25. The apparatus of claim 24, wherein said rectifier comprises at least one distillation tray.

26. The apparatus of claim 24, wherein said rectifier comprises packing.

27. The apparatus of any of claims 24 through 26, which further comprises a line for introducing quench oil from said rectifier at a point downstream of said heat exchanger and upstream of said vapor-liquid separator.

28. The apparatus of any of claims 24 through 27, wherein said separator of step (g) comprises a distillate drum for receiving mixed gaseous and liquid effluent from step (f), where the cooled gaseous effluent, pyrolysis gasoline and water are at least partially separated from each other to form a gaseous effluent stream, a liquid pyrolysis gasoline rich stream, and a liquid water rich stream.

29. The apparatus of any of claims 24 through 27, wherein said separator of step (g) comprises a settling drum for receiving liquid from the bottoms of a water quench tower, where the condensed pyrolysis gasoline and water are at least partially separated from each other to form a liquid pyrolysis gasoline rich stream and a liquid water rich stream.

CLAIMS

1. A method for treating gaseous effluent from a hydrocarbon pyrolysis unit, the method comprising:

(a) cooling said gaseous effluent at least to a temperature at which tar, formed by reaction among constituents of the gaseous effluent, condenses;

(b) passing a mixed gaseous and liquid effluent from step (a) through at least one vapor-liquid separator, where the condensed tar separates from the gaseous effluent and the condensed tar is removed from the method as separator bottoms;

(c) cooling the tar-depleted gaseous effluent from step (b) in one or more cracked gas coolers to condense a liquid effluent quench oil;

(d) passing at least a portion of the effluent from step (c) containing liquid effluent quench oil through at least one rectifier comprising a fixed number of distillation stages ranging from about 2 to about 20 and/or equivalent suitable packing and comprising a reflux inlet for introducing a pyrolysis gasoline fraction, and further, obtaining liquid effluent quench oil as rectifier bottoms;

(e) cooling the gaseous effluent from step (d) to condense a liquid effluent comprising pyrolysis gasoline and water condensed from steam;

(f) treating a mixed gaseous and liquid effluent from step (e) to at least partially separate therefrom a liquid pyrolysis gasoline rich stream; and

(g) passing at least a portion of the liquid pyrolysis gasoline rich stream as reflux to said rectifier.

2. The method of claim 1, wherein the gaseous effluent is cooled in step (a) to a temperature of less than about 371°C (700°F), cooled in step (c) to a temperature of less than about 316°C (600°F), and cooled in step (e) to a temperature of less than about 104°C (220°F).

3. The method of claim 1, wherein the gaseous effluent is cooled in step (a) to a temperature ranging from about 232° to about 316°C (450 to 600°F), cooled in step (c) to a

temperature ranging from about 93° to about 232°C (200° to 450°F), and cooled in step (e) to a temperature ranging from about 15° to about 93°C (60° to 200°F).

4. The method of claim 1, wherein the gaseous effluent is cooled in step (a) to a temperature ranging from about 249° to about 293°C (480° to 560°F), cooled in step (c) to a temperature ranging from about 121° to about 176°C (250° to 350°F), and cooled in step (e) to a temperature ranging from about 32° to about 88°C (90° to 190°F).

5. The method of claim 1, wherein said liquid pyrolysis gasoline rich stream has an initial boiling point of less than about 66°C (150°F) and a final boiling point in excess of about 149°C (300°F).

6. The method of claim 5, wherein said liquid pyrolysis gasoline rich stream has a final boiling point ranging from about 177° to about 454°C (350° to 850°F).

7. The method of claim 1, wherein step (a) includes passing the effluent through a primary transfer line heat exchanger which provides steam having a temperature of at least about 254°C (489°F) and pressure greater than about 4240 kPa (600 psig).

8. The method of claim 7, wherein step (a) includes passing the effluent through a primary transfer line heat exchanger which provides steam having a temperature ranging from about 254° to about 677°C (489° to 1250°F) and pressure ranging from about 4240 to about 17340 kPa (600 to 2500 psig).

9. The method of claim 7, wherein step (a) includes passing the effluent from the primary transfer line heat exchanger to a secondary transfer line heat exchanger wherein at least a substantial portion of said tar is condensed.

10. The method of claim 8, wherein step (a) includes maintaining an outlet temperature for said primary transfer line heat exchanger above the dew point of its effluent.

11. The method of claim 1, wherein step (a) is at least partially effected by direct quench of the gaseous effluent with a liquid quench stream.

12. The method of claim 11, wherein said liquid quench stream is selected from water and oil.

13. The method of claim 12, wherein said liquid quench stream comprises condensed quench oil from step (d).

14. The method of claim 8, wherein step (a) comprises directly contacting the gaseous effluent with a quench liquid after passage of the effluent through said primary transfer line heat exchanger.

15. The method of claim 14, wherein said quench liquid is selected from water and oil.

16. The method of claim 15, wherein said quench liquid comprises condensed quench oil from step (d).

17. The method of claim 1, wherein said rectifier comprises at least one tray.

18. The method of claim 1, wherein the cooling step (c) is effected by indirect contact heat exchange.

19. The method of claim 1, wherein the gaseous effluent of step (a) is derived from pyrolysis of a naphtha feed.

20. The method of claim 1, wherein the gaseous effluent of step (a) is derived from pyrolysis of a feed heavier than naphtha.

21. The method of claim 1, wherein the cooled gaseous effluent, liquid pyrolysis gasoline and liquid water from step (e) are at least partially separated in a distillate drum from each other to form a gaseous effluent stream which is directed to a recovery train, a liquid pyrolysis gasoline rich stream and a liquid water rich stream.

22. The method of claim 1, wherein the liquid pyrolysis gasoline rich stream has a lower end point than a corresponding stream made from a corresponding method excluding step (d).

23. A method for treating gaseous effluent from a hydrocarbon pyrolysis unit, the method comprising:

(a) passing the gaseous effluent derived from pyrolysis of a feed heavier than naphtha through at least one primary heat exchanger, thereby cooling the gaseous effluent and generating super high pressure steam;

(b) passing a mixed gaseous and liquid effluent from step (a) through at least one vapor-liquid separator, where tar, formed by reaction among constituents of the effluent is condensed and separates from the gaseous effluent and the condensed tar is removed from the method as separator bottoms;

(c) cooling the gaseous effluent from step (b) to condense a liquid effluent quench oil;

(d) passing a mixed gaseous and liquid effluent from step (c) through at least one rectifier comprising distillation media selected from trays and packing and a reflux inlet for introducing a pyrolysis gasoline fraction, where condensed quench oil separates from the gaseous effluent;

(e) cooling the gaseous effluent from step (d) to condense a liquid effluent comprising pyrolysis gasoline and water condensed from steam;

(f) treating the gaseous and/or liquid effluent from step (e) to at least partially separate therefrom a liquid pyrolysis gasoline rich stream; and

(g) passing at least a portion of the liquid pyrolysis gasoline rich stream as reflux to said rectifier.