CLAIMS

1. A process for cracking liquid hydrocarbon feed to produce cracked gaseous hydrocarbons, the process comprising the steps of:

(a) feeding a liquid hydrocarbon feed stream to an olefins furnace;

(b) cracking the liquid hydrocarbon feed stream in the olefins furnace to produce a hot gaseous cracked effluent stream having a temperature of about 1400 to about 1650° F;

(c) feeding the hot gaseous cracked effluent stream from the olefins furnace to the first section of a primary transfer line heat exchanger (TLE), which first section of said primary TLE comprises a shell-and-tube heat exchanger where the hot gaseous cracked effluent stream is indirectly cooled on the tube side while generating high-pressure steam from saturated steam on the shell side;

(d) feeding the gaseous cracked effluent exiting the first section of the primary TLE to the tube side of a second section of the primary TLE, where a flow obstruction means is positioned in said tube side of the second section to create a low-pressure zone in said gaseous cracked effluent stream immediately downstream of said flow obstruction means, and where the gaseous cracked effluent stream is indirectly cooled on the tube side while generating saturated steam from boiler feed water on the shell side;

(e) injecting a wetting fluid tangentially into said gaseous cracked effluent stream at said low-pressure zone at a momentum sufficient to cause said wetting fluid to flow circumferentially around the inside surface of said tube side; providing a sharp interface between said gaseous cracked effluent stream and said first wetting fluid; and causing said first wetting fluid to contact and wet the downstream face of said flow obstruction means;

(f) wherein the weight ratio of wetting fluid to the hot gaseous feed stream entering the tube side of a second section of the primary TLE is about 0.5 to about 2.0, the exit temperature of the gaseous effluent stream from the first section of said primary TLE is about 1100 to about 1200° F and the exit temperature of the gaseous effluent stream from the second section of the primary TLE is approximately 50° F above the temperature of the steam being generated;

(g) feeding the gaseous cracked effluent stream exiting from the second section of said primary TLE to a separator; and

(h) separating in the separator, a separator bottoms stream comprising tar and heavier hydrocarbons and a separator product stream comprising an olefin product.

2. The process of claim 1, wherein said liquid hydrocarbon feed stream is selected from the group consisting of vacuum gas oil, heavy gas oil, heavy crude oil fractions, high end point condensates, deasphalted oil, oils derived from tar sands, oil shale, SMDS (Shell Middle Distillate Synthesis) heavy ends, GTL (Gas to Liquid) heavy ends, Heavy Paraffins Synthesis products, Fischer Tropsch products and hydrocrackate.

3. The process of claim 1, wherein said wetting fluid is injected at substantially a right angle to said hot gaseous effluent stream, and the weight ratio of wetting fluid to the hot gaseous feed stream entering the tube side of a second section of the primary TLE is about 0.5 to about 1.0.

4. The process of claim 1, wherein said wetting fluid is selected from the group consisting of pyrolysis liquid products, cracked light gas oil, cracked heavy gas oil and pitch.

5. The process of claim 1, wherein said separator product stream from step (h) is routed to a secondary TLE.

6. A process for cracking liquid hydrocarbon feed to produce cracked gaseous hydrocarbons, the process comprising the steps of:

(a) feeding a liquid hydrocarbon feed stream to an olefins furnace;

(b) cracking the liquid hydrocarbon feed stream in the olefins furnace to produce a hot gaseous cracked effluent stream having a temperature of about 1400 to about 1650° F;

(c) feeding the hot gaseous cracked effluent stream from the olefins furnace to the first section of a primary transfer line heat exchanger (TLE), which first section of said primary TLE comprises a shell-and-tube heat exchanger where the hot gaseous cracked effluent stream is indirectly cooled on the tube side while generating high-pressure steam from saturated steam on the shell side;

(d) feeding the gaseous cracked effluent exiting the first section of the primary TLE to the tube side of a second section of the primary TLE, where a flow obstruction means is positioned in said tube side of the second section to create a low-pressure zone in said gaseous cracked effluent stream immediately downstream of said flow obstruction means, and where the gaseous cracked effluent stream is indirectly cooled on the tube side while generating saturated steam from boiler feed water on the shell side;

(e) injecting a first wetting fluid tangentially into said gaseous cracked effluent stream at said low-pressure zone at a momentum sufficient to cause said wetting fluid to flow circumferentially around the inside surface of said tube side; providing a sharp interface between said gaseous cracked effluent stream and said first wetting fluid; and causing said first wetting fluid to contact and wet the downstream face of said flow obstruction means, and wherein the weight ratio of wetting fluid to the hot gaseous feed stream entering the tube side of a second section of the primary TLE is about 0.5 to about 2.0 and wherein the exit temperature of said gaseous effluent stream from the first section of said primary TLE is between about 1100° F and about 1200° F and the exit temperature of the second section of the primary TLE is approximately 50° F above the temperature of the saturated steam being generated;

(f) feeding the gaseous cracked effluent stream exiting from the second section of said primary TLE to a separator;

(g) removing in the separator, a separator bottoms liquid stream comprising tar and heavier hydrocarbons and a separator product gas stream comprising an olefin rich product;

(h) feeding the separator product gas stream exiting the separator to at least one secondary TLE where the separator product gas stream is indirectly cooled on the tube side to an exit temperature of between about 400 to about 500° F while generating low-pressure steam on the shell side from boiler feed water and where a second flow obstruction means is positioned in said tube side of said secondary TLE to create a low-pressure zone in said product gas stream immediately downstream of said second flow obstruction means whereby a second wetting fluid is introduced at said low-pressure zone at sufficient flowrate to maintain the downstream internal surfaces in a wetted state;

(i) feeding the gaseous cracked effluent stream exiting from said second TLE to a second separator;

(j) removing from the second separator, a separator liquid bottoms stream comprising tar and heavier hydrocarbons and a separator product gas stream comprising an olefin rich product; and

(k) recovering olefin product(s) from the separator product stream.

7. The process of claim 6, wherein said liquid hydrocarbon feed stream is selected from the group consisting of vacuum gas oil, heavy gas oil, heavy crude oil fractions and deasphalted oil.

8. The process of claim 6, wherein said first wetting fluid is injected at substantially a right angle to said hot cracked gaseous effluent stream in said primary TLE and said second wetting fluid is injected at substantially a right angle to said gaseous cracked effluent stream in said secondary TLE.

9. The process of claim 6 wherein said first wetting fluid is selected from the group consisting of pyrolysis liquid products: cracked light gas oil, cracked heavy gas oil and pitch, and said second wetting fluid is selected from the group consisting of cracked light gas oils and mixtures of cracked light gas oils and cracked heavy gas oils.

10. A process for cracking liquid hydrocarbon feed to produce cracked gaseous hydrocarbons, the process comprising the steps of:

(a) feeding a liquid hydrocarbon feed stream to an olefins furnace;

(b) cracking the liquid hydrocarbon feed stream in the olefins furnace to produce a hot gaseous cracked effluent stream having a temperature of about 1400 to about 1650° F;

(c) feeding the hot gaseous cracked effluent stream from the olefins furnace to a primary transfer line heat exchanger (TLE)

(d) feeding the gas stream exiting the primary TLE to a secondary TLE or two or more secondary TLEs in a parallel flow where the primary TLE product gas stream is indirectly cooled on the tube side to an exit temperature of between about 400 to about 500° F while generating low-pressure steam on the shell side from boiler feed

water and where a second flow obstruction means is positioned in said tube side of said secondary TLE to create a low-pressure zone in said product gas stream immediately downstream of said second flow obstruction means whereby a second wetting fluid is introduced at said low-pressure zone at sufficient flowrate to maintain the downstream internal surfaces in a wetted state;

(e) feeding the gaseous cracked effluent stream exiting from said second TLE to a separator;

(f) removing from the separator, a separator liquid bottoms stream comprising tar and heavier hydrocarbons and a separator product gas stream comprising an olefin rich product; and

(g) recovering olefin product(s) from the separator product stream.

11. An apparatus for cracking a liquid hydrocarbon feedstock in a thermal gas cracker, to produce a gaseous cracked effluent from the cracker that includes tar, the apparatus comprising:

(a) a thermal gas cracker for receiving a liquid hydrocarbon feed stream, the cracker comprising a convection section and a radiant section to produce a gaseous cracked effluent comprising olefins;

(b) a primary transfer line exchanger (TLE) to receive the gaseous cracked effluent from the cracker, for the recovery of process energy from the gaseous cracked effluent;

(c) a first quench fluid introduction system to introduce a first quench fluid into the cracked effluent from the primary TLE;

(d) a secondary TLE to receive the cracked effluent from the primary TLE, for the recovery of process energy from the cracked effluent;

(e) a second quench fluid introduction system to introduce a second quench fluid into the cracked effluent from the secondary TLE; and

(f) a separator system for receiving a mixture of the first quench fluid, the second quench fluid and the cracked effluent from the primary TLE and the secondary TLE and separating the mixture into a separator byproduct stream comprising tar and a separator product stream.

12. The apparatus of claim 11 wherein said separator system includes a first separator associated with the primary TLE and a second separator associated with the secondary TLE.

CLAIMS

1. An apparatus for cracking a liquid hydrocarbon feedstock in a thermal gas cracker, to produce a gaseous cracked effluent from the cracker that includes tar, the apparatus comprising:

(a) a thermal gas cracker for receiving a liquid hydrocarbon feed stream, the cracker comprising a convection section and a radiant section to produce a gaseous cracked effluent comprising olefins;

(b) a primary transfer line exchanger (TLE) to receive the gaseous cracked effluent from the cracker, for the recovery of process energy from the gaseous cracked effluent;

(c) a first quench fluid introduction system to introduce a first quench fluid into the cracked effluent from the primary TLE;

(d) a secondary TLE to receive the cracked effluent from the primary TLE, for the recovery of process energy from the cracked effluent;

(e) a second quench fluid introduction system to introduce a second quench fluid into the cracked effluent from the secondary TLE; and

(f) a separator system for receiving a mixture of the first quench fluid, the second quench fluid and the cracked effluent from the primary TLE and the secondary TLE and separating the mixture into a separator byproduct stream comprising tar and a separator product stream,

wherein said separator system includes a first separator associated with the primary TLE and a second separator associated with the secondary TLE.