CLAIMS:

What is claimed is:

1. A process for steam cracking hydrocarbons, comprising:

heating a hydrocarbon feed to produce a preheated hydrocarbon feed;

combining liquid water with the preheated hydrocarbon feed to produce a mixture;

heating the mixture within a convection section of a steam cracker furnace to produce a heated mixture;

steam cracking at least a portion of the heated mixture within a radiant section of the steam cracker furnace to produce a steam cracker effluent;

separating a process gas comprising molecular hydrogen and C_1-C_4 hydrocarbons, a steam cracker naphtha, a condensed process water, and one or more heavy steam cracker products from the steam cracker effluent, wherein the condensed process water comprises entrained hydrocarbons;

separating at least a portion of the entrained hydrocarbons from the condensed process water to produce a purified process water, wherein the at least a portion of the entrained hydrocarbons is separated from the condensed process water within a process water stripper; and

heating at least a portion of the purified process water to produce dilution steam,

wherein the liquid water combined with the preheated hydrocarbon feed comprises at least one of the following: (i) a portion of the condensed process water, (ii) a portion of the purified process water, (iii) condensed dilution steam, and (iv) a mixture or two or more of (i), (ii), and (iii).

2. The process of claim 1, wherein the liquid water combined with the preheated hydrocarbon feed comprises the portion of the purified process water.

3. The process of claim 1 or 2, wherein the liquid water combined with the preheated hydrocarbon feed comprises the portion of the condensed process water.

4. The process of any of claims 1 to 3, wherein the liquid water combined with the preheated hydrocarbon feed comprises the condensed dilution steam.

5. The process of any of claims 1 to 4, wherein the liquid water combined with the preheated hydrocarbon feed comprises the portion of the purified process water and the portion of the condensed process water.

6. The process of any of claims 1 to 5, wherein the liquid water combined with the preheated hydrocarbon feed comprises the portion of the purified process water, the portion of the condensed process water, and the condensed dilution steam.

7. The process of any of claims 1 to 6, wherein an amount of liquid water combined with the preheated hydrocarbon feed is 1 wt% to 50 wt%, based on a combined weight of the preheated hydrocarbon feed and the liquid water.

8. The process of any of claims 1 to 7, wherein the hydrocarbon feed is heated within the convection section to produce the preheated hydrocarbon feed.

9. The process of any of claims 1 to 8, wherein the preheated hydrocarbon feed is at a temperature of 100°C to 350°C.

10. The process of any of claims 1 to 9, wherein the heated mixture is at a temperature of 200°C to 750°C.

11. The process of any of claims 1 to 10, wherein the steam cracker effluent is at a temperature of 400°C to 1,050°C upon exiting the radiant section of the steam cracker furnace.

12. The process of claim 11, wherein a pH within the process water stripper is controlled by introducing an amine into the process water stripper.

13. The process of claim 12, wherein the amine comprises ammonia, ammonium, one or more ammonium cations, or a mixture of two or more thereof.

14. The process of claim 12 or 13, wherein controlling the pH of the process water stripper does not utilize the introduction of any sodium containing compound into the process water stripper.

15. The process of any of claims 1 to 14, wherein the one or more heavy steam cracker products separated from the steam cracker effluent comprises a stream cracker tar, a steam cracker quench oil, a stream cracker gas oil, or a combination thereof.

16. The process of any of claims 1 to 15, wherein the hydrocarbon feed comprises crude oil or a fraction thereof.

17. The process of any of claims 1 to 16, further comprising separating a vapor phase product and a liquid phase product from the heated mixture, wherein the vapor phase product is steam cracked within the radiant section of the steam cracker furnace.

18. The process of any of claims 1 to 17, further comprising combining steam with the mixture, the heated mixture, or both the mixture and the heated mixture.

19. The process of claim 18, wherein the liquid water is combined with the preheated hydrocarbon feed before the steam.

20. The process of claim 18 or 19, wherein an amount of the liquid water combined with the preheated hydrocarbon feed and the steam is 1 wt% to 99.9 wt%, 2 wt% to 80 wt%, or 4 wt% to 50 wt%, based on the combined weight of the liquid water and the steam.

21. A system for steam cracking hydrocarbons, comprising:

a steam cracker comprising a convection section and a radiant section, wherein:

a first convection line is disposed within the convection section and configured to flow a hydrocarbon feed therethrough to produce a preheated hydrocarbon feed,

a mixing device is in fluid communication with the first convection line and configured to receive the preheated hydrocarbon feed and a liquid water feed produce a mixture,

a second convection line is disposed within the convection section and configured to receive and flow the mixture therethrough to produce a heated mixture, and

a radiant line is disposed within the radiant section and configured to receive and flow at least a portion of the heated mixture therethrough to produce a steam cracker effluent;

a first separation stage configured to separate a process gas comprising molecular hydrogen and C_1-C_4 hydrocarbons, a steam cracker naphtha, a condensed process water, and one or more heavy steam cracker products from the steam cracker effluent, wherein the condensed process water comprises entrained hydrocarbons;

a second separation stage configured to separate at least a portion of the entrained hydrocarbons from the condensed process water to produce a purified process water;

a dilution steam generator configured to heat at least a portion of the purified process water to produce dilution steam; and

at least one of:

a first recycle line configured to convey a portion of the condensed process water from the first separation stage to the mixing device to provide at least a portion of the liquid water received by the mixing device;

a second recycle line configured to convey a portion of the purified process water from the second separation stage to the mixing device to provide at least a portion of the liquid water received by the mixing device; and

a third recycle line configured to convey a condensed dilution steam from an optional dilution steam condenser to the mixing device to provide at least a portion of the liquid water received by the mixing device.

22. The system of claim 21, wherein the mixing device comprises a first mixing device and a second mixing device, wherein the first mixing device is in fluid communication with the first convection line and configured to receive and combine the liquid water with the preheated hydrocarbon feed to produce the mixture; and wherein the second mixing device is in fluid communication with the first mixing device and configured to receive and combine steam with the mixture to produce a second mixture, wherein the second convection line is configured to receive and flow the second mixture therethrough to produce the heated mixture.

23. The system of claim 21 or 22, further comprising a third separation stage configured to separate a vapor phase product and a liquid phase product from the heated mixture, wherein

the radiant line is configured to receive and flow at least a portion of the vapor phase product therethrough to produce the steam cracker effluent.

24. The system of any of claims 21 to 23, further comprising a heat exchange stage configured to produce a cooled steam cracker effluent by indirect heat exchange with a first heat transfer medium, by direct contact with a second heat transfer medium, or a combination thereof, wherein the first separation stage is configured to separate the process gas, the steam cracker naphtha, the condensed process water, and the one or more heavy steam cracker products from the cooled steam cracker effluent.

25. A process for steam cracking hydrocarbons, comprising:

heating a hydrocarbon feed to produce a preheated hydrocarbon feed;

combining liquid water with the preheated hydrocarbon feed to produce a mixture;

heating the mixture within a convection section of a steam cracker furnace to produce a heated mixture;

steam cracking at least a portion of the heated mixture within a radiant section of the steam cracker furnace to produce a steam cracker effluent;

separating a process gas comprising molecular hydrogen and C_1-C_4 hydrocarbons, a steam cracker naphtha, a condensed process water, and one or more heavy steam cracker products from the steam cracker effluent, wherein the condensed process water comprises entrained hydrocarbons;

separating at least a portion of the entrained hydrocarbons from the condensed process water to produce a purified process water; and

heating at least a portion of the purified process water to produce dilution steam,

wherein the liquid water combined with the preheated hydrocarbon feed comprises at least a portion of the purified process water.