CLAIMS

What is claimed is:

1. A method comprising:

(I) providing a first tar stream;

(II) combining the first tar stream with a utility fluid to form a first process stream having a viscosity lower than that of the first tar stream; and

(III) heating the first process stream in a pre-heater either under liquid phase conditions without feeding molecular hydrogen gas into the pre-heater or under mixed phase conditions with introducing hydrogen into the preheater, wherein the residence time of the first process stream in the pre-heater is in a rage from 10 seconds to 350 seconds,

to form a second process stream exiting the pre-heater, wherein after step (II) and before step (III) the first process stream is passed through a guard reactor.

2. The method of claim 1, further comprising:

(IV) feeding the second process stream into a hydroprocessing reactor; and

(V) hydroprocessing the second process stream in the hydroprocessing reactor in the presence of a hydroprocessing catalyst under hydroprocessing conditions to produce a hydroprocessed effluent exiting the hydroprocessing reactor.

3. The method of claim 1 or claim 2, wherein the first tar stream has a bromine number of at least 20 as determined by ASTM D1159.

4. The method of claim 3, wherein the bromine number of the first tar stream is at least 40 as determined by ASTM D1159.

5. The method of any of the preceding claims, wherein the first tar stream comprises at least one of: a steam cracker tar, a heavy coker gas oil, a vacuum tower fraction bottoms, a lube extract, a main column bottoms from fluid catalytic cracking, a steam cracker gas oil, a quench oil, and mixtures thereof.

6. The method of any of the preceding claims, wherein the first tar stream comprises a tar fraction and a steam cracker gas oil fraction and/or a quench oil fraction, and step (III) has at least one of the following features:

(a) an absolute pressure in the pre-heater in a range from 3,450 kPa to 13,790 kPa (500 psia to 2000 psia);

(b) a temperature of the second process stream in a range from 300°C to 450°C; and

(c) a residence time of the first process stream in the pre-heater in a range from 10 seconds to 350 seconds.

7. The method of any of the preceding claims, wherein step (I) comprises:

(I-a) providing a fluxed tar stream comprising a tar fraction and a steam cracker gas oil fraction; and

(I-b) removing at least a portion of the steam cracker gas oil fraction from the fluxed tar stream to produce the first tar stream, wherein the first tar stream has a normal boiling point of at least 300°C.

8. The method of claim 7, further comprising:

(VI) separating a total liquids product from the hydroprocessed effluent;

(VII) separating the total liquids product to obtain a mid-cut fraction stream and a heavy bottoms fraction stream; and

(VIII) providing at least a portion of the mid-cut fraction as at least a portion of the utility fluid in step (II).

9. The method of any of the preceding claims, further comprising removing solids, if any, from the first process stream prior to heating the first process stream.

10. The method of any of the preceding claims, wherein the pre-heater is operable for at least 100 days before an amount of foulant forms in a portion of the pre-heater, the amount of foulant in the portion of the pre-heater having a thickness of 0.25 inches or more.

11. The method of any of the preceding claims, comprising:

(i) providing a first tar stream;

(ii) heat soaking the first tar stream in a heat-soaking vessel to obtain a heat-soaked tar stream exiting the heat-soaking vessel;

(iii) combining the heat-soaked tar stream with a utility fluid to form a first process stream having a viscosity lower than that of the heat-soaked tar stream;

(iv) feeding the first process stream into a pre-heater; and

(v) heating the first process stream in a pre-heater to form a second process stream exiting the pre-heater.

12. The method of claim 11, wherein the heat-soaked tar stream has a bromine number no greater than 35, preferably no greater than 28, as determined by ASTM D1159.

13. The method of claim 11 or 12, wherein step (ii) has at least one of the following features:

(a) an absolute pressure in the heat-soaking vessel in a range from 3,450 kPa to 13,790 kPa (500 psia to 2000 psia);

(b) a temperature of the heat-soaked tar stream in a range from 220°C to 350°C; or

(c) a residence time of the first tar stream in the heat-soaking vessel in a range from 10 minutes to 120 minutes.