Claims

1. A process for reducing the viscosity of a liquid hydrocarbon feedstock into lower molecular weight hydrocarbon compounds in a hydrovisbreaking reaction zone comprising:

a. mixing the liquid hydrocarbon feedstock and an excess of hydrogen gas in a mixing zone to dissolve a portion of the hydrogen gas in the liquid hydrocarbon feedstock and produce a two-phase mixture of a hydrogen-enriched liquid hydrocarbon feedstock and the remaining excess hydrogen gas;

b. introducing the mixture of hydrogen gas and the hydrogen-enriched liquid hydrocarbon feedstock into a flashing zone under predetermined conditions to separate the undissolved excess hydrogen gas and optimize the amount of hydrogen dissolved in the hydrogen-enhanced liquid hydrocarbon feedstock, and recovering a single-phase hydrogen-enriched liquid hydrocarbon feedstock;

c. conveying the single-phase hydrogen-enriched liquid hydrocarbon feedstock under conditions that maximize the amount of dissolved hydrogen in the hydrocarbon feedstock into a hydrovisbreaking reaction zone in the presence of steam to crack the feedstock into relatively smaller molecules; and

d. recovering converted hydrocarbon products of reduced viscosity from the hydrovisbreaking reaction zone.

2. The process of claim 1, which further comprising adding a catalyst to the feedstock in the form of finely dispersed solid material or soluble catalyst in the hydrocarbon feedstock.

3. The process of claim 2, in which the catalyst is selected from the group consisting of elements from Group IVB, VB and VIB of the Periodic Table.

4. The process of claim 2, in which the soluble catalyst includes one or more of organometallic complexes.

5. The process of claim 1, wherein the mixing zone is operated at a pressure in the range of from about 40 bars to about 200 bars.

6. The process of claim 1, wherein the mixing zone is operated at a temperature in the range of from about 40°C to about 300°C.

7. The process of claim 1, wherein the mixing zone is operated at a ratio of the normalized volume of hydrogen to the volume of feedstock in the range of from about 300:1 to about 3000:1.

8. The process of claim 1, further comprising introducing steam or water to the hydrovisbreaking reaction zone at a rate in the range of from 0.1 volume % to 10.0 volume % of feedstock.

9. The process of claim 1, further comprising recycling a portion of the converted hydrocarbon products back to the mixing zone at a rate in the range of from 50-150 volume % of the initial hydrocarbon feedstock.

10. The process of claim 1, wherein the feedstock includes crude oil, straight run atmospheric or vacuum bottoms, coking gas oils, FCC cycle oils, deasphalted oils, bitumens from tar sands and/or its cracked products, and coal liquids coal liquefaction processes and other refinery intermediates boiling above 370°C.

11. The process of claim 1, wherein the flashing zone is operated at a pressure in the range of from about 10 bars to 200 bars.

12. The process of claim 1, wherein the flashing zone is operated at a pressure in the range of from about 10 bars to 100 bars.

13. The process of claim 1, wherein the flashing zone is operated at a pressure in the range of from about 10 bars to 50 bars.

14. The process of claim 1, wherein the flashing zone is operated at a temperature in the range of from about 350°C to about 600°C.

15. The process of claim 1, wherein the flashing zone is operated at a temperature in the range of from about 375°C to about 550°C

16. The process of claim 1, wherein the flashing zone is operated at a temperature in the range of from about 400°C to about 500°C.

The invention claimed is:

1. A process for reducing the viscosity of a liquid hydrocarbon feedstock into lower molecular weight hydrocarbon compounds in a hydrovisbreaking reaction zone comprising:

a. mixing the liquid hydrocarbon feedstock and an excess of hydrogen gas in a mixing zone to dissolve a portion of the hydrogen gas in the liquid hydrocarbon feedstock and produce a two-phase mixture of a hydrogen-enriched liquid hydrocarbon feedstock and the remaining excess hydrogen gas;

b. introducing the mixture of hydrogen gas and the hydrogen-enriched liquid hydrocarbon feedstock into a flashing zone under predetermined conditions to separate the undissolved excess hydrogen gas and optimize the amount of hydrogen dissolved in the hydrogen-enhanced liquid hydrocarbon feedstock, and recovering a single-phase hydrogen-enriched liquid hydrocarbon feedstock;

c. conveying the single-phase hydrogen-enriched liquid hydrocarbon feedstock under conditions that maximize the amount of dissolved hydrogen in the hydrocarbon feedstock into a hydrovisbreaking reaction zone in the presence of steam to crack the feedstock into relatively smaller molecules; and

d. recovering converted hydrocarbon products of reduced viscosity from the hydrovisbreaking reaction zone.

2. The process of claim 1, which further comprising adding a catalyst to the feedstock in the form of finely dispersed solid material or soluble catalyst in the hydrocarbon feedstock.

3. The process of claim 2, in which the catalyst is selected from the group consisting of elements from Group IVB, VB and VIB of the Periodic Table.

4. The process of claim 2, in which the soluble catalyst includes one or more of organometallic complexes.

5. The process of claim 1, wherein the mixing zone is operated at a pressure in the range of from about 40 bars to about 200 bars.

6. The process of claim 1, wherein the mixing zone is operated at a temperature in the range of from about 40° C. to about 300° C.

7. The process of claim 1, wherein the mixing zone is operated at a ratio of the normalized volume of hydrogen to the volume of feedstock in the range of from about 300:1 to about 3000:1.

8. The process of claim **1**, further comprising introducing liquid water or steam to the hydrovisbreaking reaction zone at a rate in the range of from 0.1 volume % to 10.0 volume % of feedstock.

9. The process of claim **1**, further comprising recycling a portion of the converted hydrocarbon products back to the mixing zone at a rate in the range of from 50-150volume % of the initial hydrocarbon feedstock.

10. The process of claim **1**, wherein the feedstock includes crude oil, straight run atmospheric or vacuum bottoms, coking gas oils, FCC cycle oils, deasphalted oils, bitumens from tar sands and/or its cracked products, and coal liquids coal liquefaction processes and other refinery intermediates boiling above 370° C.

11. The process of claim **1**, wherein the flashing zone is operated at a pressure in the range of from about 10 bars to 200 bars.

12. The process of claim **1**, wherein the flashing zone is operated at a pressure in the range of from about 10 bars to 100 bars.

13. The process of claim **1**, wherein the flashing zone is operated at a pressure in the range of from about 10 bars to 50 bars.

14. The process of claim **1**, wherein the flashing zone is operated at a temperature in the range of from about 350° C. to about 600° C.

15. The process of claim **1**, wherein the flashing zone is operated at a temperature in the range of from about 375° C. to about 550° C.

16. The process of claim **1**, wherein the flashing zone is operated at a temperature in the range of from about 400° C. to about 500° C.

17. The process of claim **1**, which further comprising adding a catalyst to the feedstock in the form of finely dispersed solid material and wherein the catalyst is selected from the group consisting of elements from Group IVB, VB and VIB of the Periodic Table.