CLAIMS:

1. A method of recovering components from a hydrocarbon feedstock, the method comprising:

supplying the hydrocarbon feedstock to an oxidation reactor, the hydrocarbon feedstock comprising sulfur compounds and nitrogen compounds;

contacting the hydrocarbon feedstock with an oxidizing agent in the oxidation reactor under conditions sufficient to selectively oxidize sulfur compounds and nitrogen compounds present in the hydrocarbon feedstock to produce an oxidized hydrocarbon stream that comprises hydrocarbons, oxidized sulfur compounds, and oxidized nitrogen compounds;

separating the hydrocarbons, the oxidized sulfur compounds, and the oxidized nitrogen compounds in the oxidized hydrocarbon stream by solvent extraction with a non-acidic polar organic solvent, the non-acidic polar organic solvent being dimethylformamide, to produce an extracted hydrocarbon stream and a mixed stream, the mixed stream comprising the non-acidic polar organic solvent, the oxidized sulfur compounds, and the oxidized nitrogen compounds, wherein the extracted hydrocarbon stream has a lower concentration of sulfur compounds and nitrogen compounds than the hydrocarbon feedstock;

separating the mixed stream using a distillation column into a first recovered non-acidic polar organic solvent stream and a first residue stream, the first residue stream comprising the oxidized sulfur compounds and the oxidized nitrogen compounds;

supplying the first residue stream to a fluid catalytic cracking unit, the fluid catalytic cracking unit being operative to catalytically crack the oxidized sulfur and the oxidized nitrogen to produce regenerated catalyst and gaseous and liquid products and allow for recovery of hydrocarbons from the first residue stream;

recycling at least a portion of the liquid products to the oxidation reactor to selectively oxidize sulfur compounds in the liquid products, the portion of the liquid products comprising at least one of light cycle oils and heavy cycle oils;

supplying the extracted hydrocarbon stream to a stripper to produce a second recovered non-acidic polar organic solvent stream and a stripped hydrocarbon stream; and

recycling the first recovered non-acidic polar organic solvent stream and the second non-acidic polar organic solvent stream to an extraction vessel for the separating the hydrocarbons, the oxidized sulfur compounds, and the oxidized nitrogen compounds in the oxidized hydrocarbon stream.

2. The method of claim 1, further comprising:

recycling a portion of the regenerated catalyst with a fluid catalytic cracking feedstream to the fluid catalytic cracking unit, wherein the recycling further comprises catalytically cracking the fluid catalytic cracking feedstream with the portion of the regenerated catalyst to recover the hydrocarbons from the first residue stream.

3. The method of claim 1, wherein the oxidant is selected from the group consisting of air, oxygen, peroxides, hydroperoxides, ozone, nitrogen oxides compounds, and combinations thereof.

4. The method of claim 1, wherein the contacting the hydrocarbon feedstock with an oxidizing agent occurs in the presence of a catalyst comprising a metal oxide having the formula M_xO_y, wherein M is an element selected from Groups IVB, VB, and VIB of the periodic table.

5. The method of claim 1, wherein the sulfur compounds comprise sulfides, disulfides, mercaptans, thiophene, benzothiophene, dibenzothiophene, alkyl derivatives of dibenzothiophene, or combinations thereof.

6. The method of claim 1, wherein the oxidation reactor is maintained at a temperature of between about 20 and about 350ºC. and at a pressure of between about 1 and about 10 bars.

7. The method of claim 1, wherein the ratio of the oxidant to sulfur compounds present in the hydrocarbon feedstock is between about 4:1 and about 10:1.

8. The method of claim 1, wherein the non-acidic polar organic solvent has a Hildebrandt value of greater than about 19.

9. The method of claim 1, wherein the solvent extraction is conducted at a temperature of between about 20ºC. and about 60ºC. and at a pressure of between about 1 and about 10 bars.

10. The method of claim 1, further comprising:

supplying the extracted hydrocarbon stream to an adsorption column, the adsorption column being charged with an adsorbent suitable for the removal of oxidized compounds present in the extracted hydrocarbon stream, the adsorption column producing a high purity hydrocarbon product stream and a second residue stream, the second residue stream including a portion of the oxidized compounds.

11. The method of claim 10, further comprising:

supplying the second residue stream to the fluid catalytic cracking unit.

12. The method of claim 10, wherein the adsorbent is selected from the group consisting of activated carbon, silica gel, alumina, natural clays, silica-alumina, zeolites, and combinations of the same.

13. The method of claim 10, wherein the adsorbent is a polymer coated support, wherein the support has a high surface area and is selected from the group consisting of silica gel, alumina, silica-alumina, zeolites, and activated carbon, and the polymer is selected from the group consisting of polysulfone, polyacrylonitrile, polystyrene, polyester terephthalate, polyurethane, and combinations of the same.

14. The method of claim 1, wherein the supplying the first residue stream to the fluid catalytic cracking unit further comprises contacting the first residue stream with a fluid catalytic cracking feedstream in the presence of a catalyst to catalytically crack the fluid catalytic cracking feedstream to recover hydrocarbons from the first residue stream.

15. The method of claim 14, wherein the fluid catalytic cracking feedstream comprises vacuum gas oil, reduced crude, demetalized oil, whole crude, cracked shale oil, liquefied coal, cracked bitumen, heavy coker gas oils, light cycle oils, heavy cycle oils, clarified slurry oils, or combinations thereof.

16. A method of recovering components from a hydrocarbon feedstock, the method comprising:

supplying the hydrocarbon feedstock to an oxidation reactor, the hydrocarbon feedstock comprising sulfur compounds and nitrogen compounds;

contacting the hydrocarbon feedstock with an oxidizing agent in the oxidation reactor under conditions sufficient to selectively oxidize sulfur compounds and nitrogen compounds present in the hydrocarbon feedstock to produce an oxidized hydrocarbon stream that comprises hydrocarbons, oxidized sulfur compounds, and oxidized nitrogen compounds;

separating the hydrocarbons, the oxidized sulfur compounds, and the oxidized nitrogen compounds in the oxidized hydrocarbon stream by solvent extraction with a non-acidic polar organic solvent, the non-acidic polar organic solvent being dimethylformamide, to produce an extracted hydrocarbon stream and a mixed stream, the mixed stream comprising the non-acidic polar organic solvent, the oxidized sulfur compounds, and the oxidized nitrogen compounds, wherein the extracted hydrocarbon stream has a lower concentration of sulfur compounds and nitrogen compounds than the hydrocarbon feedstock;

separating the mixed stream using a distillation column into a first recovered non-acidic polar organic solvent stream and a first residue stream, the first residue stream comprising the oxidized sulfur compounds and the oxidized nitrogen compounds;

supplying the first residue stream to a fluid catalytic cracking unit, the fluid catalytic cracking unit being operative to catalytically crack the oxidized sulfur and the oxidized nitrogen to produce regenerated catalyst and gaseous and liquid products and allow for recovery of hydrocarbons from the first residue stream;

contacting the first residue stream with a fluid catalytic cracking feedstream in the presence of a catalyst to catalytically crack the fluid catalytic cracking feedstream to recover hydrocarbons from the first residue stream;

recycling at least a portion of the liquid products to the oxidation reactor to selectively oxidize sulfur compounds in the liquid products, the portion of the liquid products comprising at least one of light cycle oils and heavy cycle oils;

supplying the extracted hydrocarbon stream to a stripper to produce a second recovered non-acidic polar organic solvent stream and a stripped hydrocarbon stream; and

recycling the first recovered non-acidic polar organic solvent stream and the second non-acidic polar organic solvent stream to an extraction vessel for the separating the hydrocarbons, the oxidized sulfur compounds, and the oxidized nitrogen compounds in the oxidized hydrocarbon stream.

17. The method of claim 16, further comprising:

recycling a portion of the regenerated catalyst with the fluid catalytic cracking feedstream to the fluid catalytic cracking unit, wherein the recycling further comprises catalytically cracking the fluid catalytic cracking feedstream with the portion of the regenerated catalyst to recover the hydrocarbons from the first residue stream.

18. The method of claim 16, wherein the oxidant is selected from the group consisting of air, oxygen, peroxides, hydroperoxides, ozone, nitrogen oxides compounds, and combinations thereof.

19. The method of claim 16, wherein the contacting the hydrocarbon feedstock with an oxidizing agent occurs in the presence of a catalyst comprising a metal oxide having the formula M_xO_y, wherein M is an element selected from Groups IVB, VB, and VIB of the periodic table.

20. The method of claim 16, wherein the sulfur compounds comprise sulfides, disulfides, mercaptans, thiophene, benzothiophene, dibenzothiophene, alkyl derivatives of dibenzothiophene, or combinations thereof.

21. The method of claim 16, wherein the oxidation reactor is maintained at a temperature of between about 20 and about 350ºC. and at a pressure of between about 1 and about 10 bars.

22. The method of claim 16, wherein the ratio of the oxidant to sulfur compounds present in the hydrocarbon feedstock is between about 4:1 and about 10:1.

23. The method of claim 16, wherein the non-acidic polar organic solvent has a Hildebrandt value of greater than about 19.

24. The method of claim 16, wherein the solvent extraction is conducted at a temperature of between about 20ºC. and about 60ºC. and at a pressure of between about 1 bar and about 10 bars.

25. The method of claim 16, further comprising:

supplying the extracted hydrocarbon stream to an adsorption column, the adsorption column being charged with an adsorbent suitable for the removal of oxidized compounds present in the extracted hydrocarbon stream, the absorption column producing a high purity hydrocarbon product stream and a second residue stream, the second residue stream including a portion of the oxidized compounds.

26. The method of claim 25, further comprising:

supplying the second residue stream to the fluid catalytic cracking unit.

27. The method of claim 25, wherein the adsorbent is selected from the group consisting of activated carbon, silica gel, alumina, natural clays, silica-alumina, zeolites, and combinations of the same.

28. The method of claim 25, wherein the adsorbent is a polymer coated support, wherein the support has a high surface area and is selected from the group consisting of silica gel, alumina, and activated carbon, and the polymer is selected from the group consisting of polysulfone, polyacrylonitrile, polystyrene, polyester terephthalate, polyurethane, silica-alumina, zeolites, and combinations of the same.

29. The method of claim 16, wherein the first residue stream and the fluid catalytic cracking feedstream are present in a weight ratio of the catalyst to the first residue stream and the fluid catalytic cracking feedstream ranges from about 1 to about 15.

30. The method of claim 16, wherein the fluid catalytic cracking feedstream comprises vacuum gas oil, reduced crude, demetalized oil, whole crude, cracked shale oil, liquefied coal, cracked bitumen, heavy coker gas oils, light cycle oils, heavy cycle oils, clarified slurry oils, or combinations thereof.

31. The method of claim 16, wherein the contacting the first residue stream with a fluid catalytic cracking feedstream in the presence of a catalyst occurs in a temperature range of about 300°C. to about 650°C..

32. The method of claim 16, wherein the contacting the first residue stream with a fluid catalytic cracking feedstream in the presence of a catalyst occurs in a residence time of about 0.1 second to about 10 minutes.

33. The method of claim 16, further comprising:

separating lower boiling components and catalyst particles from the first residue stream and the fluid catalytic cracking feedstream; and

regenerating at least a portion of the catalyst particles.

34. The method of claim 33, wherein the regenerating the at least a portion of the catalyst particles includes contacting the portion of the catalyst particles with a water-free oxygen-containing gas in a fluidized bed operated at conditions to produce regenerated catalyst and gaseous products comprising carbon monoxide and carbon dioxide and liquid products.