CLAIMS

1. A process for producing high grade coke from crude oil residue comprising:

at least partially separating, in a solvent extraction unit, the crude oil residue into a deasphalted oil (DAO)-containing stream and an asphaltene containing-stream;

producing a pressurized, heated DAO-containing stream by pressurizing and heating the DAO-containing stream, where the pressurized, heated DAO-containing stream is at a temperature greater than 75°C, and a pressure greater than a critical pressure of water;

mixing a supercritical water stream with the pressurized, heated DAO-containing stream to create a combined feed stream, where the supercritical water stream has a pressure greater than the critical pressure of water and a temperature greater than a critical temperature of water;

introducing the combined feed stream to an upgrading reactor system comprising one or more upgrading reactors operating at a temperature greater than the critical temperature of water and a pressure greater than the critical pressure of water to yield one or more upgrading reactor output streams comprising upgraded product and a slurry mixture, where the slurry mixture comprises sulfur and one or more additional metals; and

calcining the slurry mixture at a temperature of from 700°C to 1900°C to produce a product stream comprising the high grade coke.

2. The process of claim 1, where the upgrading reactor system yields one upgrading reactor output stream comprising upgraded product and the slurry mixture.

3. The process of claim 1, where the upgrading reactor system yields at least two upgrading reactor output streams such that the upgraded product and the slurry mixture are transferred from the upgrading reactor system in separate streams.

4. The process of claim 1, where the upgraded product is a gas-liquid-oil stream.

5. The process of claim 1, further comprising drying the slurry mixture in a centrifuge upstream of the calcining step.

6. The process of claim 1, further comprising passing the slurry mixture, the upgrading reactor output stream, or both to a subcritical separator upstream of the calcining step.

7. The process of claim 6, further comprising cooling the slurry mixture, the upgraded product, or both to a temperature of 200°C or less prior to delivery to the subcritical separator.

8. The process of claim 6, where the subcritical separator is a continuous stirred tank reactor.

9. The process of claim 1, further comprising delivering the slurry mixture to a supercritical CO_2 extractor upstream of the calcining step.

10. The process of claim 1, further comprising delivering the slurry mixture to a delayed coker unit upstream of the calcining step.

11. The process of claim 1, where the upgrading reactor system includes downflow reactors, upflow reactors, or combinations thereof.

12. The process of claim 1, where the upgrading reactor system lacks an external supply of hydrogen gas and a catalyst.

13. The process of claim 1, where the upgrading reactor system includes a first reactor and a second reactor downstream of the first reactor.

14. The process of claim 13, where the first reactor and the second reactor are isothermal or non-isothermal.

15. The process of claim 13, where the first reactor, the second reactor, or both include agitation or stirring devices.

16. The process of claim 13, where a ratio of a volume of the first reactor to a volume of the second reactor is 0.1:1 to 1:1.

17. The process of claim 13, where the ratio of the volume of the first reactor to the volume of the second reactor is 0.5:1 to 1:1.

18. The process of claim 1, where the crude oil residue comprises atmospheric residue, vacuum gas oil, or vacuum residue.

19. The process of claim 1, where the DAO-containing stream includes less than 30 wt% of aromatics.