

CLAIMS

What is claimed:

1. A process for upgrading resid in a system comprising:

a first ebullated bed reactor;

a first separator;

a stripping tower;

a fractionation system; and

a solvent deasphalting system;

the process comprising:

operating the system in a first mode to produce a feed for a residual fluid catalytic cracking (RFCC) unit, the first mode comprising:

reacting a deasphalted oil and a vacuum distillate in the first ebullated bed reactor containing a hydrotreating catalyst to form a first effluent;

separating the first effluent in the first separator into a first gas phase and a first liquid phase;

stripping the first liquid phase in the stripping tower to produce a strippers bottom and a stripper overhead;

fractionating the stripper overhead in the fractionation system to produce at least one atmospheric distillate and an atmospheric bottoms;

fractionating the atmospheric bottoms in the fractionation system to produce the vacuum distillate and a vacuum bottoms;

solvent deasphalting the vacuum bottoms in the solvent deasphalting system to produce the deasphalted oil; and

transporting the strippers bottoms as the feed to the RFCC unit;

operating the system in a second mode to maximize the resid conversion in the first ebullated bed reactor, the second mode comprising:

reacting the deasphalted oil in the first ebullated bed reactor containing a hydrocracking catalyst to form a second effluent;

separating the second effluent in the first separator into a second gas phase and a second liquid phase;

fractionating the second liquid phase in the fractionation system to produce at least one atmospheric distillate and an atmospheric bottoms;

fractionating the atmospheric bottoms in the fractionation system to produce the vacuum distillate and the vacuum bottoms; and
solvent deasphalting the vacuum bottoms to produce the deasphalted oil;
transitioning the system between the first mode and the second mode, wherein the transitioning comprises:
removing the hydrotreating catalyst from the first ebullated bed reactor while simultaneously adding a hydrocracking catalyst to the first ebullated bed reactor;
fractionating the first liquid phase in the fractionation system to produce the at least one atmospheric distillate and the atmospheric bottoms.

2. The process of claim 1, wherein the system further comprises:

a second ebullated bed reactor; and

a second separator;

the second mode further comprises:

reacting a resid hydrocarbon in the second ebullated bed reactor containing a hydrocracking catalyst to form a third effluent;

separating the third effluent in the second separator into a third gas phase and a third liquid phase; and

fractionating the third liquid phase in the fractionation system to produce the at least one atmospheric distillate and the atmospheric bottoms.

3. The process of claim 1, further comprising transitioning the system between the second mode back to the first mode.

4. The process of claim 1, wherein:

(a) transitioning further comprises lowering the temperature of the first ebullated bed reactor;
or

(b) removing the hydrotreating catalyst from the first ebullated bed reactor comprises increasing a speed of an ebullating pump.

5. The process of claim 1, wherein:

the first mode is operated with a first particle size distribution providing low pressure drop under a range of bed expansions from 5% to 25%;

the second mode is operated with a second particle size distribution providing low pressure drop under a range of bed expansions from 40% to 60%.

6. The process of claim 2, wherein:

the fractionating the stripper overhead in the fractionation system comprises separating the first liquid phase product and the second reactor effluent in an atmospheric distillation tower to recover a fraction comprising hydrocarbons boiling in a range of atmospheric distillates and the atmospheric bottoms fraction comprising hydrocarbons having a normal boiling point of at least 340°C; and wherein

the fractionating the atmospheric bottoms in the fractionation system to produce the vacuum distillate and a vacuum bottoms comprises separating the atmospheric bottoms fraction in a vacuum distillation tower to recover a fraction comprising hydrocarbons boiling in a range of vacuum distillates and a vacuum bottoms fraction comprising hydrocarbons having a boiling temperature of at least 480°C.

7. The process of claim 6, further comprising

cooling the first gas phase and the second gas phase to recover a hydrogen-containing gas fraction and a distillate fraction; and

feeding the distillate fraction to the first liquid phase product and the second reactor effluent.

8. The process of claim 7, further comprising recycling at least a portion of the recovered hydrogen to at least one of the first reactor and the second reactor.

9. The process of claim 2, further comprising cooling the vacuum bottoms fraction via direct heat exchange with at least one of a portion of the resid and a portion of the atmospheric bottoms fraction.

10. The process of claim 2, wherein at least one of an operating temperature and an operating pressure in the second reactor is less than an operating temperature and an operating pressure of the first reactor.