

CLAIMS

What is claimed:

1. A system for processing hydrocarbons, comprising:
 - a riser reactor configured to contact a mixture of first particles and second particles with a hydrocarbon feedstock to convert at least a portion of the hydrocarbon feedstock and to recover a riser reactor effluent comprising mixed hydrocarbons and the mixture of the first and second particles, wherein the first particle has a smaller average particle size and/or is less dense than the second particle, and wherein the first particle and second particle may independently be catalytic or non-catalytic particles;
 - a reactor configured to contact a mixture comprising the first particles and the second particles with a second hydrocarbon feedstock to convert at least a portion of the second hydrocarbon feedstock, wherein the reactor is fluidly connected to:
 - an overhead product line for recovering from the reactor a reactor effluent comprising first particles, a first portion of the second particles, and hydrocarbons;
 - a bottoms product line for recovering from the reactor a second stream comprising a second portion of the second particles;
 - a particle separator configured to separate second particles from the reactor effluent, and to produce a hydrocarbon effluent comprising the hydrocarbons and the first particles and a second stream comprising the separated second particles;
 - a feed line for returning the separated second particles from the particle separator to the reactor;
 - a separation system configured to receive the hydrocarbon effluent and the riser reactor effluent and to separate: (i) the first particles from the hydrocarbons in the hydrocarbon effluent, and (ii) the mixture of first and second particles from the mixed hydrocarbons in the riser reactor effluent, producing (a) a combined hydrocarbon effluent stream and (b) a mixture of first and second particles;
 - a regenerator for regenerating the mixture of first and second particles recovered in the separation system;
 - a particle cooler configured to exchange heat between a heat exchange medium and, alternately, intermittently, or at the same time, (i) hot regenerated particles from the

- catalyst regenerator comprising a mixture of first and second particles, and (ii) second catalyst particles recovered via the bottoms product line;
- a flow line for recovering cooled particles from the particle cooler and feeding the cooled particles to the regenerator.
2. The system of claim 1, further comprising:
a stripper intermediate the separation system and the regenerator for stripping additional hydrocarbons from the separated particles and feeding the stripped particles to the regenerator.
 3. The system of claim 1, further comprising:
a second separation system for separating the combined hydrocarbon effluent stream recovered from the separation system into two or more hydrocarbon fractions including a naphtha fraction; and
a feed line for feeding the naphtha fraction to the reactor as the hydrocarbon feedstock.
 4. The system of claim 1, further comprising:
a first feed line for feeding fresh second catalyst to the reactor;
a second feed line for feeding fresh first catalyst to the regenerator.
 5. The system of claim 1, further comprising a flow control system and associated valves configured to selectively direct a flow of: (a) first and second particles from the regenerator to the particle cooler, (b) first and second particles from the regenerator to the reactor, and/or (c) second particles from the reactor to the particle cooler.
 6. A process for the conversion of hydrocarbons, comprising:
feeding a hydrocarbon feedstock and a mixture of first particles and second particles to a riser reactor, wherein the first particle has a smaller average particle size and/or is less dense than the second particle, and wherein the first particle and second particle may independently be catalytic or non-catalytic particles;
contacting the mixture of first and second particles with the second hydrocarbon feedstock to crack the hydrocarbon feedstock and form a riser reactor effluent comprising hydrocarbons and a mixture of first and second particles;
feeding the riser reactor effluent to a separator to separate the first and second particles from the hydrocarbons;
recovering a hydrocarbon product from the separator;
feeding the separated first and second particles to a regenerator;
regenerating the first and second particles in the regenerator;

during a first period of time:

feeding regenerated first particles and second particles from the regenerator to a reactor;

feeding a hydrocarbon feedstock to the reactor and contacting the hydrocarbon feedstock with the regenerated first and second particles;

recovering an overhead product from the reactor comprising a converted hydrocarbon effluent, at least a portion of the second particles, and the first particles;

separating the second particles from the overhead product to provide a first stream comprising the first particles and the converted hydrocarbon effluent and a second stream comprising the separated second particles;

feeding the first stream to the separator; and

returning the separated second particle in the second stream to the reactor; and

during a second period of time:

feeding regenerated first particles and second particles from the regenerator to a particle cooler;

in the particle cooler, exchanging heat between a heat exchange medium and the regenerated first particles and second particles;

recovering cooled particles from the particle cooler and feeding the cooled particles to the regenerator.

7. The process of claim 6, further comprising recovering a bottoms product from the reactor comprising second particles.
8. The process of claim 7, further comprising stripping additional hydrocarbons from the second particles in the reactor and feeding the stripped particles to the regenerator.
9. The process of claim 6, further comprising:
 - feeding fresh second particles to the reactor;
 - feeding fresh first particles to the regenerator.
10. The process of claim 6, further comprising:
 - separating the hydrocarbon products into two or more hydrocarbon fractions including a naphtha fraction; and
 - feeding the naphtha fraction to the reactor as the hydrocarbon feedstock.
11. The process of claim 6, further comprising, during a third period of time:
 - feeding second particles from the reactor to the particle cooler; and

recovering second particles from the particle cooler.

12. The process of claim 11, further comprising feeding the recovered second particles to the regenerator.

13. The process of claim 6, further comprising, during a third period of time:
feeding regenerated first particles and second particles from the regenerator to both the reactor and the particle cooler, and concurrently:
operating the reactor as for the first period of time; and
operating the particle cooler as for the second period of time.