

CLAIMS

1. A method for operating a system having a first fluid catalytic cracking (FCC) unit and a second FCC unit for producing products from a hydrocarbon feed stream, the
5 method comprising:
 - introducing the hydrocarbon feed stream to a feed separator;
 - separating the hydrocarbon feed stream into a lesser boiling point fraction and a greater boiling point fraction in the feed separator;
 - passing the greater boiling point fraction to the first FCC unit;
 - 10 passing the lesser boiling point fraction to the second FCC unit, where the first FCC unit and the second FCC unit are downflow FCC units;
 - cracking at least a portion of the greater boiling point fraction in the first FCC unit in the presence of a first catalyst at a first cracking temperature of from 500°C to 700°C to produce a first cracking reaction product and a spent first catalyst;
 - 15 cracking at least a portion of the lesser boiling point fraction in the second FCC unit in the presence of a second catalyst and at a second cracking temperature of from 500°C to 700°C to produce a second cracking reaction product and a spent second catalyst; and
 - passing at least a portion of the spent first catalyst to the second FCC unit.
- 20 2. The method of claim 1 where the hydrocarbon feed stream comprises crude oil.
3. The method of claim 1 where the first FCC unit and the second FCC unit are High-Severity Fluidized Catalytic Cracking (HSFCC) units.
- 25 4. The method of claim 3 where a weight ratio of catalyst to hydrocarbon in the first FCC unit and the second FCC unit is greater than 5 and a residence time in the first FCC unit and the second FCC unit is less than 3 seconds.
- 30 5. The method of claim 1 further comprising regenerating a non-recycled portion of the spent first catalyst and a non-recycled portion of the spent second catalyst in a regeneration zone to produce a regenerated catalyst.

6. The method of claim 1 where the second catalyst comprises the at least a portion of the spent first catalyst and the regenerated catalyst.
- 5 7. The method of claim 6 where the second catalyst comprises a weight ratio of the at least a portion of the spent first catalyst to the regenerated catalyst of from 1:99 to 99:1.
8. The method of claim 6 further comprising controlling a catalytic activity of the
10 second catalyst in the second FCC unit or the second cracking temperature in the second FCC unit by adjusting a weight ratio of the at least a portion of the spent first catalyst to the regenerated catalyst in the second catalyst.
9. The method of claim 6 further comprising mixing the at least a portion of the
15 spent first catalyst, the regenerated catalyst, and the lesser boiling point fraction in a mixing zone positioned upstream of a cracking reaction zone of the second FCC unit.
10. The method of claim 1 where the first cracking reaction product or the second
20 cracking reaction product comprises one or more of ethylene, propene, butene, or pentene.
11. A system for producing olefins from crude oil, the system comprising:
a first FCC unit comprising a first cracking reaction zone, the first cracking
reaction zone being a downflow cracking reaction zone;
25 a first separation zone downstream of the first FCC unit;
a second FCC unit in parallel with the first FCC unit and comprising a second
cracking reaction zone, the second cracking reaction zone being a downflow cracking
reaction zone;
a second separation zone downstream of the second FCC unit;
30 a regeneration zone downstream of the first separation zone and the second
separation zone and fluidly coupled to the first separation zone and the second
separation zone; and

a catalyst recycle fluidly coupling the first separation zone to the second FCC unit.

12. The system of claim 11 further comprising a feed separator having an inlet, a
5 greater boiling point fraction outlet stream, and a lesser boiling point fraction outlet stream, where the greater boiling point fraction outlet stream is fluidly coupled to the first FCC unit and the lesser boiling point fraction outlet stream is fluidly coupled to the second FCC unit.
- 10 13. A method for operating a system having a first FCC unit and a second FCC unit for producing products from a hydrocarbon feed stream, the method comprising:
- introducing the hydrocarbon feed stream to a feed separator;
 - separating the hydrocarbon feed stream into a lesser boiling point fraction and a
greater boiling point fraction in the feed separator;
 - 15 passing the greater boiling point fraction to the first FCC unit;
 - passing the lesser boiling point fraction to the second FCC unit, where the first FCC unit and the second FCC unit are downflow FCC units;
 - cracking at least a portion of the greater boiling point fraction in the first FCC unit in the presence of a first catalyst at a first cracking temperature of from 500°C to
20 700°C to produce a first cracking reaction product and a spent first catalyst;
 - cracking at least a portion of the lesser boiling point fraction in the second FCC unit in the presence of a second catalyst and at a second cracking temperature of from 500°C to 700°C to produce a second cracking reaction product and a spent second catalyst;
 - 25 passing the at least a portion of the spent second catalyst to the second FCC unit, where the second catalyst comprises the at least a portion of the spent second catalyst and the regenerated catalyst; and
 - mixing the at least a portion of the spent second catalyst, the regenerated catalyst, and the lesser boiling point fraction in a mixing zone positioned upstream of a cracking
30 reaction zone of the second FCC unit.
14. The method of claim 13 where the hydrocarbon feed stream comprises crude oil.

15. The method of claim 13 where the first FCC unit and the second FCC unit are High-Severity Fluidized Catalytic Cracking (HSFCC) units.
- 5 16. The method of claim 15 where a weight ratio of catalyst to hydrocarbon in the first FCC unit and the second FCC unit is greater than 5 and a residence time in the first FCC unit and the second FCC unit is less than 3 seconds.
- 10 17. The method of claim 13 further comprising regenerating a non-recycled portion of the spent first catalyst and a non-recycled portion of the spent second catalyst in a regeneration zone to produce a regenerated catalyst.
- 15 18. The method of claim 13 where the second catalyst comprises a weight ratio of the at least a portion of the spent second catalyst to the regenerated catalyst of from 1:99 to 99:1.
- 20 19. The method of claim 13 further comprising controlling a catalytic activity of the second catalyst in the second FCC unit or the second cracking temperature in the second FCC unit by adjusting a weight ratio of the at least a portion of the spent second catalyst to the regenerated catalyst in the second catalyst.
20. The method of claim 13 where the first cracking reaction product or the second cracking reaction product comprises one or more of ethylene, propene, butene, or pentene.