

Claims

1. Additive particles for use in a fluid catalytic cracking system, comprising active particulates and a binder material, wherein at least 50 wt % of the active particulates are in a size range from 0.5 μm to 40 μm .
2. The particles of claim 1, wherein at least 90 wt. % of the active particulates are in a size range from 0.5 μm to 20 μm .
3. The particles of claim 1, wherein at least a portion of the additive particles are in a size range from 45 μm to 200 μm .
4. The particles of claim 1, wherein at least 50 wt. % of the additive particles are in a size range from 45 μm to 200 μm .
5. The particles of claim 1, wherein the binder material comprises alumina or an active source of alumina.
6. The particles of claim 1, wherein the additive particles comprise from 0.1 wt. % to 50 wt. % of the binder material.
7. The particles of claim 1, wherein the additive particles further comprise a matrix material.
8. The particles of claim 1, wherein the additive particles are SO_x additive particles, comprising at least one SO_x active particulate that is reactive with sulfur trioxide or sulfur dioxide and oxygen at fluid catalytic cracking regenerator conditions to form at least one sulfur-containing solid.
9. The particles of claim 8, wherein the at least one SO_x active particulate comprises alumina, magnesia, or combinations thereof.
10. The particles of claim 8, wherein the at least one SO_x active particulate comprises a magnesium-alumina spinel.

11. The particles of claim 8, wherein the at least one SO_x active particulate comprises a magnesium-alumina spinel and a binder.
12. The particles of claim 8, wherein the SO_x additive particles further comprise a binder selected from alumina, silica, magnesia, or combinations thereof.
13. The particles of claim 8, wherein the SO_x additive particles further comprise a promoter.
14. The particles of claim 13, wherein the promoter comprises at least one metal selected from a rare earth metal, a noble metal, a base metal, or combinations thereof.
15. The particles of claim 13, wherein the promoter comprises cerium or lanthanum.
16. The particles of claim 13, wherein the promoter comprises platinum or palladium.
17. The particles of claim 13, wherein the promoter comprises vanadium.
18. The particles of claim 1, wherein the additive particles comprise catalytic cracking particles comprising at least one active cracking particulate and the binder material.
19. The particles of claim 18, wherein the binder material comprises alumina or an active source of alumina.
20. The particles of claim 18, wherein the at least one active cracking particulate comprises a zeolite.
21. The particles of claim 1, wherein the zeolite is selected from a group consisting of rare earth-exchanged X or Y, hydrogen Y, ultrastable Y, or ZSM-5.

What is claimed is:

1. Additive particles for use in a fluid catalytic cracking system, comprising active particulates and a binder material, wherein at least a portion of the active particulates are in a size range from 0.5 μm to 40 μm .
2. A process for preparing additive particles comprising:
 - a. forming active particulates in a size range from 0.5 μm to 40 μm ; and
 - b. combining at least a portion of the active particulates with a binder material to form additive particles in a size range from 45 μm to 200 μm .
3. The process of claim 2, wherein forming active particulates comprises:
 - a. combining a reactive component selected from a group consisting of alumina, an active source of alumina, magnesia, an active source of magnesia, and combinations thereof, with a liquid to form a slurry; and
 - b. spray drying the slurry to form the active particulates.
4. The process of claim 2, wherein forming active particulates comprises:
 - a. preparing a blend of alumina or an active source of alumina and magnesia or an active source of magnesia;
 - b. drying the blend to form self-supporting particulates; and
 - c. grinding the self-supporting particulates to form the active particulates.
5. The process of claim 2, wherein forming additive particles comprises:
 - a. suspending the active particulates in a liquid to form a slurry; and
 - b. spray drying the slurry to form the additive particles.
6. The process of claim 5, further comprising providing alumina or an active source of alumina to the liquid prior to spray drying the slurry.
7. A process for cracking a sulfur-containing hydrocarbon feed in an absence of externally supplied molecular hydrogen, comprising:
 - a. cycling an inventory of particulate solids including cracking catalyst particles between a cracking zone and a catalyst regeneration zone;
 - b. cracking the sulfur-containing hydrocarbon feed with the cracking catalyst particles in the cracking zone at cracking conditions comprising a temperature in a range from

- 425° to 700° Celsius to form cracked hydrocarbon fluid products that are removed from the cracking zone, whereby sulfur-containing coke is deposited on the cracking catalyst particles;
- c. passing the cracking catalyst particles deposited with the sulfur-containing coke from the cracking zone and an oxygen-containing gaseous fluid into the catalyst regeneration zone, such that the sulfur-containing coke is burned in the catalyst regeneration zone at a temperature in a range from 538° to 816° Celsius to form coke-depleted cracking catalyst particles and a flue gas containing sulfur oxides, and removing the flue gas from the catalyst regeneration zone;
 - d. forming a sulfur-containing solid in the catalyst regeneration zone by reacting the sulfur oxides with SO_x additive particles, comprising at least one SO_x active particulate having a size range from 0.5 μm to 40 μm and a binder material;
 - e. passing the coke-depleted cracking catalyst particles and the sulfur-containing solid from the catalyst regeneration zone to the cracking zone; and
 - f. forming hydrogen sulfide in the cracking zone by contacting the sulfur-containing solid with the hydrocarbon feed.
8. A process for combusting a sulfur-containing material in a circulating bed of particulates, comprising:
- a. contacting a sulfur-containing material with an oxygen-containing gaseous fluid and producing a gaseous product comprising sulfur oxides;
 - b. contacting the sulfur oxides with SO_x additive particles comprising SO_x active particulates, having a size range from 0.5 μm to 40 μm, and a binder material; and
 - c. forming sulfur-containing solids.
9. Anyone of claims 1-8, wherein at least 50 wt. % of the active particulates are in a size range from 0.5 μm to 40 μm.
10. Anyone of claims 1-8, wherein at least 90 wt. % of the active particulates are in a size range from 0.5 μm to 20 μm.
11. Anyone of claims 1-8, wherein at least 50 wt. % of the additive particles are in a size range from 45 μm to 200 μm.
12. Anyone of claims 1-8, wherein the binder material comprises alumina or an active source of alumina.

13. Anyone of claims 1-8, wherein the additive particles comprise from 0.1 wt. % to 50 wt. % of the binder material.
14. Anyone of claims 1-8, wherein the additive particles further comprise a matrix material.
15. Anyone of claims 1-6, wherein the additive particles are SO_x additive particles, comprising at least one SO_x active particulate that is reactive with sulfur trioxide or sulfur dioxide and oxygen at fluid catalytic cracking regenerator conditions to form at least one sulfur-containing solid.
16. The particles of claim 15, wherein the at least one SO_x active particulate comprises alumina, magnesia, magnesium-alumina spinel, or combinations thereof.
17. Anyone of claims 7, 8, 15 or 16, wherein the SO_x additive particles further comprise a binder selected from alumina, silica, magnesia, or combinations thereof.
18. Anyone of claims 7, 8, 15 - 17, wherein the SO_x additive particles further comprise a promoter comprising at least one metal selected from a rare earth metal, a noble metal, a base metal.
19. The particles or process of claim 18, wherein the promoter comprises cerium, lanthanum, platinum, palladium, vanadium, or combinations thereof.
20. Anyone of claims 1-6, wherein the additive particles comprise catalytic cracking particles comprising at least one active cracking particulate and the binder material.
21. The particles of claim 20, wherein the binder material comprises alumina or an active source of alumina.
22. The particles of claim 20, wherein the at least one active cracking particulate comprises a zeolite selected from a group consisting of rare earth-exchanged X or Y, hydrogen Y, ultrastable Y, or ZSM-5.
23. A process comprising circulating a mixture of cracking catalyst and SO_x additive particles within a fluid catalytic cracking unit which includes a catalyst regeneration unit, passing an oxygen-containing gaseous fluid through the catalyst regeneration unit, and producing a flue gas that contains particulate fragments, including catalyst fragments and SO_x additive fragments, wherein at least 50 wt. % of the SO_x additive fragments have a

particle size of greater than 1 μm .

24. A process comprising circulating a mixture of cracking catalyst and SO_x additive particles within a fluid catalytic cracking unit which includes a catalyst regeneration unit, passing an oxygen-containing gaseous fluid through the catalyst regeneration unit, and producing a flue gas that contains particulate fragments, including catalyst fragments and SO_x additive fragments, the SO_x additive particles comprising SO_x active particulates and a binder, the SO_x active particulates being in a size range from 0.5 μm to 40 μm .