

CLAIMS

What is claimed is:

1. A continuous process for converting waste plastic into recycle for polyethylene polymerization comprising:

- (a) selecting waste plastics containing polyethylene and/or polypropylene;
- (b) passing the waste plastics from (a) through a pyrolysis reactor to thermally crack at least a portion of the polyolefin waste and produce a pyrolyzed effluent;
- (c) separating the pyrolyzed effluent into offgas, char and a pyrolysis oil and optionally pyrolysis wax comprising a naphtha/diesel fraction and a heavy fraction;
- (d) passing the pyrolysis oil and wax from (c) to a refinery FCC unit;
- (e) recovering a liquid petroleum C₃ olefin/paraffin mixture fraction from the FCC unit;
- (f) passing the liquid petroleum gas C₃ olefin/paraffin mixture fraction to a steam cracker for ethylene production.

2. The process of claim 1, wherein the pyrolysis oil and wax are first passed to a FCC feed pretreater unit before the refinery FCC unit.

3. The process of claim 1, wherein a liquid petroleum C₄ olefin/paraffin mixture fraction comprising butanes and butenes is recovered from the FCC unit and passed to a refinery alkylation unit.

4. The process of claim 3, wherein an alkylate gasoline and n-butane fraction is recovered from the alkylation unit and passed to a stream cracker to generate ethylene.

5. The process of claim 3, wherein a gasoline and heavy fraction are recovered from the refinery FCC unit.
6. The process of claim 3, wherein an alkylate gasoline fraction is recovered from the refinery alkylation unit.
7. The process of claim 1, wherein ethylene produced in (f) is subsequently polymerized.
8. The process of claim 7, wherein polyethylene products are prepared from the polymerized ethylene.
9. The process of claim 5, wherein the gasoline recovered from the refinery FCC unit is combined with at least a portion of the alkylate gasoline fraction recovered from the alkylation unit.
10. The process of claim 5, wherein the amount of gasoline produced by the FCC and alkylation units is increased with recycled pyrolysis oil.
11. The process of claim 1, wherein at least some contaminants are removed from the recovered pyrolysis oil of step (c) before the oil is passed to the FCC unit in (d).
12. The process of claim 1, wherein the waste plastics selected in (a) are from plastics classification group 2, 4, and/or 5.

13. A continuous process for converting waste plastic into recycle for polyethylene polymerization comprising:

- (a) selecting waste plastics containing polyethylene and/or polypropylene;
- (b) passing the waste plastics from (a) through a pyrolysis reactor to thermally crack at least a portion of the polyolefin waste and produce a pyrolyzed effluent;
- (c) separating the pyrolyzed effluent into offgas, char and a pyrolysis oil comprising a naphtha/diesel fraction and a heavy fraction;
- (d) passing the pyrolysis oil to a refinery FCC unit;
- (e) recovering a liquid petroleum gas C₄ olefin/paraffin mixture fraction comprising butanes and butenes from the FCC unit;
- (f) passing the liquid petroleum gas C₄ olefin/paraffin mixture fraction to an alkylation unit;
- (g) recovering n-butane and a portion of naphtha fraction from the alkylation unit;
and
- (h) passing the n-butane and a portion of naphtha fraction to a steam cracker for ethylene production.

14. The process of claim 13, wherein a gasoline and heavy fraction is recovered from the refinery FCC unit.

15. The process of claim 13, wherein an alkylate gasoline fraction is recovered from the refinery alkylation unit.

16. The process of claim 14, wherein the gasoline recovered from the refinery FCC unit is combined with an alkylate gasoline fraction recovered from the alkylation unit.

17. The process of claim 13, wherein at least some contaminants are removed from the recovered pyrolysis oil of step (c) before the oil is passed to the FCC unit in (d).

18. The process of claim 13, wherein the waste plastics selected in (a) are from plastics classification group 2, 4, and/or 5.

19. The process of claim 16, wherein the amount of gasoline produced by the FCC and alkylation units is increased with recycled pyrolysis oil.

20. The process of claim 13, wherein ethylene produced in (h) is subsequently polymerized.

21. The process of claim 20, wherein polyethylene products are prepared from the polymerized ethylene.

22. The process of claim 13, further comprising collecting a C₃ olefin/paraffin mixture fraction from the FCC unit and passing the fraction to a steam cracker for ethylene production.

23. A continuous process for converting waste plastic into recycle for polyethylene polymerization comprising:

- (a) selecting waste plastics containing polyethylene and/or polypropylene;

(b) passing the waste plastics from (a) through a pyrolysis reactor to thermally crack at least a portion of the polyolefin waste and produce a pyrolyzed effluent;

(c) separating the pyrolyzed effluent into offgas, char and a pyrolysis oil comprising a naphtha/diesel fraction and a heavy fraction;

(d) passing the pyrolysis oil from (c) to a refinery FCC unit;

(e) recovering a liquid petroleum gas C₃ olefin/paraffin mixture fraction from the FCC unit;

(f) separating the C₃ paraffin and C₃ olefin into different fractions; and

(h) passing the C₃ paraffin fraction to a steam cracker for ethylene production.

24. A continuous process for converting waste plastic into recycle for polyethylene polymerization comprising:

(a) selecting waste plastics containing polyethylene and/or polypropylene;

(b) passing the waste plastics from (a) through a pyrolysis reactor to thermally crack at least a portion of the polyolefin waste and produce a pyrolyzed effluent;

(c) separating the pyrolyzed effluent into offgas, char and a pyrolysis oil and optionally pyrolysis wax comprising a naphtha/diesel fraction and a heavy fraction;

(d) passing the pyrolysis oil and wax from (c) to a refinery FCC feed pretreater unit;

(e) recovering a heavy fraction from the FCC feed pretreater unit and passing it to a refinery FCC unit;

(f) recovering a liquid petroleum gas C₃ olefin/paraffin mixture fraction from the FCC unit;

(g) passing the C₃ mixture to a steam cracker for ethylene production.

25. The process of claim 24, wherein a gasoline, C₄ stream, and a heavy fraction is recovered from the refinery FCC unit.

26. The process of claim 25, wherein the gasoline recovered from the refinery FCC unit is sent to a gasoline blending pool.

27. The process of claim 25, wherein the heavy fraction and C₄ stream recovered from the refinery FCC unit are sent to refinery units for upgrading into clean gasoline and diesel.

28. The process of claim 24, wherein sulfur, nitrogen, phosphorus silica, dienes, and metal contaminants are removed from the recovered pyrolysis oil of step (c) by the FCC feed pretreater unit before the oil and wax is passed to the FCC unit in (e).

29. The process of claim 24, wherein the waste plastics selected in (a) are from plastics classification group 2, 4, and/or 5.

30. The process of claim 24, wherein the ethylene produced in (h) is subsequently polymerized.

31. The process of claim 25, wherein the amount of gasoline produced by the FCC unit is increased with recycled pyrolysis oil.