CLAIMS

What is claimed is:

1. A continuous process for converting waste plastic into recycle for polypropylene 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, a pyrolysis oil comprising a naphtha/diesel/heavy fraction, and char;

(d) passing the pyrolysis oil from (c) to a ~~filtration/metal~~filtration unit followed by a metal oxide treatment;

(e) recovering the treated pyrolysis oil from the metal oxide treatment and passing same to a refinery FCC unit;

(f) recovering a liquid petroleum C_3 olefin/paraffin mixture fraction from the FCC unit;

(g) separating the C_3 paraffin and C_3 olefin into different fractions; and

(h) passing the C_3 olefin to a propylene polymerization reactor.

2. The process of claim 1, further comprising passing the C_3 paraffin to a dehydrogenation unit to produce C_3 olefin and then passing the C_3 olefin to a propylene polymerization reactor.

3. The process of claim 1, wherein a gasoline and heavy fraction are recovered from the refinery FCC unit.

4. The process of claim 1, wherein consumer polypropylene products are prepared from the polymerized propylene.

5. The process of claim 1, wherein the amount of gasoline produced by the FCC unit is increased due to the treated ~~with recycled~~ pyrolysis oil passed to the FCC unit in (e).

6. The process of claim 1, wherein the waste plastics selected in (a) are from plastics classification group 2, 4, and/or 5.

7. The process of claim 1, wherein the filtration employs a filter having pores averaging 5 microns or less in diameter.

8. The process of claim 7, wherein the pores average less than 1 micron in diameter.

9. The process of claim 1, wherein the metal oxide treatment comprises a metal oxide selected from CaO, ZnO, MgO, NiO, MoO_3, alumina, silica, silica-alumina, clay or a mixture thereof.

10. The process of claim 1, wherein the metal oxide treatment occurs at a temperature above 200° F.

11. The process of claim 1, wherein the filtration~~/~~ and metal oxide treatment occur~~s~~ in a refinery comprising the FCC unit.

12. The process of claim 1, wherein filtration occurs at a pyrolysis facility and the metal oxide treatment occurs at a refinery comprising the FCC unit.

13. The process of claim 1, wherein the content of heptane insolubles is reduced to less than 0.1 wt. % after the filtration treatment.

14. The process of claim 1, wherein the chloride content is reduced to less 5 ppm after the metal oxide treatment.

15. The process of claim 1, wherein the total metal impurity is less than 10 ppm after the metal oxide treatment.

16. The process of claim 1, wherein solid particulate and chloride reduction is achieved in the filtration~~/~~ and metal oxide treatment of (d), and S, diene, olefin, and N reduction is achieved by the refinery FCC unit.

17. The process of claim 1, wherein only the diesel and heavy fractions of the pyrolysis oil, or the heavy fraction of the pyrolysis oil is passed to a filtration and metal oxide treatment.

18. A continuous process for converting waste plastic into recycle for polypropylene 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, a pyrolysis oil comprising a naphtha/distillate/heavy fraction, and char;

(d) passing the pyrolysis oil from (c) to a filtration unit followed by a metal oxide treatment;

(e) recovering the treated pyrolysis oil from the metal oxide treatment and passing same to a refinery FCC feed pretreatment unit;

(f) recovering effluent from the FCC pretreatment unit and passing the effluent to a FCC unit;

(g) recovering a liquid petroleum C_3 olefin/paraffin mixture fraction from the FCC unit;

(h) separating the C_3 paraffin and C_3 olefin into different fractions; and

(i) passing the C_3 olefin to a propylene polymerization reactor.~~The process of claim 1, wherein the treated pyrolysis oil recovered in (e) is first passed to an FCC pretreatment unit, from which effluent is recovered, and which recovered effluent is passed to the refinery FCC unit.~~

19. The process of claim 18, further comprising passing the C_3 paraffin to a dehydrogenation unit to produce C_3 olefin and passing the C_3 olefin to a propylene polymerization reactor.

20. The process of claim 18, wherein a gasoline and heavy fraction are recovered from the refinery FCC unit.

21. The process of claim 18, wherein consumer polypropylene products are prepared from the polymerized propylene.

22. The process of claim 18, wherein the amount of gasoline produced by the FCC unit is increased due to the treated pyrolysis oil passed to the FCC unit in (e).

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

24. The process of claim 18, wherein the filtration employs a filter having pores averaging 5 microns or less in diameter.

25. The process of claim 24, wherein the pores average less than 1 micron in diameter.

26. The process of claim 18, wherein the metal oxide treatment comprises a metal oxide selected from CaO, ZnO, MgO, NiO, MoO_3, alumina, silica or silica-alumina, or clay or a mixture thereof.

27. The process of claim 18, wherein the metal oxide treatment occurs at a temperature above 200° F (93° C).

28. The process of claim 18, wherein the filtration and metal oxide treatment occur in a refinery comprising the FCC unit.

29. The process of claim 18, wherein filtration occurs at a pyrolysis facility and the metal oxide treatment occurs at a refinery comprising the FCC unit.

30. The process of claim 18, wherein the content of heptane insolubles is reduced to less than 0.1 wt. % after the filtration treatment.

31. The process of claim 18, wherein the chloride content is reduced to less 5 ppm after the metal oxide treatment.

32. The process of claim 18, wherein the total impurity metal content is less than 10 ppm after the metal oxide treatment.

~~19~~33. The process of claim 18, wherein solid particulate and chloride reduction is achieved in the filtration~~/~~ and metal oxide treatment of (d), and S, diene, olefin, and N reduction is achieved by the refinery FCC feed pretreatment unit.

~~20~~34. The process of claim 18, wherein only the diesel and heavy fractions of the pyrolysis oil, or the heavy fraction of the pyrolysis oil is passed to a filtration and metal oxide treatment.

~~21~~35. A continuous process for converting waste plastic into recycle for polypropylene 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, a pyrolysis oil comprising a naphtha/diesel/heavy fraction, and char;

(d) passing the pyrolysis oil from (c) to a ~~filtration/metal~~filtration unit followed by a metal oxide treatment; and

(e)~~(e)~~ recovering the treated pyrolysis oil from the metal oxide treatment and forwarding same to a refinery for propylene polymerization.

~~22~~36. The process of claim ~~21~~35, wherein the filtration employs a filter having pores averaging 5 microns or less in diameter.

~~23~~37. The process of claim ~~22~~36, wherein the pores average less than 1 micron in diameter.

~~24~~38. The process of claim ~~21~~35, wherein the metal oxide treatment comprises a metal oxide selected from CaO, ZnO, MgO, alumina Silica or silica-alumina, or a mixture thereof.

~~25~~39. The process of claim ~~21~~35, wherein the metal oxide treatment occurs at a temperature above 200° F (93° C).

~~26~~40. The process of claim ~~21~~35, wherein the content of heptane insolubles is reduced to less than 0.1 wt. % after the filtration treatment.

~~27~~41. The process of claim ~~21~~35, wherein the chloride content is reduced to less 5 ppm after the metal oxide treatment.

~~28~~42. The process of claim ~~21~~35, wherein the total metal impurity is less than 10 ppm after the metal oxide treatment.

~~29~~43. The process of claim ~~21~~35, wherein filtration occurs at a pyrolysis facility and the metal oxide treatment occurs at a refinery comprising the FCC unit

~~30~~44. The process of claim ~~21~~35, wherein the waste plastics selected in (a) are from plastics classification group 2, 4, and/or 5.

~~31~~45. The process of claim ~~21~~35, further comprising producing ~~sustainable fuel products in the refinery and blending the products to produce~~ gasoline, jet fuel and/or diesel ~~products~~fuel in the refinery.

~~32~~46. The process of claim ~~31~~45, wherein a jet fuel product is ~~blended~~produced in the refinery.

47. The process of claim 45, wherein gasoline is produced in the refinery.

48. The process of claim 45, wherein diesel fuel is produced in the refinery.

49. The process of claim 1, wherein the filtration unit employs a filter having pores averaging 5 microns or less in diameter, and the metal oxide treatment comprises a metal oxide selected from CaO, ZnO, MgO, NiO, MoO_3, alumina, silica, silica-alumina, clay or a mixture thereof.

50. The process of claim 18, wherein the filtration unit employs a filter having pores averaging 5 microns or less in diameter, and the metal oxide treatment comprises a metal oxide selected from CaO, ZnO, MgO, NiO, MoO_3, alumina, silica, silica-alumina, clay or a mixture thereof.

51. The process of claim 35, wherein the filtration unit employs a filter having pores averaging 5 microns or less in diameter, and the metal oxide treatment comprises a metal oxide selected from CaO, ZnO, MgO, NiO, MoO_3, alumina, silica, silica-alumina, clay or a mixture thereof.