

What is claimed is:

1. A method of processing pyrolysis oil comprising
adjusting the polarity of said oil with a non-polar solvent,
binding unwanted components to clay,
5 eluting the clean oil in the non-polar solvent, and
separating the non-polar solvent from the oil.
2. The method of claim 1 including
employing an alkane as said non-polar solvent.
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3. The method of claim 2 including
employing an alkane selected from the group consisting of alkanes having 4 to 10
carbons.
- 15 4. The method of claim 2 including
employing a mixture of two or more alkanes selected from the group consisting of
alkanes having 4 to 10 carbons.
5. The method of claim 2 including
20 Employing an alkane selected from the group consisting of alkanes having 5 to 7
carbons.
6. The method of claim 2 including
employing hexane as said alkane.
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7. The method of claim 2 including
mixing said oil and alkane to adjust polarity.

8. The method of claim 7 including
mixing said oil and alkane preferably in a ratio of oil to alkane to about 1:2 to
1:30.
- 5 9. The method of claim 7 including
mixing said oil and alkane preferably in a ratio of oil to alkane to about 1:4 to
1:15.
- 10 10. The method of claim 7 including
mixing said oil and alkane most preferably in a ratio of oil to alkane to about 1:6
to 1:10.
- 15 11. The method of claim 7 including
after mixing said oil and alkane allow it to sit for at least 30 minutes to allow
precipitation.
12. The method of claim 1 including
effecting said separation of said solvent from said oil by evaporation.
- 20 13. The method of claim 1 including
employing attapulgit as said clay.
14. The method of claim 1 including
prior to a cycle of said process activating said clay.
- 25 15. The method of claim 1 including
said ratio of clay to oil being about 4:1 to 20:1 by weight.
- 30 16. The method of claim 1 including
said ratio of clay to oil being about 6:1 to 15:1 by weight.

17. The method of claim 1 including
cleaning said clay before performing a next cycle of said processing of said
pyrolysis oil.
- 5 18. The method of claim 17 including
employing a polar solvent to clean said clay.
19. The method of claim 18 including
employing acetone as said clay cleaning polar solvent.
- 10 20. The method of claim 17 including
employing as said clay cleaning polar solvent a material selected from the group
consisting of methanol, tetrahydrofuran and dimethylformamide.
- 15 21. The method of claim 1 including
employing a column in performing the processing of said binding unwanted
components to clay.
22. The method of claim 21 including
20 employing hexane as said alkane in said oil and alkane mixture.
23. The method of claim 22 including
creating flow of said oil-alkane mixture through said column at the rate of about
0.1 to 0.6 liters per hour of column flow per liter of column void volume.
- 25 24. The method of claim 21 including
employing hexane as said alkane in said oil and alkane mixture, and

creating flow of said mixture through said column at the rate of about 0.2 to 0.4 liters per hour of column flow per liter of column void volume.

25. The method of claim 1 including,

5 employing hexane as said alkane in said oil and alkane mixture, and

creating flow of said mixture through said column at the rate of about 0.3 to 3.5 liters per hour of column flow per liter of column void volume.

26. The method of claim 1 including

10 effecting said separation of said non-polar solvent from said oil by heating said mixture to a temperature high enough to evaporate said non-polar solvent but not high enough to evaporate said oil.

27. The method of claim 1 including

15 effecting said separation of said non-polar solvent from said oil by heating said mixture to between the boiling point of the non-polar solvent and 32°C above the boiling point of the most volatile compound in the particular pyrolysis oil fraction.

28. The method of claim 1 including

20 effecting said separation of said non-polar solvent from said oil by heating said mixture preferably to between the boiling point of the particular solvent and 10°C above the boiling point of the most volatile compound in the particular pyrolysis oil fraction.

29. The method of claim 1 including

25 effecting said separation of said non-polar solvent from said oil by heating said mixture to between the boiling point of the particular solvent and 2°C above the boiling point of the most volatile compound in the oil fraction.

30. The method of claim 20 including
employing hexane as said non-polar solvent and heating said mixture to between
5 68°C to 100°C to evaporate said hexane.

31. The method of claim 20 including
employing hexane as said non-polar solvent and heating said mixture to preferably
between 68°C and 78°C to evaporate said hexane.

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32. The method of claim 1 including
effecting said processing by employing a distillation-elution method.

33. The method of claim 1 including
15 effecting said processing by forced flow elution methods.

34. The method of claim 12 including
condensing said evaporated alkane,
introducing said condensed alkane into a first vessel,
20 said oil being in a second vessel, and
said second vessel being substantially alkane free.

35. The method of claim 14 including
regenerating said clay with a polar solvent, and
25 reactivating said regenerated clay.

36. Apparatus for processing pyrolysis oil comprising
a first vessel for receiving a mixture of said pyrolysis oil and a non-polar solvent,

a heater for evaporating said non-polar solvent,

a first condenser for receiving said evaporated non-polar solvent and condensing the same, and

5 a clay column for receiving condensed vapors from said condenser and eluting said non-polar solvent therefrom into a second vessel.

37. The apparatus of claim 36 including

said apparatus structured to deliver said evaporated non-polar solvent to a second vessel leaving said oil in said first vessel.

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38. The apparatus of claim 37 including

said first vessel structured to receive substantially all of said pyrolysis oil and to be substantially devoid of said non-polar solvent.

15 39. The apparatus of claim 36 including

said apparatus structured to clean said clay column after a cycle of operation.

40. The apparatus of claim 39 including

said apparatus structured to employ acetone as said clay cleaning polar solvent.

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41. The apparatus of claim 36 including

said apparatus structured to process non-polar solvents which are alkanes having 4 to 10 carbons.

25 42. The apparatus of claim 40 including

said apparatus structured to process hexane.

43. The apparatus of claim 36 including

said apparatus structured to function as distillation apparatus in processing said pyrolysis oils.

44. The apparatus of claim 36 including

5 said apparatus being employable in both the processing of said pyrolysis oils and the cleaning of said apparatus after a cycle of operation.

45. An apparatus for processing pyrolysis oils comprising

a first vessel for holding a mixture of said oil and a non-polar solvent,

10 a clay column for receipt of said mixture,

a second vessel for receiving said mixture passing through said clay column,

said second vessel structured to heat said mixture to a temperature at which said non-polar-solvent will vaporize, but said oil will not vaporize,

a condenser for condensing said vapors,

15 a third vessel for receipt of said condensed vapors until only oil remains in said second vessel, and

delivery means for delivering a clay cleaning material to said clay column after a cycle of operation.

20 46. The apparatus of claim 45 including

said apparatus structured to process non-polar solvents which are alkanes having 4 to 10 carbons.

47. The apparatus of claim 45 including

25 said apparatus structured to process a non-polar solvent which is hexane.

48. The apparatus of claim 45 including

said apparatus structured to simultaneously process a plurality of non-polar solvents which are alkanes having 4 to 10 carbons.

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49. The apparatus of claim 45 including
said clay cleaning material being acetone.

5 50. The apparatus of claim 45 including
said clay being attapulgite.

51. The apparatus of claim 50 including
said apparatus structured to activate said clay before performing a next cycle of
said processing of pyrolysis oil.

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52. The apparatus of claim 51 including
said apparatus structured to effect said activation by drying said clay up to about
150°C until there is no more weight loss.