CLAIMS:

What is claimed is:

1. A process to re-refine used oil, comprising:

introducing a used oil and a solvent to a separation unit under separation conditions selected to produce a purified oil product, the separation unit comprising a porous membrane, a semiporous membrane, or both; and

separating the used oil to obtain an effluent comprising a purified oil product.

2. The process of claim 1, further comprising removing the solvent by distillation, extraction, fractionation, decanting, or a combination thereof.

3. The process of claim 1 or 2, wherein the solvent comprises a non-polar solvent, or wherein the solvent has a boiling point of 200°C or less, or a combination thereof.

4. The process of any one of claims 1-3, wherein the solvent is selected from the group consisting of pentane, hexane, heptane, benzene, toluene, xylene, methanol, ethanol, 1-propanol, methyl ethyl ketone, methyl isobutyl ketone, and a combination thereof.

5. The process of any one of claims 1-4, wherein the separation conditions comprise a residence time of the used oil in the separation unit, wherein the residence time is 72 hours or less, or wherein the residence time is from about 16 hours to about 48 hours.

6. The process of any one of claims 1-5, wherein the separation conditions comprise an operating temperature of from about 15°C to about 150°C, or from about 15°C to about 90°C, or from about 15°C to about 60°C, or from about 15°C to about 30°C.

7. The process of any one of claims 1-6, wherein the used oil is a used crankcase oil, used engine oil, used hydraulic oil, used transformer oil, used refrigerator oil, used white oil, used compressor oil, used gas engine oils, used marine engine oils, or a combination thereof.

8. The process of any one of claims 1-7, wherein the porous membrane or semiporous membrane has a molecular weight cut-off of about 2,000 Daltons or less.

9. The process of any one of claims 1-8, wherein the porous membrane or semiporous membrane is a latex containing material, a polyamide containing material, a cellulose containing material, a polycarbonate containing material, a polysulfone containing material, or a combination thereof.

10. The process of any one of claims 1-9, wherein the purified oil product has a soot content of about 0.05% or less as determined by ASTM D5967-A4.

11. The process of any one of claims 1-10, wherein the purified oil product has an amount of Zn, Mg, Ca, Mo, Fe, or a combination thereof of 100 ppm or less as determined by ASTM 5185.

12. The process of any one of claims 1-11 further comprising removing water from the used oil prior to introducing the used oil to the separation unit.

13. The process of any one of claims 1-12 further comprising removing the solvent from the effluent.

14. The process of any one of claims 1-13 further comprising:

hydrotreating the effluent comprising the purified oil product;

separating the effluent comprising the purified oil product into one or more base oil fractions; or

a combination thereof.

15. An apparatus for re-refining used oil, comprising:

a separation unit comprising a porous or semiporous membrane;

a used oil feed coupled to an inlet of the separation unit; and

an inlet of a diffusate collection unit coupled to an outlet of the separation unit, the diffusate collection unit being operable to collect a diffusate comprising a base oil.

16. The apparatus of claim 15 further comprising

a retentate feed line coupled to an outlet of the separation unit.

17. The apparatus of claim 15 or 16, wherein the retentate feed line is coupled to the used oil feed.

18. The apparatus of any one of claims 15-17 further comprising a distillation unit or an extraction unit, wherein an inlet of the distillation unit or the extraction unit is coupled to an outlet of the diffusate collection unit.

19. The apparatus of any one of claims 15-18 further comprising a hydrotreating unit, wherein an inlet of the hydrotreating unit is coupled to an outlet of the diffusate collection unit.

20. A composition generated from a membrane separation process, comprising:

a base oil having a soot content of about 0.05% or less as determined by ASTM D5967-A4 or an amount of Zn, Mg, Ca, Mo, Fe, or a combination thereof of 100 ppm or less as determined by ASTM 5185.

21. The composition of claim 20, wherein the composition has an amount of Zn, Mg, Ca, Mo, Fe, or a combination thereof of 100 ppm or less as determined by ASTM 5185.

22. The composition of claim 20 or 21, wherein the composition has a trace amount of Zn, Mg, Ca, Mo, or Fe as determined by ASTM 5185.

23. The composition of any one of claims 20-22, wherein the composition has a soot content of about 0.05% or less as determined by ASTM D5967-A4.

24. The composition of any one of claims 20-23, wherein the composition has a trace amount of soot as determined by ASTM D5967-A4.