CLAIMS

We claim:

1. A method of making a multimodal polymer product comprising:

producing a first polymer in a first reactor, wherein the first polymer is a propylene homopolymer or a propylene copolymer having an ethylene or a C_4 to C_{10} olefin comonomer; wherein the first polymer has a melt viscosity of about 2000 cP or less;

producing a second polymer in a second reactor in parallel with the first reactor, wherein the second polymer is a propylene homopolymer or a propylene copolymer having an ethylene or a C_4 to C_{10} olefin comonomer, and wherein the first polymer and second polymer have a difference in heat of fusion of about 25 J/g or more;

combining the first polymer and the second polymer to form a multimodal polymer blend; and

pelletizing the multimodal polymer blend to form a plurality of pellets comprising the multimodal polymer blend.

2. The method of claim 1, wherein the difference in heat of fusion between the first polymer, and second polymer is about 30 J/g or more.

3. The method of claim 2, wherein the first polymer has a heat of fusion of about 60 J/g or more, and the second polymer has a heat of fusion of about 30 J/g or less.

4. The method of claim 3, wherein the first polymer has a heat of fusion of about 65 J/g to about 85 J/g, and the second polymer has a heat of fusion of about 10 J/g to about 20 J/g.

5. The method of claim 2, wherein the first polymer has a heat of fusion of about 80 J/g or more, and the second polymer has a heat of fusion of about 50 J/g or less.

6. The method of claim 2, wherein the first polymer has a heat of fusion of about 50 J/g or more, and the second polymer has a heat of fusion of about 15 J/g or less.

7. The method of claim 1, further comprising:

providing a vessel having an inlet and an outlet;

after combining the first polymer and the second polymer to form the multimodal polymer blend and prior to pelletizing the multimodal polymer blend, introducing a first polymer composition comprising the multimodal polymer blend and a solvent into the inlet of the vessel;

subjecting first polymer composition to a vacuum in the vessel such that at least a portion of the solvent is removed from the first polymer composition and the temperature of the first polymer composition is reduced, thereby forming a second polymer composition comprising the multimodal polymer blend and having a lower solvent content and a lower temperature than the first polymer composition; and

discharging the second polymer composition from the outlet of the vessel.

8. The method of claim 1, further comprising

providing a liquid-phase separator having an inlet, a solvent outlet, and a product outlet;

introducing the multimodal polymer blend and a solvent into the liquid-phase separator through the inlet;

operating the liquid-phase separator under conditions suitable to produce a polymer lean liquid phase and a polymer rich liquid phase;

removing a portion of the solvent from the liquid-phase separator via the solvent outlet; and

discharging the polymer rich phase from the liquid-phase separator via the product outlet.

9. The method of claim 1, further comprising:

introducing a first unsupported catalyst into the first reactor; and

introducing a second unsupported catalyst into the second reactor, wherein the first unsupported catalyst is different than the second unsupported catalyst.

10. The method of claim 1, further comprising:

introducing a first unsupported catalyst into the first reactor; and

introducing a second unsupported catalyst into the second reactor, wherein the first unsupported catalyst is the same as the second unsupported catalyst.

11. The method of claim 9, wherein the first unsupported catalyst is selected from the group consisting of:

dimethylsilyl bis(2-methyl-5-phenylindenyl) zirconium dichloride;

dimethylsilyl bis(2-methyl-5-phenylindenyl) zirconium dimethyl;

dimethylsilyl bis(2-methyl-5-phenylindenyl) hafnium dimethyl;

dimethylsilyl bis(2-methyl-5-phenylindenyl) hafnium dichloride;

dimethylsilylbis (indenyl) hafnium dimethyl;

dimethylsilylbis (indenyl) hafnium dichloride;

dimethylsilylbis (indenyl) zirconium dichloride; and

dimethylsilylbis (indenyl) zirconium dichloride.

12. The method of any of claim 10, wherein the second unsupported catalyst is selected from the group consisting of:

dimethylsilyl bis(2-methyl-5-phenylindenyl) zirconium dichloride;

dimethylsilyl bis(2-methyl-5-phenylindenyl) zirconium dimethyl;

dimethylsilyl bis(2-methyl-5-phenylindenyl) hafnium dimethyl;

dimethylsilyl bis(2-methyl-5-phenylindenyl) hafnium dichloride;

dimethylsilylbis (indenyl) hafnium dimethyl;

dimethylsilylbis (indenyl) hafnium dichloride;

dimethylsilylbis (indenyl) zirconium dichloride;

dimethylsilylbis (indenyl) zirconium dichloride;

1, 1'-bis(4-triethylsilylphenyl)methylene-(cyclopentadienyl)(2,7-di-tertiary-butyl-9-fluorenyl)hafnium dimethyl;

1, 1'-bis(4-triethylsilylphenyl)methylene-(cyclopentadienyl)(2,7-di-tertiary-butyl-9-fluorenyl)hafnium dichloride;

1, 1'-bis(4-triethylsilylphenyl)methylene-(cyclopentadienyl)(2,7-di-tertiary-butyl-9-fluorenyl)zirconium dichloride; and

1, 1'-bis(4-triethylsilylphenyl)methylene-(cyclopentadienyl)(2,7-di-tertiary-butyl-9-fluorenyl)zirconium dimethyl.

13. The method of claim 1, wherein the first polymer is a copolymer of propylene and ethylene.

14. The method of claim 13, wherein the second polymer is a copolymer of propylene and ethylene.

~~15. The method of claim 1, wherein the first polymer has a melt viscosity of about 2000 cP or less.~~

~~16.~~15. The method of claim ~~15~~ 1, wherein the first polymer has a melt viscosity of about 1000 cP or less.

~~17.~~16. The method of claim 1, wherein the second polymer has a melt viscosity of about 2000 cP or less.

~~18.~~17. The method of claim ~~15~~ 1, wherein the second polymer has a melt viscosity of about 2000 cP to 20,000 cP.

~~19.~~18. The method of claim 1, wherein the first polymer is about 10 wt% to about 90wt% of the multimodal polymer blend.

~~20.~~19. The method of claim ~~19~~ 18, wherein the second polymer is about 10 wt% to about 90 wt% of the multimodal polymer blend.

~~21. A method of processing a polymer comprising:~~

~~providing a liquid-phase separator having an inlet, a solvent outlet, and a product outlet;~~

~~supplying a product stream downstream of one or more reactors to the inlet of the liquid-phase separator, wherein the product stream comprises a propylene-based polymer, a solvent, and unreacted propylene monomers, wherein the propylene-based polymer has a weight average molecular weight of less than 100,000 g/mole;~~

~~operating the liquid-phase separator under conditions suitable to produce a polymer lean liquid phase and a polymer rich liquid phase;~~

removing a portion of the solvent from the liquid-phase separator via the solvent outlet; and

discharging the polymer rich phase from the liquid-phase separator via the product outlet.

22. The method of claim 21, wherein the propylene-based polymer has a weight average molecular weight of about 60,000 g/mole or less.

23. The method of claim 21, wherein the concentration of the polymer in the polymer lean liquid phase is less than about 7,000 wppm.

24. The method of claim 23, wherein the concentration of the polymer in the polymer lean liquid phase is less than about 1,000 wppm.

25. The method of claim 21, wherein a catalyst is used in at least one of the one or more reactors, and wherein the catalyst is selected from the group of dimethylsilyl bis(2-methyl-5-phenylindenyl) zirconium dichloride, dimethylsilyl bis(2-methyl-5-phenylindenyl) zirconium dimethyl, dimethylsilyl bis(2-methyl-5-phenylindenyl) hafnium dichloride, and dimethylsilyl bis(2-methyl-5-phenylindenyl) hafnium dimethyl.