ETHYLENE-BASED POLYMERS

REFERENCE TO RELATED APPLICATIONS

The present application claims the benefit of U.S. Provisional Application No. 62/018,863, filed June 30, 2014, and incorporated herein by reference.

BACKGROUND

Ethylene-based polymers, such as, polyethylene is known for use in the manufacture of a wide a variety of articles. The polyethylene polymerization process can be varied, in a number of ways to produce a wide variety of resultant polyethylene resins, having different physical properties that render the various resins suitable for use in different applications. It is generally known that ethylene-based polymers can be produced in solution phase loop reactors, in which ethylene monomer, and optionally one or more alpha olefin comonomers, typically having from 3 to 10 carbon atoms, are circulated in the presence of one or more catalyst systems, under pressure, around a loop reactor, by a circulation pump. The ethylene monomers, and optionally one or more comonomers, are present in a liquid diluent, such as an alkane or isoalkane. Hydrogen may also be added to the reactor. The catalyst systems for producing ethylene-based polymers may typically comprise a chromium-based catalyst system, a Ziegler Natta catalyst system, and/or a molecular (either metallocene or non-metallocene) catalyst system. Despite the research efforts in developing ethylene-based polymers, there is still a need for new ethylene-based polymers having improved properties. These needs have been met by the following invention.

SUMMARY

The instant disclosure provides an ethylene-based polymer comprising the following properties:

a) a ZSVR value from 1.2 to 2.6,

b) a MWD from 1.5 to 2.8, and

c) a tan delta (0.1 rad/s; 190°C) from 5.0 to 50.

In one aspect, there is provided an ethylene-based polymer comprising the following properties:

a) a zero-shear viscosity ratio (ZSVR) value from 1.2 to 2.6,

b) a molecular weight distribution (MWD or Mw/Mn) from 1.5 to 2.8,

c) a tan delta (0.1 rad/s; 190°C) from 5.0 to 50, and

d) a melt index (I_2) from 0.93 to 1.05 g/10 min.

CLAIMS:

1. An ethylene-based polymer comprising the following properties:
    a) a zero-shear viscosity ratio (ZSVR) value from 1.2 to 2.6,
    b) a molecular weight distribution (MWD or Mw/Mn) from 1.5 to 2.8,
    c) a tan delta (0.1 rad/s; 190°C) from 5.0 to 50, and
    d) a melt index (I2) from 0.93 to 1.05 g/10 min.

2. The ethylene-based polymer of claim 1, wherein the ethylene-based polymer has a tan delta (0.1 rad/s; 190°C) from greater than 5.0 to 50.

3. The ethylene-based polymer of claim 1, wherein the ethylene-based polymer has the following properties: a tan delta (0.1 rad/s; 190°C) from greater than 15 to 50; and a ZSVR value from 1.3 to 2.6.

4. The ethylene-based polymer of claim 1 or 2, wherein the ethylene-based polymer is an ethylene/alpha-olefin interpolymer.

5. The ethylene-based polymer of any one of the previous claims, wherein the polymer has a density from 0.885 to 0.940 g/cc.

6. The ethylene-based polymer of any one of the previous claims, wherein the polymer has a single peak in the Crystallization Elution Fractionation (CEF)-Comonomer Distribution, at a temperature from 60°C to 100°C.

7. The ethylene-based polymer of any one of the previous claims, wherein the polymer has a single peak in the CEF-Comonomer Distribution, at a temperature from 60 to 100°C, and wherein the peak width at 25% peak height is less than 30°C.

8. The ethylene-based polymer of any one of the previous claims, wherein the polymer has an I_{10}/I_2 ratio from 5.0 to 10.

9. The ethylene-based polymer of any one of the previous claims, wherein the polymer has a MWD from 1.7 to 2.5.

10. The ethylene-based polymer of any one of the previous claims, wherein the polymer has a MWD from 1.7 to 2.2.

11. A process for producing the ethylene-based polymer as defined in any one of the previous claims comprising polymerizing at least ethylene, in the presence of at least one catalyst system comprising the reaction product of the following:

A) at least one cocatalyst; and

B) a procatalyst comprising a metal-ligand complex of Formula (I):

or a substituted or unsubstituted (C_1-C_{30}) heterohydrocarbyl; and

wherein, for Formula I, two or more of R^1 through R^{22}, optionally, may form one or more ring structures, and wherein each ring structure has from 3 to 50 atoms in the ring, excluding any hydrogen atoms; and

wherein, for Formula I, one or more hydrogen atoms may optionally be substituted with one or more deuterium atoms.

12. The process of claim 11, wherein, for Formula I, wherein when R^{17} is a hydrogen atom, then R^{18} is a substituted or unsubstituted (C_1-C_{40})hydrocarbyl, a substituted or unsubstituted (C_1-C_{40})heterohydrocarbyl, -$Si(R^C)_3$, -$Ge(R^C)_3$, -$P(R^C)_2$, -$N(R^C)_2$, -OR^C, -SR^C, -NO_2, -CN, -CF_3, -$S(O)R^C$, -$S(O)_2R^C$, -$N{=}C(R^C)_2$, -$OC(O)R^C$, -$C(O)OR^C$, -$N(R)C(O)R^C$, -$C(O)N(R^C)_2$, or a halogen atom; and wherein each R^C is independently a substituted or unsubstituted (C_1-C_{30})hydrocarbyl, or a substituted or unsubstituted (C_1-C_{30}) heterohydrocarbyl; or

wherein, when R^{18} is a hydrogen atom, then R^{17} is a substituted or unsubstituted (C_1-C_{40})hydrocarbyl, a substituted or unsubstituted (C_1-C_{40})heterohydrocarbyl, -$Si(R^C)_3$, -$Ge(R^C)_3$, -$P(R^C)_2$, -$N(R^C)_2$, -OR^C, -SR^C, -NO_2, -CN, -CF_3, -$S(O)R^C$, -$S(O)_2R^C$, -$N{=}C(R^C)_2$, -$OC(O)R^C$, -$C(O)OR^C$, -$N(R)C(O)R^C$, -$C(O)N(R^C)_2$, or a halogen atom; and wherein each R^C is independently a substituted or unsubstituted (C_1-C_{30})hydrocarbyl, or a substituted or unsubstituted (C_1-C_{30}) heterohydrocarbyl; and/or

wherein, when R^{19} is a hydrogen atom, then R^{20} is a substituted or unsubstituted (C_1-C_{40})hydrocarbyl, a substituted or unsubstituted (C_1-C_{40})heterohydrocarbyl, -$Si(R^C)_3$, -$Ge(R^C)_3$, -$P(R^C)_2$, -$N(R^C)_2$, -OR^C, -SR^C, -NO_2, -CN, -CF_3, -$S(O)R^C$, -$S(O)_2R^C$, -$N{=}C(R^C)_2$, -$OC(O)R^C$, -$C(O)OR^C$, -$N(R)C(O)R^C$, -$C(O)N(R^C)_2$, or a halogen atom; and wherein each R^C is independently a substituted or unsubstituted (C_1-C_{30})hydrocarbyl, or a substituted or unsubstituted (C_1-C_{30}) heterohydrocarbyl; or

wherein, when R^{20} is a hydrogen atom, then R^{19} is a substituted or unsubstituted (C_1-C_{40})hydrocarbyl, a substituted or unsubstituted (C_1-C_{40})heterohydrocarbyl, -$Si(R^C)_3$, -$Ge(R^C)_3$, -$P(R^C)_2$, -$N(R^C)_2$, -OR^C, -SR^C, -NO_2, -CN, -CF_3, -$S(O)R^C$, -$S(O)_2R^C$,

$-N=C(R^C)_2$, $-OC(O)R^C$, $-C(O)OR^C$, $-N(R)C(O)R^C$, $-C(O)N(R^C)_2$, or a halogen atom; and wherein each R^C is independently a substituted or unsubstituted (C_1-C_{30})hydrocarbyl, or a substituted or unsubstituted (C_1-C_{30}) heterohydrocarbyl.

13. A composition comprising the ethylene-based polymer of any one of claims 1-10.

14. An article comprising at least one component formed from the composition of claim 13.