from about 10 to about 60, measured according to ASTM D1238 (I_{21} and I_5 measured at 190°C and 21.6 kg or 5 kg weight respectively), a flow index (I_{21}) in the range from about 2 to about 60, a low temperature notched Charpy impact greater than about 6.0 kJ/m^2, a melt strength greater than or equal to about 5.0 cN, and an ESCR of greater than or equal to about 50 hours, as measured by ASTM 1693, condition B.

[0017] There is also provided a polyethylene resin comprising units derived from ethylene, and optionally one or more other olefins, wherein the resin has a density greater than or equal to about 0.945 g/cm^3, measured according to ASTM D792, a melt flow ratio (I_{21}/I_5) in the range from about 10 to about 60, measured according to ASTM D1238 (I_{21} and I_5 measured at 190°C and 21.6 kg or 5 kg weight respectively), a flow index (I_{21}) in the range from about 2 to about 60, a low temperature notched Charpy impact greater than about 7.0 kJ/m^2, a melt strength greater than or equal to about 7.0 cN, and an ESCR of greater than or equal to about 70 hours, as measured by ASTM 1693, condition B.

[0018] The polyethylene resin may be a unimodal resin, a bimodal resin or a multimodal resin.

[0019] The polyethylene resins may be formed by contacting ethylene, hydrogen, and optionally one or more other olefins, with a catalyst system. The catalyst system may comprise at least two different catalyst compounds. The at least two different catalyst compounds may produce different average molecular weight polyethylene resin at the same ratio of hydrogen to ethylene.

[0020] There is also provided a method of producing a polyethylene resin, the method comprising:

contacting ethylene, hydrogen and, optionally, one or more other olefins, with a catalyst system, wherein the catalyst system comprises at least two different catalyst compounds;

wherein the polyethylene resin comprises units derived from ethylene, and optionally one or more other olefins, wherein the resin has a density greater than or equal to about 0.945 g/cm^3, measured according to ASTM D792, a melt flow ratio (I_{21}/I_5) in the range from about 10 to about 60, measured according to ASTM D1238 (I_{21} and I_5 measured at 190°C and 21.6 kg or 5 kg weight respectively), and a flow index (I_{21}) in the range from about 2 to about 60.

[0020a] In one aspect, there is provided a method of producing a polyethylene resin in a single reactor, the method comprising:

contacting ethylene, hydrogen and, optionally, one or more other olefins, with a catalyst system, wherein the catalyst system comprises two different catalyst compounds, and varying the in-reactor ratio of the two different catalyst compounds of the catalyst system on a molar

basis to maintain a substantially constant flow index (FI) while varying the ratio of hydrogen to ethylene to modify a polymerization reactor-modified weight swell of the polyethylene resin;

wherein the polyethylene resin comprises units derived from ethylene, and optionally one or more other olefins, wherein the resin has a density greater than or equal to 0.945 g/cm^3, measured according to ASTM D792, a melt flow ratio (I_{21}/I_5) in the range from 10 to 60, measured according to ASTM D1238 (I_{21} and I_5 measured at 190°C and 21.6 kg or 5 kg weight respectively), and a flow index (I_{21}) in the range from 2 to 60.

[0020b] In another aspect, there is provided a method of producing a polyethylene resin in a single reactor, the method comprising:

contacting ethylene, hydrogen and, optionally, one or more other olefins, with a catalyst system, wherein the catalyst system comprises two different catalyst compounds, and varying the in-reactor ratio of the two different catalyst compounds of the catalyst system between 2.5 and 1.8 on a molar basis while varying a H_2/C_2 ratio between 10 ppm/mole% and 15 ppm/mole%, to modify a polymerization reactor-modified weight swell of the polyethylene resin;

wherein the polyethylene resin comprises units derived from ethylene, and optionally one or more other olefins, wherein the resin has a density greater than or equal to 0.945 g/cm^3, measured according to ASTM D792, a melt flow ratio (I_{21}/I_5) in the range from 10 to 60, measured according to ASTM D1238 (I_{21} and I_5 measured at 190°C and 21.6 kg or 5 kg weight respectively), and a flow index (I_{21}) in the range from 2 to 60.

[0021] The polyethylene resin may possess a low temperature notched Charpy impact greater than about 6.0 kJ/m^2, or greater than about 7.0 kJ/m^2, or greater than about 8.0 kJ/m^2, measured according to ISO 179.

[0022] The polyethylene resin may possess a density greater than or equal to about 0.950 g/cm^3, or greater than or equal to about 0.955 g/cm^3.

CLAIMS

What is claimed is:

1. A method of producing a polyethylene resin in a single reactor, the method comprising:

contacting ethylene, hydrogen and, optionally, one or more other olefins, with a catalyst system, wherein the catalyst system comprises two different catalyst compounds, and varying the in-reactor ratio of the two different catalyst compounds of the catalyst system on a molar basis to maintain a substantially constant flow index (FI) while varying the ratio of hydrogen to ethylene to modify a polymerization reactor-modified weight swell of the polyethylene resin;

wherein the polyethylene resin comprises units derived from ethylene, and optionally one or more other olefins, wherein the resin has a density greater than or equal to 0.945 g/cm^3, measured according to ASTM D792, a melt flow ratio (I_{21}/I_5) in the range from 10 to 60, measured according to ASTM D1238 (I_{21} and I_5 measured at 190°C and 21.6 kg or 5 kg weight respectively), and a flow index (I_{21}) in the range from 2 to 60.

2. A method of producing a polyethylene resin in a single reactor, the method comprising:

contacting ethylene, hydrogen and, optionally, one or more other olefins, with a catalyst system, wherein the catalyst system comprises two different catalyst compounds, and varying the in-reactor ratio of the two different catalyst compounds of the catalyst system between 2.5 and 1.8 on a molar basis while varying a H_2/C_2 ratio between 10 ppm/mole% and 15 ppm/mole%, to modify a polymerization reactor-modified weight swell of the polyethylene resin;

wherein the polyethylene resin comprises units derived from ethylene, and optionally one or more other olefins, wherein the resin has a density greater than or equal to 0.945 g/cm^3, measured according to ASTM D792, a melt flow ratio (I_{21}/I_5) in the range from 10 to 60, measured according to ASTM D1238 (I_{21} and I_5 measured at 190°C and 21.6 kg or 5 kg weight respectively), and a flow index (I_{21}) in the range from 2 to 60.

3. The method of claim 1 or 2 wherein the catalyst system comprises at least one metallocene catalyst compound and/or at least one Group 15 and metal containing catalyst compound.

4. The method of claim 3 wherein the catalyst system comprises bis(cyclopentadienyl) zirconium X_2, wherein the cyclopentadienyl group may be substituted or unsubstituted, and at least one of a bis(arylamido) zirconium X_2 and a bis(cycloalkylamido) zirconium X_2, wherein X represents a leaving group.

5. The method of any one of claims 1, 3 or 4, wherein the hydrogen to ethylene ratio is adjusted to within a range from 0.0001 to 0.01, on a molar basis.

6. The method of any one of claims 1 to 5, wherein the ratio of the at least one Group 15 metal containing component to metallocene component is adjusted within a range from 0.5 to 6.0, on a molar basis.

7. The method of any one of claims 1 or 3 to 6, wherein the in-reactor ratio of the two different catalyst compounds of the catalyst system is adjusted to within a ratio from 1 to 3.0 on a molar basis.

8. The method of any one of claims 1 or 3 to 6, wherein the in-reactor ratio of the two different catalyst compounds of the catalyst system is adjusted to within a ratio from 2.5 to 1.8 on a molar basis.