**[0005]** Conventional polymers produced by Ziegler-Natta catalysts generally contain relatively large amounts of high density fractions compared to molecular catalysts. This high density fraction precludes the polymer from achieving the optics and abuse properties required in some applications. Accordingly, there is a need for polymer having reduced high density fraction to allow for improvement in optical and abuse properties, such as dart impact, while not suffering a significant trade-off of mechanical strength and tear properties.

## SUMMARY

**[0006]** The present disclosure meet these needs by producing LLDPE polymers with reduced high density fraction and improved optical and abuse properties without significant trade-off of mechanical strength and tear properties.

**[0007]** According to the present disclosure, a blown film comprising a linear low density polyethylene (LLDPE) polymer is provided. The LLDPE is the polymerized reaction product of ethylene monomer, and $C_3$-$C_{12}$ ethylene comonomer. The LLDPE has a density from 0.904 to 0.925 g/cc; a melt index ($I_2$) of 0.5 to 1.5 g/10 minutes when measured according to ASTM1238 under a load of 2.16 kg at a temperature of 190 °C; a melt flow ratio (I10/I2) of 6.5 to 7.6, wherein $I_{10}$ is measured according to ASTM1238 at a temperature of 190 °C with 10 kg load; and a molecular weight distribution (MWD = Mw/Mn) of 2.5 to 3.6 when measured according to gel permeation chromatography. The LLDPE comprises a short chain branching distribution defined by a copolymer fraction greater than 85%, the copolymer fraction being defined as a ratio of the mass eluted at temperatures from greater than 35 °C to less than 95 °C to the total mass eluted when measured using an improved comonomer content distribution (iCCD) curve of mass eluted versus temperature; a high density fraction from 0.5 to 8.0%, the high density fraction being defined as a ratio of the mass eluted at temperatures at or above 95 °C to the total mass; and a soluble fraction from 1.0% and 12.0%, the soluble fraction being defined as a ratio of the mass eluted at temperatures at or below 35 °C to the total mass.

**[0007a]** According to one aspect of the present disclosure, there is provided a blown film comprising a linear low density polyethylene (LLDPE) polymer wherein the LLDPE is the polymerized reaction product of ethylene monomer, and $C_3$-$C_{12}$ comonomer; wherein the LLDPE has a density from 0.904 to 0.925 g/cc; a melt index ($I_2$) of 0.5 to 1.5 g/10 minutes when measured according to ASTM D1238 under a load of 2.16 kg at a temperature of 190 °C; a melt flow ratio ($I_{10}/I_2$) of 6.5 to 7.6, wherein $I_{10}$ is measured according to ASTM1238 at a temperature of 190 °C

with 10 kg load; and a molecular weight distribution (MWD = Mw/Mn) of 2.5 to 3.6 when measured according to gel permeation chromatography; wherein the LLDPE comprises a short chain branching distribution defined by: a copolymer fraction greater than 85%, the copolymer fraction being defined of a ratio of the mass eluted at temperatures from greater than 35 °C to less than 95 °C to the total mass eluted when measured using an improved comonomer content distribution (iCCD) curve of mass eluted versus temperature; a high density fraction determined by iCCD from 0.5 to 8.0%, the high density fraction being defined as a ratio of the mass eluted at temperatures at or above 95 °C to the total mass; and a soluble fraction determined by iCCD from 1.0% and 12.0%, the soluble fraction being defined as a ratio of the mass eluted at temperatures at or below 35 °C to the total mass, wherein iCCD is performed as set out in the description, wherein the blown film comprises a blend having 50 to 95 wt% of the LLDPE.

**[0008]** According to the present disclosure, a linear low density polyethylene (LLDPE) polymer is provided. The LLDPE comprises the polymerized reaction product of ethylene monomer, and $C_3$-$C_{12}$ ethylene comonomer. The LLDPE has a density of about 0.910 to 0.920 g/cc; a melt index (I2) of 2.0 to 7.0 g/10 minutes when measured according to ASTM1238 under a load of 2.16 kg at a temperature of 190 °C; and a melt flow ratio (I10/I2)

# CLAIMS

1. A blown film comprising a linear low density polyethylene (LLDPE) polymer wherein the LLDPE is the polymerized reaction product of ethylene monomer, and $C_3$-$C_{12}$ comonomer;

wherein the LLDPE has a density from 0.904 to 0.925 g/cc; a melt index ($I_2$) of 0.5 to 1.5 g/10 minutes when measured according to ASTM D1238 under a load of 2.16 kg at a temperature of 190 °C; a melt flow ratio ($I_{10}/I_2$) of 6.5 to 7.6, wherein $I_{10}$ is measured according to ASTM1238 at a temperature of 190 °C with 10 kg load; and a molecular weight distribution (MWD = Mw/Mn) of 2.5 to 3.6 when measured according to gel permeation chromatography;

wherein the LLDPE comprises a short chain branching distribution defined by:

a copolymer fraction greater than 85%, the copolymer fraction being defined of a ratio of the mass eluted at temperatures from greater than 35 °C to less than 95 °C to the total mass eluted when measured using an improved comonomer content distribution (iCCD) curve of mass eluted versus temperature;

a high density fraction determined by iCCD from 0.5 to 8.0%, the high density fraction being defined as a ratio of the mass eluted at temperatures at or above 95 °C to the total mass; and

a soluble fraction determined by iCCD from 1.0% and 12.0%, the soluble fraction being defined as a ratio of the mass eluted at temperatures at or below 35 °C to the total mass,

wherein iCCD is performed as set out in the description,

wherein the blown film comprises a blend having 50 to 95 wt% of the LLDPE.

2. The blown film of claim 1, wherein the blown film has a dart value of at least 900 g when at a thickness of 50.8 μm (2.0 mil), measured according to ASTM D1709, Method A, and a resin density below 0.918 g/cc, measured using ASTM D792-09, Method B.

3. The blown film of claim 1 or 2, wherein the blown film has a total haze (%) between 4.5% and 10.5% at a thickness of 50.8 μm (2.0 mil), measured in accordance with ASTM D1003.

4. The blown film of any of claims 1 to 3, wherein the $I_2$ of the LLDPE is 1 g/10 min or less, when measured according to ASTM D1238 under a load of 2.16 kg at a temperature of 190 $^oC$.

5. The blown film of any of claims 1 to 4, wherein the blown film has a thickness of 12.7 to 152.4 μm (0.5 to 6 mils).

6. The blown film of any of claims 1 to 5, wherein the soluble fraction of the LLDPE is less than 5%, determined by iCCD, wherein iCCD is performed as set out in the description.

7. The blown film of any of claims 1 to 6, wherein the copolymer fraction of the LLDPE is greater than 90%, determined by iCCD, wherein iCCD is performed as set out in the description.

8. A linear low density polyethylene (LLDPE) polymer, wherein the LLDPE comprises the polymerized reaction product of ethylene monomer, and $C_3$-$C_{12}$ comonomer, wherein

the LLDPE has a density of about 0.910 to 0.920 g/cc; a melt index ($I_2$) of 2.0 to 7.0 g/10 minutes when measured according to ASTM D1238 under a load of 2.16 kg at a temperature of 190 °C; and a melt flow ratio ($I_{10}/I_2$) of 6.5 to 7.6, wherein $I_{10}$ is measured according to ASTM1238 at a temperature of 190 °C with 10 kg load;

wherein the LLDPE comprises a short chain branching distribution defined by:

a high density fraction from 0.5 to 6.0%, the high density fraction being defined as a ratio of the mass eluted within the temperature range of at 95 °C or above to the total mass eluted when measured using an iCCD curve of mass eluted versus temperature;

a soluble fraction determined by iCCD from 1.0% and 3.0%, the soluble fraction being defined as a ratio of the mass eluted within the temperature range of at or below 35 °C to the total mass eluted;

a ratio of the soluble fraction to the high density fraction is from 0.40 to 0.65; and

a maximum elution peak height occurs at a temperature of above 80 °C,

wherein iCCD is performed as set out in the description.

9. The LLDPE of claim 8, wherein the high density fraction is from 3.0% to 6.0%.

10. The LLDPE of claim 8 or 9, wherein the soluble fraction is from 2.0% and 3.0%.

11. The LLDPE of any of claims 8 to 10, wherein the maximum elution peak height occurs at a temperature below 90 °C.

12. A cast film comprising a blend having 5 to 95 wt% of the LLDPE of any of claims 8 to 11.

13. The blown film of any of claims 1 to 7 or the cast film of claim 12, further comprising a low density polyethylene (LDPE); wherein the LDPE has a density in the range of 0.915 to 0.935 g/cm$^3$.

14. The blown film of any of claims 1 to 7 or the cast film of claim 12, wherein the blown film or cast film comprises 50 to 95 wt% of the LLDPE, and 5 to 50 wt% of the LDPE.

15. The blown film of any of claims 1 to 7 or the cast film of any of claims 12 to 14, wherein the blown film or cast film is a multilayer film.