CLAIMS

1. A process for forming an ethylene-based polymer, the process comprising:

introducing catalyst to a solution-phase loop reactor through at least two catalyst injection points, where:

the loop reactor comprising a loop, the loop comprising a first half and a second half,

a first catalyst injection point is in the first half of the loop and a second catalyst injection point is in the second half of the loop, and

the same catalyst is introduced through the first catalyst injection point and the second catalyst injection point;

introducing ethylene and a comonomer to the loop reactor through at least two feed injection points, where a first feed injection point is in the first half of the loop and a second feed injection point is in the second half of the loop; and

polymerizing the ethylene and copolymer while controlling a ratio of catalyst injected at the second catalyst injection point to catalyst injected at the first catalyst injection point such that:

a ratio of an amount of polymerization in the first half of the loop to an amount of polymerization in the second half of the loop is from 0.7 to 1.3;

a ratio of a heat of polymerization in the first half of the loop to a heat of polymerization in the second half of the loop is from 0.7 to 1.3; or

both, thereby forming the ethylene-based polymer.

2. The process of claim 1, the ratio of catalyst injected at the second catalyst injection point to the catalyst injected at the first catalyst injection point is from 0.7 to 1.3.

3. The process of any one of claims 1-2, wherein the one or more polymerization conditions are controlled such that a ratio of the heat of polymerization in the first half to the heat of polymerization in the second half is from 0.7 to 1.3.

4. The process of any one of claims 1-3, wherein the number of catalyst injection points equals the number of feed injection points.

5. The process of any one of claims 1-4, wherein:

the loop reactor comprises a first heat exchanger and a second heat exchanger,

the first catalyst injection point and the first feed injection point are upstream of the first heat exchanger and downstream of the second heat exchanger, and

the second catalyst injection point and the second feed injection point are upstream of the second heat exchanger and downstream of the first heat exchanger.

6. The process of claim 5, a ratio of heat extracted at the second heat exchanger to heat extracted at the first heat exchanger is from 0.7 to 1.3.

7. The process of any one of claims 1-6, wherein a half-life of the catalyst in the loop reactor is less than 80% of a recirculation time of the catalyst in the loop reactor.

8. The process of any one of claims 1-7, wherein the ethylene and copolymer polymerization conditions are controlled such that:

the ratio of the amount of polymerization in the first half of the loop to the amount of polymerization in the second half of the loop is from 0.9 to 1.1;

the ratio of the heat of polymerization in the first half of the loop to the heat of polymerization in the second half of the loop is from 0.9 to 1.1; or both.

9. The process of any one of claims 1-8, wherein less than 4.8 wt. % of the polymer has a TGIC elution temperature less than 80 °C.

10. The process of any one of claims 1-9, wherein the loop reactor has an operating temperature of from 180 °C to 210 °C.

11. The process of any one of claims 1-10, wherein the comonomer comprises C_3-C_{14} olefins.

12. The process of any one of claims 1-11, wherein the ethylene-based polymer has a density of from 0.85 to 0.94 g/cc.

13. The process of any one of claims 1-12, wherein the ethylene-based polymer has a melt index of from .2 to 2000 dg/min.

14. The process of any one of claims 1-13, wherein polymerizing the ethylene and copolymer while controlling one or more polymerization conditions comprises:

determining the ratio of the heat of polymerization in the first half of the loop to the heat of polymerization in the second half of the loop; and

if the ratio of the heat of polymerization in the first half of the loop to the heat of polymerization in the second half of the loop is greater than 1.2, increasing the proportion of catalyst injected at the second catalyst injection point, or

if the ratio of the heat of polymerization in the first half of the loop to the heat of polymerization in the second half of the loop is less than 0.8, decreasing the proportion of catalyst injected at the second catalyst injection point.