PROCESS TO FORM OIL CONTAINING ETHYLENE-BASED POLYMERS

REFERENCE TO RELATED APPLICATIONS

The present application claims the benefit of U.S. Provisional Application No. 62/097257, filed December 29, 2014, and incorporated herein by reference.

BACKGROUND OF THE INVENTION

There is a need to prepare high molecular weight (e.g., high Mooney Viscosity), oil-extended, high molecular weight (for example, Mw > 200,000 g/mole) ethylene-based polymers that can be successfully isolated from the polymerization reactor. Polymerization processes of the art are described in the following references: U.S. Patent Nos. 7,910,637; 7,985,804; 5,516,849; 6,686,419; 6,545,088; 3,726,843; U.S. Provisional 62/097268 (filed December 29, 2014); International Publication Nos. WO2013/096573; WO2014/003857. See also, P. S. Ravishankar et al., treatise on EPDM, Rubber Chemistry and Technology, Vol. 85, No. 3, pp 327-349, 2012; P. S. Ravishankar et al., Recent Advances in EPDM and Dynamically Vulcanized Thermoplastic Elastomers, 186th Technical Meeting of Rubber Division, ACS, Nashville, TN, 2014; pp. 1-15. However, as discussed above, there remains a need to prepare high molecular weight ethylene-based polymers, which can be readily isolated from the polymerization process. These needs have been met by the following invention.

SUMMARY

The disclosure provides a process to form a composition comprising at least one ethylene-based polymer and at least one oil, said process comprising the following:

polymerizing a mixture comprising ethylene, and optionally one or more comonomers, in a reactor system, comprising at least one reactor and at least one mixer, located downstream from the reactor, to form the ethylene-based polymer; and wherein the oil is added to the ethylene-based polymer upstream of the mixer.

In an aspect, there is provided a process to form a composition comprising at least one ethylene-based polymer and at least one oil, said process comprising the following: polymerizing a mixture comprising ethylene, and optionally one or more comonomers, in a reactor system, comprising at least one reactor and at least one mixer, located downstream from the reactor, to form the ethylene-based polymer;

wherein the oil is added to the ethylene-based polymer upstream of the mixer, and the oil has a volatile fraction, at 400°C and atmospheric pressure, less than, or equal to, 2.0 wt%, based on the total weight of the oil, the mixture further comprises a polymerization solvent, the reactor system comprises a line for recycled polymerization solvent, and the recycled polymerization solvent is re-introduced into the at least one reactor.

In another aspect, there is provided a composition comprising at least one ethylene-based polymer and at least one oil formed by the process as defined herein.

In another aspect, there is provided an article comprising at least one component formed from the composition as defined herein.

The disclosure also provides a reactor system for a process to form a composition comprising at least one ethylene-based polymer and at least one oil, said reactor system comprising at least one reactor, at least one mixer, and an oil feed into the ethylene-based polymer, and wherein the oil feed is located after the reactor and before the mixer.

In another aspect, there is provided a reactor system for a process to form a composition comprising at least one ethylene-based polymer and at least one oil, said reactor system comprising at least one reactor, at least one mixer, and an oil feed into the ethylene-based polymer, and wherein the oil feed is located after the reactor and before the mixer, and wherein the oil has a volatile fraction, at 400°C and atmospheric pressure, less than, or equal to, 2.0 wt%, based on the total weight of the oil, and the reactor system comprises a line for recycled polymerization solvent.

CLAIMS

1. A process to form a composition comprising at least one ethylene-based polymer and at least one oil, said process comprising the following:

polymerizing a mixture comprising ethylene, and optionally one or more comonomers, in a reactor system, comprising at least one reactor and at least one mixer, located downstream from the reactor, to form the ethylene-based polymer;

wherein the oil is added to the ethylene-based polymer upstream of the mixer, and

the oil has a volatile fraction, at 400°C and atmospheric pressure, less than, or equal to, 2.0 wt%, based on the total weight of the oil,

the mixture further comprises a polymerization solvent,

the reactor system comprises a line for recycled polymerization solvent, and

the recycled polymerization solvent is re-introduced into the at least one reactor.

2. The process of claim 1, wherein the mixer is a static mixer.

3. The process of claim 1 or claim 2, wherein the polymerization is a solution polymerization.

4. The process of any one of the previous claims, wherein the at least one reactor is a continuous stirred tank reactor or a Loop reactor.

5. The process of any one of the previous claims, wherein the reactor system comprises two reactors.

6. The process of claim 5, wherein the reactor system comprises a stirred tank reactor followed by a Loop reactor.

7. The process of any one of the previous claims, wherein the difference between the temperature of the oil and the temperature of at least one reactor ($T_{oil} - T_{reactor}$) is from 50°C to 150°C.

8. The process of any one of the previous claims, wherein the ethylene-based polymer is an ethylene/α-olefin interpolymer.

9. The process of claim 8, wherein the ethylene/α-olefin interpolymer is an ethylene/α-olefin/diene interpolymer, and further an ethylene/α-olefin/diene terpolymer.

10. A composition comprising at least one ethylene-based polymer and at least one oil formed by the process of any one of the previous claims.

11. An article comprising at least one component formed from the composition of claim 10.

12. A reactor system for a process to form a composition comprising at least one ethylene-based polymer and at least one oil, said reactor system comprising at least one reactor, at least one mixer, and an oil feed into the ethylene-based polymer, and wherein the oil feed is located after the reactor and before the mixer, and wherein the oil has a volatile fraction, at 400°C and atmospheric pressure, less than, or equal to, 2.0 wt%, based on the total weight of the oil, and the reactor system comprises a line for recycled polymerization solvent.