Claims

1. A process for preparing high-reactivity isobutene homo- or copolymers with a content of terminal vinylidene double bonds per polyisobutene chain end of at least 50 mol%, by polymerization of isobutene or of an isobutene-comprising monomer mixture in the presence of at least one Lewis acid suitable as a polymerization catalyst or of a complex which is effective as a polymerization catalyst and is formed from at least one Lewis acid and at least one donor, and in the presence of at least one initiator, which comprises using, as the at least one initiator, an organic sulfonic acid of the general formula $Z\text{-}SO_3H$ in which the variable Z denotes a C_1- to C_{20}-alkyl radical, C_1- to C_{20}-haloalkyl radical, C_5- to C_8-cycloalkyl radical, C_6- to C_{20}-aryl radical or a C_7- to C_{20}-arylalkyl radical.

2. The process according to claim 1, wherein the at least one initiator used is an organic sulfonic acid selected from methanesulfonic acid, trifluoromethanesulfonic acid, trichloromethanesulfonic acid and toluenesulfonic acid, or mixtures thereof.

3. The process according to claim 1 or 2, in which the Lewis acid used for the complex effective as a polymerization catalyst is at least one compound selected from the binary chlorine and fluorine compounds of the elements of transition groups 1 to 8 and of main groups 3 to 5 of the Periodic Table or mixtures thereof.

4. The process according to claim 3, in which the Lewis acid used is a binary chlorine or fluorine compound selected from BCl_3, $AlCl_3$, $TiCl_4$, $FeCl_2$, $FeCl_3$, $ZnCl_2$, BF_3, AlF_3, TiF_4, FeF_2, FeF_3 and ZnF_2.

5. The process according to claims 1 to 4, in which a complex which is effective as a polymerization catalyst and which comprises, as the donor, an organic compound with at least one ether function or a carboxylic ester function is used.

6. The process according to claim 5, in which the organic compound functioning as the donor is a dihydrocarbyl ether of the general formula $R^1\text{-}O\text{-}R^2$ in which the variables R^1 and R^2 are each independently C_1- to C_{20}-alkyl radicals, C_5- to C_8-cycloalkyl radicals, C_6- to C_{20}-aryl radicals or C_7- to C_{20}-arylalkyl radicals, or a hydrocarbyl carboxylate of the general formula $R^3\text{-}COOR^4$ in which the variables R^3 and R^4 are each independently C_1- to C_{20}-alkyl radicals, C_5- to C_8-cycloalkyl radicals, C_6- to C_{20}-aryl radicals or C_7- to C_{20}-arylalkyl radicals.

7. The process according to claim 6, in which the organic compound functioning as the donor has a total carbon number of 3 to 16.

8. The process according to claims 1 to 7, in which the polymerization is performed with additional use of at least one further initiator which is mono - or polyfunctional and selected from organic hydroxyl compounds, organic halogen compounds, protic acids and water.

9. The process according to claim 8, wherein the at least one further initiator is selected from water, one or more protic acids, methanol, ethanol, 1-phenyl-ethanol, 1-(p-methoxyphenyl)ethanol, n-propanol, isopropanol, 2-phenyl-2-propanol, n-butanol, isobutanol, sec-butanol, tert-butanol, 1-phenyl-1-chloroethane, 2-phenyl-2-chloropropane, tert-butyl chloride and 1,3- or 1,4-bis(1-hydroxy-1-methylethyl)benzene, and mixtures thereof.

10. The process according to claims 1 to 9, in which the polymerization is performed in the presence of 0.01 to 10 mmol, based in each case on 1 mol of isobutene monomer used in the case of homopolymerization of isobutene or on 1 mol of the total amount of the polymerizable monomers used in the case of copolymerization of isobutene, of a nitrogen-containing basic compound.

11. The process according to claim 10, wherein the nitrogen-containing basic compound used is pyridine or a derivative of pyridine.

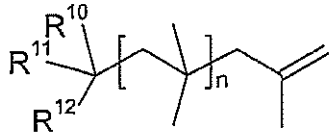
12. The process according to claims 1 to 11 for preparing high-reactivity isobutene homo- or copolymers with a number-average molecular weight M_n of 500 to 250 000.

13. The process according to claims 1 to 12 for preparing high-reactivity isobutene homo- or copolymers with a polydispersity of 1.05 to less than 3.5.

14. The process according to claims 1 to 13, wherein the polymerization is performed at a temperature of -30°C to +50°C.

15. The process according to claims 1 to 14, wherein the polymerization is performed in an aliphatic, cycloaliphatic or aromatic hydrocarbon, in a halogenated aliphatic hydrocarbon or in a mixture of aliphatic, cycloaliphatic and/or aromatic hydrocarbons or of halogenated aliphatic hydrocarbons or in a mixture of at least one halogenated aliphatic hydrocarbon and at least one aliphatic, cycloaliphatic or aromatic hydrocarbon as an inert diluent.

16. Isobutene polymers of the general formula I



(I)

in which

R^{10} is a sulfo moiety of the general formula $-O-SO_2Z$, in which the variable Z denotes a C_1- to C_{20}-alkyl radical, C_1- to C_{20}-haloalkyl radical, C_5- to C_8-cycloalkyl radical, C_6- to C_{20}-aryl radical or a C_7- to C_{20}-arylalkyl radical, and R^{11} and R^{12} are each independently hydrogen, C_1- to C_{20}-alkyl radicals, C_5- to C_8-cycloalkyl radicals, C_6- to C_{20}-aryl radicals or C_7- to C_{20}-alkylaryl radicals, and

n is a number from 9 to 4500.

Claims

1. A process for preparing high-reactivity isobutene homo- or copolymers with a content of terminal vinylidene double bonds per polyisobutene chain end of at least 50 mol%, by polymerization of isobutene or of an isobutene-comprising monomer mixture in the presence of at least one Lewis acid suitable as a polymerization catalyst or of a complex which is effective as a polymerization catalyst and is formed from at least one Lewis acid and at least one donor, and in the presence of at least one initiator, which comprises using, as the at least one initiator, an organic sulfonic acid of the general formula $Z\text{-}SO_3H$ in which the variable Z denotes a C_1- to C_{20}-alkyl radical, C_1- to C_{20}-haloalkyl radical, C_5- to C_8-cycloalkyl radical, C_6- to C_{20}-aryl radical or a C_7- to C_{20}-arylalkyl radical.

2. The process according to claim 1, wherein the at least one initiator used is an organic sulfonic acid selected from methanesulfonic acid, trifluoromethanesulfonic acid, trichloromethanesulfonic acid and toluenesulfonic acid, or mixtures thereof.

3. The process according to claim 1 or 2, in which the Lewis acid used for the complex effective as a polymerization catalyst is at least one compound selected from the binary chlorine and fluorine compounds of the elements of transition groups 1 to 8 and of main groups 3 to 5 of the Periodic Table or mixtures thereof.

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9. The process according to claim 8, wherein the at least one further initiator is selected from water, one or more protic acids, methanol, ethanol, 1-phenyl-ethanol, 1-(p-methoxyphenyl)ethanol, n-propanol, isopropanol, 2-phenyl-2-propanol, n-butanol, isobutanol, sec-butanol, tert-butanol, 1-phenyl-1-chloroethane, 2-phenyl-2-chloropropane, tert-butyl chloride and 1,3- or 1,4-bis(1-hydroxy-1-methylethyl)benzene, and mixtures thereof.

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14. The process according to claims 1 to 13, wherein the polymerization is performed at a temperature of -30°C to +50°C.

15. The process according to claims 1 to 14, wherein the polymerization is performed in an aliphatic, cycloaliphatic or aromatic hydrocarbon, in a halogenated aliphatic hydrocarbon or in a mixture of aliphatic, cycloaliphatic and/or aromatic hydrocarbons or of halogenated aliphatic hydrocarbons or in a mixture of at least one halogenated aliphatic hydrocarbon and at least one aliphatic, cycloaliphatic or aromatic hydrocarbon as an inert diluent.

16. Isobutene polymers of the general formula I

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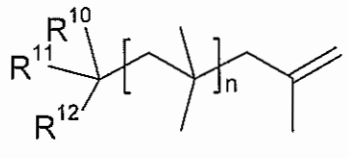

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