CLAIMS

1. An oil extended functionalized styrene-butadiene copolymer wherein the functionalized styrene-butadiene copolymer comprises 15 to 50 wt.%, based on 100 wt.% of the copolymer, of repeating units based on styrene, 42 to 80 wt.%, based on 100 wt.% of the copolymer, of repeating units based on butadiene, and 0.3 to 10 wt.%, based on 100 wt.% of the copolymer, of units based on at least one functional monomer having at least one polar group and wherein the at least one extender oil is based on vegetable oils.

2. The oil extended functionalized styrene-butadiene copolymer according to claim 1 wherein the functional monomer is polymerized with the styrene monomer and butadiene monomer to form the functionalized copolymer therefore representing a functionalized terpolymer.

3. The oil extended functionalized styrene-butadiene copolymer according to *claim 2 comprising 0.5 to 5.0 wt.% and more preferably 0.7 to* 3.5 wt.%, based on 100 wt.% of the copolymer, of units based on the functional monomer.

4. The oil extended functionalized styrene-butadiene copolymer according to claim 3 wherein the functionalized copolymer has a Mooney viscosity (ML 1+4 at 100°C) of 35 to 65, preferably 40 to 60, and an average molecular weight (Mw) determined via GPC (Gel permeation Chromatography) of 100.000 to 2.200.000 g/mol, preferably 200.000 to 900.000 g/mol.

5. The oil extended functionalized styrene-butadiene copolymer according to claim 1 wherein the functional monomer is grafted to the copolymer.

6. The oil extended functionalized styrene-butadiene copolymer according to any one of claims 1 to 5 wherein the functional monomer is selected from the group consisting of acrylate based monomers preferably glycidyl methacrylate, glycidyl acrylate, hydroxypopyl methacrylate, hydroxyethyl methacrylate, acrylonitrile, methacryloxypropyltrimethoxysilane, methacryloxypropyltriisopropoxysilane, or methacryloxysilane.

7. The oil extended functionalized styrene-butadiene copolymer according to any one of claims 1 to 6 wherein the extender oil is selected from the group consisting of soybean, cottonseed, castorbean, palm, linseed, coconut, sunflower, pine, corn, olive, peanut, rapeseed, canola, sesame, rice bran, jatropha oils and mixtures thereof.

8. The oil extended functionalized styrene-butadiene copolymer according to claim 7 wherein the extender oil is transesterified, preferably epoxidized.

9. The oil extended functionalized styrene-butadiene copolymer according to claim 7 or 8 wherein the extender oil is used in an amount of 25 to 42 phr, preferably 37.5 phr.

10. A process for producing the oil extended functionalized styrene-butadiene copolymer according to any one of claims 1 to 9 comprising:

(1a) emulsion polymerization of styrene, butadiene and a functional monomer using a buffering system and controlling the pH of the latex in the range of 8.5 to 9.5 wherein the buffering system is selected from the group consisting of disodium hydrogen phthalate/sodium dihydrogen orthophosphate, acetic acid/sodium acetate, boric acid/sodium tetraborate, sodium phosphate disubstituted/sodium hydroxide, monosodium phosphate/phosphoric acid, potassium dihydrogen orthophosphate/sodium hydroxide, disodium phosphate/phosphoric acid, monosodium phosphate/sodium hydroxide, boric acid/sodium hydroxide, dipotassium hydrogen phtalate/potassium dihydrogen orthophosphate, potassium dihydrogen orthophosphate/sodium hydroxide, sodium tetraborate/hydrochloric acid, sodium carbonate/sodium hydrogen carbonate, disodium phosphate/phosphoric acid, potassium phosphate/potassium hydroxide, sodium tetraborate/sodium hydroxide, sodium bicarbonate/sodium hydroxide, sodium hydrogen orthophosphate/sodium hydroxide, potassium chloride/sodium hydroxide, or

(1b) grafting a styrene-butadiene copolymer obtained by emulsion polymerization of styrene and butadiene with a functional monomer having at least one polar group,

(1c) direct functionalization of the polymer chain through the modification of a common ESBR by functionalizing its polymeric chain with epoxide groups, and

(2) blending such copolymer obtained by (1a), (1b) or (1c) with at least one extender oil based on vegetable oils, preferably epoxidized vegetable oil.

11. The process according to claim 10 wherein the functional monomer is selected from the group consisting of acrylate based monomers such as glycidyl methacrylate, glycidyl acrylate, hydroxypopyl methacrylate, hydroxyethyl methacrylate, acrylonitrile, methacryloxypropyltrimethoxysilane, methacryloxypropyltriisopropoxysilane, and methacryloxysilane.

12. The process according to claim 10 or claim 11 wherein the extender oil is selected from the group consisting of soybean, cottonseed, castorbean, palm, linseed, coconut, sunflower, pine, corn, olive, peanut, rapeseed, canola, sesame, rice bran, jatropha or mixtures thereof.

13. The process according to claim 12 wherein the extender oil is transesterified having a mixture of fatty acid ethyl ester from 5 to 60 wt.%, diglyceride from 40 to 80 wt.% and triglyceride from 0.01 to 99.9 wt.%, preferably resulting in the composition consisting of fatty acid ethyl ester varying from 35 to 48 %, diglyceride varying from 50 to 75 % and triglyceride varying from 0.01 to 50% and more preferably resulting in the composition consisting of fatty acid ethyl ester varying from 40 to 44 %, diglyceride varying from 56 to 60 % and triglyceride varying from 0.01 to 4%, based on 100 wt.% of the mixture.

14. The process according to claim 13 wherein the transesterified extender oil is epoxidized having a degree of epoxidation of 2.5 to 4.5% and preferable of 3.3 to 3.5 %.

15. A rubber composition comprising the oil extended functionalized styrene-butadiene copolymer according to any one of claims 1 to 9 and at least one carbon black and/or at least one silica.

16. Use of the rubber composition according to claim 15 for the production of technical articles, preferably tires, treads, conveyor belts, shoe soles, piping, carpets, hoses and mouldings.

CLAIMS

1. An oil extended functionalized styrene-butadiene copolymer wherein the functionalized styrene-butadiene copolymer comprises 15 to 50 wt.%, based on 100 wt.% of the copolymer, of repeating units based on styrene, 42 to 80 wt.%, based on 100 wt.% of the copolymer, of repeating units based on butadiene, and 0.3 to 10 wt.%, based on 100 wt.% of the copolymer, of units based on at least one functional monomer having at least one polar group and wherein the at least one extender oil is based on vegetable oils, wherein the extender oil is transesterified and epoxidized and wherein the extender oil is present in an amount of 25 to 42 phr.

2. The oil extended functionalized styrene-butadiene copolymer according to claim 1 wherein the functional monomer is polymerized with the styrene monomer and butadiene monomer to form the functionalized copolymer therefore representing a functionalized terpolymer.

3. The oil extended functionalized styrene-butadiene copolymer according to claim 2 comprising 0.5 to 5.0 wt.% and more preferably 0.7 to 3.5 wt.%, based on 100 wt.% of the copolymer, of units based on the functional monomer.

4. The oil extended functionalized styrene-butadiene copolymer according to claim 3 wherein the functionalized copolymer has a Mooney viscosity (ML 1+4 at 100°C) of 35 to 65, preferably 40 to 60, and an average molecular weight (Mw) determined via GPC (Gel permeation Chromatography) of 100.000 to 2.200.000 g/mol, preferably 200.000 to 900.000 g/mol.

5. The oil extended functionalized styrene-butadiene copolymer according to claim 1 wherein the functional monomer is grafted to the copolymer.

6. The oil extended functionalized styrene-butadiene copolymer according to any one of claims 1 to 5 wherein the functional monomer is selected from the group consisting of acrylate based monomers preferably glycidyl methacrylate, glycidyl acrylate, hydroxypopyl methacrylate, hydroxyethyl

methacrylate, acrylonitrile, methacryloxypropyltrimethoxysilane, methacryloxypropyltriisopropoxysilane, or methacryloxysilane.

7. The oil extended functionalized styrene-butadiene copolymer according to any one of claims 1 to 6 wherein the extender oil is selected from the group consisting of soybean, cottonseed, castorbean, palm, linseed, coconut, sunflower, pine, corn, olive, peanut, rapeseed, canola, sesame, rice bran, jatropha oils and mixtures thereof.

8. A process for producing the oil extended functionalized styrene-butadiene copolymer according to any one of claims 1 to 7 comprising:

(1a) emulsion polymerization of styrene, butadiene and a functional monomer using a buffering system and controlling the pH of the latex in the range of 8.5 to 9.5 wherein the buffering system is selected from the group consisting of disodium hydrogen phthalate/sodium dihydrogen orthophosphate, acetic acid/sodium acetate, boric acid/sodium tetraborate, sodium phosphate disubstituted/sodium hydroxide, monosodium phosphate/phosphoric acid, potassium dihydrogen orthophosphate/sodium hydroxide, disodium phosphate/phosphoric acid, monosodium phosphate/sodium hydroxide, boric acid/sodium hydroxide, dipotassium hydrogen phtalate/potassium dihydrogen orthophosphate, potassium dihydrogen orthophosphate/sodium hydroxide, sodium tetraborate/hydrochloric acid, sodium carbonate/sodium hydrogen carbonate, disodium phosphate/phosphoric acid, potassium phosphate/potassium hydroxide, sodium tetraborate/sodium hydroxide, sodium bicarbonate/sodium hydroxide, sodium hydrogen orthophosphate/sodium hydroxide, potassium chloride/sodium hydroxide, or

(1b) grafting a styrene-butadiene copolymer obtained by emulsion polymerization of styrene and butadiene with a functional monomer having at least one polar group,

(1c) direct functionalization of the polymer chain through the modification of a common ESBR by functionalizing its polymeric chain with epoxide groups, and

(2) blending such copolymer obtained by (1a), (1b) or (1c) with at least one extender oil based on vegetable oils, preferably epoxidized vegetable oil.

9. The process according to claim 8 wherein the functional monomer is selected from the group consisting of acrylate based monomers such as glycidyl methacrylate, glycidyl acrylate, hydroxypopyl methacrylate, hydroxyethyl methacrylate, acrylonitrile, methacryloxypropyltrimethoxysilane, methacryloxypropyltriisopropoxysilane, and methacryloxysilane.

10. The process according to claim 8 or claim 9 wherein the extender oil is selected from the group consisting of soybean, cottonseed, castorbean, palm, linseed, coconut, sunflower, pine, corn, olive, peanut, rapeseed, canola, sesame, rice bran, jatropha or mixtures thereof.

11. The process according to claim 10 wherein the extender oil is transesterified having a mixture of fatty acid ethyl ester from 5 to 60 wt.%, diglyceride from 40 to 80 wt.% and triglyceride from 0.01 to 99.9 wt.%, preferably resulting in the composition consisting of fatty acid ethyl ester varying from 35 to 48 %, diglyceride varying from 50 to 75 % and triglyceride varying from 0.01 to 50% and more preferably resulting in the composition consisting of fatty acid ethyl ester varying from 40 to 44 %, diglyceride varying from 56 to 60 % and triglyceride varying from 0.01 to 4%, based on 100 wt.% of the mixture.

12. The process according to claim 11 wherein the transesterified extender oil is epoxidized having a degree of epoxidation of 2.5 to 4.5% and preferable of 3.3 to 3.5 %.

13. A rubber composition comprising the oil extended functionalized styrene-butadiene copolymer according to any one of claims 1 to 7 and at least one carbon black and/or at least one silica.

14. Use of the rubber composition according to claim 13 for the production of technical articles, preferably tires, treads, conveyor belts, shoe soles, piping, carpets, hoses and mouldings.