this context is the improvement of the volumetric efficiency of the hydraulic systems. This is favorably influenced by higher lubricant viscosities, since leakage flows in the hydraulic pump are minimized as a result. However, improvement in the volumetric efficiency is accompanied by reduced mechanical efficiency. In the case of transmission oils, however, mechanical efficiency is crucial, which is the reason why low viscosities and, in particular, low coefficients of traction of the lubricant oil are required in the transmission oil sector. Therefore, the development of energy-efficient hydraulic oils does not permit any conclusions about the development of transmission oils.

WO 2012/025901 A1 discloses the use of comb polymers in lubricants in combination with particular friction modifiers. There is no disclosure of combinations of comb polymers and base oils specifically matched to the demands of transmission oils.

Since the properties of the lubricants disclosed in the prior art are still unsatisfactory in relation to use as a transmission oil and in respect of the reduction in fuel consumption, it is the aim of the present invention to provide a transmission oil formulation having a kinematic minimum viscosity at 100°C of 5.5 $mm^2/s$ to ASTM D445 after a 20 h tapered roller bearing test CEC-L-45-A-99, and simultaneously high shear dilution. In addition, the kinematic fresh oil viscosity at 100°C should be not more than 6.4 $mm^2/s$ to ASTM D445 and preferably about 6.0 $mm^2/s$. The transmission oil formulation should also have a high viscosity index, preferably a viscosity index of greater than 180 to ASTM D2270, more preferably greater than 190.

In addition, the transmission oil formulation should have a low coefficient of traction. The coefficient of traction is the force required to move a load, divided by the load. The numerical value of the coefficient expresses how easy it is to shear a lubricant film. Transmission oils ideally have a low coefficient of traction because, when the coefficient of traction is low, less energy is consumed because of lubricant shearing.

This object is achieved by a transmission oil formulation comprising
(i) a base oil having a kinematic viscosity at 100°C of at least 1.5 $mm^2/s$ to ASTM D445 and an aromatics content of less than 15% by weight to ASTM D 2007; and
(ii) a copolymer obtained by free-radical polymerization from a monomer composition, said monomer composition comprising the following monomers:
(A) 30% to 50% by weight of an ester of (meth)acrylic acid and a hydroxylated hydrogenated polybutadiene, where the hydroxylated hydrogenated polybutadiene has a number-average molar mass $M_n$ to DIN 55672-1 of 4000 to 6000 g/mol;
(B1) 0.2% to 50% by weight of methyl (meth)acrylate;
(B2) 0.2% to 50% by weight of butyl (meth)acrylate;
(B3) 0.2% to 5% by weight of C5-C30 alkyl (meth)acrylates;
(C) 10% to 50% by weight of styrene monomers having 8 to 17 carbon atoms; and
(D) 0% to 5% by weight of further free-radically polymerizable comonomers,

where the sum total of the proportions by weight of monomers (B1), (B2) and (B3) is at least 10% by weight.

In an aspect, there is provided a transmission oil formulation comprising

(i) a base oil having a kinematic viscosity at 100°C of at least 1.5 $mm^2/s$ to ASTM D445 and an aromatics content of less than 15% by weight to ASTM D 2007, wherein the base oil is a group III oil as defined by the American Petroleum Institute; and

(ii) a copolymer obtained by free-radical polymerization from a monomer composition, said monomer composition comprising the following monomers:

(A) 30% to 50% by weight of an ester of (meth)acrylic acid and a hydroxylated hydrogenated polybutadiene, where the hydroxylated hydrogenated polybutadiene has a number-average molar mass $M_n$ to DIN 55672-1 of 4000 to 6000 g/mol;

(B1) 0.2% to 50% by weight of methyl (meth)acrylate;

(B2) 0.2% to 50% by weight of butyl (meth)acrylate;

(B3) 0.2% to 5% by weight of C5-C30 alkyl (meth)acrylates;

(C) 10% to 50% by weight of styrene monomers having 8 to 17 carbon atoms; and

(D) 0% to 5% by weight of further free-radically polymerizable comonomers,

where the sum total of the proportions by weight of monomers (B1), (B2) and (B3) is at least 10% by weight.

In another aspect, there is provided the use of a transmission oil formulation as disclosed above as transmission oil for reducing the fuel consumption of motor vehicles.

## Claims

1. A transmission oil formulation comprising

(i) a base oil having a kinematic viscosity at 100°C of at least 1.5 $mm^2/s$ to ASTM D445 and an aromatics content of less than 15% by weight to ASTM D 2007, wherein the base oil is a group III oil as defined by the American Petroleum Institute; and

(ii) a copolymer obtained by free-radical polymerization from a monomer composition, said monomer composition comprising the following monomers:

(A) 30% to 50% by weight of an ester of (meth)acrylic acid and a hydroxylated hydrogenated polybutadiene, where the hydroxylated hydrogenated polybutadiene has a number-average molar mass $M_n$ to DIN 55672-1 of 4000 to 6000 g/mol;

(B1) 0.2% to 50% by weight of methyl (meth)acrylate;

(B2) 0.2% to 50% by weight of butyl (meth)acrylate;

(B3) 0.2% to 5% by weight of C5-C30 alkyl (meth)acrylates;

(C) 10% to 50% by weight of styrene monomers having 8 to 17 carbon atoms; and

(D) 0% to 5% by weight of further free-radically polymerizable comonomers,

where the sum total of the proportions by weight of monomers (B1), (B2) and (B3) is at least 10% by weight.

2. The transmission oil formulation as claimed in claim 1, characterized in that the monomer composition comprises

as monomer (B1) 0.2% to 45% by weight of methyl methacrylate;

as monomer (B2) 0.2% to 45% by weight of n-butyl methacrylate and/or n-butyl acrylate; and

as monomer (B3) 0.2% to 5% by weight of C12-C14 alkyl (meth)acrylates.

3. The transmission oil formulation as claimed in either of the preceding claims, characterized in that the hydroxylated hydrogenated polybutadiene is a hydroxyethyl- or hydroxypropyl-terminated hydrogenated polybutadiene.

4. The transmission oil formulation as claimed in any of the preceding claims, characterized in that the copolymer has an iodine number to DIN 53241-1:1995-05 of up to 5 g of iodine per 100 g of copolymer.

5. The transmission oil formulation as claimed in any of the preceding claims, characterized in that the further free-radically polymerizable comonomers are selected from the group consisting of maleic anhydride, (di)alkyl fumarates, (di)alkyl maleates, aminoalkyl (meth)acrylates, aminoalkyl(meth)acrylamides, hydroxyalkyl (meth)acrylates, carbonyl-containing (meth)acrylates, heterocyclic (meth)acrylates, heterocyclic vinyl compounds and mixtures thereof.

6. The transmission oil formulation as claimed in any of the preceding claims, characterized in that the copolymer has a molar branching level of 1.0 to 3.1 mol%.

7. The transmission oil formulation as claimed in any of the preceding claims, characterized in that the base oil has a proportion of aromatic carbon atoms of not more than 2%.

8. The transmission oil formulation as claimed in any of the preceding claims, characterized in that the transmission oil formulation comprises 60% to 99.9% by weight of component (i) based on the total weight of the transmission oil formulation.

9. The transmission oil formulation as claimed in any of the preceding claims, characterized in that the transmission oil formulation comprises 0.1% to 40% by weight of component (ii) based on the total weight of the transmission oil formulation.

10. The transmission oil formulation as claimed in any of the preceding claims, characterized in that the transmission oil formulation additionally comprises, as component (iii), a second polymer selected from the group of the hydrogenated polybutadienes, hydroxylated hydrogenated polybutadienes or (meth)acrylic esters thereof, polyalkyl (meth)acrylates and mixtures thereof.

11. The transmission oil formulation as claimed in claim 10, characterized in that the transmission oil formulation comprises 0% to 3% by weight of component (iii) based on the total weight of the transmission oil formulation.

12. The transmission oil formulation as claimed in any of the preceding claims, characterized in that the transmission oil formulation additionally comprises, as component (iv), further additives selected from the group consisting of dispersants, defoamers, detergents, antioxidants, antiwear additives, extreme pressure additives, friction modifiers, anticorrosion additives, dyes and mixtures thereof.

13. The use of a transmission oil formulation as claimed in any of claims 1 to 12 as transmission oil for reducing the fuel consumption of motor vehicles.

14. The use as claimed in claim 13, characterized in that the transmission oil formulation is used as transmission oil for automatic transmission systems.

15. The use as claimed in claim 13, characterized in that the transmission oil formulation is used as transmission oil for reducing a coefficient of traction.