tertbutyl C7-C9 mixed alcohol ester of phenpropionate, 1.8 to 2.2 parts of 2-methyl-4, 6-di-(octylsulfanylmethyl)phenol, 0.8 to 1.2 parts of reaction product of N-phenylphenylamine and 2, 4, 4-trimethylpentene. The obtained antioxidant composition is dissolved in cyclohexane first before added into SBS resin solution. And cyclohexane is the solvent of solution polymerization of SBS. The dissolving rate is low because of the polarity discrepancy between cyclohexane and antioxidant composition. Furthermore, cyclohexane has a boiling point of 80.74°C, which is lower than that of water. In "drying" step of preparing raw rubbers, i.e. removing solvent as well as monomer residue from rubber resins by hot water or steam, antioxidants tend to move into water, which brings a significant decrease of efficient antioxidants in raw rubbers. Moreover, the contaminated water requires further treatment to avoid polluting environment.

Therefore, it is still required to provide a new liquid antioxidant composition that is stable during "drying" process of rubber resins synthesized via solution polymerization, non-staining as well as applicable for wide temperature range besides sufficient anti-oxidation.

Summary

In one aspect, the present disclosure provides a liquid antioxidant composition used for raw rubbers, comprising

a) 5% to 30% by weight of at least one aromatic amine-based antioxidant agent;
b) 20% to 70% by weight of at least one hindered phenol-based antioxidant agent;
c) 0% to 40% by weight of at least one phosphite-based antioxidant agent; and
d) 20% to 40% by weight of at least one solvent having boiling point higher than 185°C and freezing point lower than -10°C under 101.325KPa, the weight percentage of component a), b) , c) or d) is based on the total weight of antioxidant composition, wherein the mixture of component a), b) and c) is liquid at 25°C under 101.325KPa.

In another aspect, the present disclosure provides a liquid antioxidant composition used for raw rubbers, comprising

a) 5% to 20% by weight of solid aromatic amine-based antioxidant agent;
b) 20% to 50% by weight of solid hindered phenol-based antioxidant agent;
c) 0% to 30% by weight of solid phosphite-based antioxidant agent; and

d) 30% to 40% by weight of solvent having boiling point higher than 185°C and freezing point lower than -10°C under 101.325KPa, the weight percentage of component a), b) , c) or d) is based on the total weight of antioxidant composition.

In another aspect, the present disclosure provides a use of said antioxidant composition in raw rubbers synthesized via solution polymerization or in natural rubbers.

In another aspect, there is provided a process of using antioxidant composition as defined above in raw rubbers synthesized via solution polymerization comprising steps of i) dissolving component a), b) and c) into d); ii) diluting liquid antioxidant composition by solvent for solution polymerization of raw rubbers; iii) adding diluted liquid antioxidant composition into raw rubbers synthesized via solution polymerization.

In another aspect, the present disclosure provides a raw rubber product comprising said antioxidant composition.

In a an embodiment, the present disclosure provides a process of using the invented antioxidant composition in raw rubbers synthesized via solution polymerization or natural rubbers comprising steps of i) dissolving component a), b) and c) into d); ii) diluting liquid antioxidant composition by solvent for solution polymerization of raw rubbers; iii) adding diluted liquid antioxidant composition into raw rubbers synthesized via solution polymerization or natural rubbers.

Detailed Description of Invention

Technical Problems

For rubber resins synthesized via solution polymerization, one significant step of process is to remove solvent and monomer residues from raw rubber solution by hot water or steam. During this step, antioxidant agents are prone to separate from rubber resins and dissolve into water, which in one side, leads to a loss of antioxidant agents in rubber resins and in another side contaminates water. The contaminated water needs to be treated to prevent environmental damages.

Part of antioxidant agents are liquid while the others are solid at around 25°C. The term "liquid" means the upper limit of melting range or melting point of an antioxidant agent without dissolving into any solvent is no more than 25°C under 101.325KPa. The term "solid" means the lower limit of melting range or melting point of an antioxidant agent without dissolving into any solvent is more than 25°C under 101.325KPa. The liquid antioxidant agents turn to freeze at temperature like 5°C,