

PUBLICATIONS

VEGETABLE OIL EXTENDED EMULSION STYRENE BUTADIENE RUBBERS FOR PASSENGER CAR RADIAL TIRE TREAD APPLICATION

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Abstract

Currently emulsion polymerized Styrene Butadiene Rubber (E-SBR) is extended with various petroleum based mineral oils like Distillate Aromatic Extract (DAE), Treated Distillate Aromatic Extract (TDAE), Residual Aromatic Extract (RAE) and Naphthenic oils. It is obvious that introduction of vegetable oil should result in almost zero Polycyclic Aromatic Content (PCA) content and therefore, are environmentally friendly, renewable, and sustainable. In the present work, vegetable oil extended Styrene Butadiene Rubber (OE-SBR) were characterized for chemical properties and found that all the properties were meeting the specification requirements of mineral oils extended grades. These rubbers were also evaluated in standard Passenger Car Radial (PCR) tire tread compound recipe for various processing, different vulcanizate and other performance properties. The developed grades with vegetable oils required less mixing energy (around 10% for master batch and 15% for final batch) and shown better flow behavior (around 15% power law index and 20% activation energy reduction), better carbon dispersion (around 20%), high reinforcement index (around 15%), better rubber-filler interaction parameter (around 20%), better abrasion resistance (around 20%) and lower $\tan \delta$ value @60°C (around 15%) as compared to TDAE oil extended SBR based compound. This may help to improve life of a PCR tire and reduction in fuel consumption of the vehicle.

Keywords: Sustainability, vegetable oils, reinforcement index, rubber-filler interaction parameter, performance properties, etc

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TO EXPLORE EXTENSION OF EMULSION STYRENE BUTADIENE RUBBER WITH MODIFIED VEGETABLE OILS

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Abstract

Increasing industrialization and rapid change in market demand has led to aggressive competition impacting both business and environmental sustainability globally. In view of the new legislations, regulations and restrictions on the usage of hazardous materials, it becomes mandatory to use eco-friendly materials. In the present work, various petroleum-based and different modified vegetable oils are characterised for chemical and analytical properties. Styrene butadiene rubber (SBR) is extended with these oils at laboratory scale through emulsion polymerisation technique. Totally four number of petroleum-based oils like distillate aromatic extract (DAE), treated distillate aromatic extract (TDAE), residual aromatic extract (RAE) and naphthenic type oil and two number of modified vegetable oils, NO_2 and NO_6, are evaluated. All oils have shown compatibility with SBR latex which is confirmed by checking solvent extractables as well as oil leaching checking by visual inspection of oil extended rubber samples. These raw rubber samples are characterised for raw rubber properties as well as in ASTM-based rubber compound recipe to check their processing behaviour. Compounds prepared with both vegetable oil-based styrene butadiene rubber have shown comparable or slightly better processing properties as compared to compounds prepared with petroleum oil-based rubbers. Experimental compounds are also showing comparable carbon black dispersion and better polymer–filler interaction which may be due to the presence of various surface functional groups in vegetable oils. Microscopic pictures also confirm the comparable carbon black dispersion for all the samples.

Keywords: Sustainability, Eco-friendly materials, Vegetable oil, oil extended, styrene butadiene rubber, Compatibility, Processing properties, etc.

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