CHAPTER – IV

DISCUSSION

CONTENTS

4.1 ASTM MASTER BATCH RECIPE

Modified vegetable oils are eco-friendly in nature and may be used for extension of styrene butadiene rubber at latex stage to produce eco-friendly rubbers. The NO_2 and NO_6, samples were found compatible with SBR latex. Compounds prepared with these oils based SBR rubbers have comparable or slightly better processing properties, which was confirmed by lower mixing energy, lower activation energy and better rubber-filler interaction in the master rubber compound based on lower Payne effect and higher bound rubber content. All the samples have comparable carbon black dispersion, which was confirmed by strain sweep test in RPA and surface topology.

4.2 PCR TIRE TREAD COMPOUND RECIPE

E-SBR could be extended with vegetable oils like other mineral oils. Selected vegetable oils with solubility parameter close to SBR were used for oil extension purpose for better compatibility. Various chemical properties were checked for these rubbers and these were found in line with properties of mineral oil extended SBR. The developed grades of SBR were highly sustainable products as these were prepared with use of vegetable oils in place of petroleum-based oils. This is because NMR study evident from aromatic content was almost absent in these vegetable origin oils.

Passenger car radial (PCR) tire tread compounds were prepared with these new grades of SBR rubbers along with mineral oil based SBR rubbers. They have better processing properties, which was confirmed by lower mixing energy by 10-15%, lower power law index around 15%, higher filler dispersion around 20% and lower activation energy around 20%. Compounds prepared with NO_6 and NO_10 vegetable oil-based SBRs have better performance properties due to high reinforcement index around 15% and high rubber-filler interaction parameter around 20%. These compounds have also improvement in performance properties like abrasion resistance increased around 20% and tan δ value @60°C reduction around 15% as compared to TDAE oil extended SBR based compound. This may enhance service life of PCR tire and may also reduce fuel consumption. Vegetable origin oils may be alternative solution for extension of SBRs for use in PCR tire tread compound.

4.3 ASTM COMPOUND MIXING (With curatives adjustment)

ASTM compounds were prepared using OE-SBRs extended with naphthenic and various vegetable oils. Curatives like sulfur and accelerator dosage were adjusted to achieve similar static modulus for the oils (NO_2 and NO_7 to NO_9), which are having higher unsaturation to saturation fatty acid ratio. Curatives dosage was increased for these oil-based rubbers after taking few trials. Compounds prepared with NO_6 and NO_10 (Palmolein and coconut oils) vegetable oil-based SBRs have better performance (better abrasion resistance around 23%) properties due to high reinforcement index (around 5%) and high rubber-filler interaction parameter (around 12%). Vegetable origin oils may be alternative solution of naphthenic oil for extension of E-SBR in various tire and non-tire applications. Tire industry is encouraged to create sustainability culture, to reduce carbon footprint or circular economy by replacing tire components by sustainable products and replacing mineral oil by natural oils in last few years. These new grades of E-SBRs will be sustainable due to use of vegetable origin oils, which are having almost negligible PCA content. Also, these grades are improving the performance properties of the rubber compound and hence, these OE-SBR grades may be used in high performance applications.

4.4 MOTORCYCLE TIRE TREAD COMPOUND RECIPE

High styrene ESBR were extended with vegetable origin oils at laboratory scale. Selected vegetable origin oils with solubility parameter close to SBR were used for oil extension purpose. Various chemical properties for rubbers were checked for these rubbers and found in line with properties of mineral oil extended SBR. Rubbers developed with vegetable oils could find application in manufacturing of colored products due to their light color. These new grades of SBR are eco-friendly products as these were prepared with use of vegetable origin oils.

Motorcycle tire tread compounds prepared with vegetable oils based SBR rubbers have comparable or slightly better processing properties, which was confirmed by lower mixing energy, lower activation energy and better rubber-filler interaction in rubber compound. Compound prepared with samples S40_NO_6 and S40_NO_10 have most of the properties comparable with naphthenic oil extended SBR based compound.

Therefore, these vegetable origin oil extended SBR rubbers can be used for manufacturing of tire tread compound for high quality motorcycle.

Few vegetable oils based SBRs exhibited improvement in processing, performance and dynamic mechanical properties. These oils may be used for commercialisation to produce sustainable SBRs. Few vegetable oils based SBRs exhibited slow cure behaviour in rheometeric characterization. These oils extended SBRs based rubber compounds may be evaluated with higher dosage of curatives to adjust the cure rate and crosslink density. Research work may also be conducted with use of blend of oils in place of using single oil for extension of SBR. This may further optimise the properties of the rubber compounds.

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