Manufacture of a Rubber Paver from a Blend of Nitrile Butadiene Rubber (NBRr) Latex Waste and Polyamide (PAr) Waste with Improved Properties Using Gamma Irradiation

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Abstract: This study presents an experimental and practical analysis of the effect of gamma irradiation on blend of recycled nitrile butadiene rubber and polyamide samples for the manufacture of rubber paver as an alternative for cement paving blocks. Gamma irradiation radical–radical interaction crosslinking of elastomers and thermoplastic is a special crosslinking method as process is fast, pollution free and simple.

NBR and PA polymer blends with various blend ratios were prepared through a low temperature mixing process. In this study a blend of polymer, based on waste nitrile butadiene rubber and waste polyamide (Nylon 6,6) has been investigated for several physical properties at varying NBR/ PA content. NBR/PA (100:5) blend was selected for gamma irradiation. It achieved a tensile value of 3.040 N/mm^2, tear value of 23.805 N/mm^2 and hardness value 40 (Shore A). These values are at higher range when compared with other ratios of (100:1.25), (100:2.5) and (100:10) NBR/ PA blend.

The structural properties of the polymer blends before and after they had been exposed to gamma irradiation were investigated.

Rheological properties are measured to study curing behavior of blends. Mechanical properties like tensile strength, elongation at break, hardness and modulus at different elongations were studied and compared with those of un-irradiated sample. A relatively low-radiation dose (54.4 kGy) was found to be effective in improving the level of mechanical properties. According to FT-IR spectroscopic analysis of irradiated sample, there are no novel peaks corresponding to novel functional group in NBR/ PA blend. Enhancement in mechanical properties has been observed for low radiation dose, showing that gamma irradiation affects the NBR/ PA blend in a more efficient way at lower dose rates.

Considering the current waste disposal difficulties and disposal cost (Rs.15,000 per ton) to the industry, a paving block sample was prepared as a green solution for waste NBR and Nylon 6,6. Water leachate of paving block was analyzed for heavy metals, BOD, COD, oil and grease levels. Those values are lower than the tolerance limits for discharge industrial waste into inland surface waters, on land for irrigation and into marine coastal areas. Mechanical properties of paving block such as compression set, hardness, swelling in water, UV exposure test, abrasion resistance, cut resistance, tear resistance and puncture resistance indicate suitability for application in hospital OPD floor area, nurseries, children play area, gymnasium and public walk ways. This study successfully offers solution for environmentally friendly disposal of nitrile rubber waste and nylon waste with reasonable profit to the industry.

Keywords: gamma irradiation, waste nitrile butadiene rubber, waste polyamide, mechanical properties, rubber paver.

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