ISSN: 1391-8796
Proceedings of 9th Ruhuna International Science & Technology Conference
University of Ruhuna, Matara, Sri Lanka
January 19, 2022

Performance of surface modified pyrolytic carbon black in rubber compounding

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Waste tyres pyrolysis (WT- pyrolysis) process provides a sustainable solution for waste tyre recycling. Value addition to pyrolytic tyre char (PT-char) is particularly essential because it will reduce enormous inventories of wasted PT-char, generate income, and enhance WT-pyrolysis sustainability while still being environmentally friendly. This study was aimed at modifying the surface properties of unusable PT-char to be amalgamated in a rubber compound. PT-char was obtained from a WT-pyrolysis plant, sieved, demineralized using diluted HCl and or Citric acid followed by diluted NaOH. The purified samples were then heated with different ratios of 92-octane at 220-250 °C until the self-ignition of octane occurred. The heat produced by the self-ignition triggered the activation of the surface of PT-char as well as it initiated localized explosions which resulted in breaking up the large PT-char particles. The modified pyrolytic char (PT-char $_M$) was characterized by XRD, Elemental Analyses, and SEM. SEM images of PT-char $_M$ samples and commercial carbon black (CB–N660) samples clearly demonstrate the uniform distribution of nano-size (~50 nm) particles. Modified samples were blended with various additives according to ACS 1 formula to prepare rubber compounds and their cure characteristics and mechanical properties were evaluated and compared with CB–N660 and recycled carbon black. The physico - mechanical properties of the PT-char $_M$ samples were greater than the unmodified samples but little lower than the commercial carbon black. Most interestingly, almost all PT-char $_M$ samples showed better physico - mechanical properties compared to recycled carbon black which suggests that the current PT-char modification protocol might be a promising route to replace recycled carbon black in industry

Keywords: Pyrolytic carbon char, Pyrolysis, Demineralization, Waste tyre

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