World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:14, No:06, 2020

Thermosonic Devulcanization of Waste Ground Rubber Tires by Quaternary Ammonium-Based Ternary Deep Eutectic Solvents and the Effect of α-Hydrogen

Authors : Ricky Saputra, Rashmi Walvekar, Mohammad Khalid

Abstract : Landfills, water contamination, and toxic gas emission are a few impacts faced by the environment due to the increasing number of αof waste rubber tires (WRT). In spite of such concerning issue, only minimal efforts are taken to reclaim or recycle these wastes as their products are generally not-profitable for companies. Unlike the typical reclamation process, devulcanization is a method to selectively cleave sulfidic bonds within vulcanizates to avoid polymeric scissions that compromise elastomer's mechanical and tensile properties. The process also produces devulcanizates that are re-processable similar to virgin rubber. Often, a devulcanizing agent is needed. In the current study, novel and sustainable ammonium chloride-based ternary deep eutectic solvents (TDES), with a different number of α-hydrogens, were utilised to devulcanize ground rubber tire (GRT) as an effort to implement green chemistry to tackle such issue. 40-mesh GRT were soaked for 1 day with different TDESs and sonicated at 37-80 kHz for 60-120 mins and heated at 100-140oC for 30-90 mins. Devulcanizates were then filtered, dried, and evaluated based on the percentage of by means of Flory-Rehner calculation and swelling index. The result shows that an increasing number of α-Hs increases the degree of devulcanization, and the value achieved was around eighty-percent, thirty percent higher than the typical industrial-autoclave method. Resulting bondages of devulcanizates were also analysed by Fourier transform infrared spectrometer (FTIR), Horikx fitting, and thermogravimetric analyser (TGA). The earlier two confirms only sulfidic scissions were experienced by GRT through the treatment, while the latter proves the absence or negligibility of carbon-chains scission.

Keywords : ammonium, sustainable, deep eutectic solvent, α-hydrogen, waste rubber tire
Conference Title : ICWMT 2020 : International Conference on Waste Management and Technology
Conference Location : San Francisco, United States
Conference Dates : June 05-06, 2020