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UTILIZATION OF SOYBEAN HULLS AS FILLER IN VULCANIZED NATURAL RUBBER COMPOSITES.

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Introdução

The increasing demand for sustainable materials has encouraged the use of agro-industrial residues as alternative fillers in polymer composites. Soy husk, an abundant and underutilized by-product, represents a potential low-cost alternative to conventional synthetic fillers. Its incorporation into natural rubber may contribute to waste valorization and resource efficiency. However, the effects of vegetable filler loading on the rheological and mechanical properties of vulcanized rubber must be evaluated to determine its potential applications.

Objetivos

To evaluate soy husk as an alternative filler in vulcanized natural rubber composites, investigating the effects of filler loading on rheological behavior, tensile properties, Shore A hardness, and abrasion resistance.

Metodologia

Soy husk was dried, ground, and sieved to obtain particles with a size of 400 mesh. The composites were prepared by homogenization in an open two-roll mill using natural rubber and a conventional vulcanization system consisting of sulfur, zinc oxide, stearic acid, and accelerators. Four formulations were produced with 0, 5, 10, and 20 parts per hundred rubber (phr) of soy husk.

The materials were characterized by oscillating disc rheometry to determine optimum cure time and torque parameters, tensile testing to obtain stress–strain properties, Shore A hardness measurements, and abrasion resistance testing.

Resultados e Discussão

Rheological behavior: The rheometric results showed no evidence of reversion under the evaluated conditions, with curing times compatible with conventional natural rubber processing.

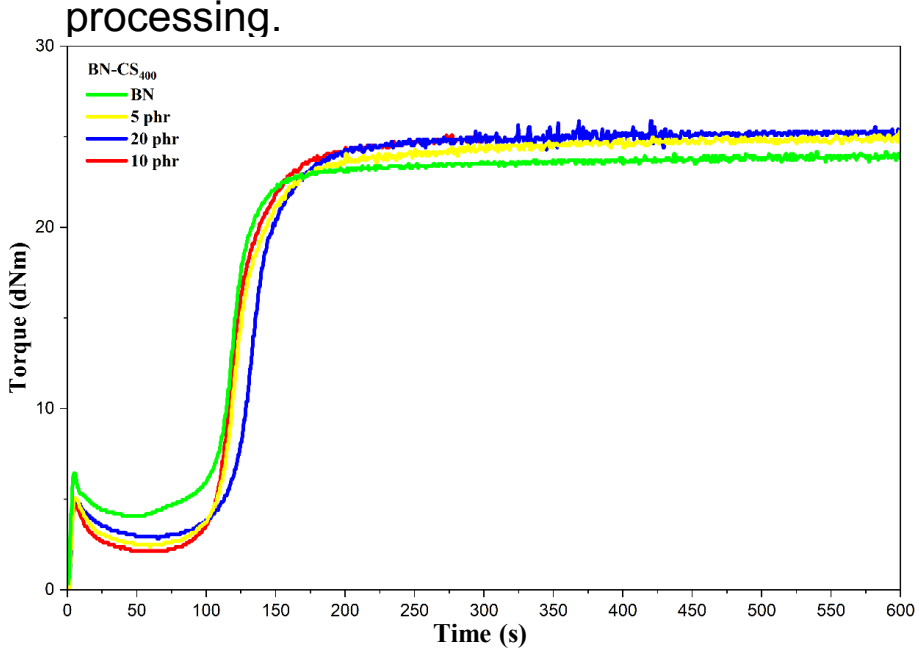


Figura 1. Rheometry curves for NR/HS_{400} composites.

Tensile properties: The incorporation of soy husk reduced tensile strength compared with unfilled natural rubber. The reference material exhibited a tensile strength of 16.8 MPa, while the formulation containing 5 phr reached 15.6 MPa, corresponding to a 7.1% reduction. At 20 phr, tensile strength decreased to 12.8 MPa, representing a 23.8% reduction relative to the unfilled matrix.

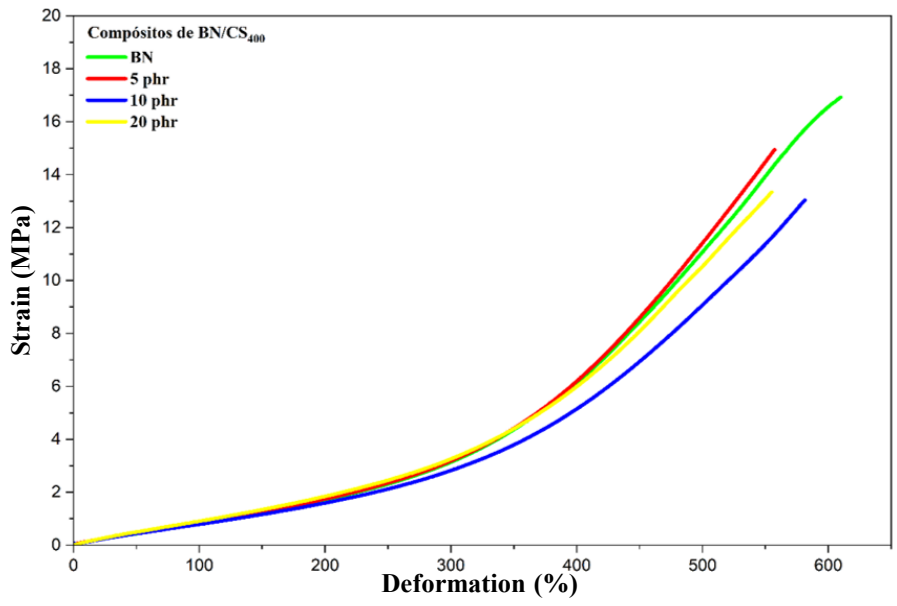


Figura 2. Stress-strain curves for BN/CS400 composites

Hardness: Shore A hardness increased from 45 for unfilled natural rubber to 46.7 with the incorporation of soy husk, corresponding to an increase of approximately 3.8%.

Abrasion loss: The volumetric abrasion loss increased progressively with the incorporation of soy husk, rising from approximately 130 $mm^3 \cdot 40\ m^{-1}$ (0 phr) to 232 $mm^3 \cdot 40\ m^{-1}$ (20 phr), corresponding to a 78.5% increase in wear loss.

Conclusões

Soybean husk shows potential as an alternative filler in natural rubber composites, reducing tensile strength while slightly increasing hardness. Its application in general-purpose products may contribute to the valorization of agro-industrial waste and the promotion of a circular economy.

Referências

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