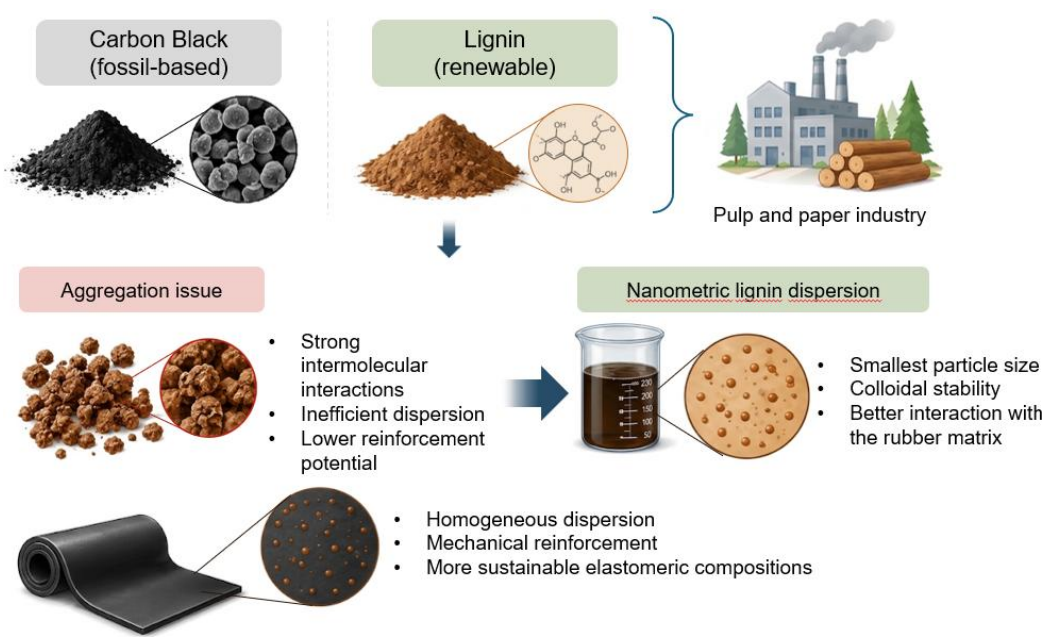
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Development of Nanometric Lignin Dispersions for Application as a Sustainable Filler in XNBR Rubber

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Introduction



Objectives

- To develop an aqueous-based approach for producing nanoscale lignin dispersions.
- To determine the influence of processing conditions on lignin particle size and colloidal stability.
- To characterize the physicochemical properties of the lignin dispersions.
- To assess the suitability of nanoscale lignin for incorporation into XNBR latex.

Metodology

pH-induction precipitation



Lignin, H_2O, glycerin, and NaOH — 1h mixing — Acetic acid drip

Ultra-Turrax



Lignin, H_2O, and NaOH — 1h mixing

Results and Discussion

Parameters	Z-Average (nm)	PdI
Average	409.8	0.253
Median	392.4	0.240
Standard deviation	69.2	0.049
Coeff. of variation (%)	17%	19%
Minimum	331,5	0.191
Maximum	520.7	0.315
Range	189.3	0.124
Interquartile range	78.3	0.068

Table 1: Statistical analysis of the ultraturrax method

Parameters	pH	Z-Average (nm)	PdI
Average	6.6	208.9	0.269
Median	6.5	204.2	0.264
Standard deviation	0.4	28.6	0.042
Coeff. of variation	6%	14%	16%
Minimum	6	149.4	0.199
Maximum	7.5	298.9	0.383
Range	1.5	149.5	0.184
Interquartile range	0.7	21.95	0.060

Table 2: Statistical analysis of the antisolvent method

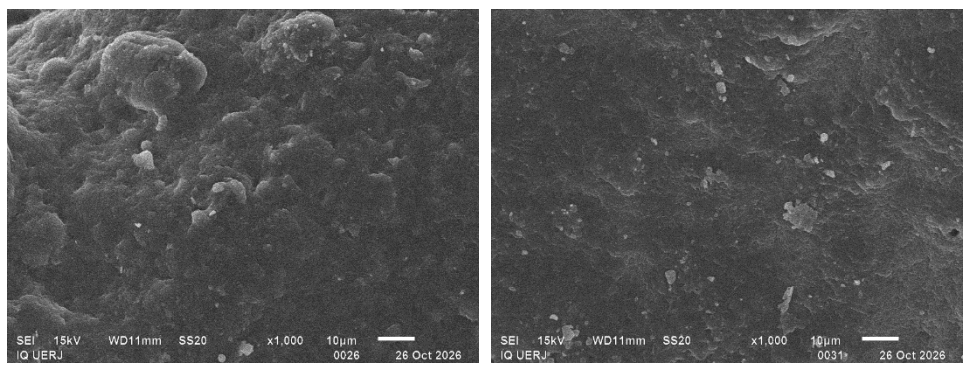


Figure 1. SEM - Glycerin:H_2O (left) and Ultraturrax (right)

Conclusions

The processing route influenced the hydrodynamic size of the lignin particles. Acid-induced precipitation yielded a lower mean Z-average diameter than the Ultra-Turrax method. The two dispersions had comparable PdI values, indicating similar levels of polydispersity. Overall, particle size and colloidal stability are important factors to consider when seeking to limit aggregation and promote a more homogeneous distribution of lignin in the XNBR matrix. The precipitation approach used in this study therefore shows promise for valorizing lignin as a renewable raw material and for developing elastomeric composites that may reduce reliance on conventional fossil-derived fillers.

Referências e Agradecimentos

MOHAMAD AINI, Nor Anizah *et al.* Lignin as Alternative Reinforcing Filler in the Rubber Industry: A Review. **Frontiers in Materials**, v. 6, 8 jan. 2020.
KAZEMI, Hossein; MIGHRI, Frej; RODRIGUE, Denis. A Review of Rubber Biocomposites Reinforced with Lignocellulosic Fillers. **Journal of Composites Science**, v. 6, n. 7, p. 183, 1 jul. 2022.
ZHANG, Zhongping *et al.* Lignin as a green filler for elastomers: A review of sustainable reinforcement and functionalization strategies. **International Journal of Biological Macromolecules**, v. 344, p. 150383, 1 fev. 2026.

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