

High aging resistance of rubber tire composites including aminated lignin by Mannich reaction

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Synthetic anti-aging agents, such as N-(1,3-dimethylbutyl)-N'-phenyl-p-phenylenediamine (6PPD), commonly used in the rubber industry, have potential environmental concerns. In this study, we applied aminated lignin (AL) into natural rubber (NR) to ensure improved anti-aging effect. AL was synthesized by a Mannich reaction between diethylenetriamine (DETA) and kraft lignin (KL), which was considered advantageous in providing effective radical scavenging activity. In the AL-NR and KL-NR composites, the sulfur, contained in lignin, was crosslinked with NR chains during the curing process, improving 100% modules and hardness than 6PPD-NR. After thermal aging at 120°C/24hr, AL-NR composites exhibited much lower degradation of mechanical properties than 6PPD-NR and KL-NR. The ozone aging and fatigue test results showed that the aging resistance effect of AL was approximately similar to 6PPD. These excellent performances likely stem from the high content of amine groups of AL, which could protect rubber chain to oxygen radicals by the radical scavenging activity of the AL in the NR matrix.