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Kraft Lignin Ameliorates Degradation Resistance of Starch in Urea Delivery Biocomposites

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Abstract

Starch high biodegradation is the one limitation for commercialization of starch derived slow release fertilizers (SRFs). To reduce starch biodegradation, kraft lignin (5% to 20%) was tested to reduce the starch biodegradability in urea cross-linked starch (UcS) films, reported as SRF. Biodegradability tests were conducted under anaerobic soil microcosm for 60 days. Fourier transformed infrared spectroscopy results showed an absence of peak at 1776 cm^{-1} (pertained to oxidation of starch) in biodegraded lignin reinforced films. Thermogravimetric analysis of lignin reinforced films showed deceleration of biodegradability rates which evident from increase in decomposition temperature at 5% weight loss, $\sim 67.0\text{ }^{\circ}\text{C}$ and at maximum weight, $\sim 13.6\text{ }^{\circ}\text{C}$ while char contents increased, $\sim 11.3\%$. Molecular weight distribution indicated lignin conserved the molecular weight and polydispersity of starch in films. Lignin role in protecting the starch morphology confirmed through optical microscopy results, which recorded less change for feret mean and particle area of starch particles. Further, lignin increased the average roughness, ~ 1.04 to 4.76 times for biodegraded films, possibly due to accumulation of lignin after loss of starch in films. Further, study concludes that lignin influence effectively the reduction in starch

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