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Optimizing the mechanical properties of papers reinforced with refining and layer-by-layer treated recycled fibers using response surface methodology

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Highlights:

- LbL technique was conducted to assemble starch PEMs on recycled fibers.
- Recycled fibers was also treated by refining as commonly industrial method.
- RSM optimized PEMs-treated fibers as mixed with refined pulp on paper properties.
- The model predicted acceptable paper strengths at lower-refined fibers loading.

Abstract

Layer-by-layer (LbL) treated recycled fibers were investigated in mixtures with refined pulp relative to the mechanical properties of paper. The LbL treatments were conducted to assemble consecutive cationic and anionic starch layers on the fibers of old corrugated container (OCC) pulp. Fibers zeta potential was measured to examine the success of LbL treatment. Atomic force microscopy (AFM) and scanning electron microscopy (SEM) were used to reveal the differences between treated and untreated fibers surface and network. Subsequently, the LbL-treated fibers were added to the refined OCC pulps. Optimization of paper (60 ± 3 g m⁻² basis weight) strength properties including: tensile index, Scott bond (internal bonding), and ring crush test (RCT) was carried out by response surface methodology (RSM). The meaningful change of zeta potential substantiated cationic/anionic starch layers construction. The AFM results showed that the surface of fibers

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