Crosslinking or starch reinforcement? Exploring strategies to enhance recycled fiber bonding ability

Context

Paper and cardboard recycling has made great progress in recent decades. However, conventional processes cannot recycle more than 90% of the material. The remaining 10% waste, in liquid or solid form, is not valorized by the papermaker. This represents both a cost and a challenge in terms of environmental impact.

The "PACkaging, Recycling, Recyclability, Re-use of papers and cardboards" (PAC3R) project focuses on cellulose-based packaging. The project is part of a national program, known as PEPR (Priority Programs and Equipment for Research), funded by the French National Research Agency (ANR). One of the objectives is to develop new and sustainable processes to improve the properties of fibers originating from corrugated paper recycling. It is generally considered that cellulosic fibers cannot be recycled more than seven times, partly due to the hornification phenomenon, which damages the fiber structure. The growing demand for recycled fibers leads to the use of increasingly low-quality recovered paper and cardboard. To compensate for this quality loss, paper mills are currently adding starch and/or virgin fibers. The mission is to avoid these additions by enhancing the bonding potential of fibers through chemical processes.

Missions

Promising results have been obtained with the use of citric acid as a crosslinking agent to enhance fiber bonding potential. This innovative approach will be compared with bulk starch addition, a widely used practice that nevertheless presents certain limitations. The work will aim to deepen the understanding of the mechanisms, with particular attention given to the long-term effects of both treatments, especially after recycling. After treatment, analyses will be carried out on both the pulp and the laboratory sheets, including analytical characterizations (FTIR, etc.), physico-chemical properties (water retention value, etc.), mechanical properties (tensile strength, burst index, etc.), and barrier properties (Cobb test, contact angle, etc.).

Profile

Student in Master 2 Chemistry, Materials or Process Engineering, looking for an internship in the research sector applied to industrial challenges. Pre-requisites in process engineering, analytical chemistry, or lignocellulosic biomass is highly appreciated. However, a more general background in chemistry, chemical analysis, physical chemistry, and process engineering—combined with a strong interest in recycling and biomass—is also welcome. The selected candidate will be able to demonstrate scientific curiosity, rigor, autonomy and dynamism, as well as team spirit and personal skills. Candidates should be fluent in French or English and have good writing and presentation skills. The gratification will be equal to that required by the legislation. The internship will be supervised by the PhD student on the project.

Location: LGP2 (Grenoble, France, https://lgp2.grenoble-inp.fr/en)

Duration: 5 to 6 months from January/February 2026

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Send your CV and a motivation letter before November 14^{h}, 2025.