Synergic action between CNF and biorefining in recycled and deinked pulps

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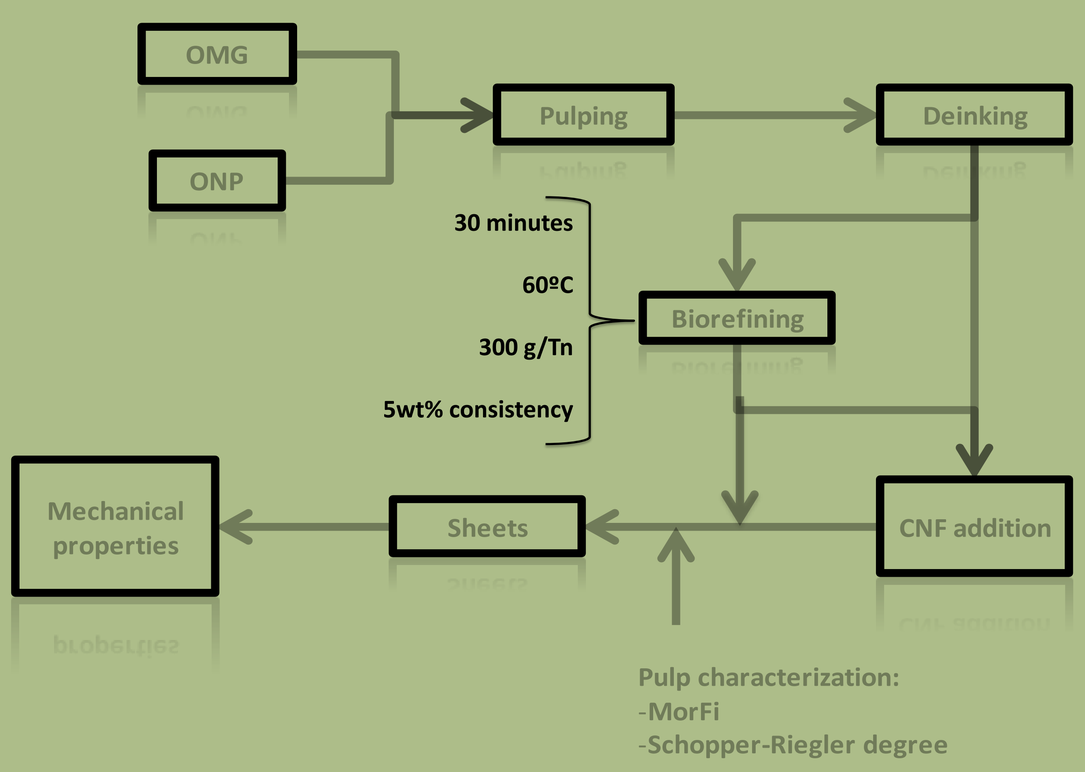
Abstract

Each recycling cycle involves a properties decrease from the original one and, in consequence, a mechanical beating treatment in order to reach the commercial objectives. The mechanical beating produces external and internal fibre deterioration, important increases in fine elements, reducing the drainability and compromising the following recycling cycle. The present work proposes an alternative to the conventional recycling process of old newspaper: biorefining and nanofibrillated cellulose. The main objective is to reach the mechanical requirements or to improve them. Furthermore, the paper wants to introduce a new philosophy in the sense of reaching a sustainable and higher quality recycling process. All the pulps were characterized from a physical point of view, specifically the drainage rate was determined. Sheets of each pulp were produced in a Rapid-Köthen sheet former and breaking length of each paper was determined. It was observed that by the combination of both treatments, it is possible to reach high breaking length values without affecting hard the drainage rate.

Introduction

During recycling and deinking processes, there is fibre quality loss due to hornification and external fibrillation. Conventional processes like mechanical refining contribute to the improvement of mechanical properties but it harms, consequently, fibres. It is well known that CNF added in bulk are good mechanical properties enhancers because of their high specific surface (high bonding capability) and their intrinsic mechanical properties. On the other hand, CNF have a poor drainage rate and this fact is harmful for large scale productions, since pulp needs more time to drainage water in the formation cloth. The present work explores the combination between CNF added in bulk and biorefining, a process carried on by enzymes (endo-β-1,4-glucanasse). It was observed that is possible to reach high tensile strength without increasing excessively the drainage rate.

Experimental



Recycled and deinked pulp was treated using different methodologies. Pulps were biorefined and CNF were added to it, separately. On the other hand, those pulps that firstly were biorefined, were also treated with CNF in bulk, in order to study the compatibility of fibres treated with enzymes with CNF. Once pulps were prepared, they were characterized from a morphological and physical point of view, in order to determine the drainage rate and fibre size. Then sheets were formed in a Rapid-Köthen sheet former in order to be characterized from a mechanical point of view, studying specifically the breaking length.

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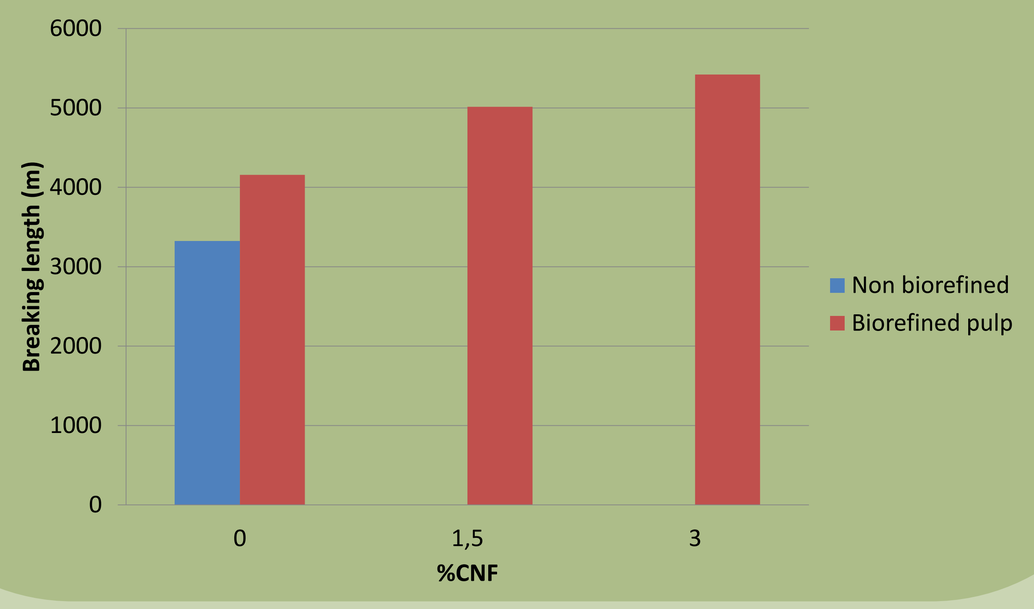
Results and discussion

The following table shows the pulp characterization and breaking length of sheets.

PULP TYPE	ºSR	RoM (%)	Fines (%)	Breaking length (m)
Deinked pulp	64	0,919	40,43	3326
Biorefined pulp	66	3,487	40,38	4158
Bioref+1,5%CNF	77	2,603	43,25	5015
Bioref+3,0%CNF	80	3,385	45,56	5421

Glucanasses cause an increase on the external fibrillation of fibres, increasing the Ratio of Macrofibrils from 0,919 to 3,487. The effect of CNF over this parameter is nearly negligible, since they are nano-sized fibres. Biorefining processes does not have any effect over the fines content. On the other hand, when CNF are added in bulk over deinked and recycled pulps, fine elements increase. This can be noticed on Schopper – Riegler degree, which is increased through CNF addition. It is observed that biorefining has not a pronounced effect over the drainage rate, since ºSR increases from 64 to 66. Breaking length evolution is reflected in the column graph below:



Conclusions

The main conclusions of this work are the following:

- Through enzymatic refining is possible to superpass the breaking length that is possible to reach through mechanical refining without having a pronounced effect over the drainage rate.
- The combination of CNF and biorefining improves the mechanical properties of paper more than refining mechanically or simply adding CNF in bulk.
- This combination ables, thus, to reach better mechanical properties with lower Schopper – Riegler degree and without damaging fibres.

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