9th World Congress on **Biopolymers & Bioplastics**

August 26-27, 2019 | London, UK

Recycling of silicon coated paper and design of new cellulose based materials

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An innovative green chemistry approach is used to recycle silicon coated paper and obtain cellulose based materials with industrial applications. The silicon coated paper is used in labeling industry and constitutes a challenge for recycling due to the stability of the siloxane covalent bonding to the OH cellulose ending groups. The silicon coated paper has been successfully processed using a combination of mechanical and chemical processes to obtain recycled cellulose fibers. From this process two types of cellulose fibrous materials were made and tested, depending on their properties, a fibrous pulp material to be integrated in the paper recycling industry and an cellulose based material to be used in civil engineering applications. The coating made from silicone based polymers proved to be very stable and the evaluation of the modifications induced by different combination of unit operation was done using techniques such as scanning electron microscopy, optical microscopy, x-ray dispersive spectroscopy, Fourier transformed infrared attenuated total reflectance spectroscopy and contact angle. The recycled cellulose fibers were used to produce recycled paper, and tensile strength and optical properties were quantified using ISO standards. The recycled pulps were compared with reference Eucalyptus globulus fibers. Using an optimized combination of mechanical and chemical process operations the recycled cellulose fibers obtained presented good mechanical strength with tensile index values for recycled paper of 39,6 Nm/g, in the same range of virgin eucalyptus paper, presenting 42,2 Nm/g. The recycled fibers integration in the paper industry also depends on the paper structure ability to drain water. These step of the formation of paper, because involves an high energy consume, is considered a key process parameter, and has been evaluated by using the Schopper Riegler degree method. The results indicate that 80% of the fibers originating from the recycling process present acceptable values for drainage. The remaining material was processed to be used as a biopolymer material in engineering applications. The results indicate that this material can be molded, its porosity optimized, and different applications can be designed, departing from these recycled cellulose natural fibers.

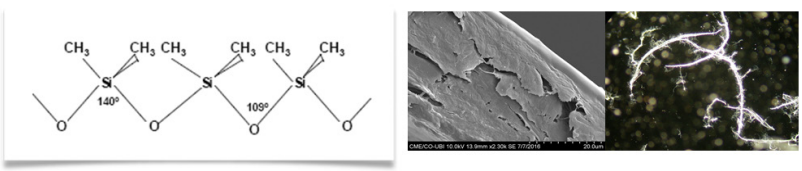

Figure1- Molecular structure of the Polymeric silicon coating; SEM Image of the coating; Fiber image

Recent Publications

1. Curto J M R, Conceição E L T, Portugal A T G, et. al., (2011) Three dimensional modelling of fibrous materials and experimental validation. Materialwiss Werkst 42(5):370-374.

2. Curto J M R, Mendes A O, Conceição ELT, et. al., (2015) Development of an innovative 3D simulator for structured polymeric fibrous materials and liquid droplets. In: Ochsner A, Altenbach H (eds) Mechanical and Materials Engineering of Modern Structure and Component Design - Advanced Structured Materials, Springer International Publishing, 301-321.
3. Morais F P and Curto J M R (2018) Design of porous nano cellulose based biopolymers for nanomedicine applications. Curr Sci Res Biomed Sciences 1:180003.
4. Martins V D F, Cerqueira M A, Fuciños P, Garrido-Maestu A, Curto J M R and Pastrana L M (2018) Active bi-layer cellulose-based films: development and characterization. Cellulose 25(11):6361-6875.

Biography

Joana M R Curto has her expertise in the development and optimization of cellulose fibrous materials and biopolymers. She is a Professor in the Chemistry Department at Beira Interior University. She has more than twenty years of experience on research and development of projects in the field of sustainable processes and products. Her method to design polymeric porous materials is based on experimental and computational optimization approach. She has been publishing, coordinates research projects and supervises thesis as a Member of Fibrous Materials and Environmental Technologies Research Unit, in collaboration with other International Research Centers.

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