ENVIRONMENTAL ASSESSMENT OF TRADITONAL AND ALTERNATIVE PULPS, LIFE CYCLE ASSESSMENT AND CARBON BALANCE

Ronalds W. Gonzalez[1,*], Naycari G. Forfora[1], Isabel Urdaneta[1], Ramon E. Vera[1], Jorge Franco[1], Ryen M. Frazier[1], Fernando Urdaneta[1]

[1] Sustainable and alternative fibers initiative, Department of Forest Biomaterials, North Carolina State University, Box 8005, Raleigh, NC 27695-8005 USA
*rwgonzal@ncsu.edu

ABSTRACT

Climate change, overpopulation and resource depletion are shaping the future of all industries world-wide. The pulp and paper industry, dependent of biomass resources, do not escape from this reality. Alternative fibers such as grasses and agricultural residues are targeted as raw materials to produce tissue and packaging. However, if an informed decision wants to be done, an environmental analysis of the impacts of both traditional and alternatives should be made for comparison. In this study, two pulps were targeted for study: northern bleached softwood kraft (NBSK) and alkaline mechanical pulp (APMP) from wheat straw, both targeted for tissue production. The methodology used for the construction of the life cycle inventory was established as following: literature review for biomass production systems, estimation of soil organic carbon sequestration by stabilization of below-ground carbon inputs, mass and energy balances using simulators for conversion processes. Once the life cycle inventory is constructed, the environmental analysis was performed using the life cycle assessment (LCA) methodology (ISO 14040 framework), Ecoinvent database, and TRACI 2.1 as method. Additionally, a carbon balance analysis was incorporated to estimate the carbon debt due to biomass utilization for single use products and biomass regrowth. A sensitivity analysis for 20 and 100 years as time horizon for the analysis was also included.

The results for traditional attributional LCA (excluding carbon balance and 100 years' time horizon) show that the main hotspots related to the production of NBSK are the bleaching stage and the burning of fossil fuels for steam and power generation. In the case of wheat straw APMP, electricity consumption and source are the biggest contributors, having in overall higher emissions than NBSK pulp. However, once the carbon debt is included, the sensitivity analysis shown that NBSK pulps have a higher carbon footprint, more noticeable at the 20 years' time frame. This comes as result of the long growing and harvesting times of northern softwood biomass.

Our results allow to conclude that the production of single use products, such as tissue, should be complemented with easy to pulp, short rotation biomasses, that allow to reduce the overall carbon footprint and carbon dioxide accumulation in the atmosphere in the short term. Additionally, if bleaching is reduced or dropped, and if we move to renewable sources for electricity the pulp and paper industry could have a big decrease in its total emissions.

Keywords: life cycle assessment, tissue, carbon footprint, mitigation strategies, net zero fibers.