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Optimization the soda-AQ process for cellulose pulp production and energy content of black liquor from *L. leucocephala* K360

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HIGHLIGHTS

- The chemical composition of *Leucaena leucocephala* is comparable to that of other *Leucaena* varieties and hardwoods.
- Optimum conditions for the production of sheet papers with optimal viscosity and resistance were determined.
- Black liquor with greater calorific value was obtained at low active alkali concentration.

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ABSTRACT

A commercial variety of *Leucaena leucocephala* K360 was used for pulp production and papermaking employing the soda-anthraquinone process. Also, the chemical and energy contents of the resultant black liquors were determined to simultaneously optimize: pulp and paper production and energy generation. A process temperature of (185 °C), an operating time of (120 min) and an active alkali concentration of (21%) provided sheets of paper with good strength (tensile index of 12.12 N m/g, burst index of 0.38 kPa m^2/g, tear index of 1.29 mN m^2/g and a Kappa number of 20.5) and black liquor with a greater calorific value (14.1 MJ/kg) than that obtained with higher active alkali concentrations.

However, reducing the active alkali concentration to a level in the low operation range led to less marked degradation of cellulose and allowed paper sheets with good properties to be obtained and energy to be optimally produced from the black liquor.

1. Introduction

Non-wood plants offer several advantages over wood species as sources of papermaking fibers, including short growth cycles, moderate irrigation requirements and low lignin contents which help to alleviate energy and chemical requirements during pulping (Hurter and Riccio, 1998). The pulp and paper industry is the sixth largest industrial energy user in Europe and a major user of biomass. Usually black liquor generated during the Kraft process is burnt in a boiler to recover energy in the form of electricity, process utility steam, and pulping chemicals; however, black liquor could also be used as a source of biofuels.

The fast-growing, nitrogen-fixing tree/shrub *Leucaena leucocephala*, is cultivated as a fodder plant, for green manure, as a windbreak or as a biofuel crop. *Leucaena* has been widely introduced in Chine due to its beneficial qualities (Guo et al., 2012; Yu et al., 2012); but has become an aggressive invader in many tropical and sub-tropical locations. This tree can form dense monospecific thickets and is difficult to eradicate once established.

Leucaena species have a high production of biomass and resprout capacity of more than 50 tons/ha/year, (Sánchez et al., 2003, Feria et al., 2012). Pulping and papermaking from varieties of *L. diversifolia* and *L. leucocephala* by the soda-anthraquinone-ethanol process have already be explored (Díaz et al., 2007; López et al., 2008; López et al., 2010a; Feria et al., 2012).

In the present work, the *L. leucocephala* variety, which was selected in terms of its improved biomass yield, was used for pulp production and papermaking by the soda-anthraquinone process and the process was optimized to obtain the best properties of paper and energy recovery from black liquor. Also, the black liquors were chemically and energetically characterized.

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