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A combined process of activated carbon adsorption, ion exchange resin treatment and membrane concentration for recovery of dissolved organics in pre-hydrolysis liquor of the kraft-based dissolving pulp production process

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HIGHLIGHTS

- A new process for recovering lignocelluloses from pre-hydrolysis liquor was proposed.
- Three sequential steps were included in the process.
- The adsorption step significantly facilitated the subsequent steps by removing lignin.
- The resin treatment step resulted in the removal/concentration of acetic acid.
- The membrane filtration step resulted in the concentration of purified sugars.

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ABSTRACT

To recover dissolved organics in pre-hydrolysis liquor (PHL) of the kraft-based dissolving pulp production process, a new combined process concept of sequential steps of activated carbon adsorption, ion exchange resin treatment, and membrane concentration, was proposed. The removal of lignin in the PHL was achieved in the activated carbon adsorption step, which also facilitates the subsequent operations, such as the membrane filtration and ion exchange resin treatment. The ion exchange resin treatment resulted in the removal/concentration of acetic acid, which opens the door for acetic acid recovery. The membrane filtration is to recover/concentrate the dissolved sugars. The combined process resulted in the production of PHL-based concentrate with relatively high concentration of hemicellulosic sugars, i.e.,

1. Introduction

Globally, the adoption of the biorefinery concept for the production of platform chemicals, bio-materials, and bio-energy is of strategic significance. In this concept, instead of fossil-based resources, regenerable lignocellulosic feedstocks are used in a sustainable and environmentally friendly way.

For lignocellulosic materials, pre-extraction of lignocellulosic materials prior to pulping has been considered as an important aspect for the implementation of integrated forest biorefinery (Amidon and Liu, 2009; Chen et al., 2010; Liu, 2010; Liu et al., 2012; van Heiningen, 2006). In the pulp and paper industry, successful commercialization of forest biorefinery in integrated mills (Ghezzaz and Stuart, 2011; van Heiningen, 2006) will produce extra economic benefits, thus providing new opportunities. In this context, the commercial pre-hydrolysis kraft-based dissolving pulp production process fits well into the biorefinery concept (Liu et al., 2011a,b,c; Shen et al., 2011, 2012; Shi et al., 2011). For such a process, the removal/depletion of hemicelluloses prior to pulping and bleaching based on the steam (or hot water) pre-hydrolysis technology is a critical step for producing high-quality product, as the presence of hemicelluloses can impair the downstream processes associated with dissolving pulp (Sixta, 2006). In addition to hemicelluloses, acetic acid, lignin, and furfural can also be present in the pre-hydrolysis liquor (PHL) (Shen et al., 2011, 2012). Essentially, the recovery of these valuable dissolved organics in a cost-effective way is the key to their downstream processing and utilization. Distillation/evaporation is widely used for the recovery

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