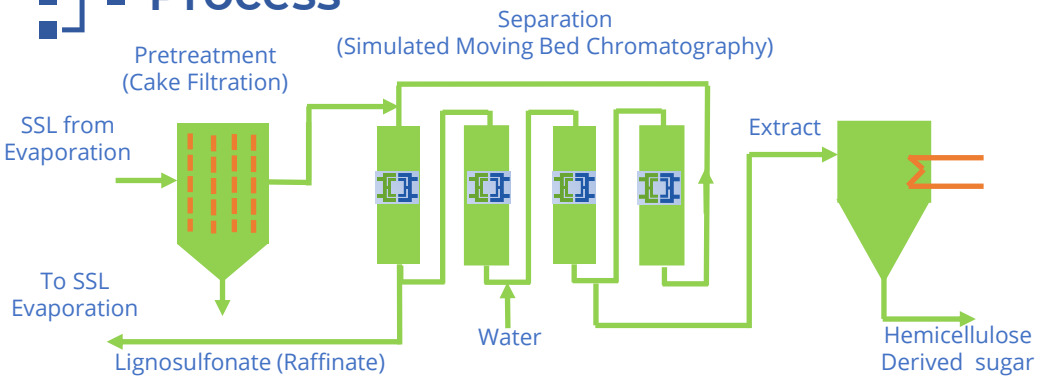
ARi Chromatography Application Study:

The recovery of Hemicellulose Derived Sugar Syrup from Spent Sulfite Liquor using Simulated Moving Bed Chromatography

Filtered SSL was successfully separated by ARi Simulated Moving Bed Chromatography (SMBC) yielding an extract fraction containing more than 89% of the SSL sugars and a raffinate containing magnesium lignosulphonate. Sugar recovery of up to 95% were achieved at higher water to feed ratios. The ARi technology was shown to be a robust, scalable and tuneable unit operation for the recovery of sugar, lignosulfonate and magnesium from Spent Sulfite Liquor.

Process



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Background

The global impetus to produce alternatives for the petroleum-based fuels and value-added chemicals in order to reduce greenhouse gases is currently emphasizing the need on industry to diversify and valorize byproducts. The finite natural resources are driving a need to move beyond a 'take, make, dispose' economy towards one where all materials are treated as precious resources. This circular economy thinking is of growing importance for the sustainable use of these resources.

Overview

Spent Sulfite Liquor (SSL) is a waste stream of the sulfite process in the production of pulp from lignocellulosic biomass, a basic material for the production of paper or regenerated cellulose fibers. This case study describes how ARi SMBC has been used to separate lignosulfonates from the sugar fraction of Spent Sulfite Liquor in order to valorize the hemicellulose derived sugar fraction. The hemicellulose derived sugar syrup (HDSS) was subsequently used as sole carbon source for L-Lactic acid production through fermentation whilst the lignosulfonates can be further used in the production of surfactants, additives or animal feed.

Science

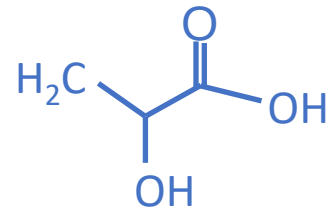
In order to achieve satisfactory fermentation of HDSS it is important to remove potential growth inhibitors such as Furfural and 5-hydroxymethylfurfural (5-HMF) in the SSL. This can be achieved in numerous ways but many of the techniques have a chemical burden. It had been previously shown that the recovery of monosaccharides from lignocellulosic hydrolysates using SMBC for ethanol production was economically competitive to an enzymatic process. Therefore, SMBC was studied as an alternative process for detoxifying sugar rich hydrolysates.

Following successful batch chromatography of SSL at laboratory scale an SMBC test was carried out on a 4 column pilot ARi SMBC system with Mitsubishi 530 cation resin in the magnesium form. The pulping waste side stream SSL was upgraded by evaporation, cake filtration and ARi Simulated Moving Bed Chromatography and the subsequent sugar rich extract from SMBC was concentrated to a dissolved solids of 60% to improve stability during storage and transport.

Performance

The objective of the SMBC is to maximise the yield of detoxified HDSS (Extract) from the lignosulfonic , magnesium, furfural and 5-HMF (Raffinate) components. The performance data in the table below demonstrates the performance at a resin loading of 2.40kg dissolved solids/L resin / day and a volumetric water to feed ration of ~1.6 .

	Filtered SSL	Extract	Raffinate	HDSS
Dissolved Solid [%]	48.0	22.7	20.1	58.1
Sugar Purity [g/10g DS]	17.0	62.6	2.7	57.5
Lignosulfonate Pty [g/100g]	74.0	14.6	94.0	15.6
Mg^{2+} purity [g/100g DS]	2.9	0.8	4.0	2.1
Total Sugar Recovery [%]		89.9		
Mg^{2+} recovery			92.5	
Lignosulfonate Recovery [%]			94.3	
Furfural [g/kg sugar]	7.5			0.1
5-HMF [g/kg sugar]	3.8			1.5



Reference

R. Hoheneder, E. Fitz, R.H. Bischof, H. Russmayer, P. Ferrero, S. Peacock, M. Sauer: Efficient conversion of hemicellulose sugars from spent sulfite liquor into optically active L-Lactic acid.