Water-soluble kraft lignin products through sulphomethylation

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Introduction

One way to remove lignin in pulp mills is by precipitation from black liquor with carbon dioxide. With the new LignoBoost process the washing is performed in a new way. Instead of washing the lignin directly after filtration (left box), figure 1, the filter cake is re-dispersed at controlled pH and temperature to even out the ionic strength. After that, the re-slurry is filtered and washed using displacement washing (right box), figure 1.[1]

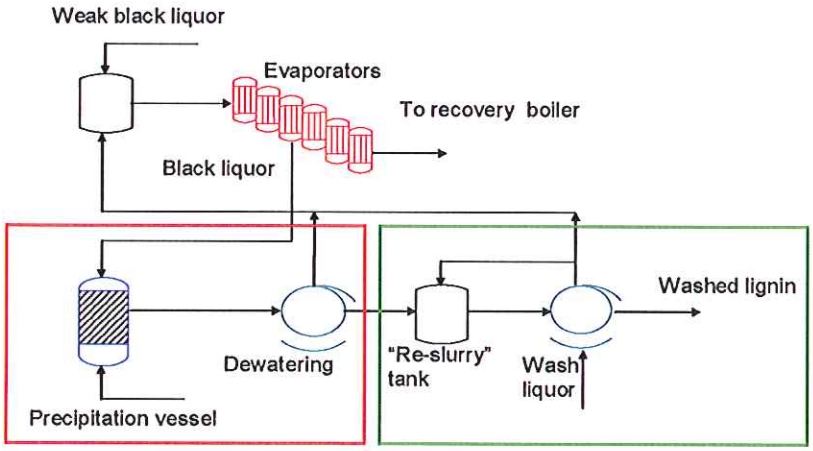

Figure 1. *The LignoBoost process for washing lignin precipitated from black liquor. The new method in right box.*[1]

Using the LignoBoost process, a washed lignin with a low ash and sodium content is received. Separated washed lignin can be utilized for the production of valuable products within the mill, as biofuel or as a raw material for production of chemicals.

The most common way to change the physical properties of lignin is through sulphomethylation and thereby convert it into water-soluble lignin products. The reaction occurs at the free C-5 positions of the phenolic rings, see figure 2. These products are extensively used as dispersants in various industries for example in cement, textile and oil industries. Dispersants are chemicals that reduce the viscosity of a suspension by increasing the surface charge of the individual mineral particles in a suspension.

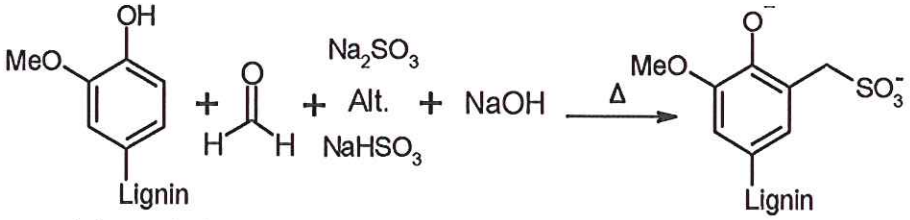

Figure 2. *Sulphomethylation of kraft lignin.*

The aim of this project was to study the conversion of softwood LignoBoost lignin into water-soluble lignin derivatives by sulphomethylation, and further to analyse the

product and compare the dispersing abilities with commercial dispersants from lignin such as lignosulphonate and sulphonated kraft lignin.

Results and conclusions

By the introduction of a sufficient number of sulphonic acid groups into the lignin structure, kraft lignin was converted effectively to a water-soluble lignin by the sulphomethylation treatment. The analyses show that approximately one sulphonic acid group per two phenolic rings each was introduced in the samples. The total sulphur content and the content of sulphonic acid groups, before and after sulphomethylation of lignin, are shown in table 1.

Table 1. The total sulphur content, analyzed by ICP-AES, Inductively Coupled Plasma-Atomic Emissions Spectrometer and the content of sulphonic acid groups.

Sample	*Sulfur content* (wt.%)	(wt.%)*	*Content of –SO_3H* (mmol/g lignin)
Lignin	1.48	0	0
Sulphomethylated lignin	8.55	7.07	2.20

* The increase in sulphur content after sulphomethylation of the lignin samples.

The rheological measurements show that sulphomethylated kraft lignin was more suitable for dispersing of kaolin suspension than both commercial kraft lignin dispersants and commercial lignosulphonate, see figure 3.

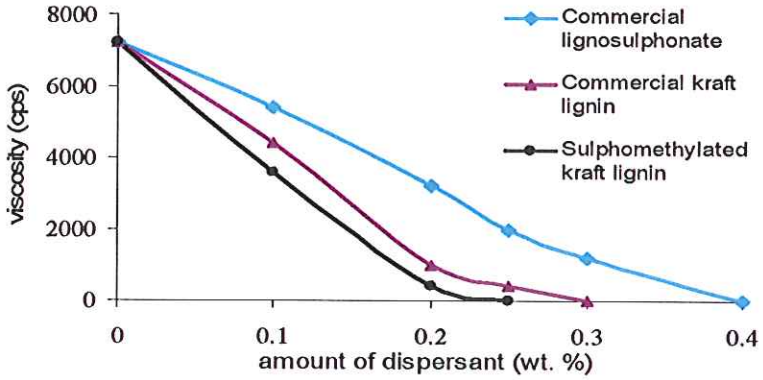

***Figure 3.** The registered viscosity of kaolin suspensions as a function of the amount of different dispersants.*

The main conclusions from this study are:

- For the production of water-soluble kraft lignin, sulphomethylation is a suitable reaction.
- Sulphomethylated kraft lignin is a useful dispersant that control the rheological properties of a suspension.

References

1. Öhman, F.: Precipitation and separation of lignin from kraft black liquor, PhD Thesis. Forest Products and Chemical Engineering, Department of Chemical and Biological Engineering, Chalmers university of technology, Chalmers Reproservice, Gothenburg, Sweden 2006.