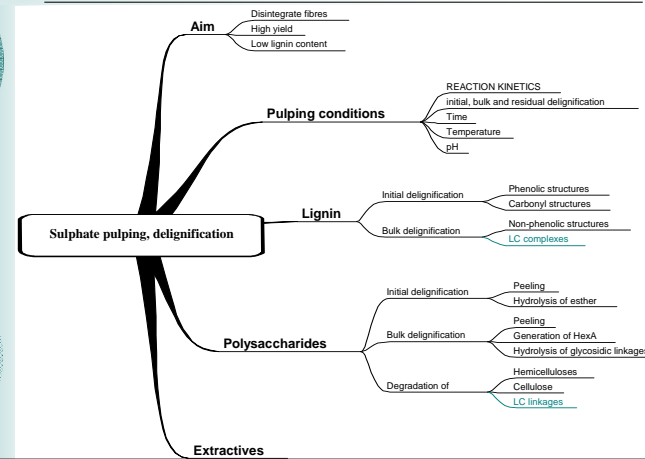


Lignin – carbohydrate complexes

Outline

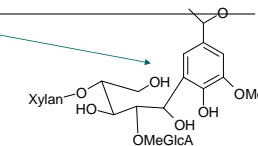
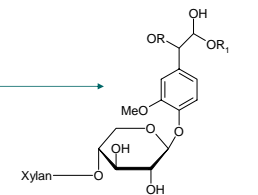


Lignin – carbohydrate complex (LCC)

- Lignin and carbohydrate molecules can be physically or chemically bonded with each other
- Chemical bonds are mainly covalent bonds
 - The term LCC is used for these structures
- Lignins are mainly linked with hemicellulose constituents

Types of lignin – hemicellulose bonds

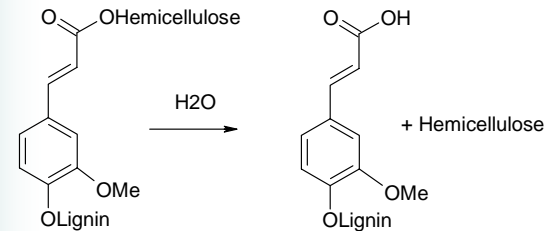
- I Ester bond**
 - in native wood
- II Glycosidic bond**
 - in native wood
- III Ether bond**
 - in native wood
 - possible formation during pulping
- IV Carbon – carbon bond**
 - possible formation during pulping



Linkage types

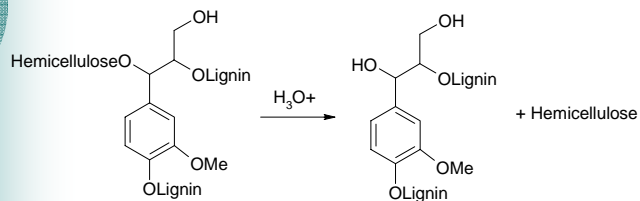
- Native LC-linkages are likely to exist thorough out the cell wall structure.
- During the wood delignification quinone methides are formed. It is possible that these structures are attacked by nucleophilic cell wall polysaccharides.
- It is possible that the main part of native lignin-carbohydrate complexes are of this origin.

Reactions of LC ester bonds in pulping



In acidic and alkaline media ester linkages are cleaved off easily by hydrolysis.

Reactions of LC ether bonds in pulping



•Non-phenolic α -ether linkages are stable in kraft pulping.

•In sulphite pulping under acidic conditions also non-phenolic α -ether linkages are cleaved off.

Effect of LCC on delignification

- Certain linkages are cleaved off by hydrolysis
 - ester and glycosidic linkages
- Others are formed during pulping
 - α -ether and carbon-carbon linkages
 - alkali stable
 - ⇒ linkages can't be cleaved
 - ⇒ continuation of cooking will only reduce the yield and not the amount of lignin in the pulp
 - ⇒ Residual lignin

Lignin-carbohydrate linkages

Improving selectivity of delignification:

1. To find selective delignification reagents
 - cleavage of specific linkages (LC)
2. To prevent formation of new alkali stable lignin – carbohydrate linkages during pulping

Characterization of lignin – carbohydrate linkages

- There aren't any available direct method
- ⇒ all the information about LC-linkages is obtained with indirect methods, such as:
 - Isolation by enzymatic treatments
 - cellulases and hemicellulases
 - Model compound studies

Isolation of RLC-Linkages

- In the primary wall
 - high molecular mass fraction
 - mainly galactose
- In the secondary wall
 - low molecular mass fraction
 - mainly xylose
 - also other hemicelluloses and cellulose

Isolation of RLC-Linkages

Conclusions

- Pulping chemicals migrate via lumens into the cell wall
- Delignification starts in the *secondary wall*
- As the delignification continues lignin of the *primary wall* and *middle lamella* dissolve
 - ⇒ liberation of fibres
 - ⇒ improved delignification of primary wall lignin
- The residual lignin content in pulp is five times higher in the primary wall than in the secondary wall