Wood Chemistry

Wood Chemistry

PSE 406 / Chem E 470

Lecture 8

Hemicellulose II

Wood Chemistry

Class Agenda

- Arabinogalactans
- Minor Species
  - » Glucans
  - » Galactans
  - » Pectins
- Starch
- Chitin

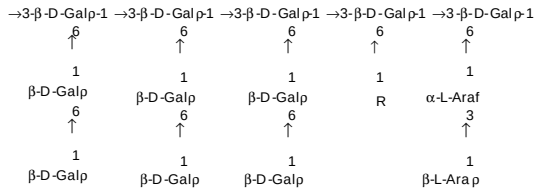
Wood Chemistry

Arabinogalactan

- Minor hemicellulose except in Larch
  - » 10-20% of Larch
  - » 0.5-3% of other woods
- DP ~ 220
- Backbone 1→3 β -D-Galactopyranose units
- Branches: Nearly every galactose in backbone attached 1→6 to:
  - ≈ β-D-Galactopyranose
  - ≈ α-L-Arabinofuranose, β-L-Arabinopyranose
  - ≈ β-D-Glucopyranosyluronic acid Text

Wood Chemistry

Arabinogalactan



R = galactopyranose or L-Arabinofuranose or D-glucopyranosyluronic acid

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Pectins

- Often described as water soluble extractives, not as hemicelluloses.
- Found in middle lamella and primary cell wall.
- Pectins is a class of several compounds
  - » Galactans (discussed on next slide)
  - » Galacturonans:
    - – Rhamnogalacturonan: α 1→4 galacturonic acid backbone with rhamnose 1/8 units, sidechain of galcturonic units
  - » Arabinans
    - – 90% arabinose linked α 1→5

Text

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Galactans

- Very minor component in normal and tension wood. Can be major (10%) component of compression wood.
- Galactan from Tamarack
  - » 200-300 β 1→4 galactopyranose backbone, 1/20 1→6 galacturonic acid
- Rhamnoarabinogalactan
  - » Sugar Maple
  - » Gal:Ara:Rha (1.7:1:0.2)
- Many other varieties

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Glucans

- Glucans are very minor components in wood.
  - » The major representatives of this group are starch and callose.
    - – Starch
      - Amylose:1→4 α-D-Glucopyranose
      - Amylopectin: 1→4 -D-Glucopyranose + 1→6 α D Glucopyranose
    - – Callose 1→3 β-D-Glucopyranose

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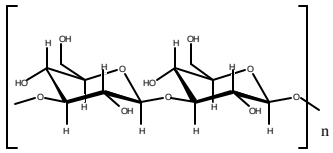
Callose

- Callose is found in very minor amounts in wood.
  - » Small granular hemicelluloses found in a few isolated locations.
- Polymer of 1→3 β-D-Glucopyranose



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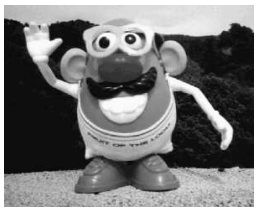
Starch in Plants

- Starch serves as an energy reserve in plants.
  - » High concentrations of starch are found in seeds, bulbs, and tubers.
  - » Starch can be as high as 70-80% of certain tubers and seeds.
- Wood contains minor amounts of starch in the form of granules in living parenchyma cells.
  - » Typical amounts: 0.2-0.6% of total wood
  - » Sapwood >3%



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Chemical Composition of Starch

- Plants contain two types of starch, linear (helix) amyloses and branched amylopectins.
- The amounts of each of these starch types present is plant dependent.
  - » Typical amounts are 25% amylose, 75% amylopectin
  - » Mutant species can have from 50-90% amylose

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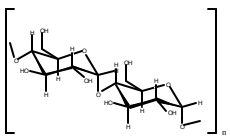
Amylose

- 1→4 α-D-Glucopyranose
- Because of the bonding, this molecule forms a helix
  - » It takes 6 gluopyranose units for each turn
  - » Addition of iodide to amylose results in a deep blue color. It is believed to be due to a complex of I_5^- within the polyglucoside spiral.
  - » Amylose is not water soluble



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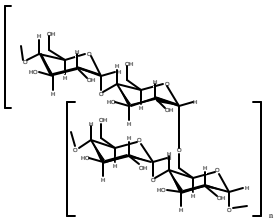
Amylopectin

- 1→4 αD-Glucopyranose + 1→6 α D Glucopyranose
- Amylopectin is a branched polymer
  - » Branching inhibits helix formation
  - » This starch is therefore somewhat water (hot) soluble.



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Isolation of Starch

- From tubers (potato, tapioca, etc.)
  - » Wet tuber is ground fine.
  - » Hot water dissolves soluble fraction of tuber.
  - » Insoluble starch is separated from the liquid phase.
  - » Starch is dried.
- From corn
  - » The skin and the germ (oil containing portion) are mechanically removed from the kernel after soaking in water. Isolation of the starch is then similar to tubers.

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Chitin

- Cellulose type polymer found in insects and crustaceans; used in making the hard exoskeletons (~30%). Second or third most abundant biopolymer.
  - » Second most abundant if you study this kind of thing for a living.
  - » Third most if you are a lignin chemist.

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Chitin Structure

- Chitin is an amino polysaccharide
  - » It is a linear polymer of 1→4 β-D-Glucopyranose units just like cellulose
  - » The difference is that the hydroxyl group of C2 has been replaced by an amide group