



Ecobinders, Lignin modification for application in adhesives and coatings

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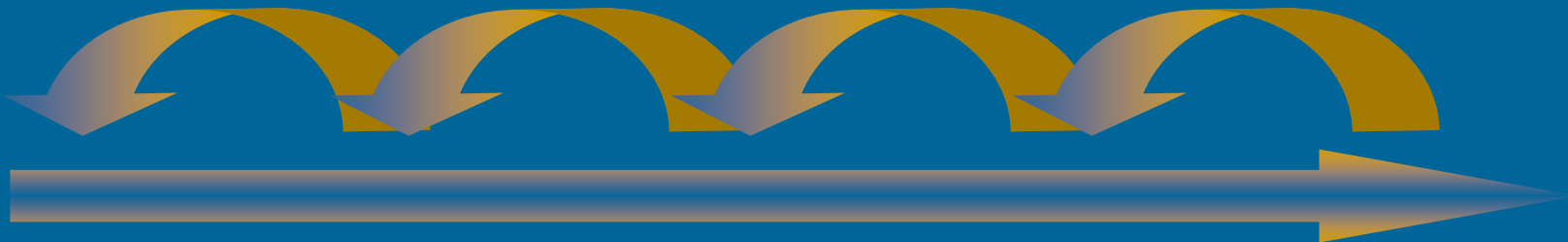
26 08 2005



ECOBINDERS

Development of **lignin** based adhesives

plant source extract chemical component adhesive



Ecobinders: Lignin modification

Lignin properties

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desired **Lignin** properties



waste

£ € \$ ¥

Lignin properties

Chemical properties

- reactivity
- chemical bonding
- functional groups
- degree of polymerisation
- solubility

Physical properties

- thermo stability / melting
- rheology



Desired Lignin properties

Controlled (cross-) linking

- initiation
- stabilisation
 - * catalysts
 - * enzyme
 - * uv / x-ray

Colour

- conjugated double bonds

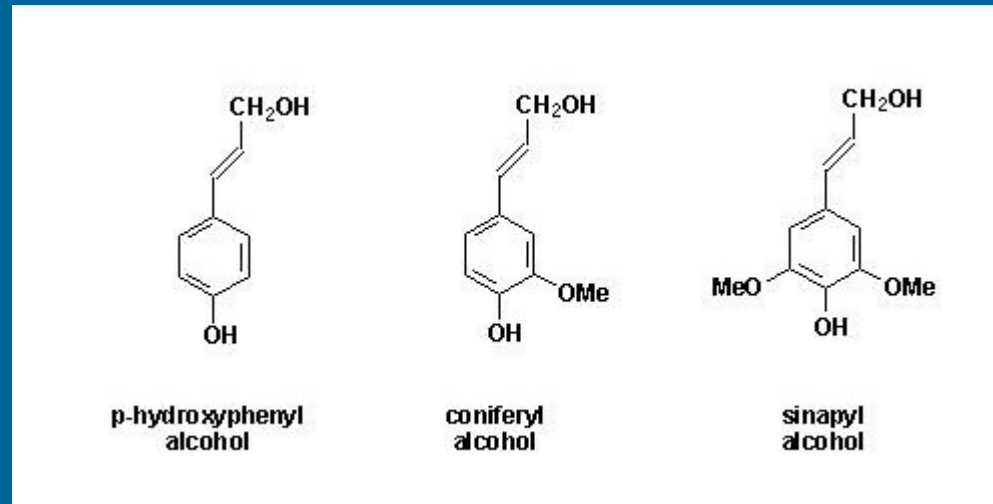
Odour

- low mw contaminants / degradation products



Lignin modification

- Chemical structure
 - phenyl-propanoic structural elements

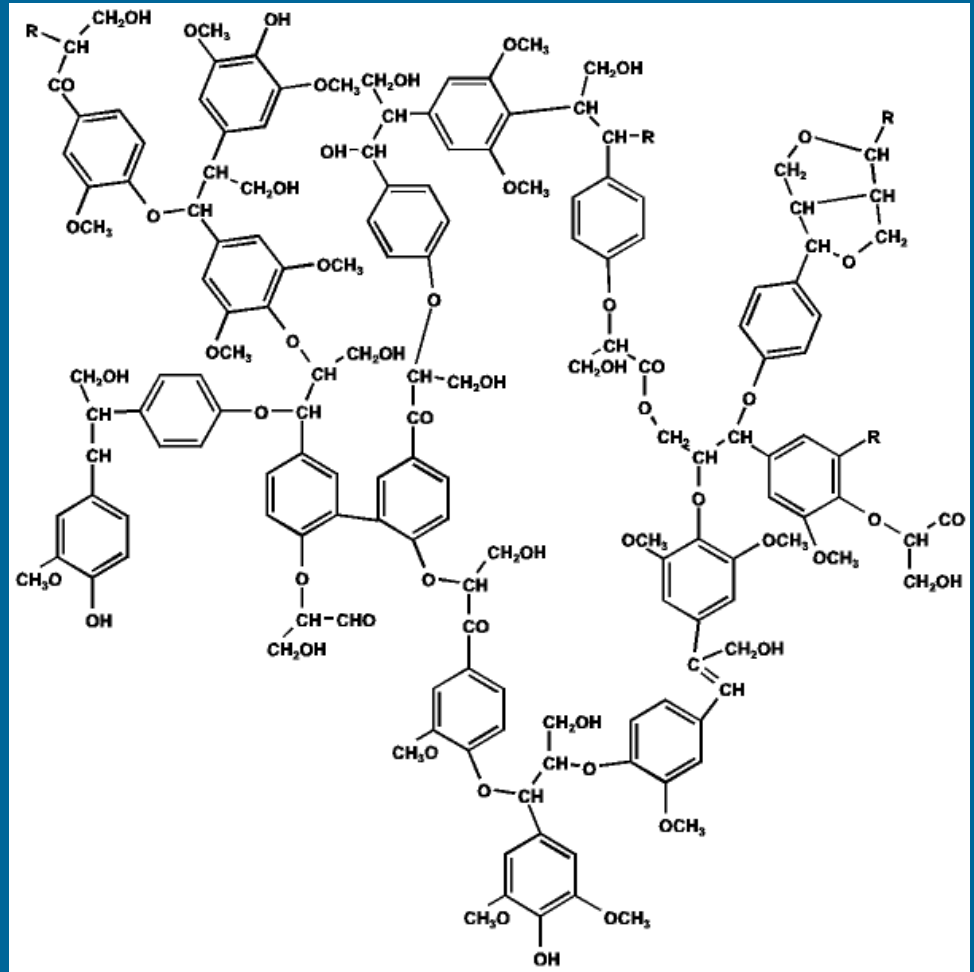


- sulphur free lignins



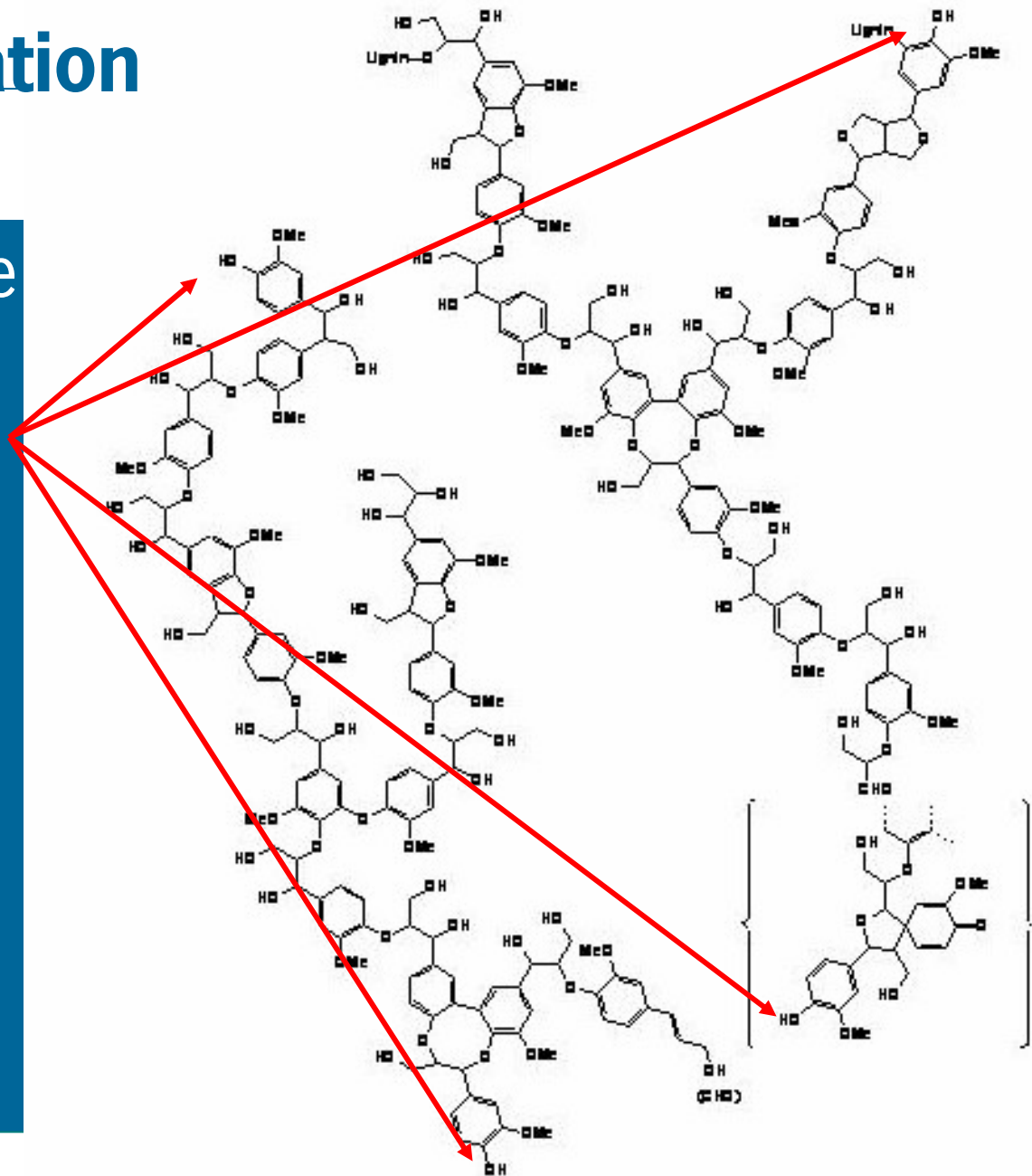
Lignin modification

- Chemical structure
 - condensed polymer
 - functional groups
 - * aromatic hydroxyl
 - * aliphatic hydroxyl
 - * methoxyl
 - * aldehyde
 - * ketone
 - * carboxyl
 - * alkene



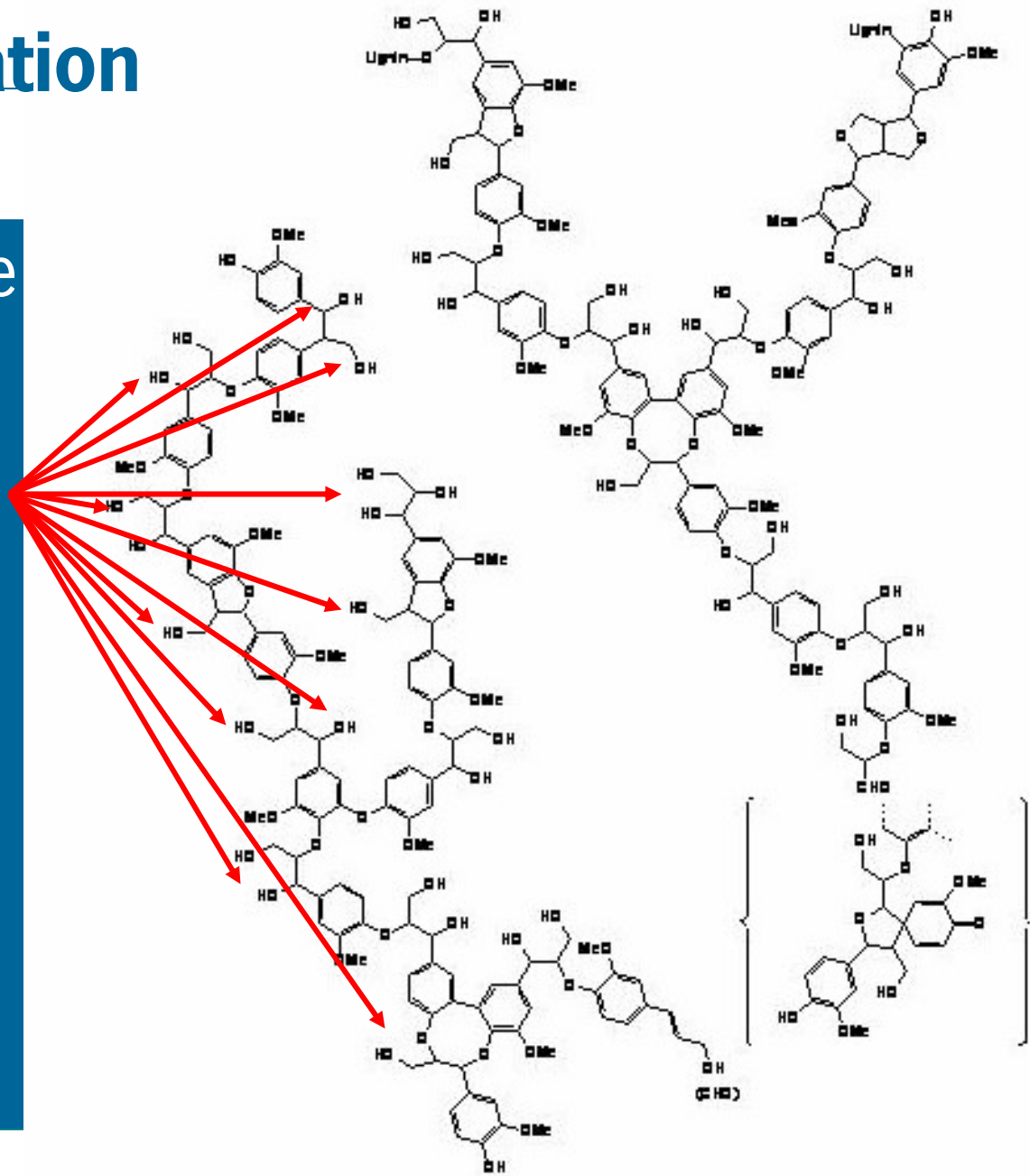
Lignin modification

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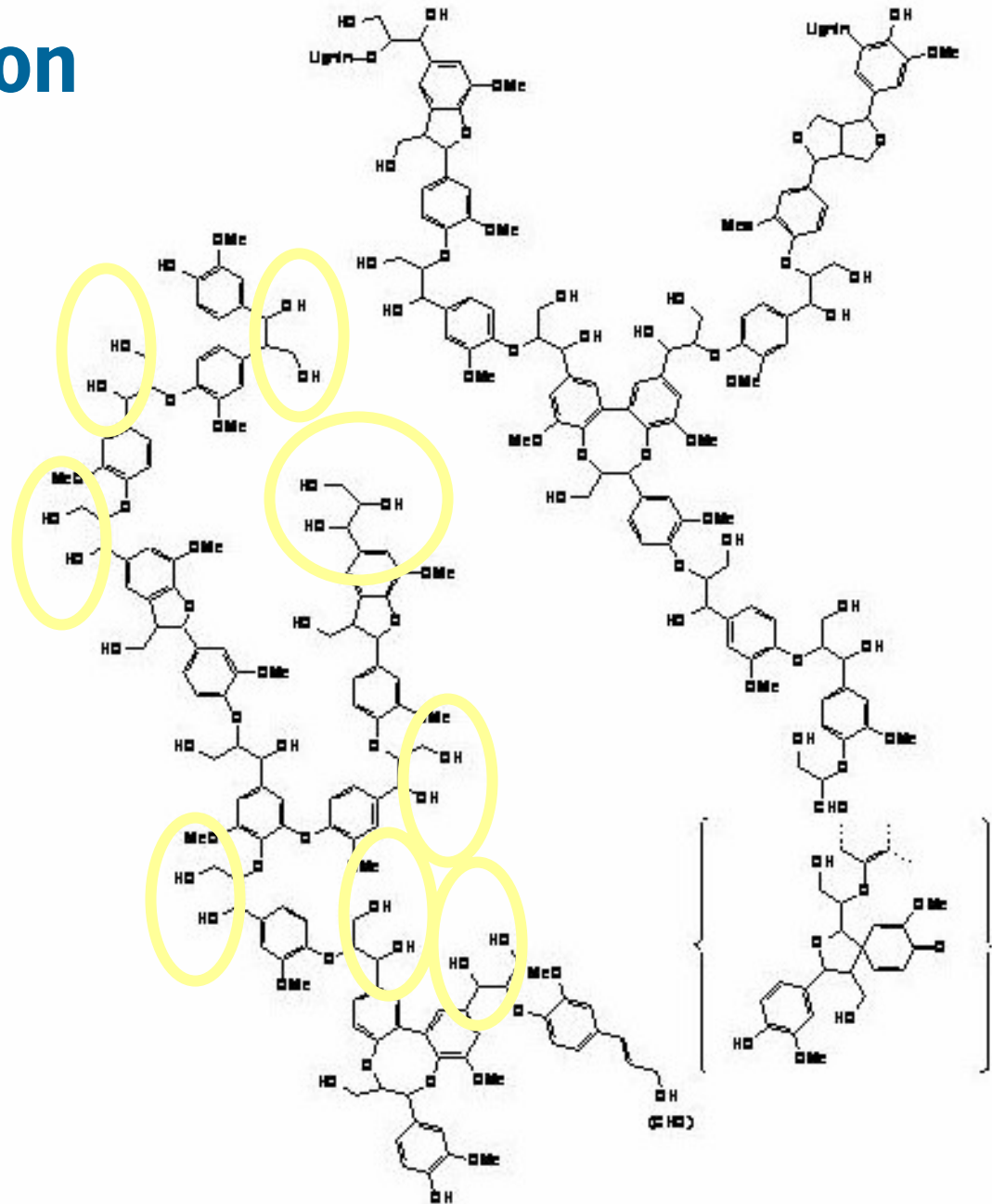
Lignin modification

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 - functional groups
 - * aromatic hydroxyl
 - * **aliphatic hydroxyl**
 - * methoxyl
 - * aldehyde
 - * ketone
 - * carboxyl
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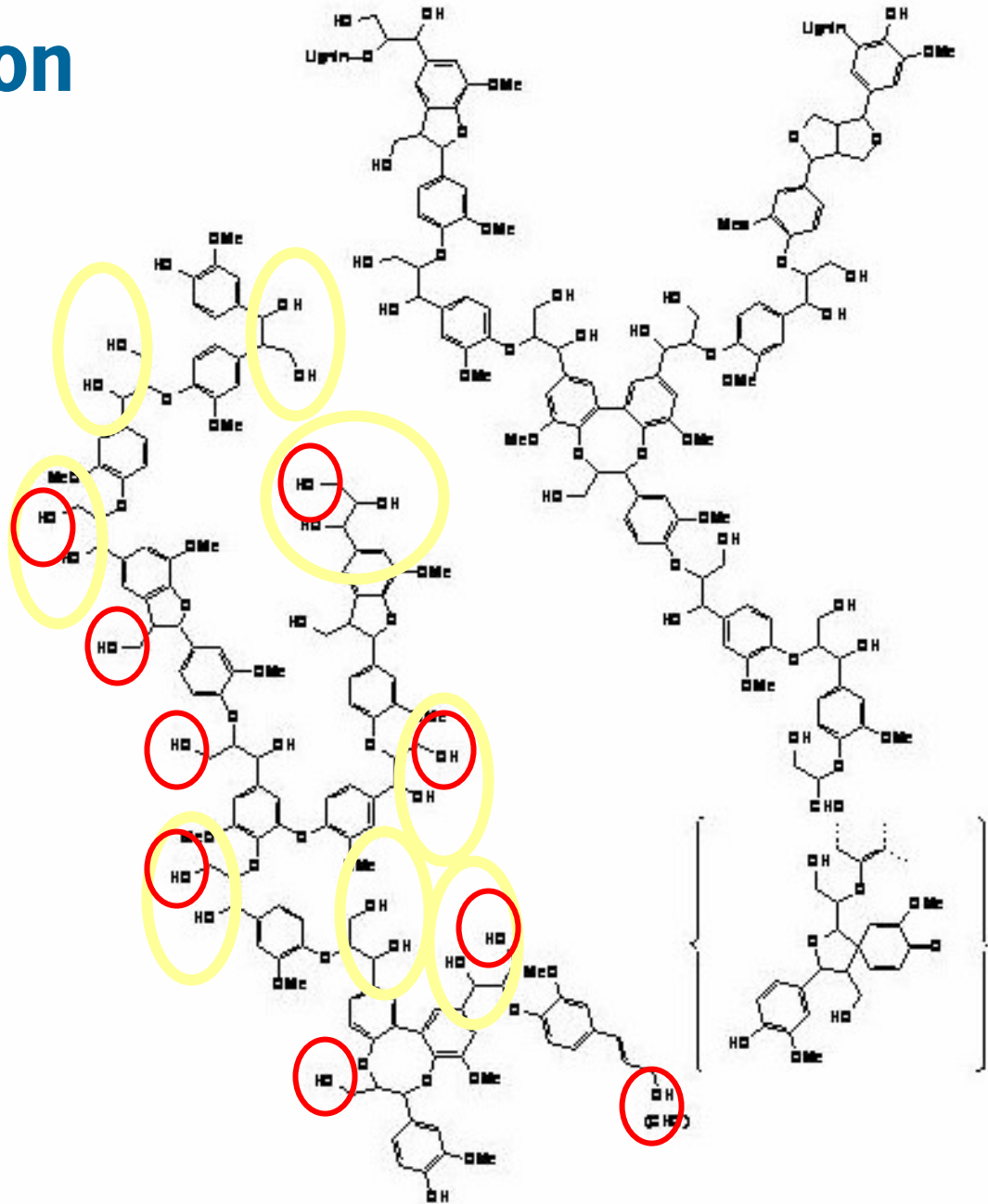
Lignin modification

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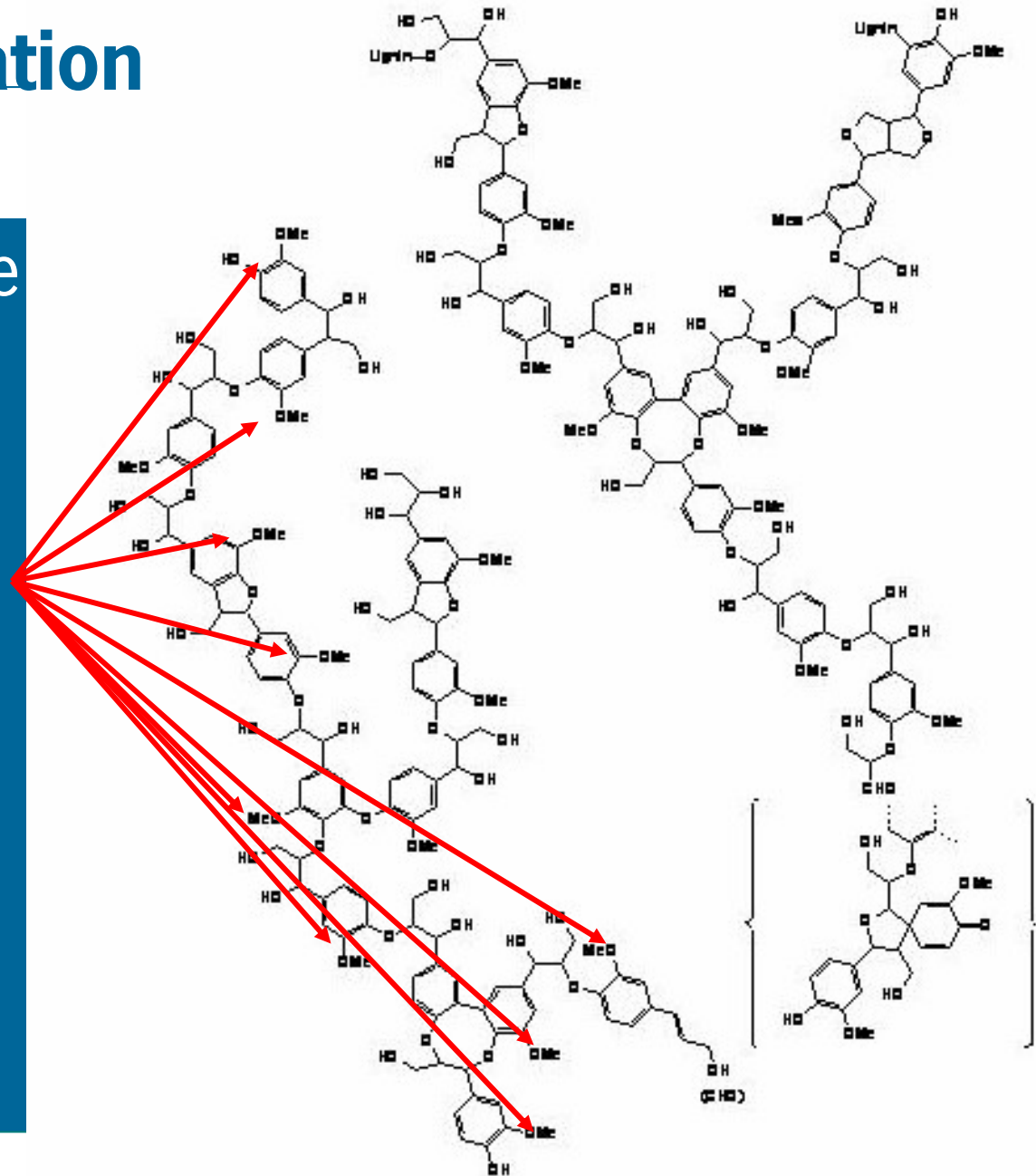
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Lignin modification

- Chemical modification
 - oxidation / reduction
 - alkylation (ether bond)
 - acylation (ester bond / Friedel-Craft)
 - elimination / substitution / addition reactions
 - condensation (radical polymerisation)
 - hetero atoms (N, S)
 - * nitration, amidation, sulphonation, isocyanate,
 - organometallic reactions
 - copolymerisation

Lignin modification

- Enzymatic modification
 - controlled (?) oxidation
 - * peroxidase / laccase
 - alkylation (ether bond formation / cleavage)
 - acylation (ester bond)
 - directed cross- coupling (?) and ring formation
 - condensation (enzyme initiated radical polymerisation)
 - template hypothesis

Lignin modification

- Physical modification

- thermal

- uv

- x-ray

- swelling - shrinking // absorption - desorption

- mechanical action

- * surface exposure / orientation

- * particle size control

- electrostatic separation

radical initiation

Desired Effects of modification

- Higher reactivity, better specificity
- Controlled handling / product formulation
- reduction of odour
- stabilised properties



Lignin origin and functionality assessment

	pulp process	plant source	isolation process
purity	+++	-	+++
particle size	++	++	++
polymerisation	++	++	+++
reactivity	+++	++	++
solubility	++	++	+++
colour	-	+	++
odour	+++	-	+++



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Thank you
for your
attention

