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Substitution of chemical phenols by plant polyphenols for processing phenolic biomaterials

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**INTRODUCTION**

**WORLD ANNUAL PRODUCTION OF PHENOL**
- 2000: 6 million tons
- 2010: 8 million tons
- 2020: 12 million tons (prediction)

**EUROPEAN PHENOL USE**
- 2 million tons per year; more than 80% for plastic materials and resin

**APPLICATIONS**
- Plastic materials: thermosetting (polycarbonate, epoxy)
- Plastic fibers: nylon (polyamide)
- Electric isolating
- Bactericid paint
- Hydrophobic coating
- Anionic detergent
- Thermic ink
- Insulating glue

**PHENOL MARKET**
- Market in expansion
- New production plant in Nanjing, China (INEOS and SINOPEC): 400,000 tons (end 2013)

**ECOBIOCAP**
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Need to find quickly alternatives to petroleum-based aromatic compounds to halt the massive contamination of our environment and protect human beings from its negative impacts on health.
Substitution of chemical phenol by natural polyphenols

Lignin

Condensed tannins

Extension units

Terminal unit

R\(^1\), R\(^2\) = OH or H
R\(^3\) = H, Gal
Agro-industrial wastes (wine and cider making, fruit juice)

Winemaking Biomass

<table>
<thead>
<tr>
<th></th>
<th>seeds</th>
<th>pomaces</th>
<th>stems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual output</td>
<td>80 000-140 000 t</td>
<td>700 000 t</td>
<td>300 000 t</td>
</tr>
<tr>
<td>Tannins (% DM weight)</td>
<td>6 -16%</td>
<td>0,04 - 1,2%</td>
<td>3%</td>
</tr>
</tbody>
</table>

Pomace, fruit marcs

Sawmill co-products and forest biomass

Barks

Pine needles, leaves

Conifera (36%)
France

French Forest
16 000 000 Ha
2,5 billions m³

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RESEARCH WORKS

- From phenolic models
  - Gallic acid
  - Catechin

- From commercial extracts
  - Hydrolysable tannins
  - Condensed tannins
DEPOLYMERIZATION: a key step

- to get an homogeneous raw material or fine chemicals
- to get the same synthons from different tannin sources
- to suppress one step (simultaneous extraction/depolymerization)

Large scale process for production of biobased phenols
DEPOLYMERIZATION: obtention of phenolic synthons

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**Perspectives**

- **Materials**: thermoplastic; polyester, polyamide, vinylester,… and composite
- **Fine chemistry**: Medicinal, cosmetic, Lubricant, Surfactant

**RESULTS**

Functionnalization

Curing

Epoxy resins (thermosetting)
Thank you for your attention!

Co-workers

Lucas Suc

Guillaume Billerach