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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

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

Bisphenol A (BPA) and polyphenylene oxide (for epoxy and polycarbonate resins)

Specialities
Fiber production (caprolactame, cyclohexanol and cyclohexanone)
Phenolic resins (composite materials)

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26/02/2015
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

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

**Sawmill co-products**
and forest biomass

**Winemaking Biomass**

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<thead>
<tr>
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<th>seeds</th>
<th>pomaces</th>
<th>stems</th>
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</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>

**Conifers (36%)**

France

French Forest
16 000 000 Ha
2,5 billions m³
- From phenolic models

- From commercial extracts

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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
Thank you for your attention!

Co-workers
Lucas Suc
Guillaume Billerach