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

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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

R\(^1\), R\(^2\) = OH or H

R\(^3\) = H, Gal

Terminal unit
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>

Sawmill co-products and forest biomass

Conifers (36%)
France

French Forest
16 000 000 Ha
2,5 billions m³

Pomace, fruit marcs

Barks

Pine needles, leaves

RESOURCES
- 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 synths

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26/02/2015
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