



Substitution of chemical phenols by plant polyphenols for processing phenolic biomaterials



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WORLD ANNUAL PRODUCTION OF PHENOL

2000 : 6 million tons

2010 : 8 million tons

2020 : 12 million tons (prediction)

Market in expansion

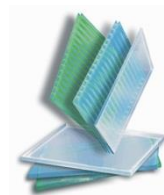
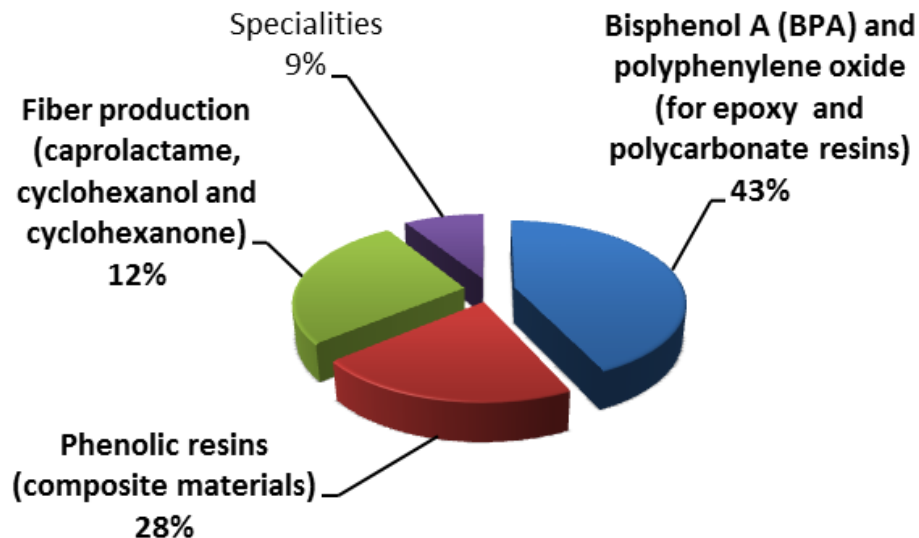
New production plant in Nanjing, China (INEOS and SINOPEC) : 400 000 tons (end 2013)

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



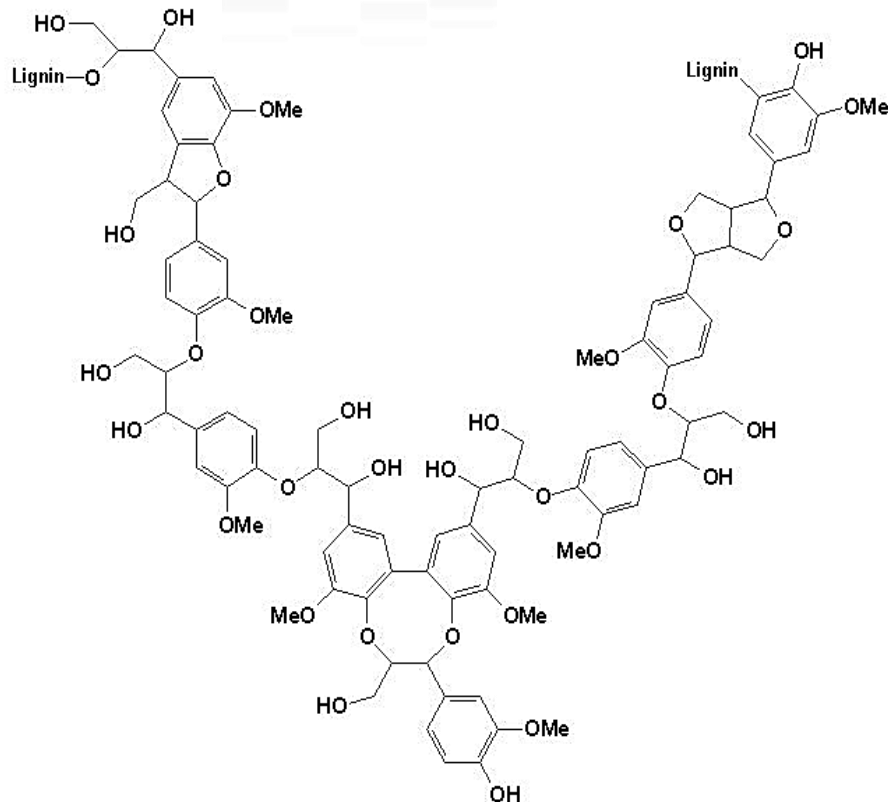
INTRODUCTION

PROBLEMATIC



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

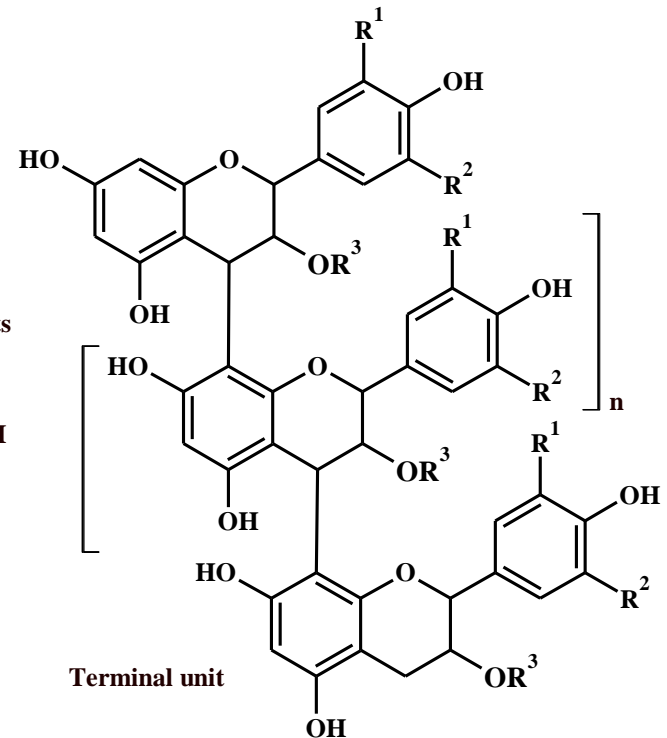
■ Substitution of chemical phenol by natural polyphenols



Lignin

Extension units

$R^1, R^2 = \text{OH or H}$
 $R^3 = \text{H, Gal}$



Terminal unit

**Condensed
tannins**

RESEARCH WORKS

RESSOURCES

Agro-industrial
wastes
(wine and
cider making,
fruit juice)



Pomace, fruit marcs

Winemaking Biomass	seeds	pomaces	stems
Annual output	80 000-140 000 t	700 000 t	300 000 t
Tannins (% DM weight)	6 -16%	0,04 - 1,2%	3%

Sawmill co-
products
and forest
biomass



Barks



Pine needles, leaves

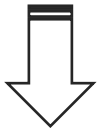
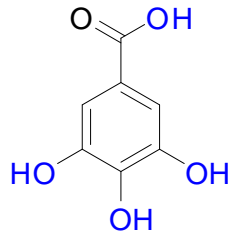


Conifers (36%)
France

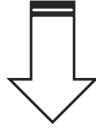
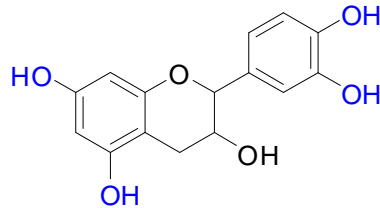
French Forest
16 000 000 Ha
2,5 billions m³

- From phenolic models

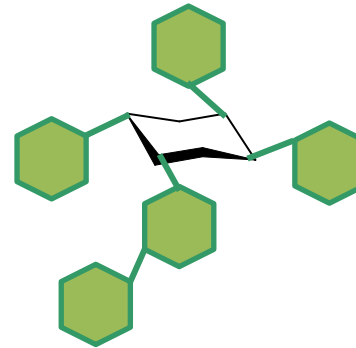
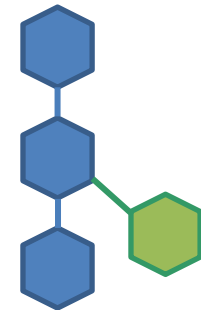
Gallic acid



Catechin

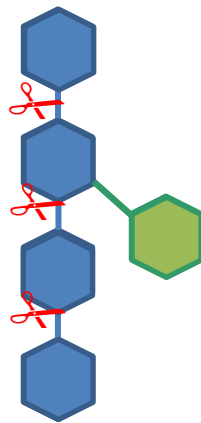


- From commercial extracts

Hydrolysable
tanninsCondensed
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)

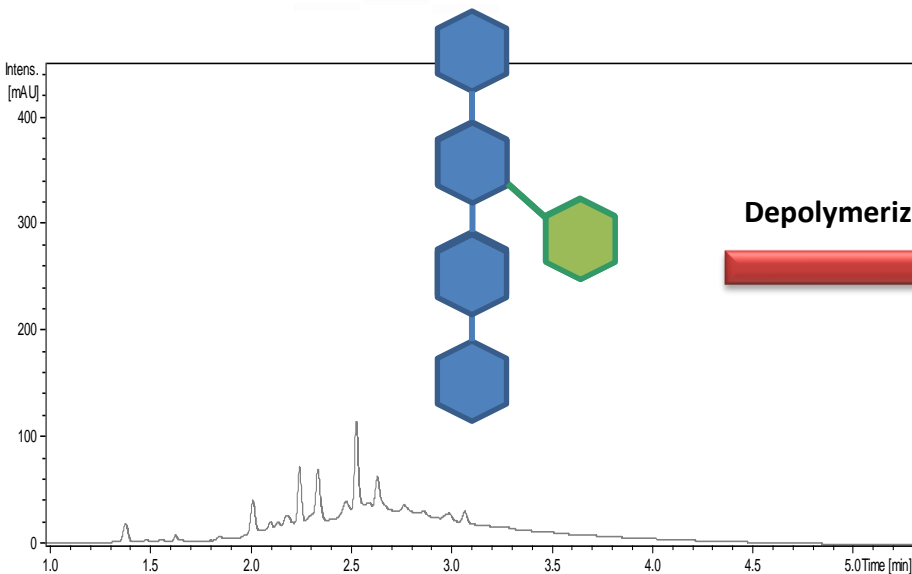


Depolymerization

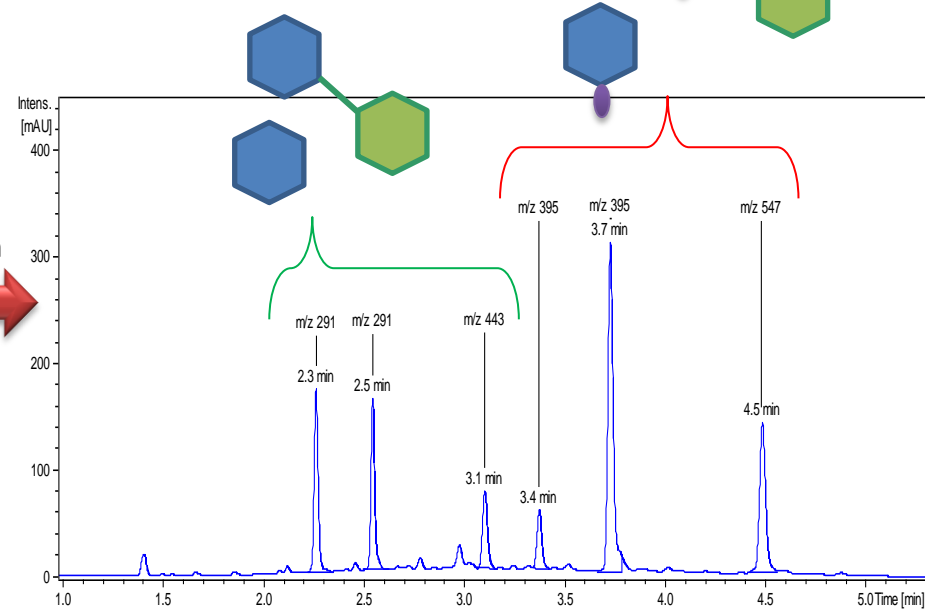


**Large scale process for production
of biobased phenols**

⇒ DEPOLYMERIZATION : obtention of phenolic synthons



Depolymerization





Fonctionnalization



Curing



Epoxy resins
(thermosetting)

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