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ATELIER INTERNATIONAL DE DIAGNOSTIQUE DE L´INDUSTRIE DES RÉSINEUX DE SECONDE TRANSFORMATION

"LA COLOPHANE ET SON AVENIR DANS LE DOMAINE DU SUDOE"

BORDEAUX (France), OCTOBRE 2012

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What is Rosin?

Rosin is a solid form of natural resin obtained from conifers and mainly pine trees

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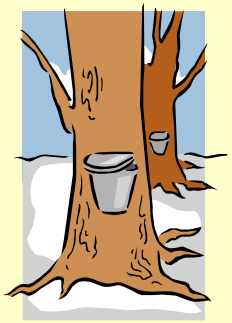
Rosin Sources



- **GUM:**
  Tapping the Oleoresin of Living Pine Trees

- **Tall Oil Rosin (TOR):**
  By-product of Kraft Pulping Process

- **Stumpwood: Extraction/Special Processing of Oleoresin from Stumps**

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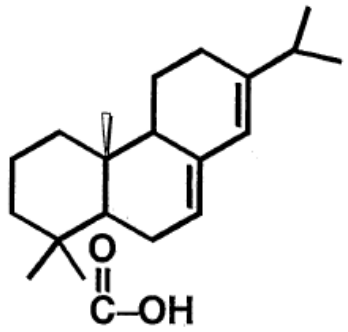
Rosin composition

Rosin is mainly composed (>90%) of resin acids with similar basic structures

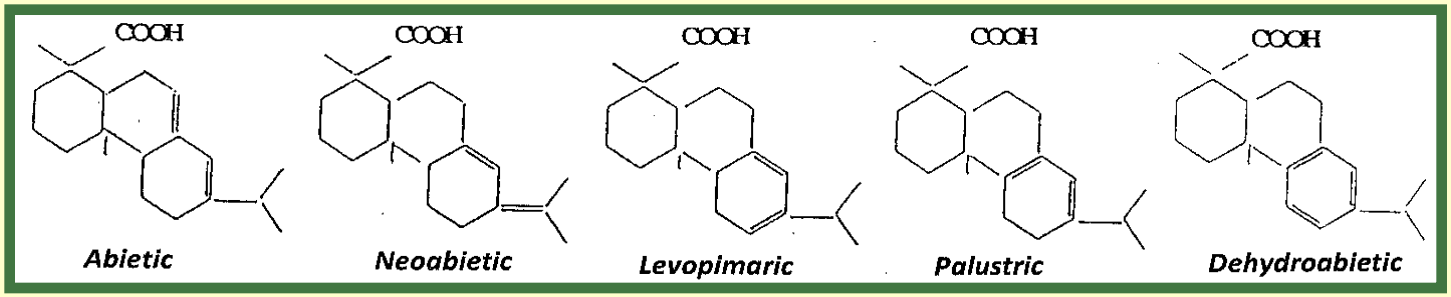


Abietic Acid

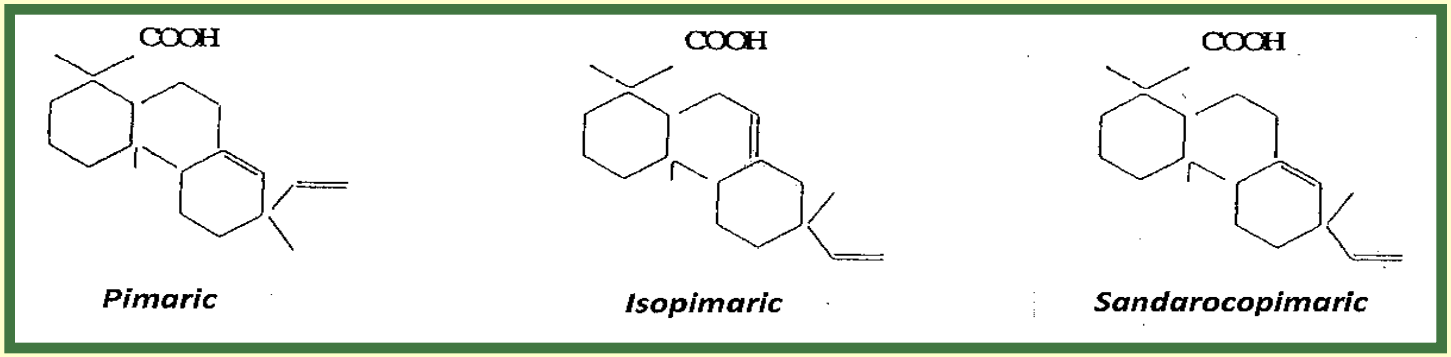
- O ‖ C–OH Carboxylic Acid
- = Unsaturation
- Ring Size & Structure

Two common families of resin acids:

- **Abietane skeletal class:**



- **Pimarane skeletal class:**



Rosin, as natural resin, has a variable composition depending on:

- *Origin of the Rosin (sources)*
- *Types of the trees (species)*
- *Location of the trees (geographical area)*

Typical composition of resin acids in rosin by sources

Resin Acid (% of acid fraction)	Gum rosin	Tall Oil rosin	Wood rosin
Abietic	32-37	40-45	25-35
Palustric/Levopimaric	18-23	5-10	5-10
Neoabietic	15-20	1-6	5-15
Dehydroabietic	8-10	27-32	20-25
Pimaric	7-12	5-10	3-5
Isopimaric	6-11	4-9	2-6
Sandarcopimaric	1-3	<2	1-3

Principal resin acids of gum rosin by species

Species (origin) / Resin acid (%)	P. pinaster (France)	P. halepensis (Greece)	P. sylvestris (Russia)	P. massoniana (China)	P. elliotti (Brazil)	P. merkusii (Indonesia)
Abietic	35	45	35	39	37	28
Isopimaric	10	11	7	2	17	16
Neoabietic	15	13	15	16	16	5
Palustric/ Levopimaric	20	23	23	25	15	27
Dehydroabietic	9	5	10	7	5	4
Pimaric	10		9	10	5	
Communic					4	
Mercusic						11

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Principal resin acids of gum rosin from P. pinaster by geographical area

P. pinaster tree location / Resin acid (%)	P. pinaster France	P. Pinaster Portugal	P. Pinaster Spain	P. pinaster USA
Abietic	35	34	26	14
Isopimaric	10	7	5	12
Neoabietic	15	19	27	18
Palustric/ Levopimaric	20	21	22	39
Dehydroabietic	9	9	6	4
Pimaric	10	8	9	8
Sandarocopimaric	2	2	2	2

Rosin is not an homogenous substance

Typical physical and chemical properties of rosin by sources	Gum rosin	Tall Oil rosin	Wood rosin
Acid number	164	167	166
Saponificaction index	172	174	172
Unsaponifiable matter	8%	7%	6%
Fatty acids	-	<5	-
Color, U.S. rosin grade	WW	WG	WG
Softening point (R&B)	76 ºC	77 ºC	76 ºC
Refractive index	1.541	1.540	1.545
Density	1.07	1.07	1.07

Typical physical and chemical properties of gum rosin

Typical physical and chemical properties of gum rosin by types	Clear types	Middle types	Dark types
Acid number	165-171	160-170	155-163
Saponificaction index	171-177	170-176	165-174
Unsaponifiable matter	4.3%-5.5%	5.3%-8%	7%-10%
Color, U.S. rosin grade	XC-WW	WG-I	H-D
Softening point (R&B)	76 ºC	77 ºC	76 ºC
Ashes	0.041-0.02%	0.041-0.02%	0.01-0.17%
Refractive index	1.541	1.540	1.545
Density	1.07	1.07	1.07

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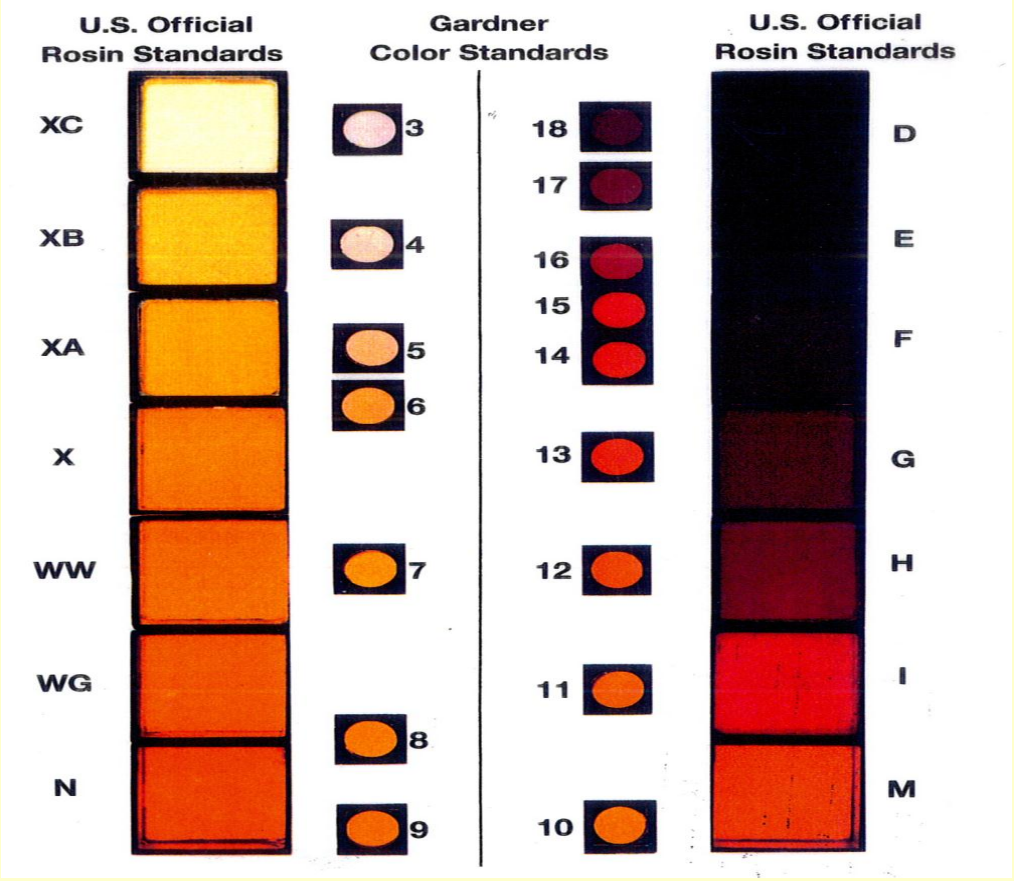
Rosin Color



Why Rosin Derivatives?

Not suitable rosin properties:

- Low softening point (70 - 80ºC)
- Oxidation trend
- High acidity (I_a= 155 – 170)
- Crystallization trend
- Low viscosity
- Quite dark color
- High solvent retention
- Other

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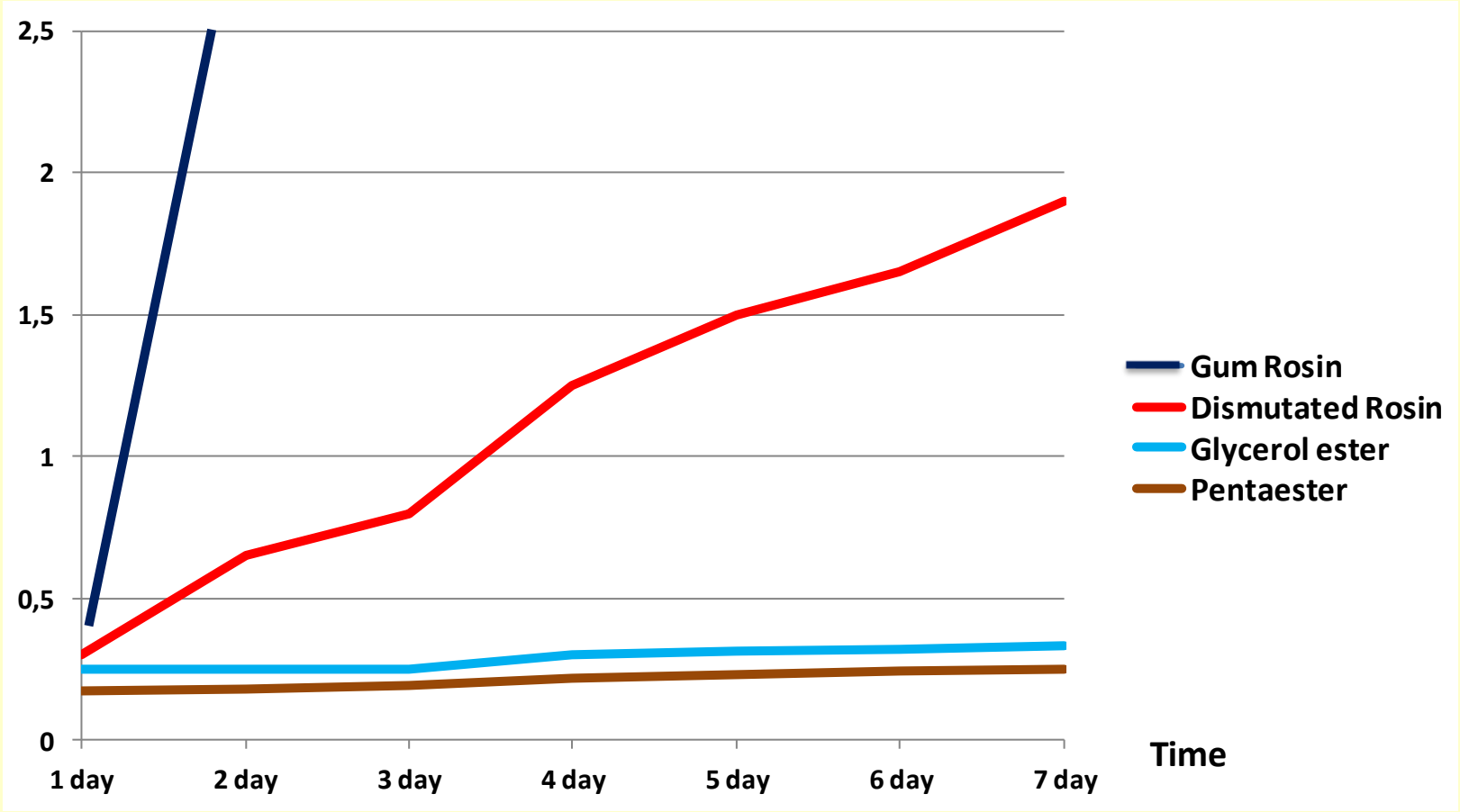
Oxydation test

(21 Kg. of pressure of O_2 for 7 days)

% Weight Increase



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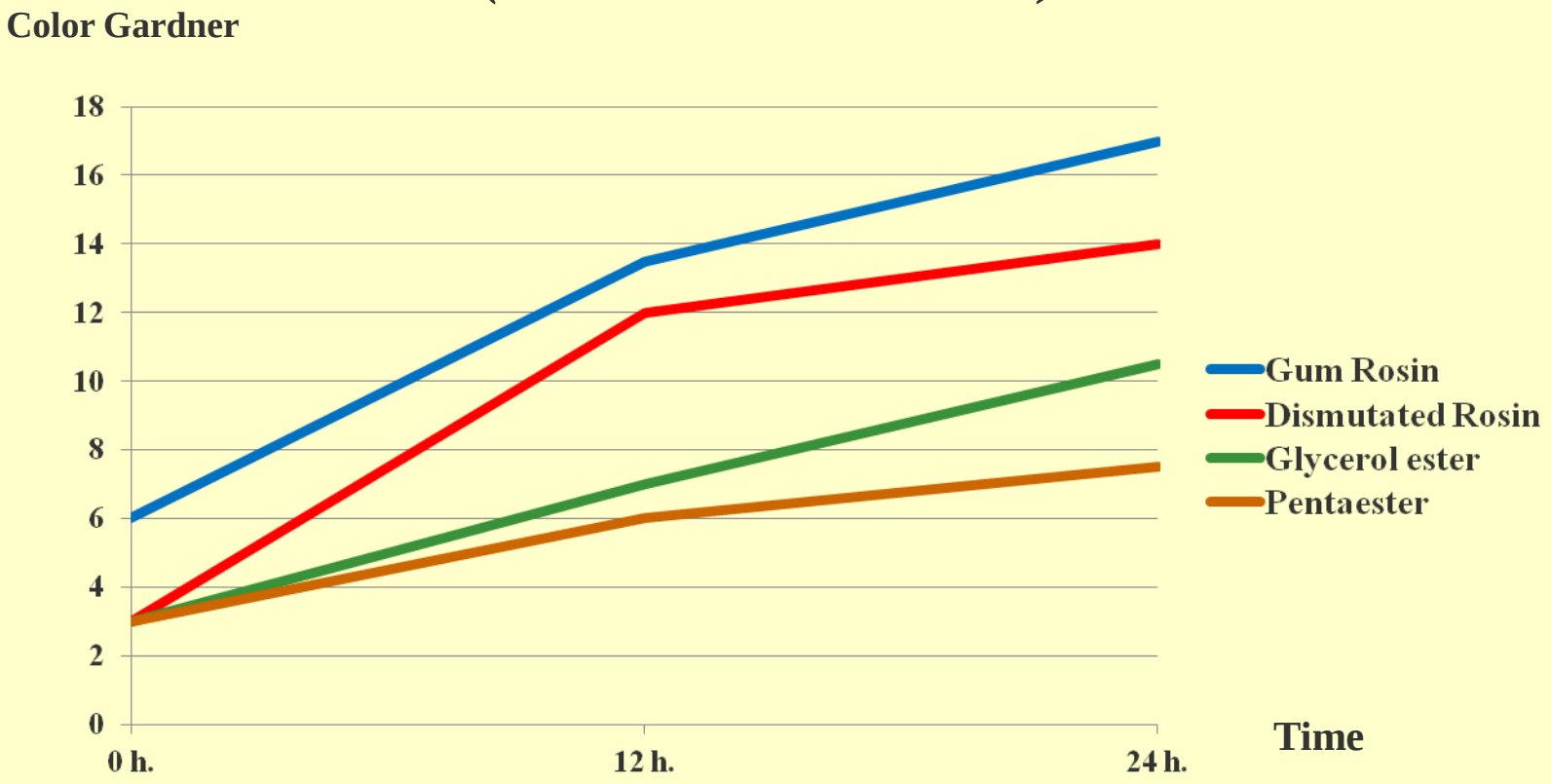
Heat stability test

(Color evolution at 170 ºC)



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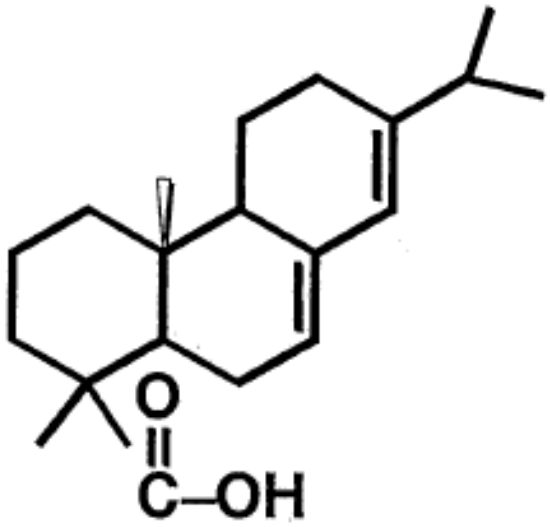
Rosin Chemistry



Abietic Acid

- O ‖ C–OH Carboxylic Acid
- = Unsaturation
- Ring Size & Structure

Rosin Reactivity

- **Reaction of Double Bonds:**
  - Adduction
  - Hydrogenation
  - Disproportionation
  - Polymerization
  - Etc.
- **Reaction of Carboxylic Acid:**
  - Esterification
  - Salt Formation (Soaps, Resinates)
  - Phenolic modified rosins
  - Etc.

Rosin Resins Uses

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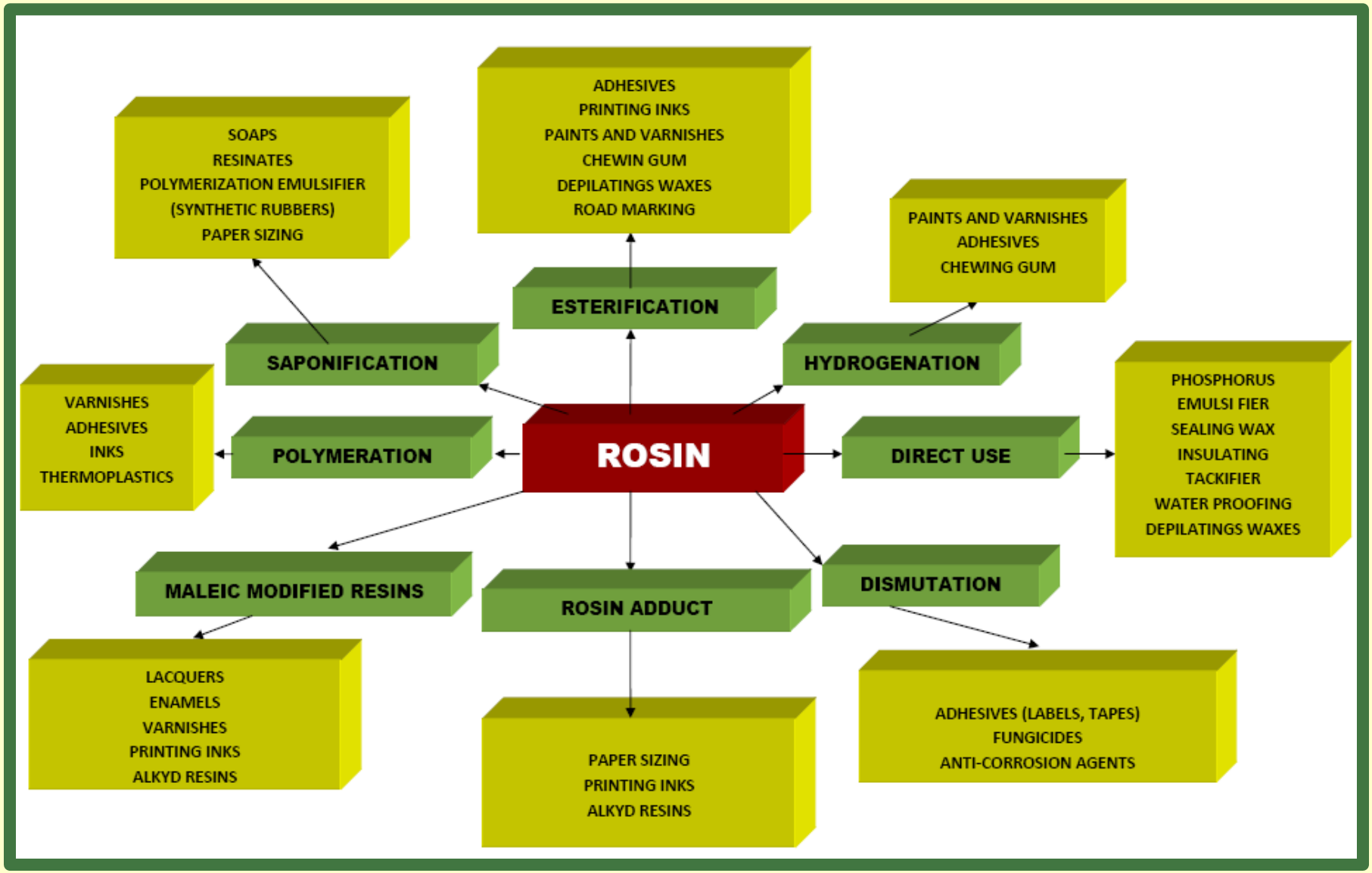

Rosin Resins Industrial Applications

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Rosin good or poor?

It depends on the particular industrial use

some examples:

Brazilian rosin (P. elliottii) is suitable for depilatory waxes

Indonesian rosin (P. merkusii) is suitable for inks

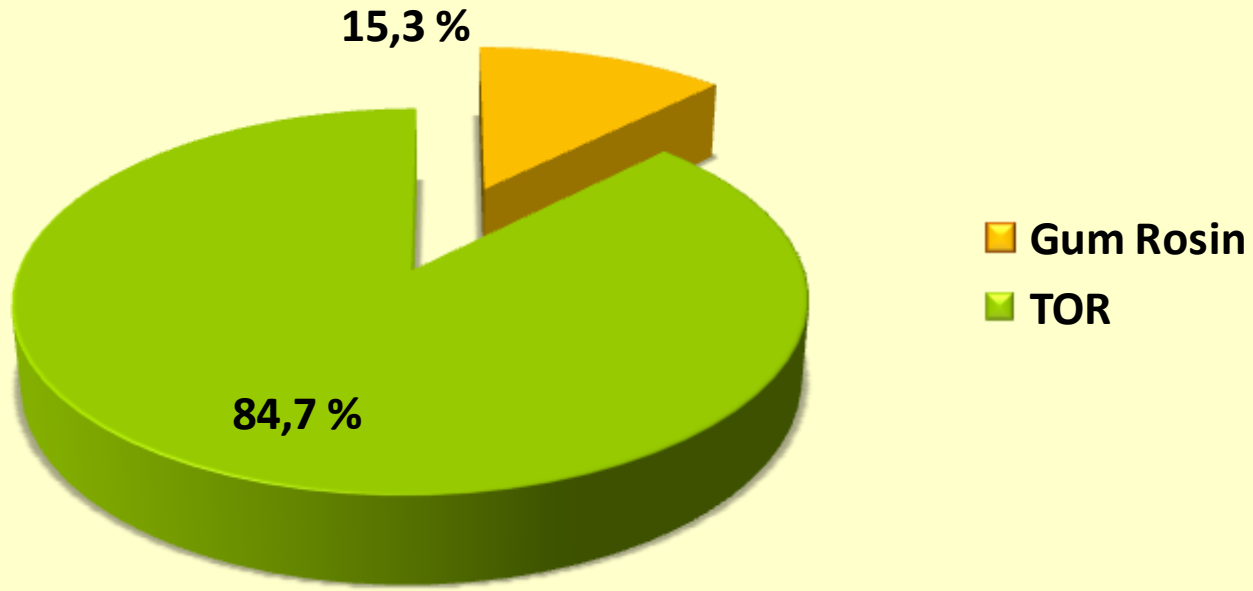
Chinese rosin (P. massoniana) is suitable for adhesives

SUDOE rosin (P. pinaster) is suitable for most uses (versatile)

EU Rosin Production (Forecast 2012)

Gum Rosin + Tall-Oil Rosin = 147,500 MT

UE Gum Rosin Production = 22,500 MT.(15.3%)
UE TOR production = 125,000 MT. (84.7%)



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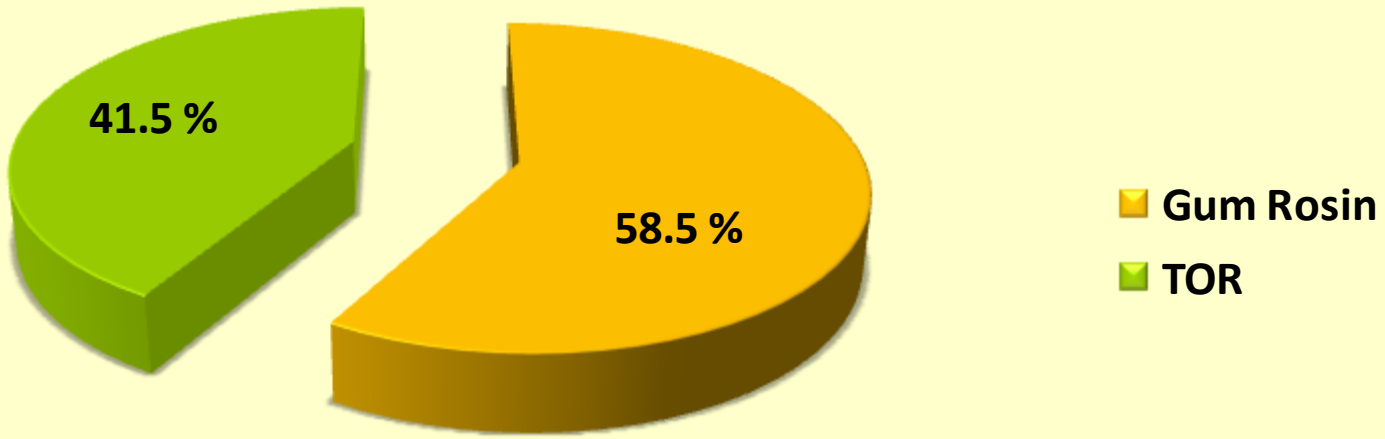
EU Rosin demand (Forecast 2012)

Gum Rosin + Tall-Oil Rosin = 325,000 MT

UE Gum Rosin market= 190,000 MT.(58.5%)
UE TOR market =135,000 MT. (41.5%)



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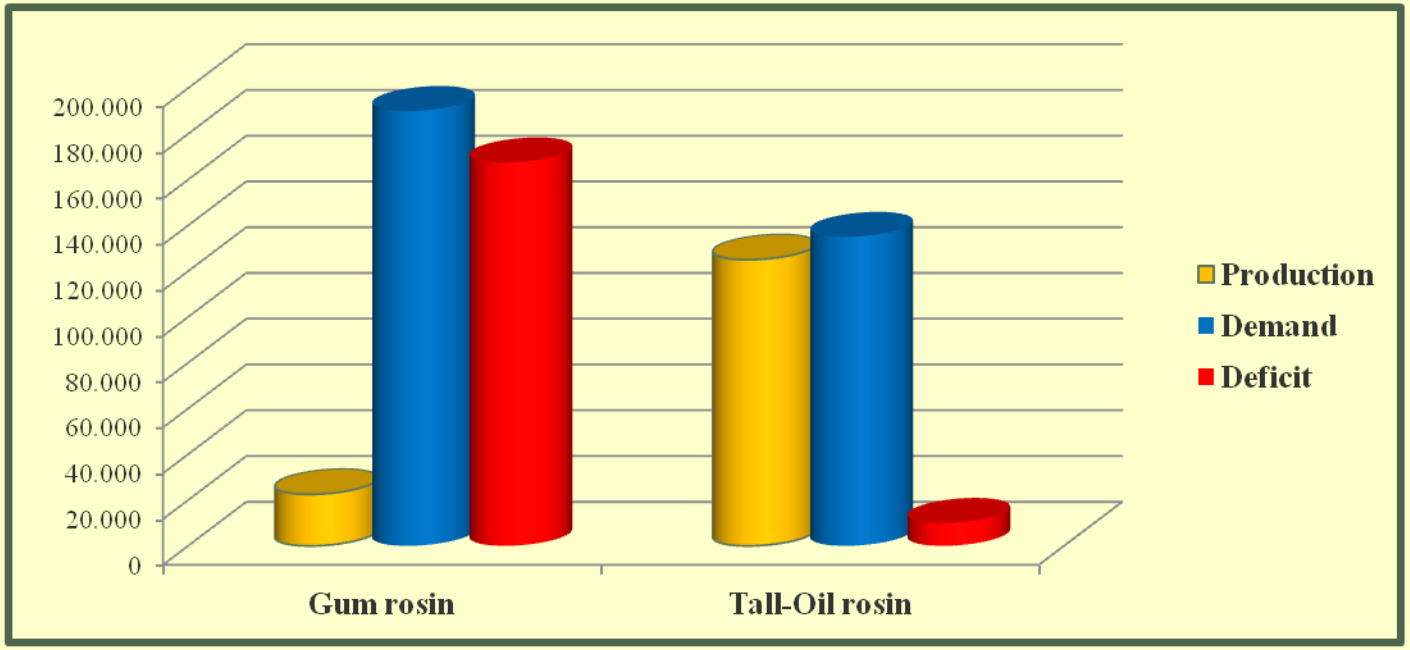
EU Rosin Balance (Production vs. Demand)

Deficit = - 177,500 MT

EU Deficit of Gum Rosin = - 167,500 MT. (94.4%)

EU Deficit of TOR = - 10,000 MT. (5.6 %)



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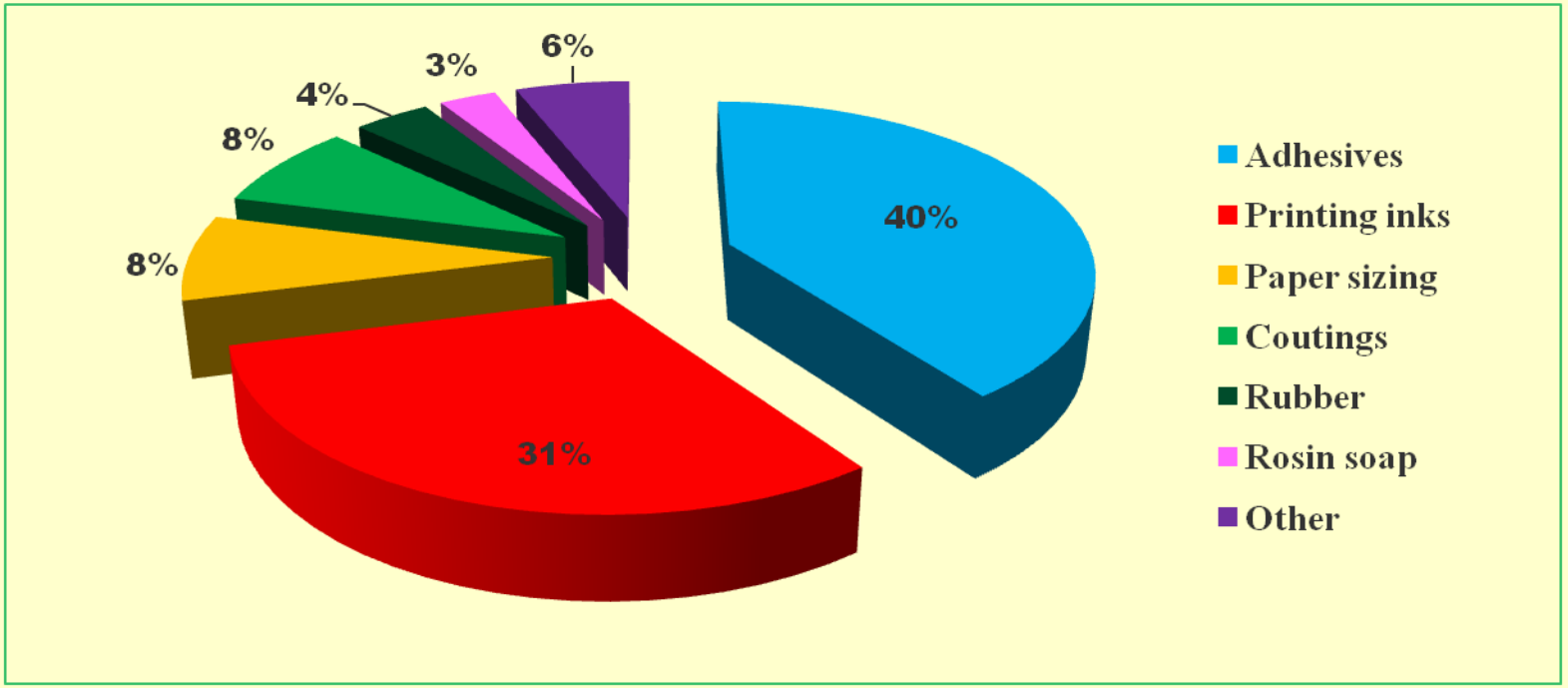
European Rosin market by applications
Gum Rosin + Tall-Oil Rosin = 325.000 MT



Source: PCA International Conference, Boston September 2012

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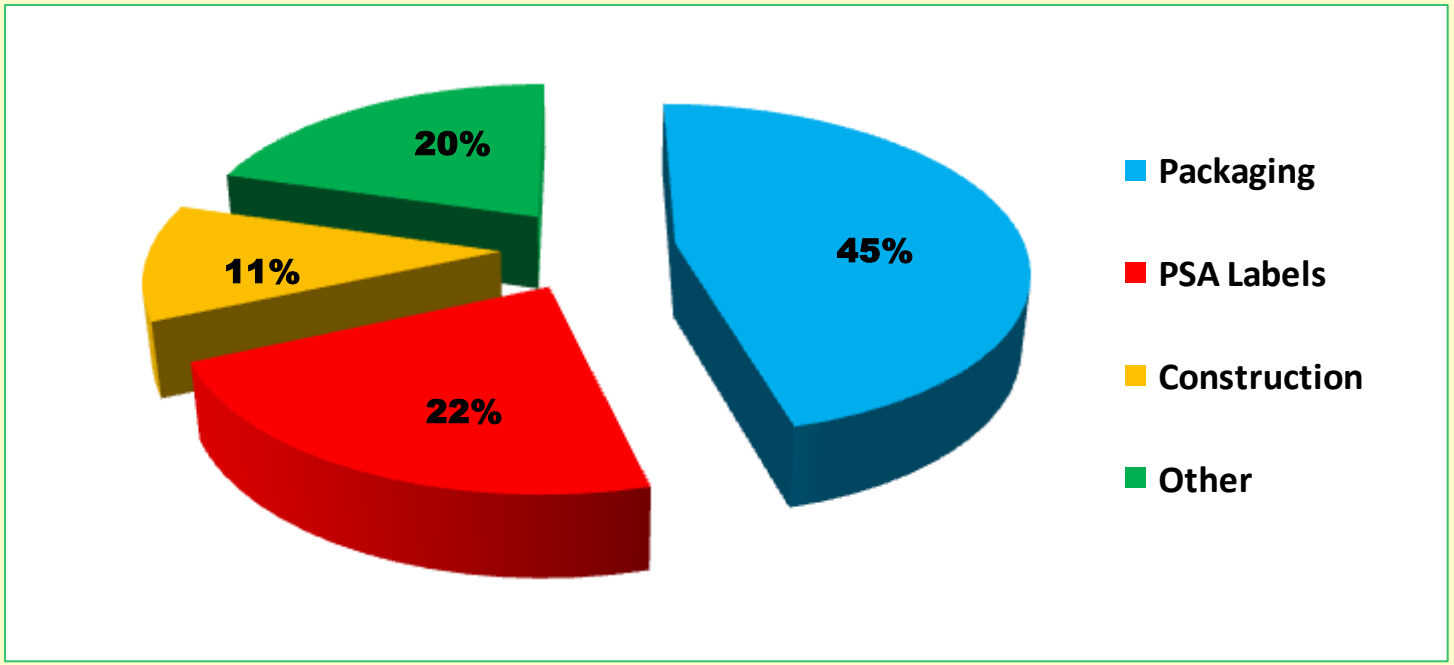
European Rosin Adhesives and Sealants market

Gum Rosin + Tall-Oil Rosin = 130.000 MT

Average annual market growth : 4-5%



Source: PCA International Conference, Boston September 2012

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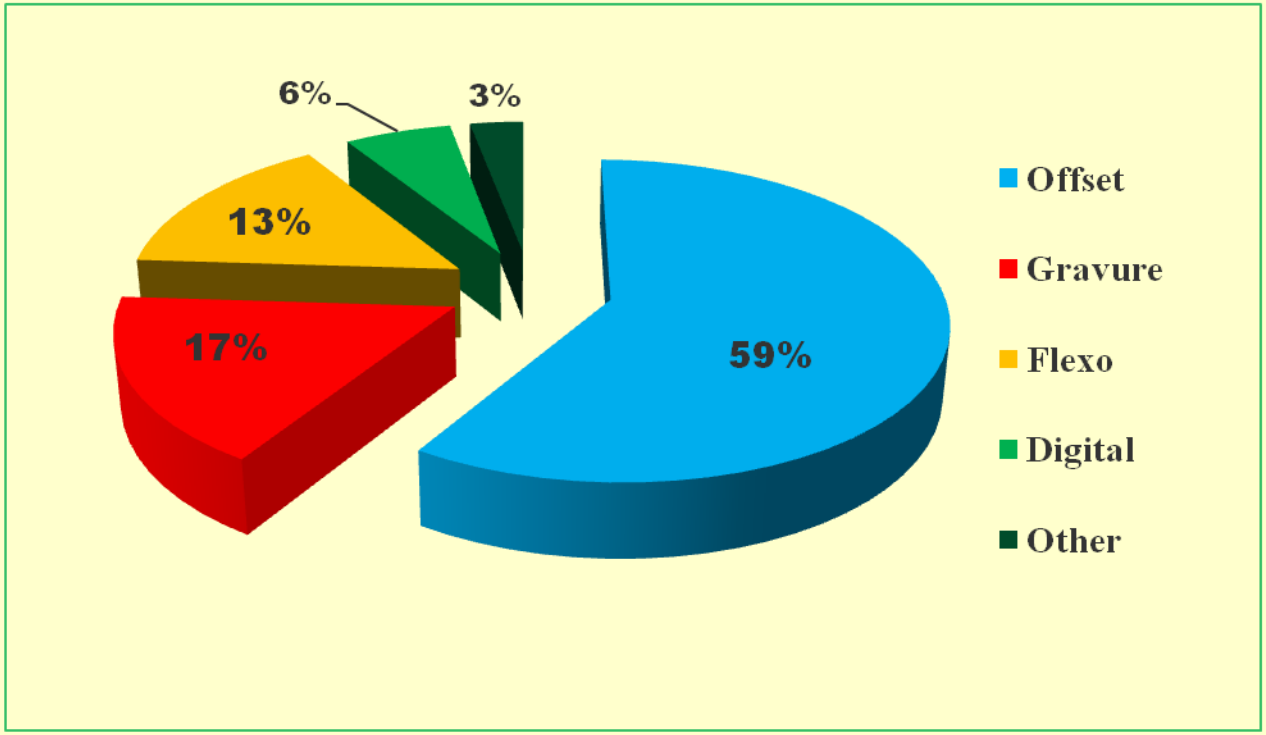
European Rosin Printing Inks market

Gum Rosin + Tall-Oil Rosin = 100.000 MT

Average annual market growth : 3-3,5%



Source: PCA International Conference, Boston September 2012

Rosin Resins are not alone

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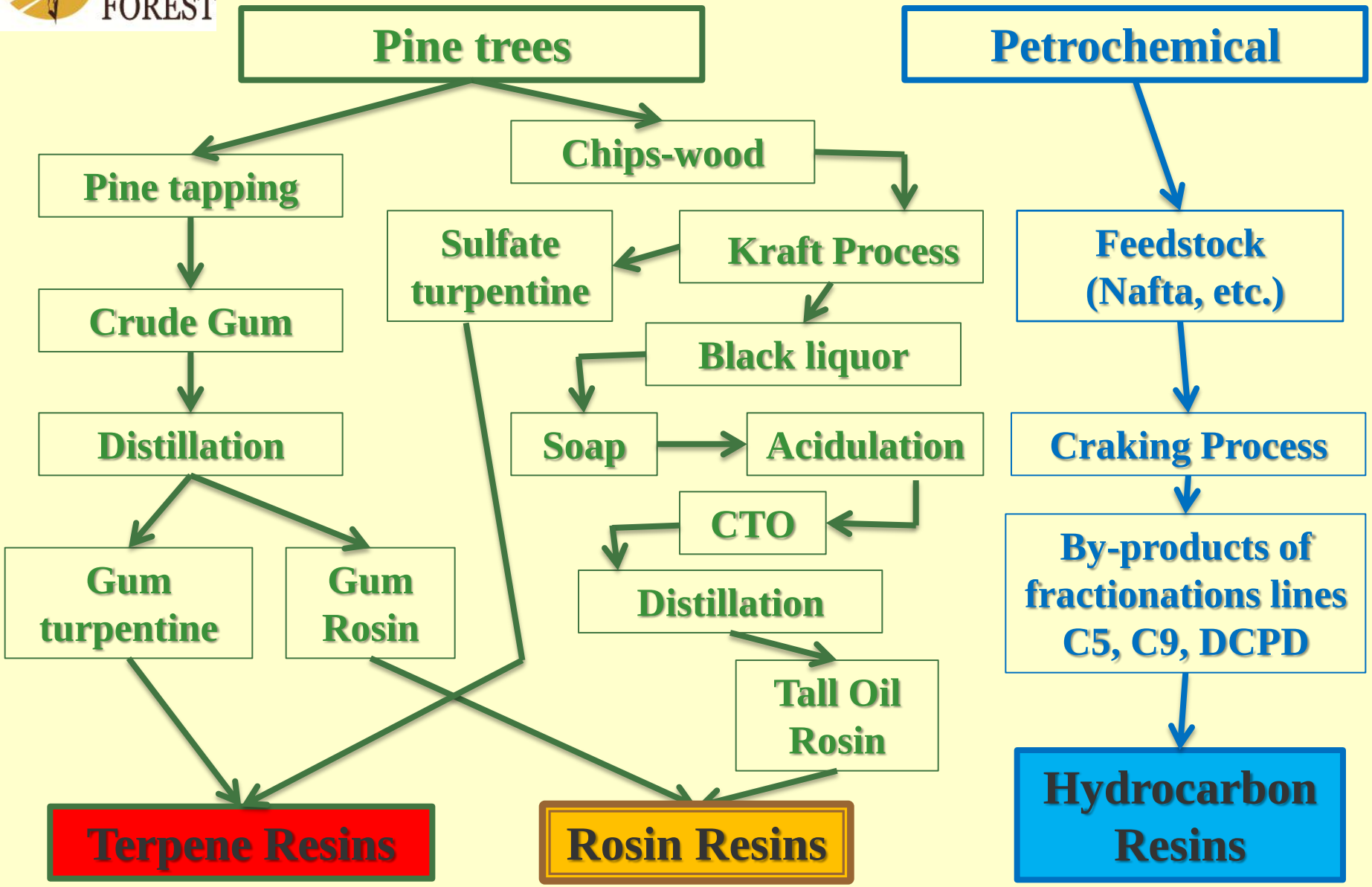

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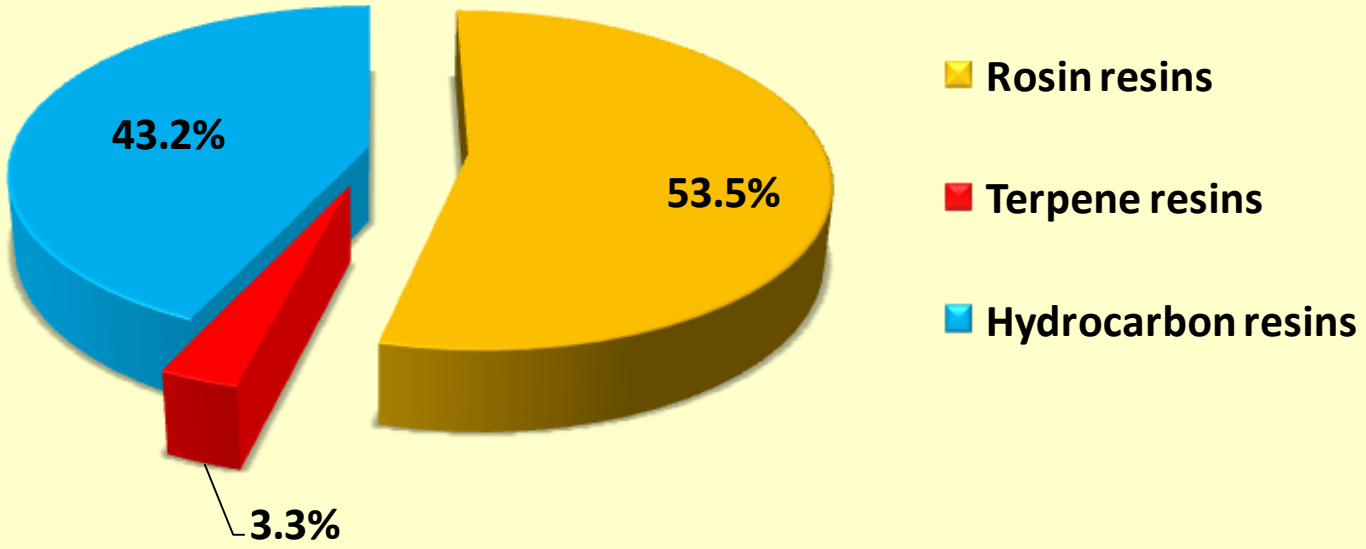
Global Resin Production (Forecast 2012)

Total world resin production = 2,430,000 MT

- **Rosin resins = 1,300,000 MT.**
- **Hydrocarbon resins = 1,050,000 MT.**
- **Terpene resins = 80,000 MT.**



Soure: PCA International Conference, Boston September 2012

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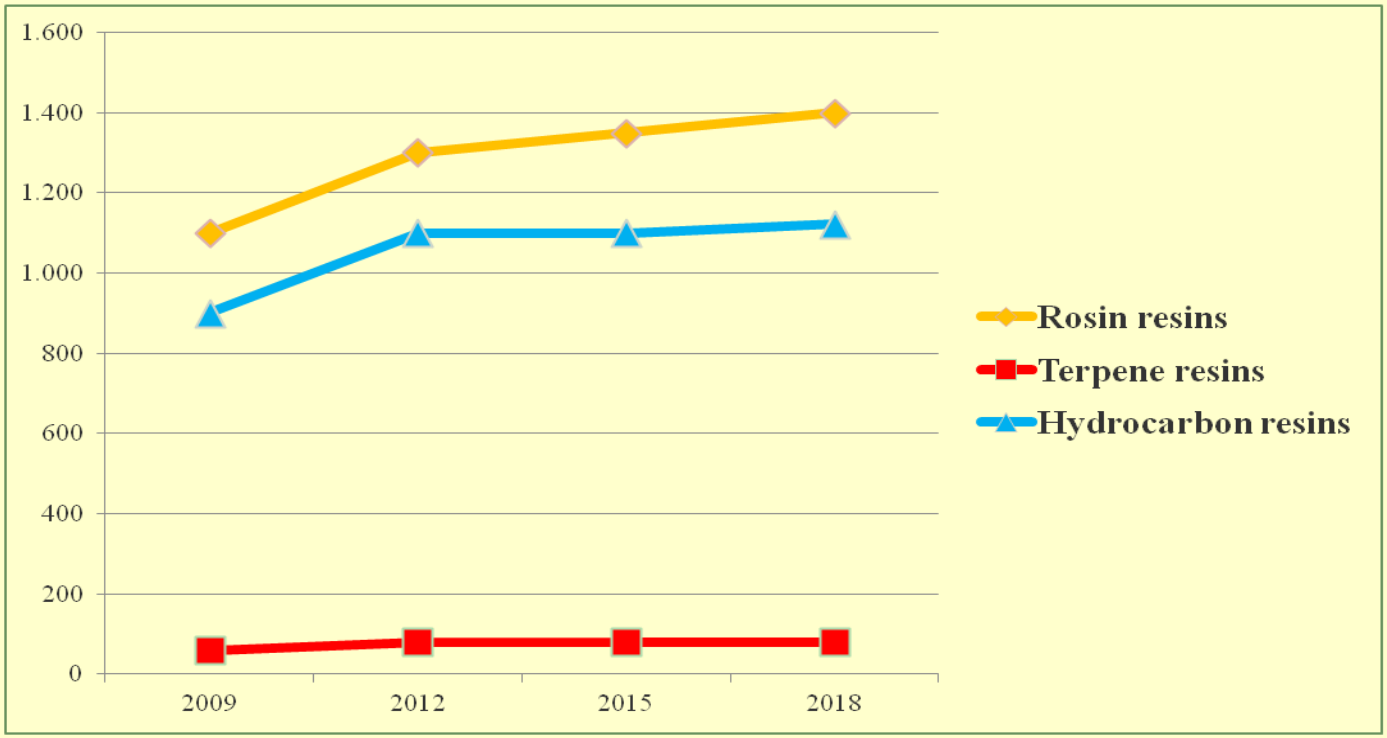
Global ResinTrend

- **Moderate growth production of hydrocarbon resins (2%)** →
- **Slightly more sharper growth production of rosin resins (3%)** ↗
- **Stable production of terpene resins (0%)** →



Source: PCA International Conference, Boston September 2012

Rosin Resin Trend

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Gum Rosin

- Production is closely linked to the market price and the increase in living standards (labor costs).
- Moderate growth of production in the short term (3%) and increased market demand as a renewable raw material.
- Long term limited availability of crude gum rosin (Eucaliptus vs. Pinus, salary increases, etc.)

Tall Oil,

- Production limited by the unavailability of crude tall-oil, linked to the price of energy (biodiesel production).
- Stable production in the short and medium term and longer-term shortages.

Wood Rosin

Sharp decline of wood rosin production in the long term. Small and irrelevant proportion of total rosin production.

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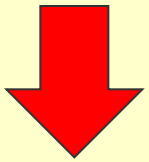
World Rosin Resin Trend

- Moderate growth of Gum Rosin production in the coming years (3% p.y.), but high risk of decline in the longer term.
- TOR production expectied to remain flat because production of softwood kraft pulp also will be flat in the long term.
- Market demand for Rosin Resins 4 to 5 % p. y., leaded by emerging countries (China, India, Brazil, etc.)
- At longer term Trend, demand for Rosin Resins will exceed the offer.



Higher prices and limited availability in the future

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Rosin resins advantages

- **Rosin market demands the more and more for ecological, biological and green products.**

- **Current economy requires development of products from renewable resources for sustainable industrial activities.**

- **Development of friendly environmental products (pine chemicals industry helps to preserve pine forests and reduce carbon footprint).**

Clear advantage of Rosin resins over Hydrocarbon resins

Conclusions

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- *Pine chemical industry in EU has a growing raw material demand, limited only by supply difficulties. This limited availability of rosin and turpentine will probably increase in near future.*

- *The geographic pine forest area of SUST-FOREST (Portugal, Spain and France), has enough resources to meet their own industrial needs.*

- *Pine chemical industry is sustainable and environmentally friendly.*

- *Pine chemical industry generates economic, social and environmental benefits.*

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