



Innovative bio-based resins for the polyurethane and composite industries

Andrea Minigher – Biophenolika Ltda

Who we are

Biophenolika Ltda:

- is a Brazilian company based in Fortaleza (Ceara)

- exploits the original and patented know-how

developed in Italy and USA

- is specialized in the production
of the EXAPHEN™ products line



EXAPHEN product line



- high-performance resins and pre-polymers for the PU, epoxy and composite markets
- obtained from natural agro-wastes
- using only non-edible sources from agriculture or food industry

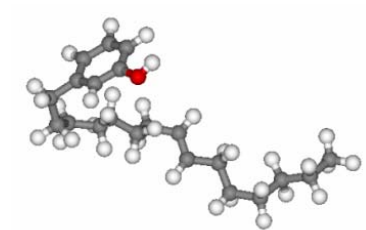


Bio-based raw materials

A green equation:



EXAPHEN products



EXAPHEN products available

Two families of products are available on the market:

- **Polycard XFN**

polyols for the polyurethane market

- **Novocard XFN**

novolacs for the polyurethane,
epoxy and composites markets





Polycard XFN: bio-based polyols

Applications

Polycard XFN polyols are profitably used in the PU industry.

- ❑ **Rigid polyurethane foams for thermal insulation** (buildings, trucks, appliances, etc.) is the main application of Polycard XFN polyols
- ❑ Uses for **other PU applications** (microcellular, binders, etc.) are also possible
- ❑ Use in PUR flexible foams is in the testing phase

Rigid PUR

In rigid PUR, Polycard XFN polyols have been already used:

- for **all insulating applications** (panels for buildings, air conditioning, refrigerated trucks, appliances, district heating pipes, etc.)
- with **all the available technologies** (spraying, continuous slabstock production, discontinuous moulding)
- **easily adapting** reactivity and viscosity to the specific technologies
- replacing **from 20 to 100%** of the traditional petrol-derived polyols

Properties

- Complete range of products (different viscosity, OH value, etc.)
- High compatibility with other components
- Self-catalytic polyols available
- Bio-based content from 73%
- Improved fire resistance properties in comparison to other bio-based polyols



Properties

Physical-chemical Properties	POLYCARD XFN 50	POLYCARD XFN 100	POLYCARD XFN 150	POLYCARD XFN 500
Color ⁽¹⁾	4 - 5			
Hydroxyl Equivalent Weight (g/mole)	307	~400	~104	~211
Hydroxyl Value (mg KOH/g)	190	140	540	266
Functionality	4-5	2(diol)	3 (mannich)	6
Viscosity 25°C (cps)	1,500-2,000	850 - 1,000	4,000 - 8,000	1,550 - 1,650
Density (g/mL)	0.95	0.99	1.04	1.04
Water content (%)	≤0.5			
Bio-Content ⁽²⁾ (%)	95	90	73	85
Global Warming Potential ⁽³⁾ (kg CO ₂ /kg)	- 5.91	- 4.46	- 5.21	- 3.54

Ex.1: R-PUR panels production

Continuous production of PUR panels.

Up to 100% Polycard XFN-50 used.



PUR panels used for the thermal insulation of air conditioning channels (80% Polycard XFN-50 + 20% Polycard XFN-150).

Ex.2: R-PUR insulated pipes

PUR-insulated pipes for district heating and cooling, produced in collaboration with VEM Spa (Italy), using 40% of Polycard XFN-150

[Video](#)

The slide features a decorative header consisting of two horizontal bars. The left bar is orange and the right bar is green. The text 'Novocard XFN: bio-based Novolacs' is centered in white on the green bar.

Novocard XFN: bio-based Novolacs

Applications

Novocard XFN products can be used:

- As **polyols**, for rigid PUR systems
- As **hardeners** of epoxy resins

and composites



Applications

Uses of **epoxies** and **composites**:

- Flooring
- Automotive
- Marine
- Wind turbines
- Aerospace
- ...and many others



Properties

- Liquid at room temperature
- Wide range of molecular weight, viscosities and OH values
- Toughening of the epoxy resin
- Good chemical resistance
- Very high bio-based content 95%



Properties

Physical-chemical Properties	Novocard XFN 1050	Novocard XFN 1300	Novocard XFN 1400
Color ⁽¹⁾	4-5		
Hydroxyl Equivalent Weight (g/mol)	295-367		
Hydroxyl Value (mg KOH/g)	190	153	160
Viscosity 25°C (cps)	900 - 1500	25000 - 35000	36000 - 45000
Density (g/mL)	0.95	0.98	0.99
Water content (%)	≤0.5		
Bio-Content ⁽²⁾ (%)	95±3		

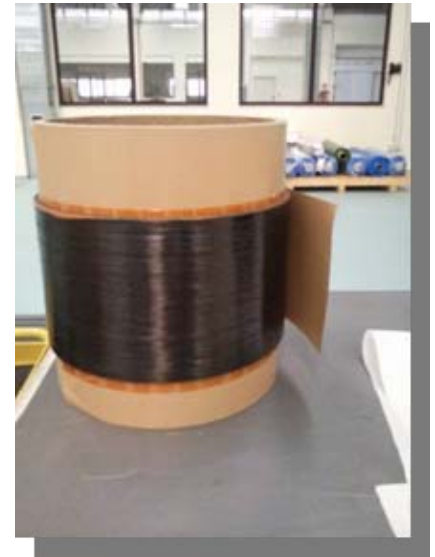
Ex.1: Natural fibres reinforced pipe

- 30/70% Novocard XFN-1050/epoxy
- Pipe reinforced with jute fibers
- very good adhesion and compatibility between resin and natural fibers
- Toughening effect of the novolac on the epoxy matrix



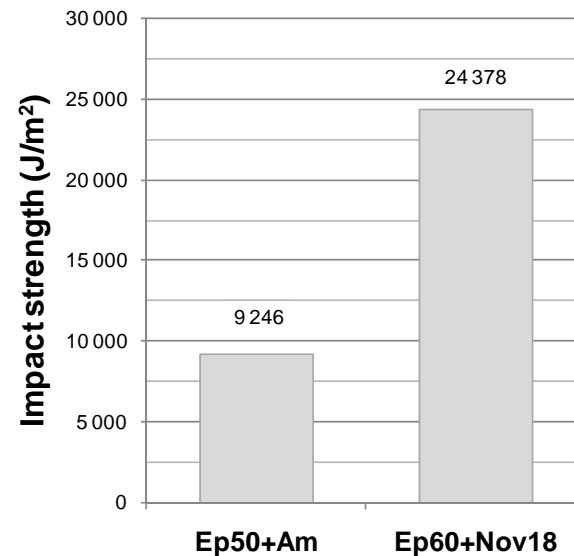
Ex.2: Epoxy pre-pregs

- Epoxy + carbon fibers
- Pre-impregnation of fibers by hot-melt process
- Fiber content: 49%



Ex.2: Epoxy pre-pregs

- high-quality 16-sheets laminate produced by press-claving
- Thermal and tensile properties maintained
- IZOD impact strength of the resin increased by 163%



Ex.3: Press moulding

Helmet for U.S. firefighter produced with 30% Novocard XFN 1300.



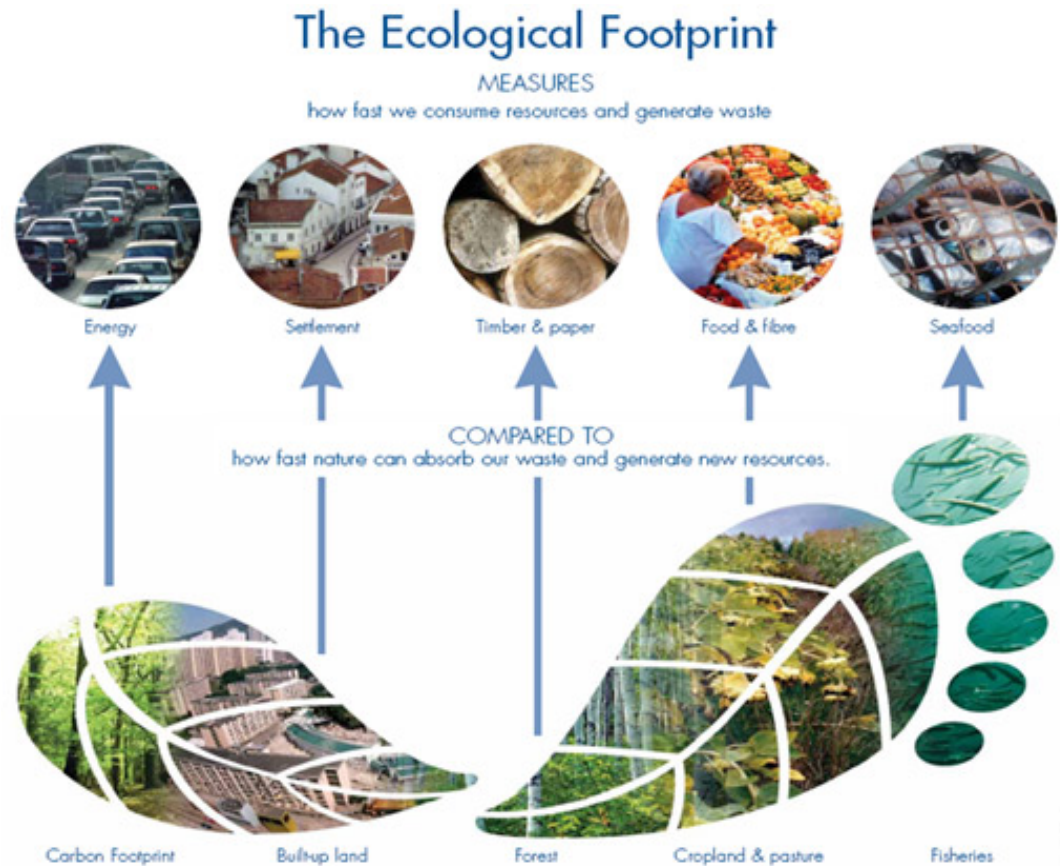
Roof laminate produced in India, reinforced with bamboo fibers.



Bio-based resins: why?

The Ecological Footprint

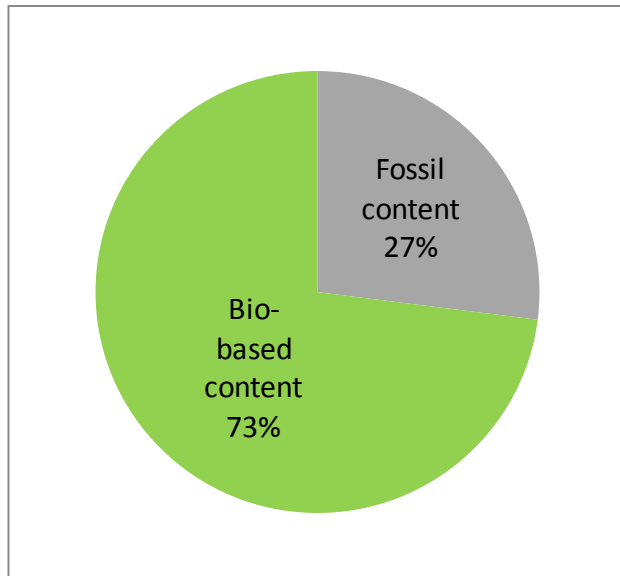
A real sustainable development needs products with lighter ecological footprint.



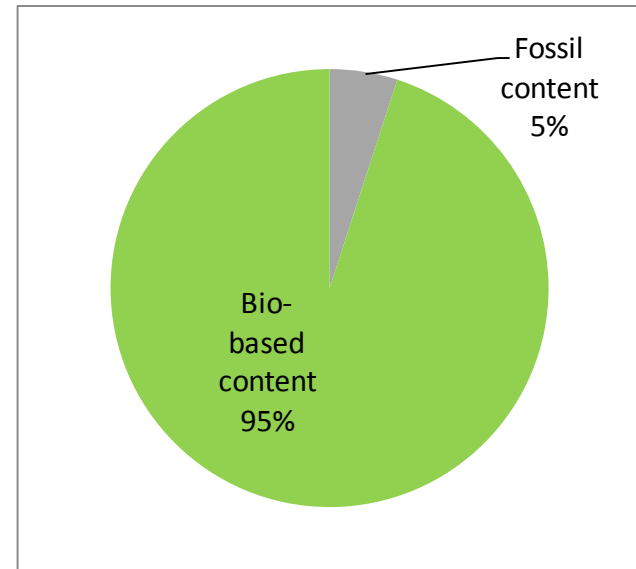
Bio-based content

Bio-based content of EXAPHEN products measured according to ASTM D6866-08 standard.

Polycard XFN



Novocard XFN



Life Cycle Assessment

Cradle-to-gate approach, following ISO 14040 Series Standards.

Complete range of parameters considered:

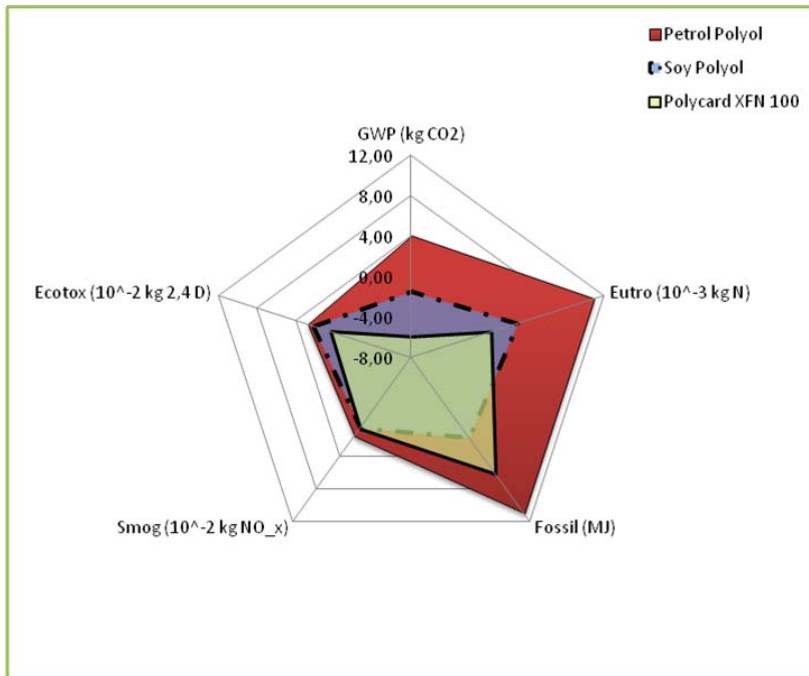
- GWP, Global Warming Potential
- Eutrophication
- Fossil Fuel Depletion
- Smog Generation
- Ecological Toxicity



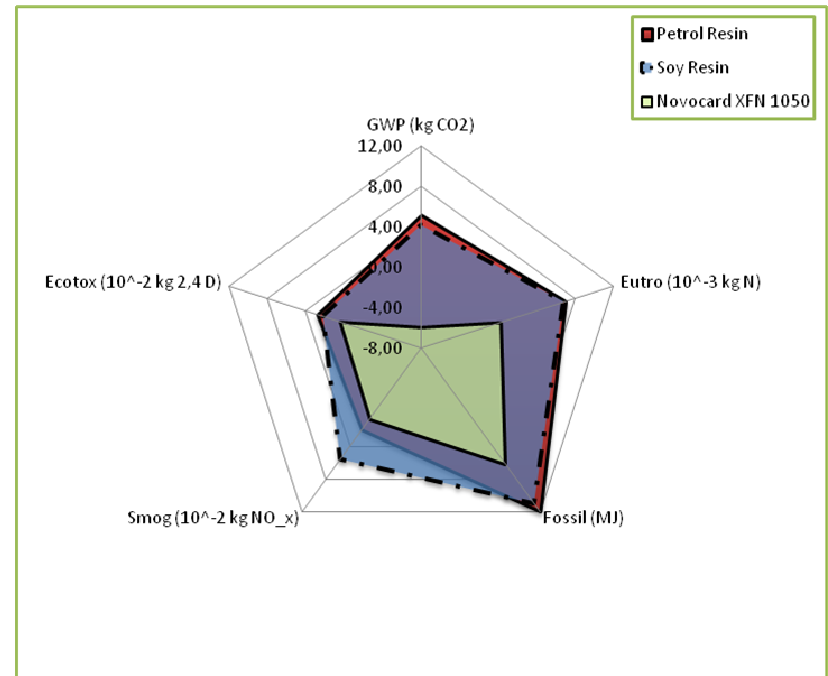
Life Cycle Assessment

The lower the area, the lower the environmental impact

Polycard XFN-100



Novocard XFN-1050



Green areas = EXAPHEN products

Life Cycle Assessment

The lower the GWP, the lighter the Ecological Footprint

Polyol	GWP (kg CO ₂)
Petrol polyol	4,10
Soy polyol	- 1,40
Polycard XFN-100	- 5,91
Polycard XFN-150	- 5,21

If we substitute 1 Mton of petrol polyol with Polycard XFN-100, we save 5,91 Mton of CO₂, equivalent to:

- the emission of 1 person flying from Brazil to Italy and back
- the emission of 30.000 km driving by car

Developmental products

Our R&D team is working to develop new resins from many natural sources:

- ❑ epoxy-novolacs
- ❑ benzoxazines
- ❑ amino-alcohols
- ❑ UV-curable acrylates
- ❑ ...and many other derivatives.



Thank you for your attention



info@biophenolika.com.br

**website
available soon!**