



From tomato peels

To metal packaging coating



# Key-idea



From renewable sources



Tomapaint®  
Bio-resin

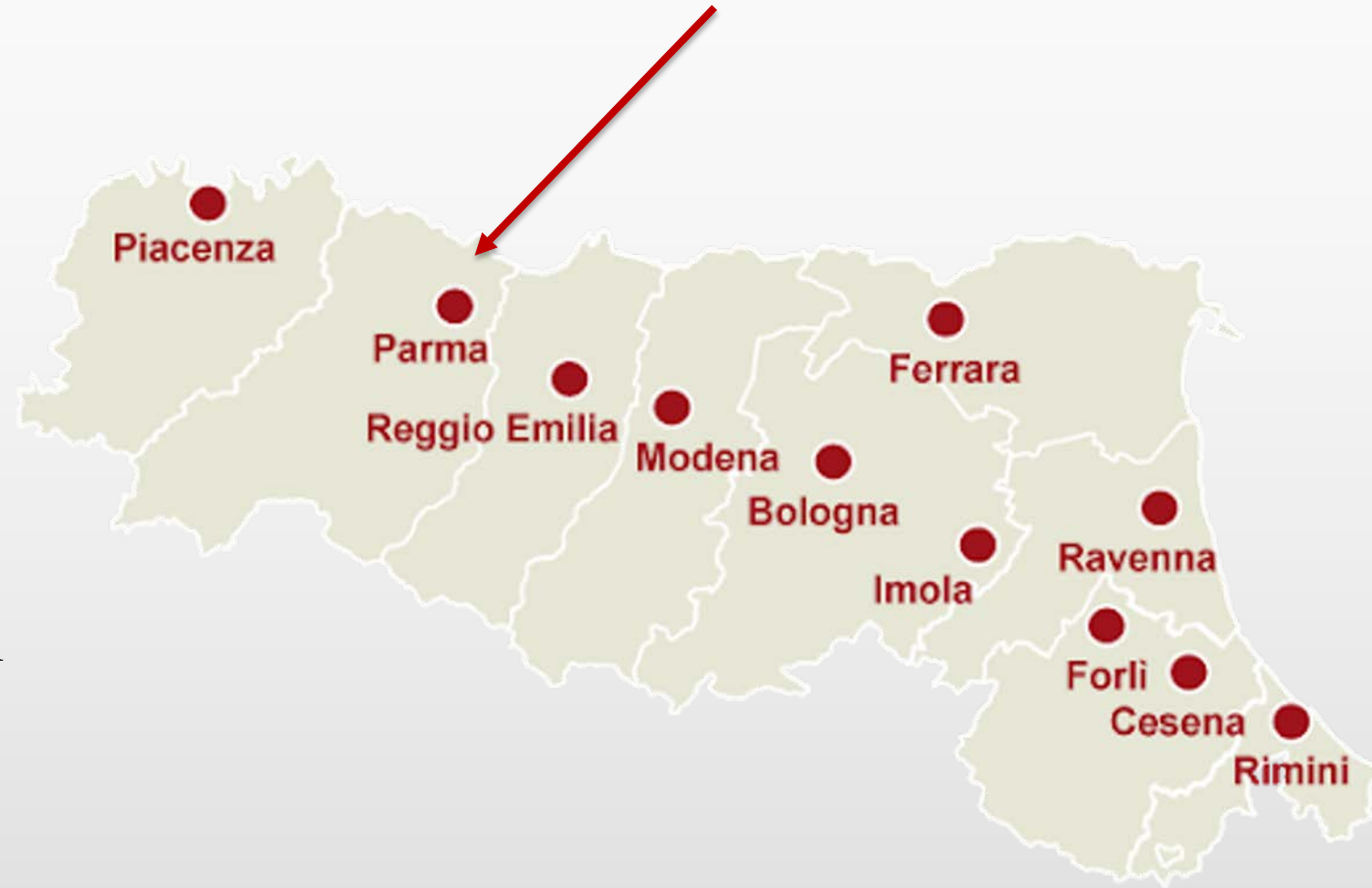


To metal packaging

**Circular Economy business model:** valorising tomato wastes/by-products

# Location

- 300kt/year by-products in Europe
- 70kt/year by-products: **50%** of the Italian tomatoes processed between Piacenza and Reggio Emilia





# Cutin

The original substance is **cutin**, a component of the cuticle of the tomato peels.



- The tomato cutin is a **natural polymer of polyester type**
- The main component of tomato cutin is the **10,16 dihydroxyhexadecanoic acid** (70-80%), starting substance for the polymerization

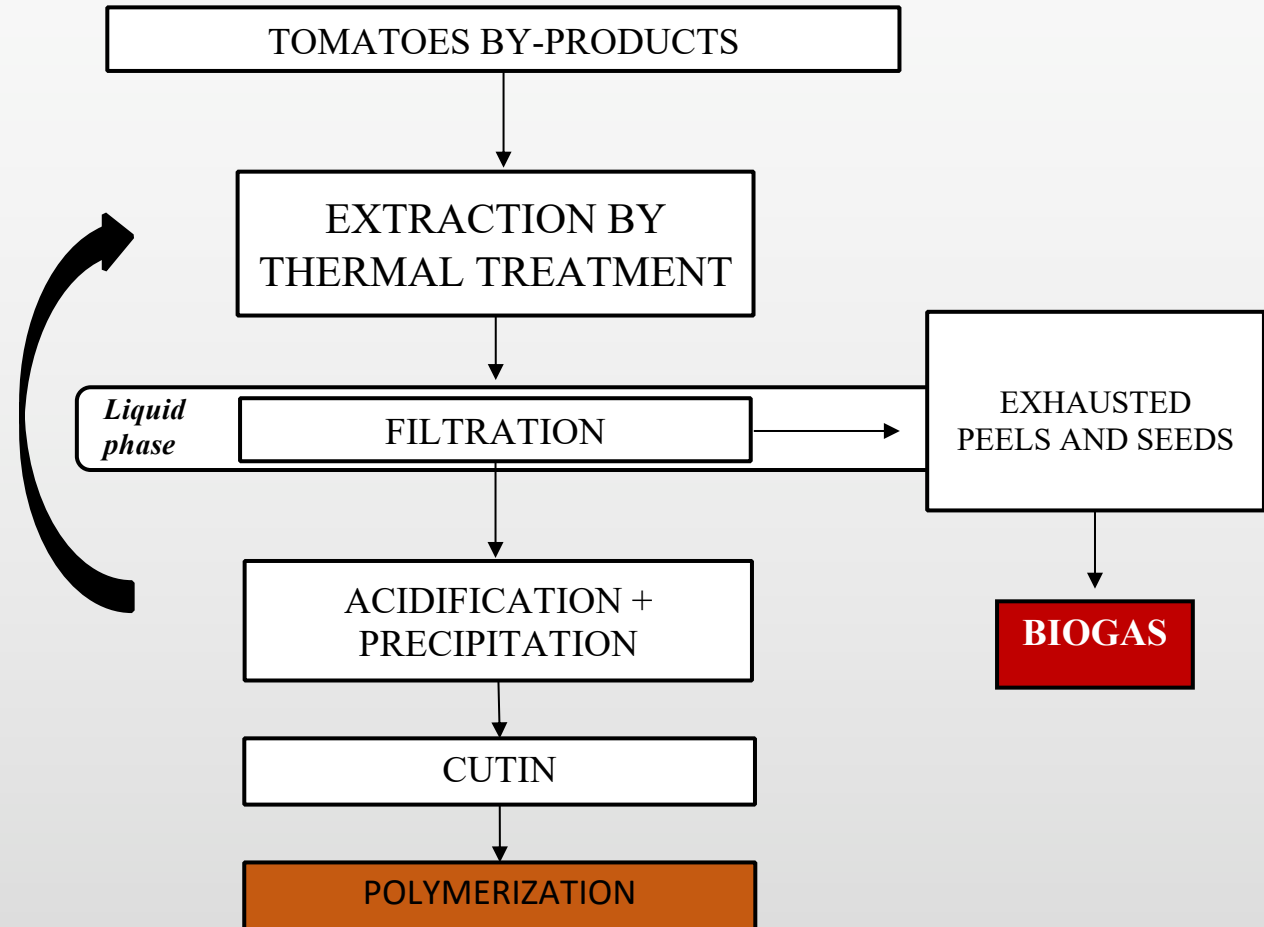
# Chemical composition

Identification	Composition (%)
<b>Hydroxyacids</b>	
10,16-dihydroxyhexadecanoic acid	62 ± 15
16-Hydroxyhexadecanoic acid	2.2 ± 0.5
9,10-epoxy-18-hydroxyoctadecanoic acid	2 ± 1
<b>Alkanoic acids</b>	
Hexadecanoic acid	2 ± 1
Decanedioic acid	2 ± 1
Docosanedioic acid	0.70 ± 0.04
<b>Unsaturated acids</b>	
18-hydroxyoctadec-9-enoic acid	2 ± 1
9,12-octadecandienoic acid	3 ± 2
<b>Aromatics</b>	
(E)-3-(4-hydroxyphenyl)-2-propenoic acid	2.0 ± 0.5
Isomer of p-coumaric acid	3 ± 1
1,4-Benzenedicarboxylic acid	0.44 ± 0.01

Table 1. Cifarelli, A., Cigognini, I., Bolzoni, L. and Montanari, A., 2016. Cutin isolated from tomato processing by-products: extraction methods and characterization. In *Proceedings of CYPRUS 2016 4th international conference on sustainable solid waste management* (pp. 1-20).

# Cutin Extraction

Italian and European Patent n. EP14750228.0



# Industrial plant



- Plant productivity: 200 ton/years by 2023.
- Plant Capacity: 150Kg/h;
- Yield of extraction: 13%



Horizon 2020  
European Union funding  
for Research & Innovation



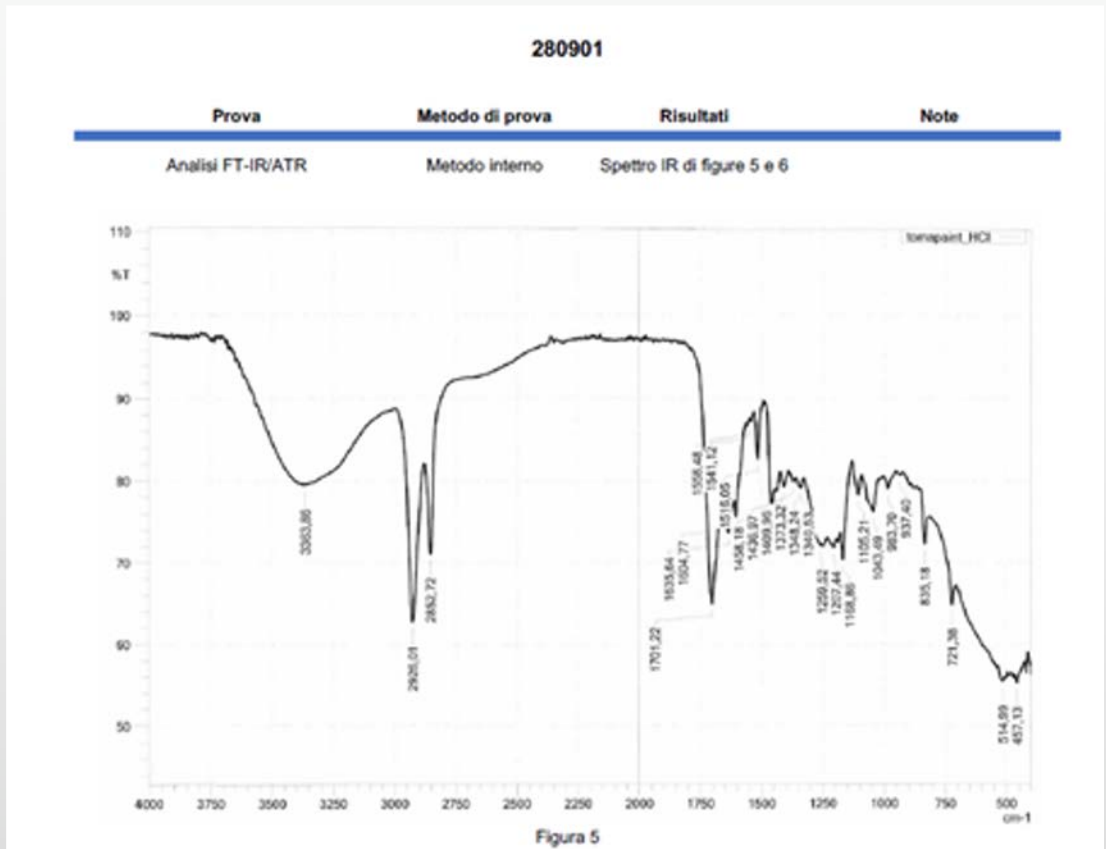


# Characterization

- Cutin composition.

Humidity	28.72%
Ash	9.5%
NaCl	0.28%
N (total)	0.48 mg/kg
Lipids	1.93%
Lycopene	152 mg/kg
Density	1.03 g/cm <sup>3</sup>
Flocculation measure	14% in 1.5h

- IR spectra obtained on cutin samples by FTIR technique





# Solubility

- Completely soluble in organic solvents:

Solvent	Solubility of cutin
Ethanol	39 g/L
THF	134 g/L
DOWANOL DPM	<b>freely soluble</b>
MIBK	<b>freely soluble</b>
Buthyl glycole	<b>freely soluble</b>

- Up to 95% solubility in aqueous ethylenediamine solution (2%).
- Up to 27% solubility in polyphosphate/ethanol solvent.
- Up to 75% solubility in methanol.

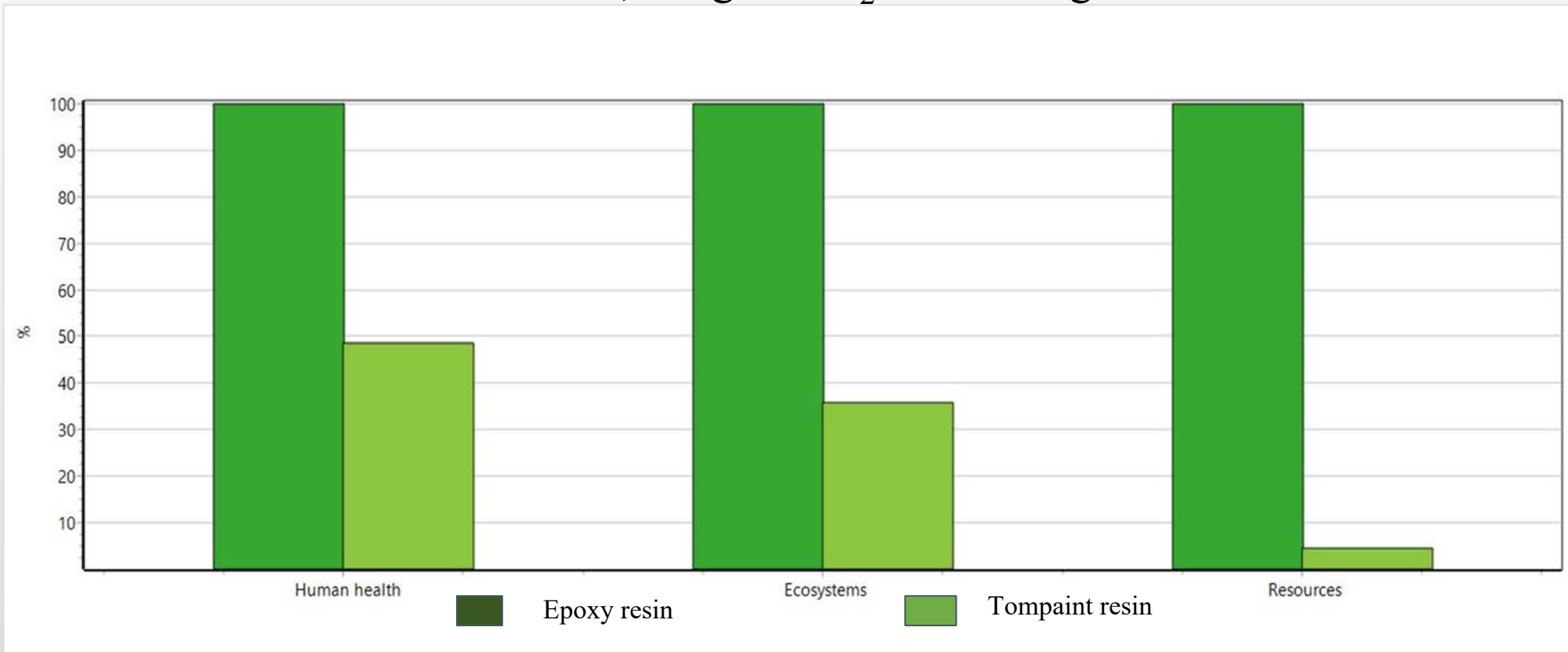
Legend: THF: Tetrahydrofuran; DOWANOL: Dipropylene Glycol-methyl-Ether. \* of natural origin. MIBK: Methyl-isobutylketone.

Table 2. Cifarelli, A., Cigognini, I., Bolzoni, L. and Montanari, A., 2016. Cutin isolated from tomato processing by-products: extraction methods and characterization. In *Proceedings of CYPRUS 2016 4th international conference on sustainable solid waste management* (pp. 1-20).

# Climate Impact

## Comparison 1kg epoxy resin VS 1 kg **Tomapaint®** resin

LCA: - 4,81 kg of CO<sub>2</sub> for each kg of cutin



ReCiPe 2016 Endpoint (E)V1.04/World (2010)E/E/ Impact Damage

# Application on tinplate

## PROBLEM

Food metal cans internally coated by oil-based paints



- Consumption of fossil resources
- Risk of food contamination with dangerous substances (eg BPA)

## SOLUTION

Replacement of synthetic resins with Bio-resin → Bio-lacquer

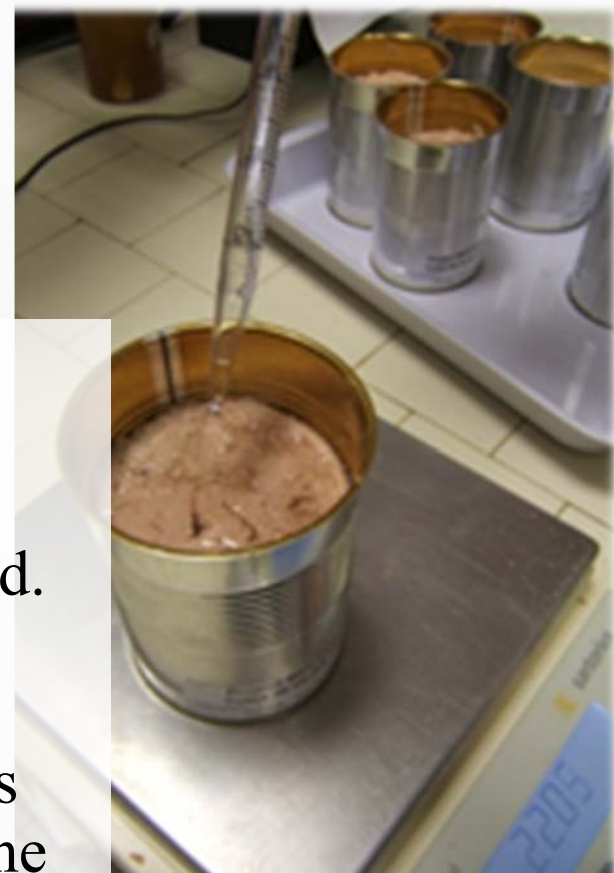


- + Valorisation of by-products
- + Safety for the consumers

## Application on tinplate

✓ Use of cutin directly in dedicated formulation

- BPA free.
  - No modification of the sensory properties of the food.
  - Better corrosion resistance vs synthetic paints.
- An industrial trial for the production of metallic cans for tomato and tuna products will be carried out in the coming weeks.

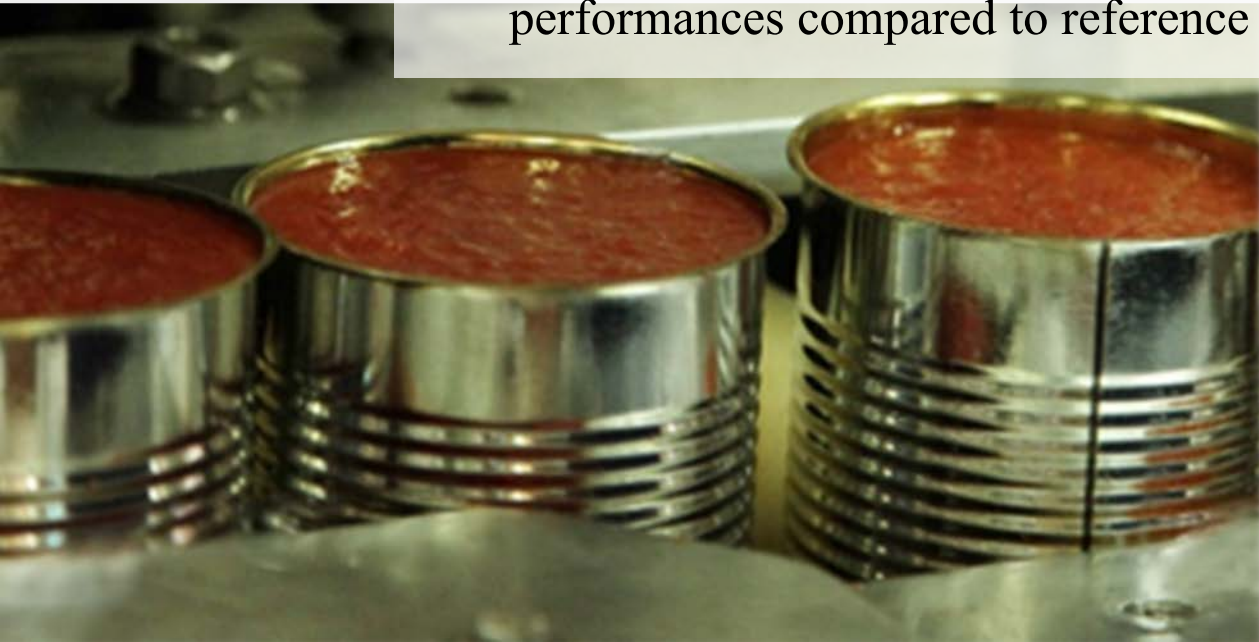




## Application on tinplate

Standard Test were carried out on coated tinplate sheets

- Reactivity by MEK double rubs
- Mechanical performance
- Adhesion by crosshatch.
- Tooled ends porosity check with  $\text{CuSO}_4$ .
- Thermal treatment at high T in several media showed good performances compared to reference standard.



## Application on aluminium

- A. Room temperature cured cutin-based coating applied on a AA2017 T4 alloy, grammage 6.5g/m<sup>2</sup>.
- A. Cured cutin-based coating (at 200°C for 10 minutes) formulated for industrial purposes and applied on AA6063 alloy, grammage 6.5g/m<sup>2</sup>.
- Corrosion resistance 15 days of exposure to an artificial acidic rain at pH =4.5 and 30°C + acid rain spray tests at 30 °C for 4 weeks on cross scratched coupons.

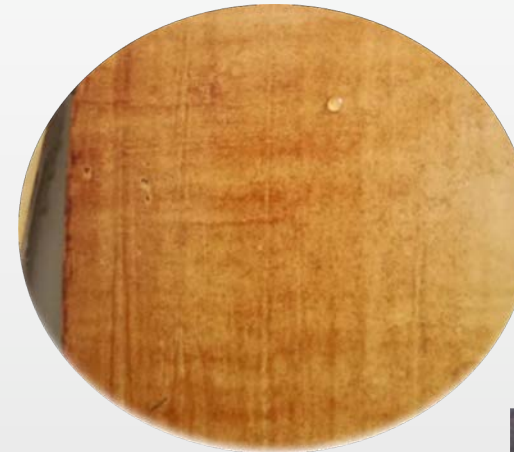


Very **low corrosion rates** of the substrates and very high **barrier effects**.

## Future applications

FOOD METAL PACKAGING	RESIN FOR WOOD PAINT	COSMETICS	PAPER PACKAGING COATING
2 BLN €	8 BLN €	400 BLN €	45 BLN €

- **Paper and Plastic:**  
Resistance to water, oil and fat.
- **Fabrics:**  
Water resistance.
- **Household detergents and cosmetics:**  
Assessed as natural product, low microbiological total charge.



# Collaborations

- **UniFE** → Department of Industrial Chemistry.
  - Study on the corrosion resistance of cutin resin on aluminium and steel.
- **UniPR** → Department of Engineering and Architecture
  - Plant design and consulting.
- **FH Salzburg** → Department of Applied Sciences
  - Study on the application of cutin-rich extracts to low-durable wood species.







## Thanks for your attention

### **CONTACTS INFO**

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