coim

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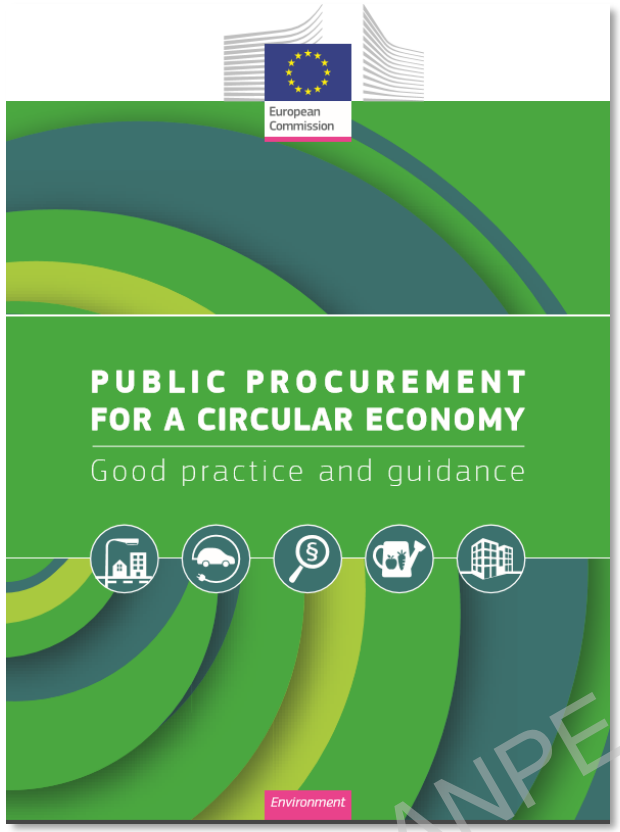
“New polyester polyols based on chemical recycling of PET”

A. Gallipoli – R&D Manager

Push from media and public opinion…

Push from legislation…..

GPP Green Public Procurement



Europe's **public authorities** are major consumers. By using their **purchasing power** to choose **environmentally friendly goods, services and works**, they can make an important contribution to sustainable consumption and production - what we call Green Public Procurement (GPP) or green purchasing.

EPBD Energy performance of buildings directive

Buildings are responsible for approximately **40% of energy consumption** and **36% of CO2 emissions** in the EU, making them the single largest energy consumer in Europe. To boost energy performance of buildings the EU has established a **legislative framework** that includes the Energy performance of buildings directive (EPBD)

Push from legislation…..

Dal GPP ai Criteri Ambientali Minimi (CAM)

I Criteri Ambientali Minimi (CAM) sono i requisiti ambientali (obbligatori) definiti per le varie fasi del processo di acquisto, volti a individuare la soluzione progettuale, il prodotto o il servizio migliore sotto il profilo ambientale.

2.4.2.8 Isolanti termici ed acustici

- non devono essere prodotti utilizzando **ritardanti di fiamma che siano oggetto di restrizioni o proibizioni**;
- non devono essere prodotti con **agenti espandenti con un potenziale di riduzione dell'ozono superiore a zero**;
- il prodotto finito deve contenere le **quantità minime** (v. Tabella) di **materiale riciclato** e/o recuperato

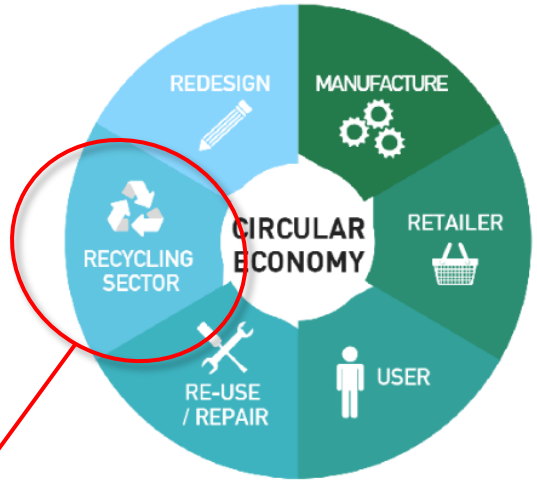
Gli isolanti in poliuretano

- Per gli isolanti poliuretanici è richiesto un **contenuto minimo di materiale riciclato e/o recuperato compreso tra l'1 e il 10%** in funzione della tipologia del prodotto e della tecnologia adottata per la produzione

	Isolante in forma di pannello	Isolante stipato, a spruzzo/insufflato	Isolante in materassini
Cellulosa		80%	
Lana di vetro	60%	60%	60%
Lana di roccia	15%	15%	15%
Perlite espansa	30%	40%	8%-10%
Fibre in poliestere	60-80%		60 - 80%
Polistirene espanso	dal 10% al 60% in funzione della tecnologia adottata per la produzione	dal 10% al 60% in funzione della tecnologia adottata per la produzione	
Polistirene estruso	dal 5 al 45% in funzione della tipologia del prodotto e della tecnologia adottata per la produzione		
Poliuretano espanso	1-10% in funzione della tipologia del prodotto e della tecnologia adottata per la produzione	1-10% in funzione della tipologia del prodotto e della tecnologia adottata per la produzione	
Agglomerato di Poliuretano	70%	70%	70%
Agglomerati di gomma	60%	60%	60%
Isolante riflettente in alluminio			15%

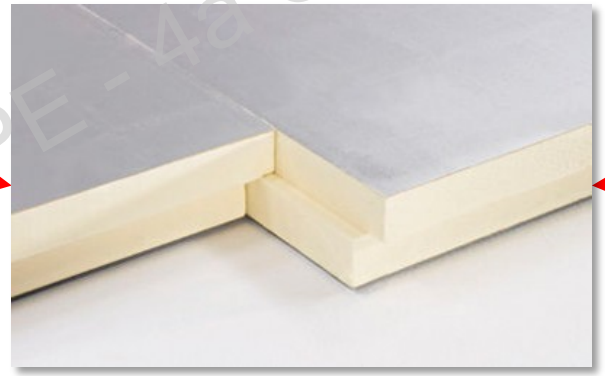
Circular economy

A **circular economy** is an economic system aimed at eliminating waste and the continual use of resources. Circular systems employ reuse, sharing, repair, refurbishment, remanufacturing and **recycling** to create a closed system, minimising the use of resource input and the creation of waste, pollution and emissions



Carbon footprint

A **carbon footprint** is historically as the total emissions caused by an individual, event, organization, or product. Greenhouse gases, including carbon dioxide, can be emitted through land clearance and the production and **consumption** of food, **fuels**, manufactured goods…



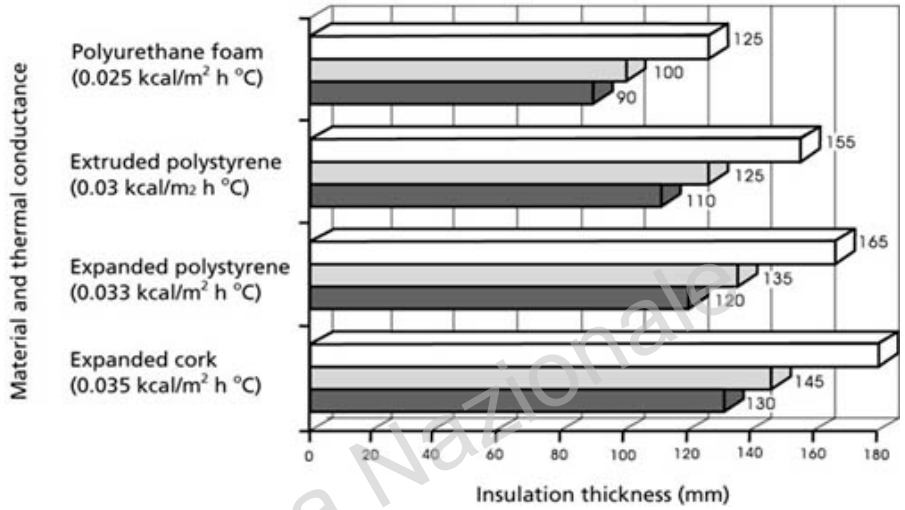
Would polyurethane foam containing recycled materials be considered a «*sustainable match*»?

Carbon footprint…

Thermal insulation of rigid polyurethane foam

In the EU more than 40% of energy use is fossil fuel-based, much of which is associated with the heating and cooling of buildings.

The use of polyurethane rigid foam insulation would reduce CO2 emissions by 10%



From: Food and Agriculture Organization of the United Nations (FAO)

isopa EUROPEAN DIISOCYANATE & POLYOL PRODUCERS ASSOCIATION

PU EUROPE EXCELLENCE IN INSULATION
FEDERATION OF EUROPEAN RIGID POLYURETHANE FOAM ASSOCIATIONS

Factsheet n° 16

Durability of polyurethane insulation products

Property	Initially declared characteristics	Measured value after 28 years
Facing: Aluminium multilayer facing on both sides, one side perforated		
Thickness	100 mm	101.08 mm
Moisture content	Not declared	0.05 Vol.%
Compressive strength	150 kPa	208 kPa
Thermal conductivity	0.030 W/(m·K)	0.0292 W/(m·K) (10°C mean temperature)
Reaction to fire	Class B2 (normally ignitable) in accordance with DIN 4102-1 No flaming droplets / particles	Class B2 (normally ignitable)[4] in accordance with DIN 4102-1 No flaming droplets / particles

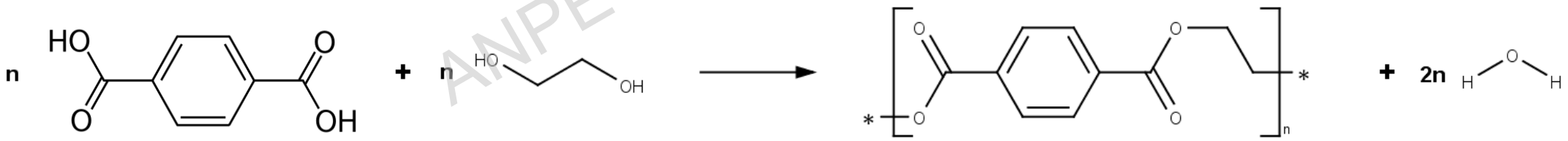
Circular economy:
PET applications and synthesis

An overview

bottles

fibers

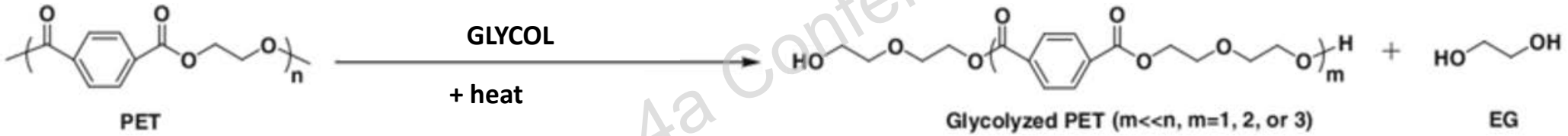
- very inert material, resistant to attack by micro-organisms, and does not react with food products
- is used in fibres for clothing, containers for liquids and foods (90%), thermoforming for manufacturing



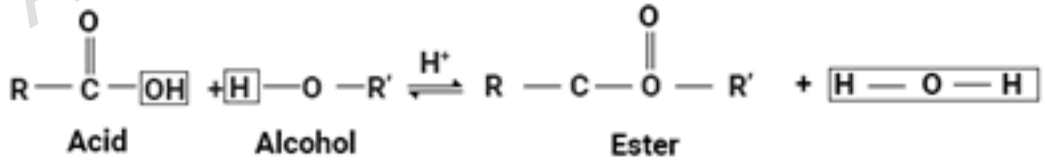
Terephthalic Acid | Ethylene Glycol | Polyethylene Terephthalate | Water

Circular economy

Synthesis of polyester polyols based on recycled PET



Chemical recycling is any process by which a polymer is chemically reduced to its original monomer form so that it can eventually be processed and remade into new plastic materials.



Esterification is the well-known **equilibrium reaction** of acids and alcohols to form **esters**, with varying means being applied to push the equilibrium to the product.

Circular economy

COIM polyester polyols based on recycled PET:

- ❑ 20 years of proven experience in PET polyesters
- ❑ **2019 improved version**
- ❑ Over 20 products for rigid foams applications
- ❑ Countertypes of PA based polyesters are available
- ❑ Tailor made for customer needs
- ❑ Main characteristics:

- ✓ Better processing
- ✓ Quality and reactivity consistency
- ✓ Same reaction profile as PA based polyesters

	m.u.	min-max
Functionality		2.0 - 3.0
OHv	mg KOH/g	180-500
Viscosity	cps @ 25°C	1500-15000
Recycled content	%	5-45

2019 PET improved technology:

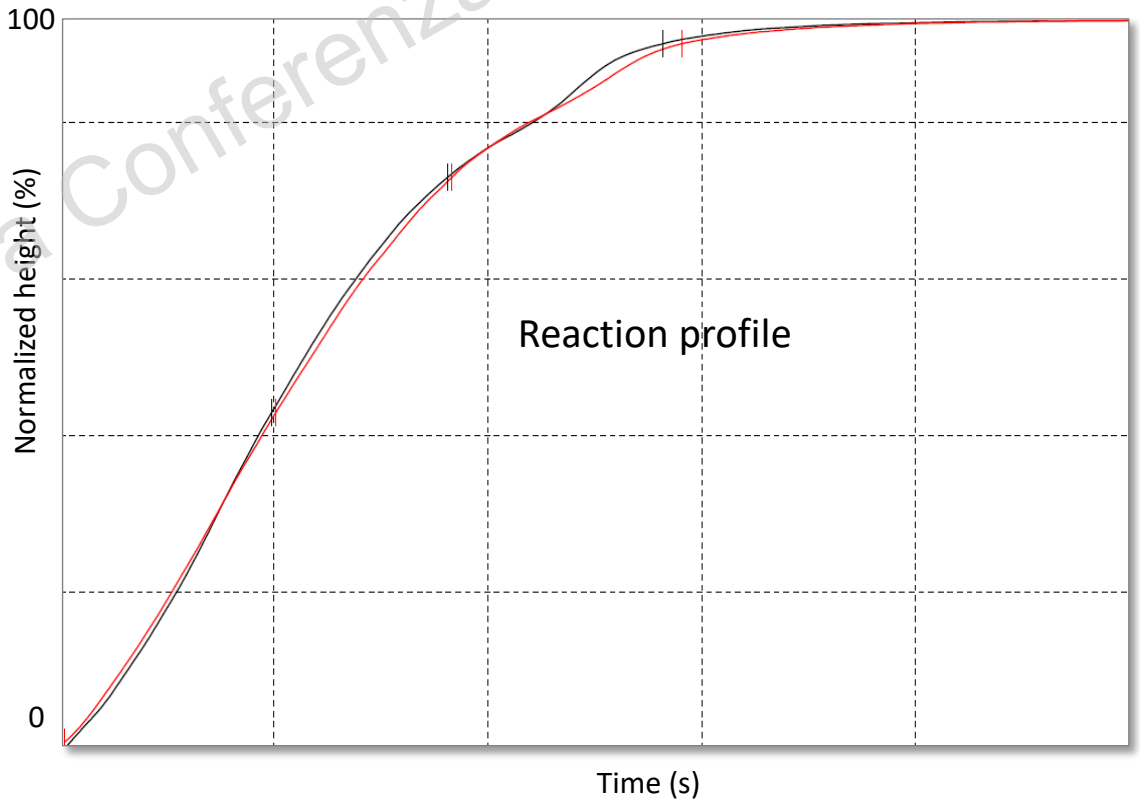
Polyurethane foam manufacturing: reactivity with MDI

PA vs PET based polyesters comparison

	m.u.	PA polyol	PET countertype
Functionality		2,0	2,0
OHv	mg KOH/g	200-215	200-215
Viscosity	cps @ 25°C	5800	5800
Recycled content	%	-	35-40

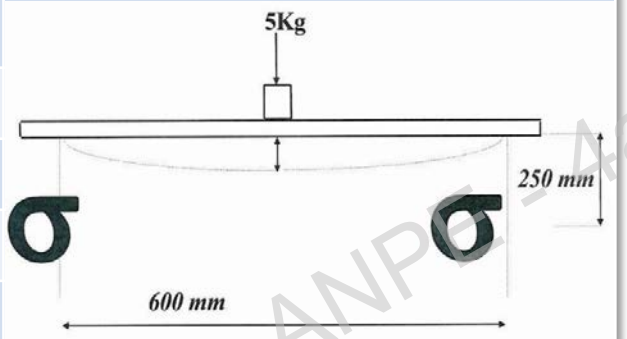
We are now able to guarantee **tight reactivity specifications**

PIR foam recipe:	PA	PET
POLYOL	100	100
Flame retardants	16	16
Silicone surfactant	3.0	3.0
KOct	0,7	0,7
Kac	0,4	0,4
Amine cat.	0,4	0,4
Water	1,3	1,3
Iso-Cyclopentane	19	19
MDI High Fn	205	205
Index	285	285
Cream Time (s)	10	10
Gel Time (s)	85	87
Tack free Time (s)	140	143
Free Rise Dens. (kg/m^3)	29,2	28,5



2019 PET improved technology:

curing and flowability

Mould dimension	**700 x 190 x 50 mm**
Mould Temp.	**60 ° C**
Overpacking	**10%**
Demoulding Time	**6 min**
Test method	

Same curing

	PA	PET
Curing after 7,5 min	6,1 mm	5,8 mm
Curing after 10 min	120 mm	119 mm
Curing after 15 min	123 mm	124 mm

Similar flowability

	PA	PET
Flowability	237 g	246 g

2019 PET improved technology:

Mechanical characteristics, dimensional stability and fire properties of foams

	PA	PET
Dimensional Stability		
% var. -25°C		
Length	- 0,0	- 0,1
Width	- 0,1	- 0,1
Thickness	+ 0,1	+ 0,1
Specimens Density (kg/m³)	29,9	29,3
% var. 70°C/90% r.h.		
Length	+ 1,6	+ 0,9
Width	+ 0,9	+ 0,9
Thickness	- 0,5	- 0,7
Specimens Density (kg/m³)	30,2	29,2
10% compression strenght (kPa) EN ISO 844		
Parallel to rise (Mpa)	0,24	0,23
Perpendicular to rise	0,9	0,9
Specimens Density (kg/m³)	30,7	30,5
Small flame test (EN ISO 11925-2)	12,5 cm	11,5 cm

- ❑ Similar mechanical characteristics
- ❑ Similar dimensional stability
- ❑ Better fire

2019 PET improved technology:

Emulsion with pentane and lambda

After 2 min

After 2 h

- Same emulsification power
- Further studies on lambda optimization are ongoing

	PA	PET
Closed cells %	88,6	88,1
Lambda 10°C (W/m·K)	0,0225	0,0230

What have we just discussed today?

- Public opinion and European legislation are pushing for a **more environmentally sustainable products**
- How polyurethane foam and **polyesters based on recycled PET** can contribute
- **COIM new polyesters** based on recycled PET overview
- **Comparison with PA** polyester polyols (reactivity, physical-mechanical characteristics)

What about the future?

- **COIM** deeply focused in sustainable projects in partnership with several companies and universities
- synthesis of **polyols 100% from renewable sources**
- COIM at the final step of a **new process** for the **production of high quality PET based polyols**

Thank you