



**INDUSTRIE SPA**

# **RAVECARB**

high performance polycarbonate glycols

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the new generation of chemistry

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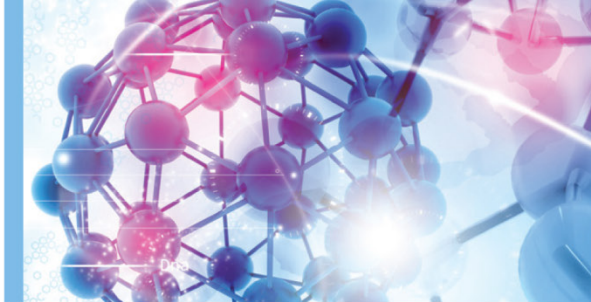
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# HIGH PERFORMANCE AND QUALITY

Ravecarb are polycarbonate diols (PCD), which are aliphatic polycarbonate with molecular weight around 500-3000, and two terminal OH groups. PCD are increasingly well known and used intermediates for high performance PU systems in sectors like synthetic leathers, various coatings and resins for flooring or wooden surfaces, paints, elastomers, adhesives, sealants, liquid inks for printers, etc.

In all those sectors PCD are undisputedly considered as the ultimate solution in terms of quality improvement for mechanical resistance, chemical resistance, elongation property, UV resistance, anti-scratch and anti-stain properties.





**RAVECARB**

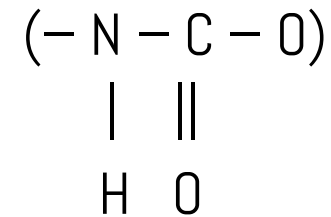


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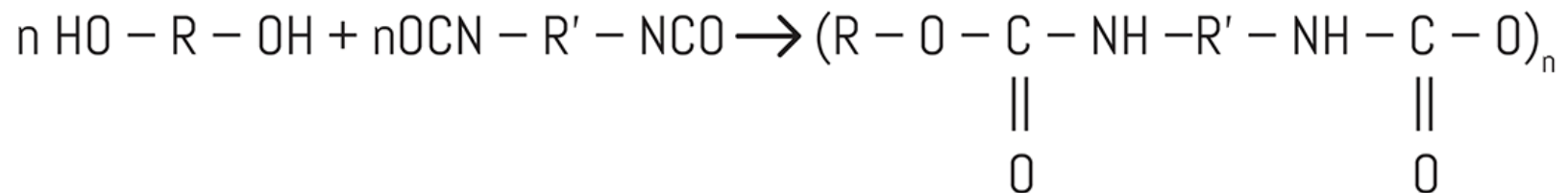
In all those sectors PCD are undisputedly considered as the ultimate solution in terms of quality improvement for mechanical resistance, chemical resistance, elongation property, UV resistance, anti-scratch and anti-stain properties.

# POLYURETHANES (PUR)

PUR are polymeric substances containing urethane groups



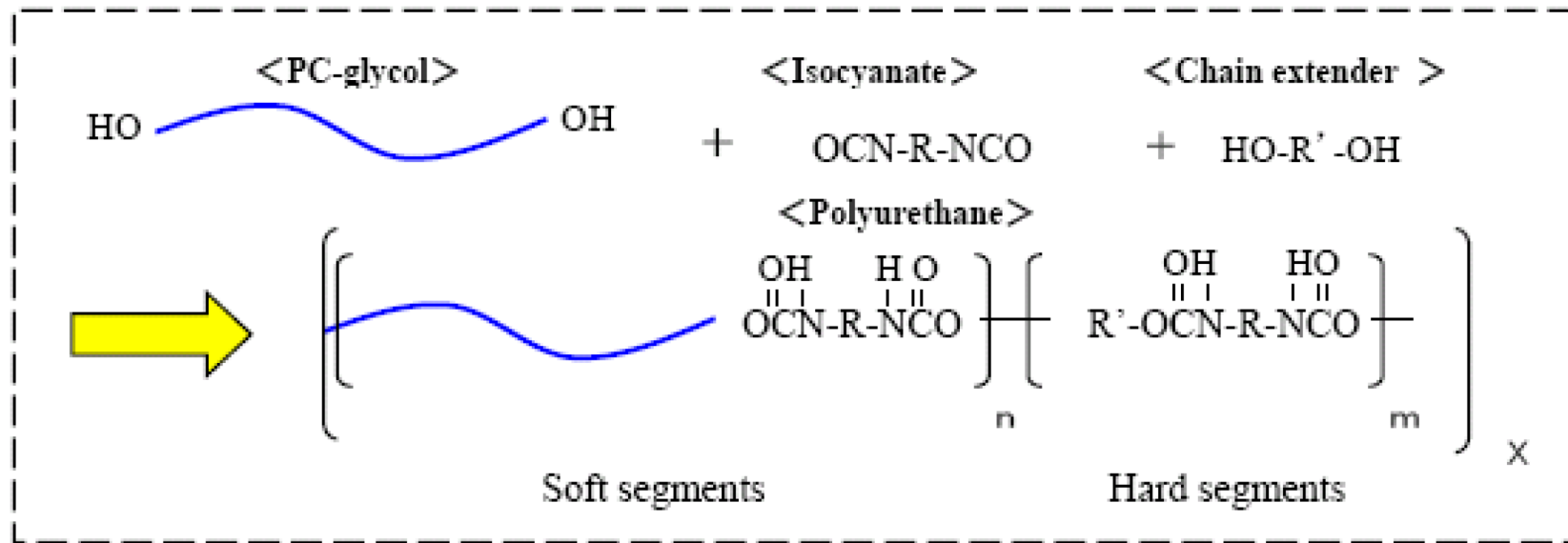
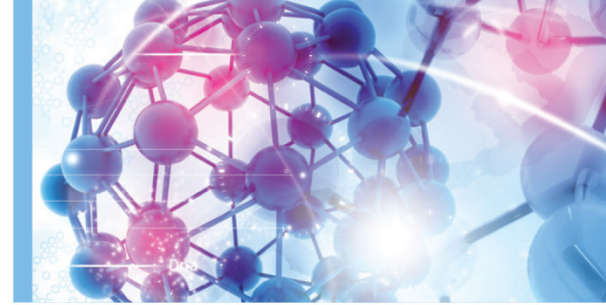
Through the reaction between polyalcohols and isocyanates.



Polyalcohols and isocyanates structures, together with possible additives, determine the characteristics of the final PUR product.



# PUR SYNTHESIS

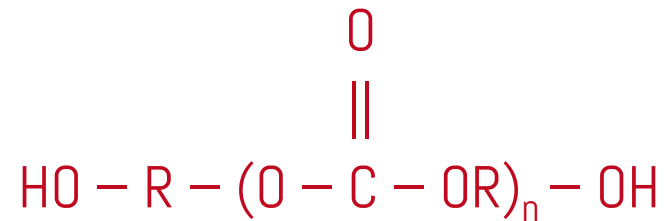


## POLYMER GLYCOLS

- A) POLYETHER GLYCOLS – PPG poly (oxy propylene) glycol // PTMG poly (oxytetramethylene) glycol
- B) POLYESTER GLYCOLS – PCL poly (caprolacton) glycol // PHC poly (hexamethylene) carbonate glycol //PBA poly (butylene adipate) glycol // PHA poly (hexamethylene adipate) glycol
- C) POLYCARBONATE DIOLS - RAVECARB

# THE QUALITY OF RAVECARB

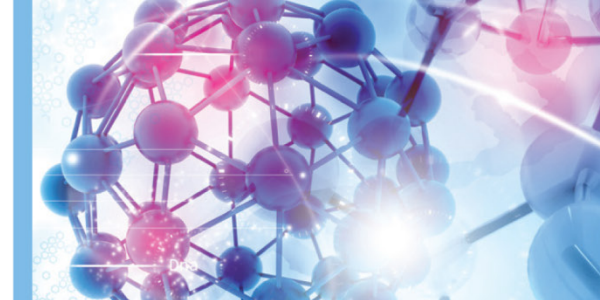
Ravecarb's are High performance polycarbonate diols



Aliphatic polycarbonate diols deriving from the reaction of dimethylcarbonate with aliphatic diols  
Used as intermediates for the production of high performances polyurethanes



# CHEMICAL PHYSICAL PROPERTIES



	<b>RAVECARB 102</b>	<b>RAVECARB 103</b>	<b>RAVECARB 106</b>	<b>RAVECARB 107</b>	<b>RAVECARB 111</b>
Chemical Structure	Homopolymer from hexandiol	Copolymer from hexandiol and pentandiol	Homopolymer from hexandiol	Copolymer from hexandiol and pentandiol	Copolymer from polycaprolacton diol and hexandiol
Appearance	White solid	Liquid	White solid	Liquid	Liquid
Theoretical OH functionality	2	2	2	2	2
OH number (mg KOH/g)	106 – 118	100 – 120	53 – 59	58 – 64	56
Average molecular weight	1000	1025	2000	1850	2000
Acidity number (mg KOH/g)	0,1	0,1	0,1	0,1	0,1
Color APHA	200	100	200	200	<100
Water %	0,1	0,1	0,1	0,1	0,1
Melting range °C	33-43	-----	36-50	-----	-----
Viscosity (cps at 50°C)	1000	1000	10000	8000	3500

# CHEMICAL PHYSICAL PROPERTIES

UNDER DEVELOPMENT	RAVECARB 101	RAVECARB 108	RAVECARB 109
Chemical Structure	Homopolymer from hexandiol	Homopolymer from hexandiol	Copolymer from 1.6 hexandiol and 1.4 cyclohexanedymethanol
Appearance	White solid	White solid	Liquid
Theoretical OH functionality	2	2	2
OH number (mg KOH/g)	150	37,5	122
Average molecular weight	750	3000	900
Acidity number (mg KOH/g)	0,1	0,1	0,1
Color APHA	200	200	<100
Water %	0,1	0,1	0.1
Melting range °C	30-36	40-55	-----
Viscosity (cps at 50° C)	600	7000 ( at 75° C)	11750 ( at 75° C)



**RAVECARB**

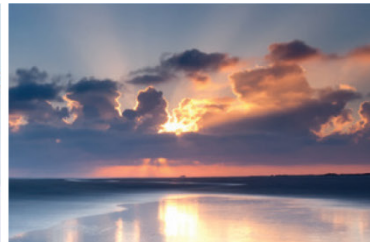
## Product list of Ravecarb 2 Series [Currently under development]

<b>RAVECARB 90:10</b>	<b>Mw</b>	<b>OH [KOH mg/g]</b>	<b>AV [KOH mg/g]</b>	<b>VISCOSITY [mPa·s (60°C)]</b>	<b>TG [°C]</b>	<b>APPEARANCE</b>
291	1000	112	<0.5	1800	-53.2	Liquid
292	2000	56	<0.5	4600	-45.3	Liquid
293	3000	37	<0.5	15700	-42.0	Liquid
294	4000	28	<0.5	33300	-40.9	Liquid
295	5000	22	<0.5	61000	-39.8	Liquid

Whenever used in polyurethane formulations,  
Ravecarb's provide

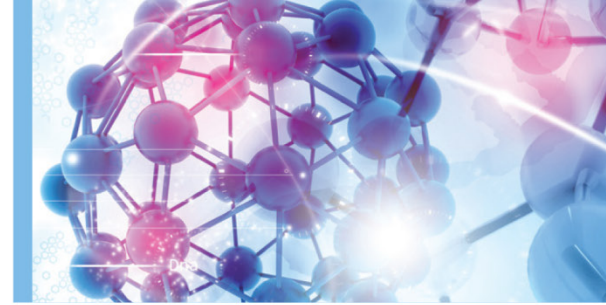
## SUPERIOR RESISTANCE TO

- temperature
- hydrolysis
- degradation by ultraviolet light
- oxygen
- solvents

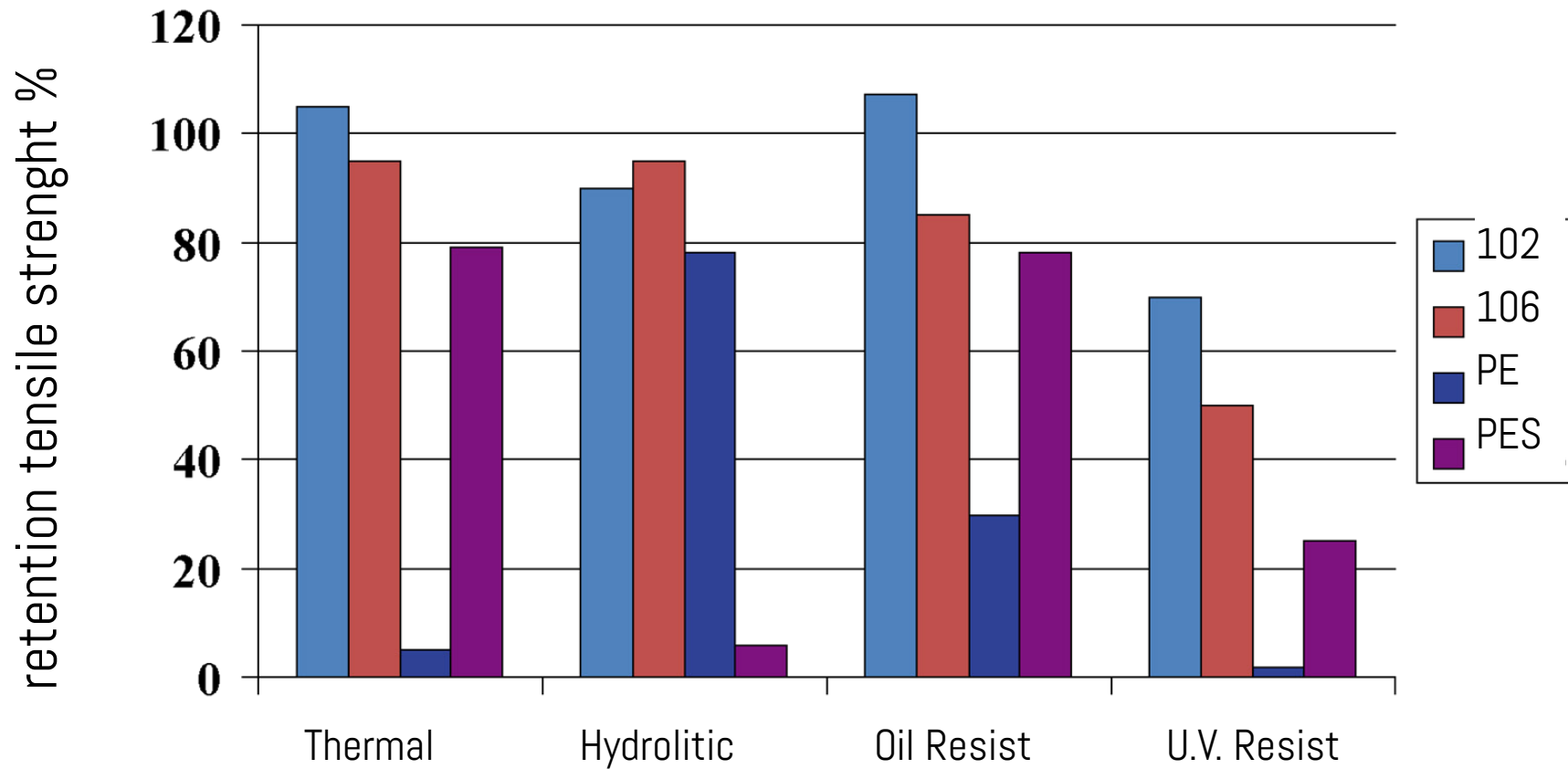


# PU FILM

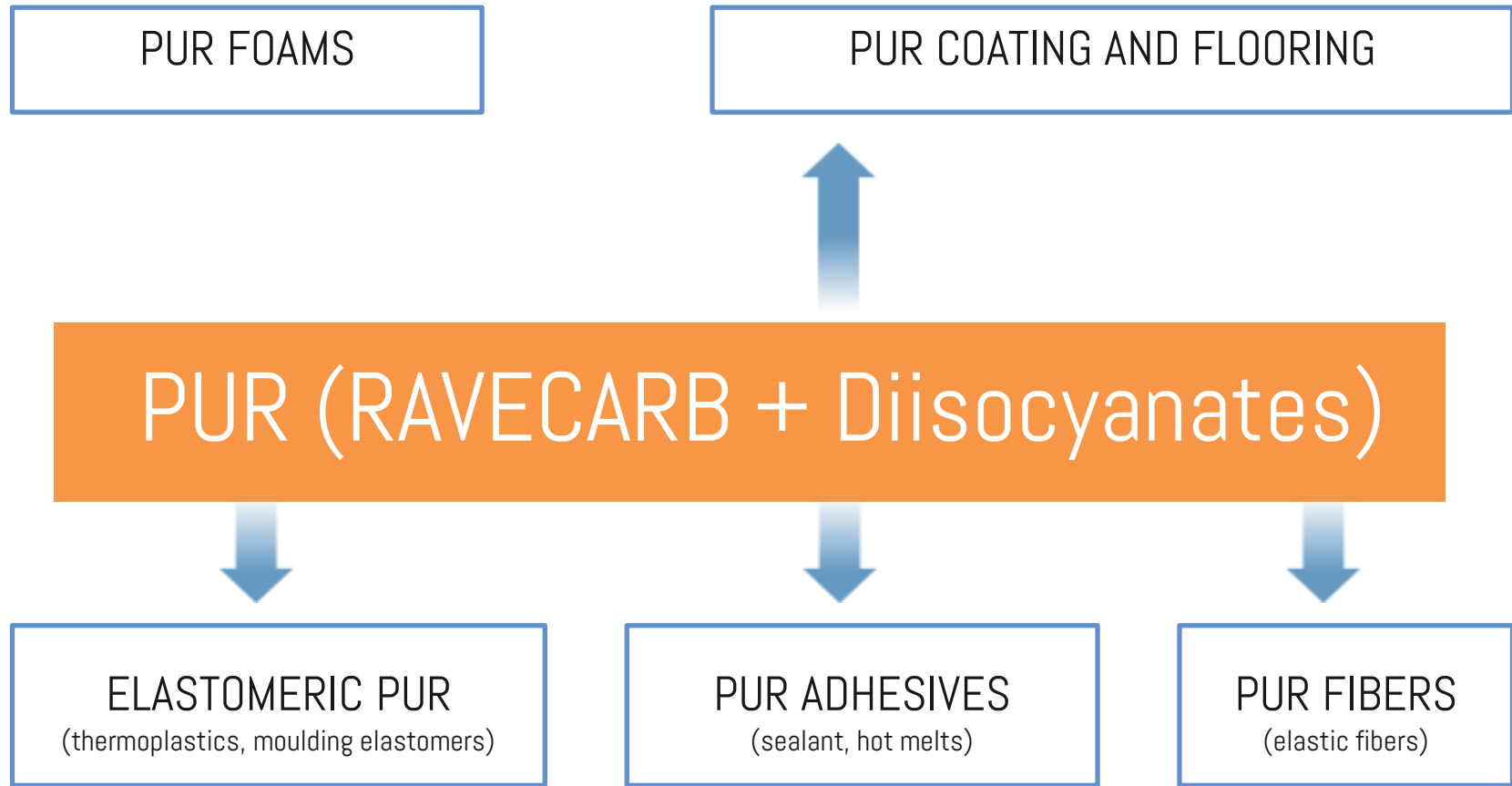
## RESISTANCE



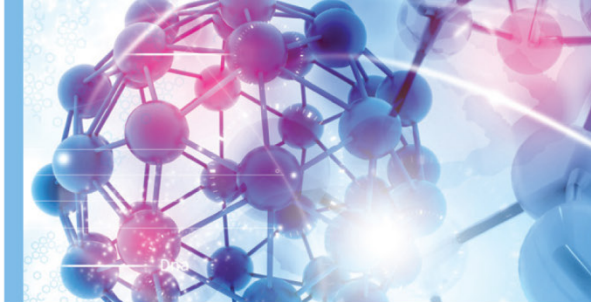
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PE=polyethers; PES= polyesters







**RAVECARB**

	<b>POLYETHER</b>	<b>POLYESTER</b>	<b>RAVECARB</b>
<b>USES</b>	PUR foam, Elastic fiber, synthetic leather	Thermoplastic Pur, sundry uses (shoe sole)	Paints and varnishes, synthetic leather, thermoplastics, adhesives
Tensile strength	fair	good -excellent	excellent
Heat stability	poor	good	excellent
Weather ability	poor	good	excellent
Hydrolysis resistance	good	fair	excellent
Fungi resistance	excellent	fair	good
Oleic acid resistance	poor	good	excellent

# COMPARATIVE TESTS: THERMOPLASTIC PUR

## Synthesis conditions

Polyol + BD 14 (14 Butandiol) + MDI  
(4,4' diphenyl methanediisocyanate)  
Stoichiometric condition:  $\text{NCO/OH} = 1,04 // 14$   
 $\text{BD/Polyol} = 1$   
Polymerisation 60-80°C in DMF; 5 hours

## Receipe

Polyol	100 part by weight
14 BD	9
MDI	52
DMF	300 ( 100 + 200)

(Polyol+ 14BD in DMF)+ MDI - (80 °C, 3 h) + DMF  
to control the increase of viscosity  
PUR is dried in ventilated oven at 70 °C and then  
pressed at 150 °C to obtain PUR specimen



RAVECARB

# COMPARATIVE TESTS: THERMOPLASTIC PUR

## Synthesis conditions

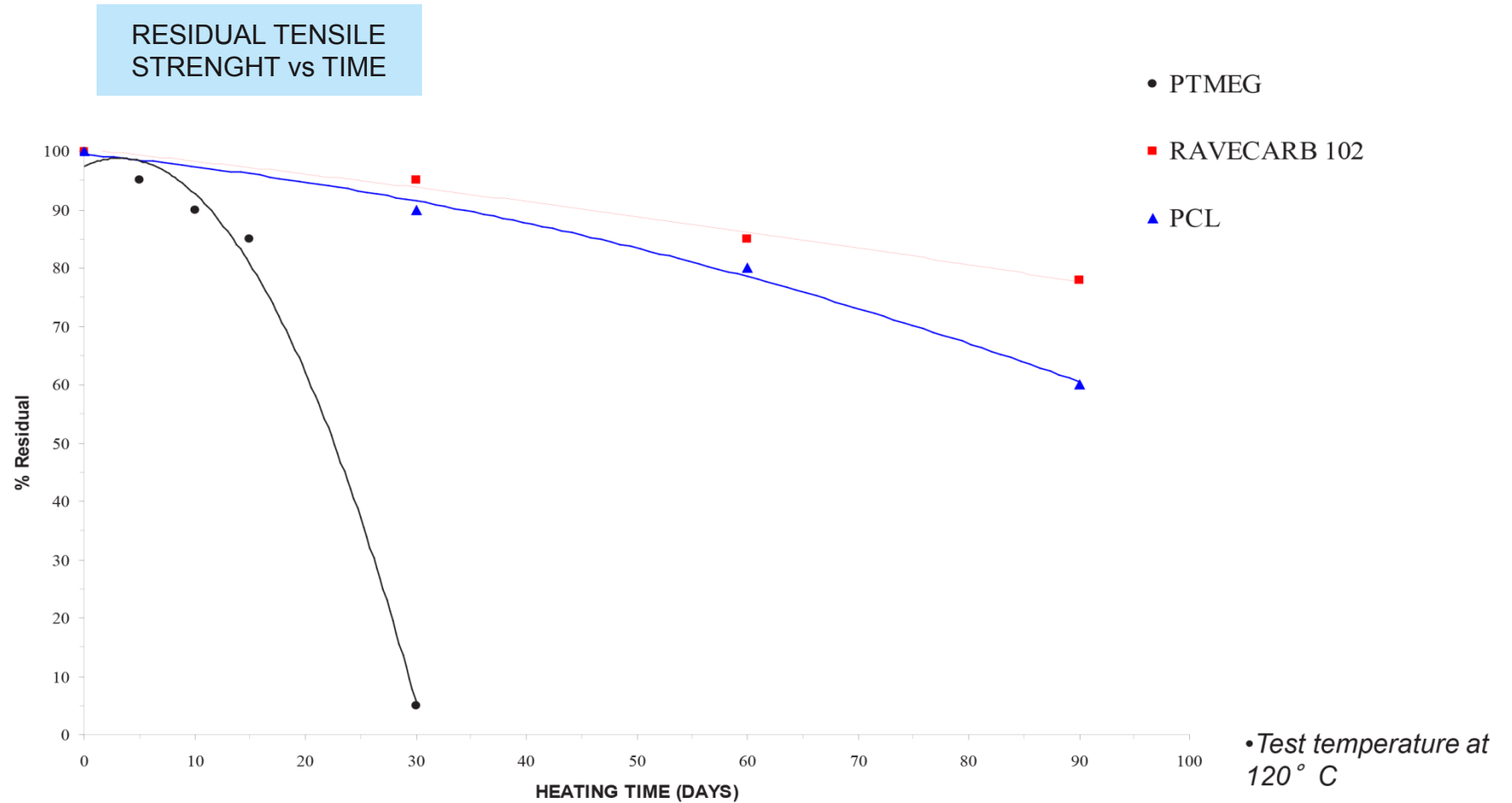
Polyol + BD 14 (1,4 Butandiol) + MDI  
(4,4' diphenyl methanediisocyanate)  
Stoichiometric condition:  $\text{NCO/OH} = 1,04$  //  $1,4 \text{ BD/Polyol} = 1$   
Polymerisation 60-80°C in DMF

## Polyol

PCL = Polycaprolactone  
PTMEG = Polytetramethyleneglycol

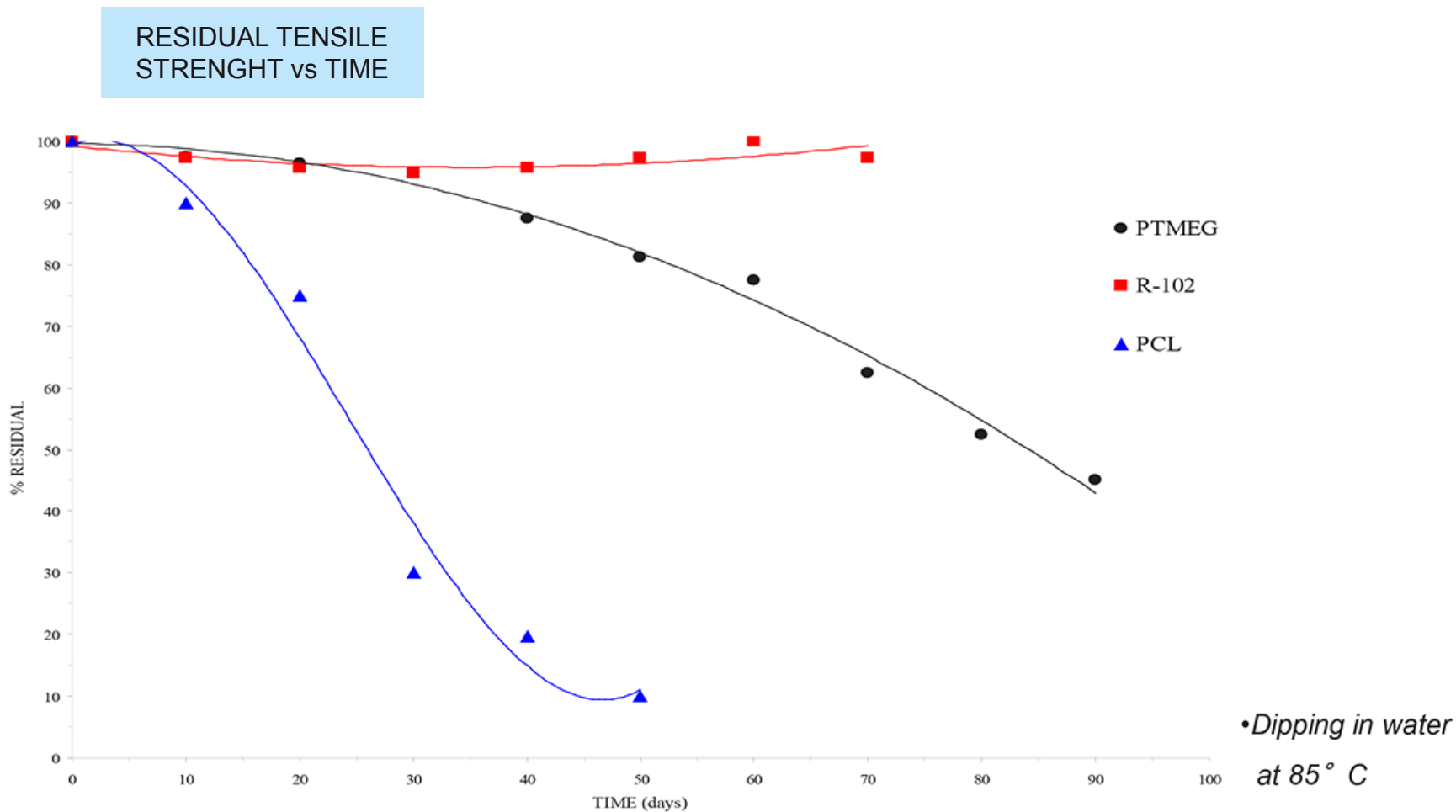
Polyols \ Properties	MODULUS 100% Kg/cm <sup>2</sup>	ELONGATION %	TENSILE S. Kg/cm <sup>2</sup>
RAVECARB 102	80	570	400
PCL	50	500	500
PTMEG	40	400	640

# THERMAL RESISTANCE OF THERMOPLASTIC PUR



# HYDROLISIS

## RESISTANCE OF THERMOPLASTIC PUR



High MW Ravecarb increases the flexibility while low MW Ravecarb increases the cristallinity of PUR structures

<b>RAVECARB</b>	<b>MW</b>	<b>USES</b>
102	1000	Waterborne coatings, Lenses
103	1000	Waterborne coatings, Lenses
106	2000	Adhesives, Synthetic leather
107	1850	Adhesives, Synthetic leather





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