



# Polyurea hybrid coatings

## Raw materials comparisons and starting formulation



Operating in 17 countries, in 39 different locations, PCC SE currently employs over 3 300 people.



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the dynamic development of the chemicals business by exploiting the potential of new market segments and diversifying the portfolio of raw materials and chemical formulations in line with current trends in various industries. Every day, our specialists work on the stable growth and development of their organisations, making the PCC Group stronger and building a solid business platform for all contractors interested in reliable and long-term cooperation.

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<b>Polyols</b> 	<b>Chlorine</b> 	<b>Phosphorus</b> 	<b>Surfactants</b> 	<b>Alkylphenols</b> 
<ul style="list-style-type: none"> <li>• Polyether polyols</li> <li>• Polyester polyols</li> <li>• Prepolymers</li> <li>• Polyurethane Systems</li> </ul>	<ul style="list-style-type: none"> <li>• Chlorine</li> <li>• MCAA</li> <li>• Other Chlorine Downstream Product</li> </ul>	<ul style="list-style-type: none"> <li>• Phosphorus derivatives</li> <li>• Naphthalene derivatives</li> <li>• Polycarboxyethers (PCE)</li> </ul>	<ul style="list-style-type: none"> <li>• Anionic surfactants</li> <li>• Cationic surfactants</li> <li>• Nonionic surfactants</li> <li>• Amphoteric surfactants (betaines)</li> <li>• Chemical formulation</li> </ul>	<ul style="list-style-type: none"> <li>• Nonylphenol</li> <li>• Dodecylphenol</li> <li>• Tristyrylphenol</li> </ul>
<b>PCC CONSUMER PRODUCTS SA</b>	<b>PCC</b> <b>ROKITA SA</b>	<b>PCC</b> <b>INTERMODAL SA</b>	<b>PCC</b> <b>BAKKISILICON HF.</b>	<b>PCC</b> <b>SE</b>
<b>Consumer Products</b> 	<b>Energy</b> 	<b>Logistics</b> 	<b>Silicon</b> 	<b>Holding &amp; Projects</b> 
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## Polyurea hybrid coatings


Polyurea coatings are considered to be one of the best in terms of physicochemical and physicomechanical properties. Polyurea linkages are formed as a result of the reaction of NCO groups with amino groups. Aliphatic polyurea is excellent as a finish coat, with

some limitation to other applications due to raw materials high costs. Therefore, polyurea hybrid coatings are considered as solution with physicomechanical properties which are between the polyurea and polyurethane coatings.

### Prepolymer

Product name	Chemical name	Appearance / colour at 25°C	NCO content, % [m/m]	Dynamic viscosity at 25°C [mpa•s]	Density, at 25°C, [g/ml]
Rokanate M PE 1501	Prepolymer based on diphenylmethane diisocyanate	clear or opalescent liquid, colorless to yellow	15.0-16.0	700-1500	1.10-1.13

### Polyols

Product name	Chemical name	Appearance / colour at 25°C	Hydroxyl value [ASTM D4274-16, met. D]	Water content [ASTM D4672-18]	Acid value [ASTM D7253-16, bromothymol blue]
Rokopol EP2242.01	 Hydrophobic polyol	homogenous, clear liquid, light yellow to yellow	83-93	max. 0.1	max. 0.80
Rokopol D1002	Polyether polyol, polyoxypropylenediol	homogenous, clear liquid	108-116	max. 0.06	max. 0.08

### Dispersing agent

Product name	Description	Appearance / colour at 25°C	Water content % [m/m]	Inorganic pigments	Organic pigments
EXOdis PC220	Polyether copolymer	liquid	min. 99		•
EXOdis PC230	Polymeric wetting and dispersing agent with anionic character	liquid	min. 97.5	•	

### Flame retardant

Product name	Description	Appearance / colour at 25°C	Water content % [m/m]	Acid value [mg KOH/g]
Roflam P	tris(2-chloro-1-methylethyl) phosphate	homogenous, colourless liquid	max. 0.10	max. 0.10
Roflam R	Tetraphenyl resocinol diphosphate	homogenous, colourless liquid	max. 0.10	max. 0.10

## General formulation for polyurea hybrid coating

Rokopol EP 2242.01 is polyol for hybrid polyurea coatings, showing enhanced hydrophobic properties. Starting formulation is suitable for use in polyurea hybrid waterproofing membranes. In addition,

the coating from the recipe is characterized by good parameters of resistance to rain and foot traffic. These values are sufficient for industrial and construction applications.

### Compositions of components A and B

Component B	m [kg]
Rokanate M PE 1501	111
Component A	m [kg]
Rokopol EP2242.01	77.5
MPDiol	2.3
DETDA	16.4
Coscat 83	0.2
Sylosiv A3	2.0
Pigment paste	2.0
Defoamer	0.2

Samples were prepared by Sulzer air gun Mixcoat 1500-01 or by industrial unit **The Evolution G-35H**. Water sorption tests were made using the gravimetric method. Polyurea samples, approximately

20 cm x 20 cm were immersed in tap water for 7 days at room temperature. After this period, the samples were dried of residual water and weighed immediately.

### Physiochemical properties of the coat

Parameter	Result
Tensile strength, MPa	17.3
Elongation at break, %	383
Shore A	86
Shore D	34
Gelling time, s	10
Adhesion to concrete, MPa	3.3*
Water absorption, %	1.6

\* break in concrete



## EXOdis PC230 performance

EXOdis PC230 is a wetting and dispersing additive for inorganic pigments, particularly titanium white and iron oxides. The product provides excellent pigment stability in polyurea hybrid coatings

formulations. The following tables present the composition of pigment concentrates (colourants) prepared with EXOdis PC230 as a dispersing agent and Rokopol D1002 as a carrier.

### Formulation of titanium dioxide concentrate

Component	m [kg]
Rokopol® D1002	33.5
EXOdis PC230	6
Defoamer	0.5
Pigment White 6	60

### Formulation of iron yellow oxide concentrate

Component	m [kg]
Rokopol® D1002	44.5
EXOdis PC230	5
Defoamer	0.5
Pigment Yellow 42	50



## Results of application tests

### Sedimentation



To the polyol mixture of the polyurea formulation (Component A), 2% wt of colourant was added. After 30 days at room temperature

tendency to sedimentation was determined. The results, as well as comparison to colourants from the market are shown on following pictures:



#### Pigment White 6 colourants

Initial appearance

Appearance after 30 days in RT



Pigment concentrate with Exodis PC230

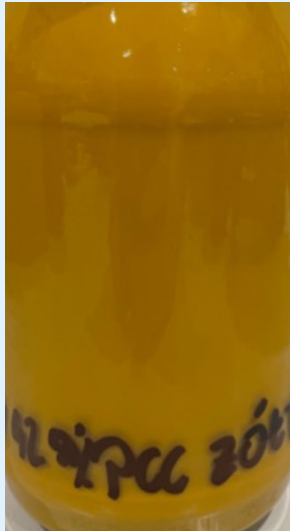



Reference colourant



#### Pigment Yellow 42 colourants

Initial appearance

Appearance after 30 days in RT



Pigment concentrate with Exodis PC230



Reference colourant

## Physicochemical properties of PC230 pigment paste coating

The following table presents the physicochemical properties of polyurea hybrid coatings, coloured with pigment concentrates, prepared in the previous example.

Parameter	Pigment White 6	Pigment Yellow 42
Tensile strength, MPa	18.7	16.8
Elongation at break, %	494	520
Shore A	84	84
Shore D	33	30
Gelling time, s	8	8

**EXOdis PC230 provides excellent pigment stability in polyol mixture, significantly reducing the sedimentation of pigments. The product does not affect physicochemical properties of the coat.**





## Roflam P performance

Roflam P (TCPP) is one of the most effective flame retardant due to the presence of chlorine and phosphorus in the chemical structure. The use of Roflam P increases the resistance of the material to the fire and reduces the rate of flame propagation in the event of material burning. The product is widely used as a flame retardant of coating

and construction materials based on various type of resins. Following table presents the results of application tests of polyurea hybrid coating after addition of 10% wt of Roflam P to the polyol mixture:

Parameter	Result
LOI, %	22.3
Tensile strength, MPa	7.3
Elongation at break, %	340
Shore A	83
Shore D	26





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**PCC Group**  
Sienkiewicza 4  
56-120 Brzeg Dolny, Poland  
[products@pcc.eu](mailto:products@pcc.eu)

Please visit our capital group business platform:  
**[www.products.pcc.eu](http://www.products.pcc.eu)**



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