

# Roflam Series

Flame retardants for composite industry



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



# About Us

PCC Rokita SA is one of the largest chemical companies in Poland, offering a wide range of advanced products for various industrial sectors. The company has four main chemical complexes: Chlorine Complex, Polyols Complex, Phosphorus Chemicals Complex and Lubricants Complex. Each specialises in the production of innovative raw materials and additives used in a wide range of industries. Thanks to modern technologies and strong research and development facilities, PCC Rokita SA plays an important role in the European chemical market,

providing high quality products that meet the stringent requirements of its customers.

PCC Rokita pays particular attention to sustainable development, which is one of the key elements of its corporate strategy. In order to strengthen its competitive position in the chemical market, the company is committed to promoting responsible production and consumption along the entire value chain. The concept of sustainable development is therefore a key aspect of all the company's management and operational processes.

<b>PCC ROKITA SA</b> <b>PCC PCG</b> <b>OXYALKYLATES</b> <b>IRPC</b>	<b>PCC</b> <b>ROKITA SA</b>	<b>PCC</b> <b>ROKITA SA</b>	<b>PCC EXOL SA</b> <b>PCC CHEMAX INC</b> <b>PCC PCG OXYALKYLATES</b>	<b>PCC</b> <b>SYNTEZA</b>
<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> 
<ul style="list-style-type: none"> <li>• Household &amp; industrial Cleaners, Detergents and Personal Care Products</li> </ul>	<ul style="list-style-type: none"> <li>• Renewable Energy</li> <li>• Conventional Energy</li> </ul>	<ul style="list-style-type: none"> <li>• Intermodal transport</li> <li>• Road Haulage</li> <li>• Rail Transport</li> </ul>	<ul style="list-style-type: none"> <li>• Microsilica</li> <li>• Silicon Metal</li> </ul>	<ul style="list-style-type: none"> <li>• Portfolio Management</li> <li>• Project Development</li> </ul>

## Roflam Series

Halogen-free phosphate flame retardants in a colorless liquid form. When combined with inorganic powder flame retardants, these products exhibit synergistic effects, significantly increasing fire resistance while reducing viscosity levels.

### Key applications

- Composites
- Pultrusion & Infusion processes
- Thick intumescent coatings (epoxy resins)

### Key features

- Excellent flame retarding profile
- Synergistic effect with solid FRs
- Easy for processing
- Viscosity reduction
- Fibers soak enhancing

### Typical properties

Ingredient	Chemical name	Density [g/cm <sup>3</sup> ] at 25°C	Viscosity [mPa·s] at 25°C	Phosphorus content [% w/w]	Features
Roflam F5	isopropylated triaryl phosphate	1.21	58	8.5	Low viscosity
Roflam B7	t-butylated triaryl phosphate	1.18	78	8.5	Safe to human health
Roflam B7L		1.12	300	7.4	No-labelling Oeko-tex®
Roflam R	resocinol bis(diphenyl phosphate)	1.30	600	11.0	High P-content
Roflam BR 102	modified aryl phosphates	1.26	250	proprietary	



## Unsaturated polyester resin

### Product performance

FR solution / features	FR efficiency	Viscosity reduction	Labelling
Roflam F5	• •	• •	•
Roflam B7	• •	• •	• •
Roflam B7L	• • •	• •	• • •
Roflam R	• • •	•	• • •
Roflam BR 102	• • •	• •	• •

• moderate • • good • • • excellent

### FR solutions for polyester resin

Raw material	Loadings [phr]
Polyester resin	100
Flame retardant	10
Hardener	2

Flame retardant	LOI [%]	Viscosity at 25°C* [mPa·s]	Deflection [%]	Flexural strength [MPa]
n/a	18.4	434.9	3.0	69.3
Roflam F5	20.6	367.5	>6.0	30.8
Roflam B7	20.6	333.7	>6.0	29.7
Roflam B7L	21.8	339.0	5.1	72.9
Roflam R	22.0	299.0	5.0	83.2
Roflam BR 102	22.6	305.0	6.0	58.4

\*Anton Paar – Spindle 2

## Glass fiber reinforced plastics (GFRP)

### Basic formulation

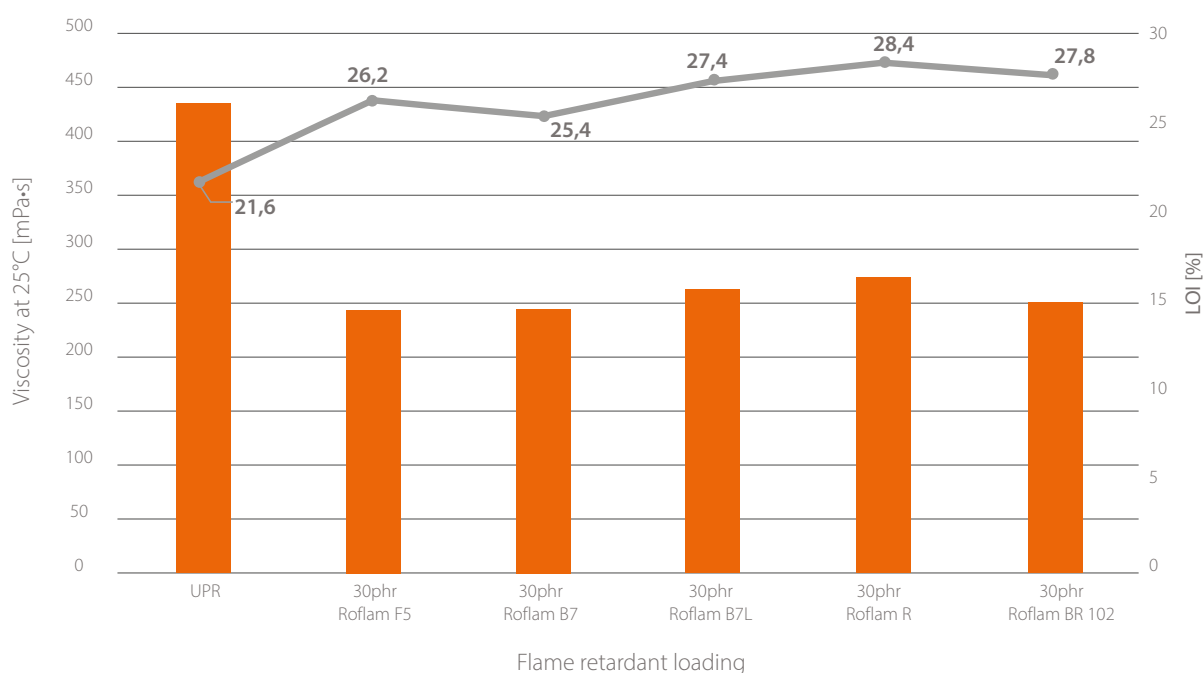
Raw material	Loadings [phr]
Polyester resin	100
Flame retardant	0-30
Glass matt 450g/m <sup>2</sup>	6 layers
Hardener	2

### Flammability and mechanical performance and viscosity reduction

Flame retardant	Loadings [phr]	LOI [%]	Viscosity at 25°C* [mPa·s]	Deflection [%]	Flexural strength [MPa]
n/a	-	21.6	434.9	3.7	232.0
Roflam F5	10	23.8	367.5	4.1	244.8
	30	26.2	243.5	5.3	41.6
Roflam B7	10	23.2	333.7	4.3	208.5
	30	25.4	243.5	4.9	84.1
Roflam B7L	10	25.4	339.0	3.8	245.0
	30	27.4	261.5	3.9	170.7
Roflam R	10	25.6	299.0	3.7	219.6
	30	28.4	272.9	4.3	161.3
Roflam BR 102	10	25.2	305.0	3.9	251.9
	30	27.8	251.3	4.4	136.1

\*Anton Paar – Spindle 2

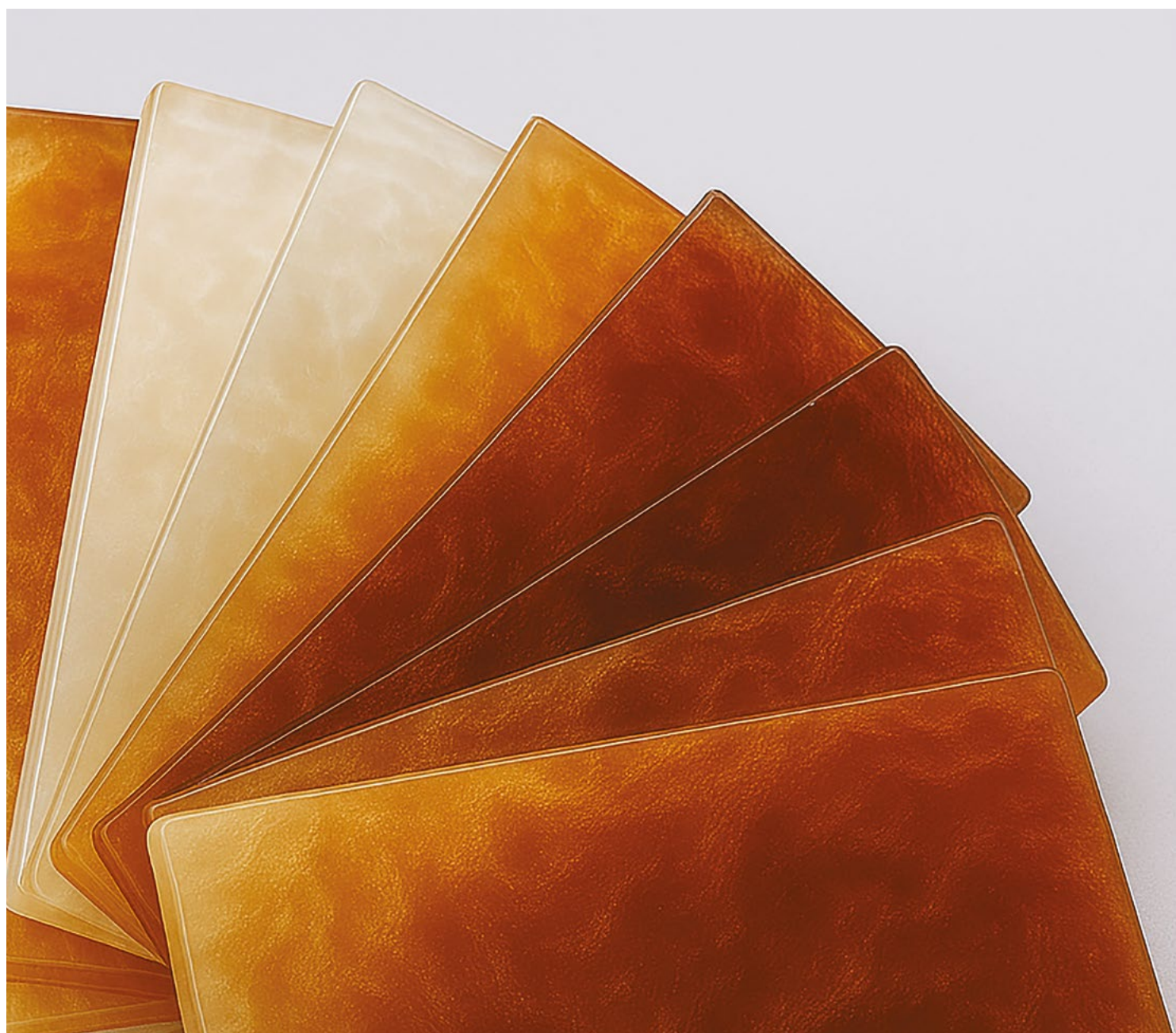
## FR efficiency and viscosity reduction





## FR solutions with solid additives in composite industry

Raw material	Loadings [phr]	Flame retardant	LOI [%]	Viscosity at 25°C* [mPa·s]	Deflection [%]	Flexural strength [MPa]
Polyester resin	100	n/a	26.6	788.8	3.4	234.6
Flame retardant	20	Roflam F5	28.4	563.4	4.2	175.0
ATH	50	Roflam B7	28.6	541.4	4.4	165.1
Glass matt 450g/m <sup>2</sup>	6 layers	Roflam B7L	29.8	602.2	4.3	181.5
Hardener	2	Roflam R	31.2	593.9	4.4	182.6
		Roflam BR 102	30.3	551.9	4.8	162.1



## Epoxy resins

### Product performance

FR solution / features	FR efficiency	Viscosity reduction	Labelling
Roflam F5	• •	• •	•
Roflam B7	• •	• •	• •
Roflam B7L	• •	•	• • •

• moderate • • good • • • excellent

### FR solutions for epoxy based plastics

Basic formulation

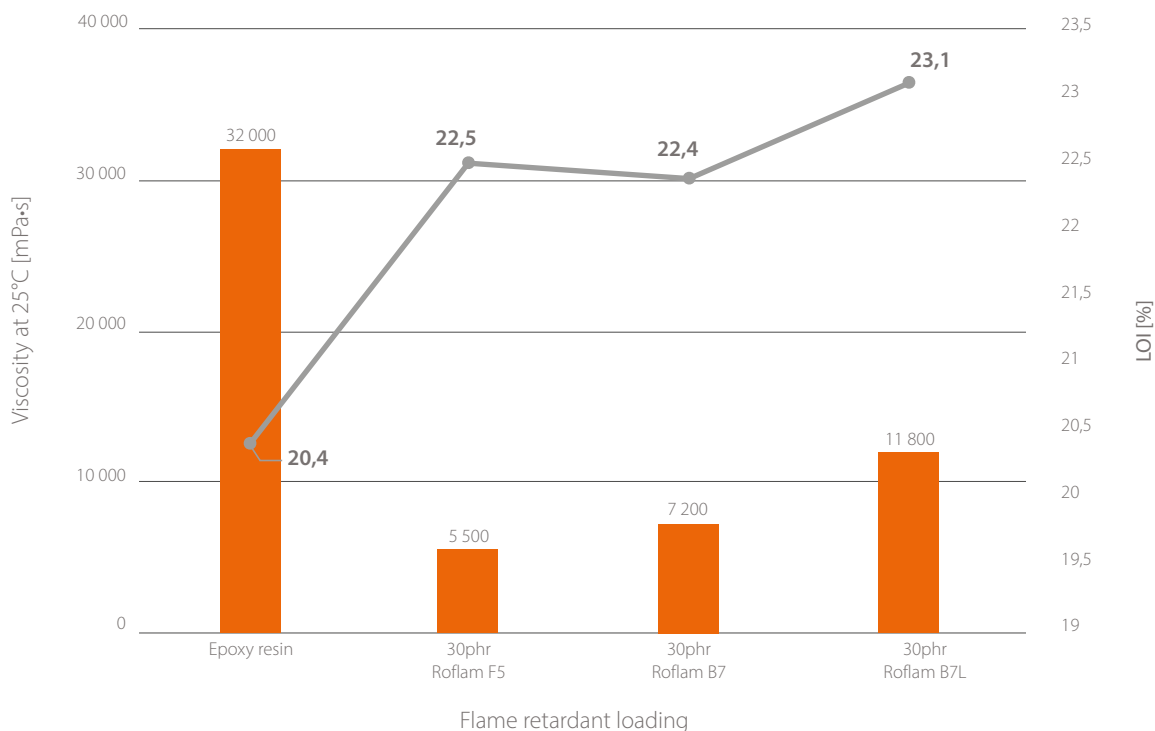
Raw material	Loadings [phr]	Processing
Epoxy resin DGEBA	100	Cold cured resin
Aliphatic amine	10	
Flame retardant	0 – 30	

Flammability performance and viscosity reduction

Flame retardant	Loadings [phr]	Viscosity at 25°C [mPa·s]	LOI [%]
n/a	-	32 000	20.4
Roflam F5	10	15 000	21.9
	30	5500	22.5
Roflam B7	10	16 700	22.0
	30	7200	22.4
Roflam B7L	10	20 500	22.8
	30	11 800	23.1



## FR efficiency and viscosity reduction



## Product performance

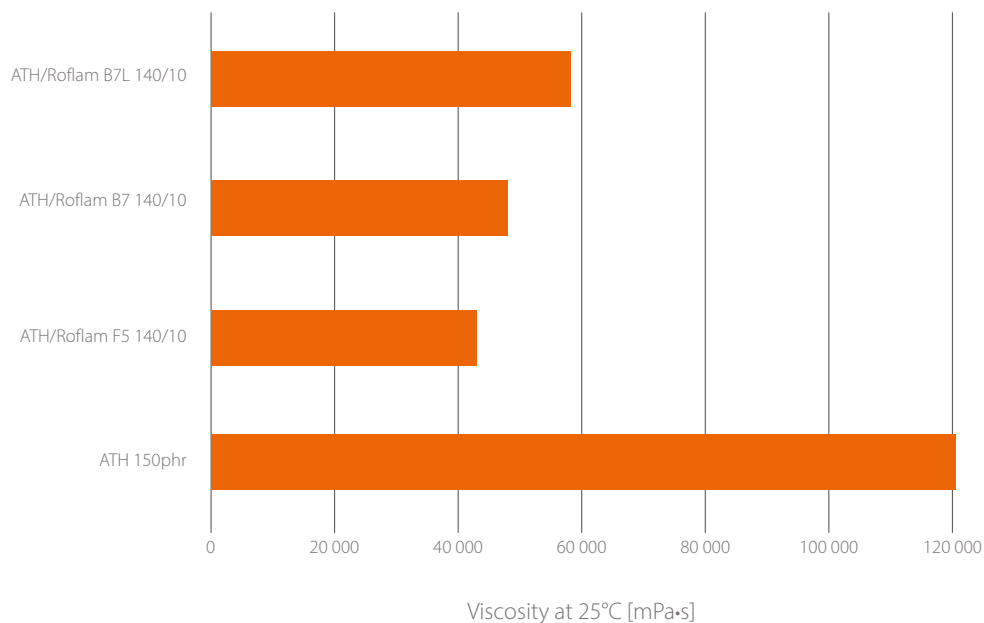
### Basic formulation

Raw material	Loadings [phr]	Processing
Epoxy resin DGEBA	100	Cold cured resin
Aliphatic amine	10	
ATH	140-150	
Roflam	0-10	

### Flammability performance and viscosity reduction

Flame retardant	Loadings [phr]	Solid flame retardant	Loadings [phr]	Viscosity [mpa·s] at 25°C	LOI [%]	UL-94
n/a	150	ATH	-	120 000	37.0	V0
Roflam F5				43 000	37.0	
Roflam B7	140		10	47 500	36.8	
Roflam B7L				58 000	37.2	

## Viscosity reduction - high filled systems



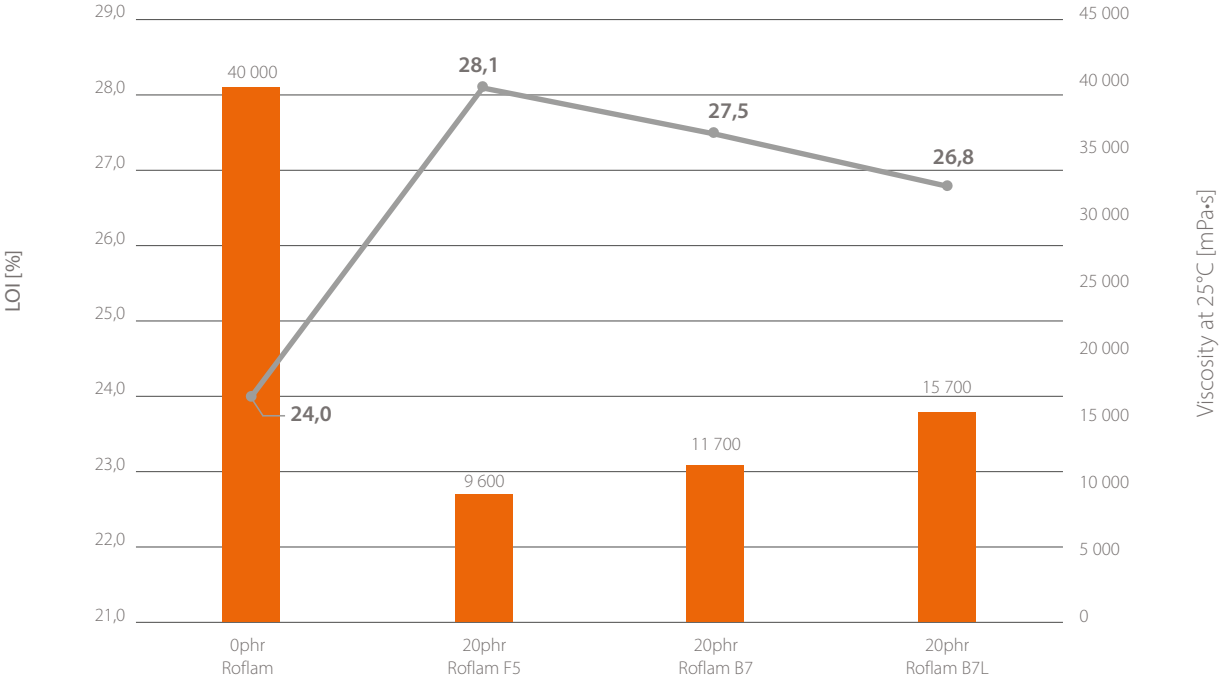
## FR solutions for high filled systems

### Basic formulation

Raw material	Loadings [phr]	Processing
Epoxy resin DGEBA	100	Cold cured resin
Aliphatic amine	10	
APP / Melamine / Pentaerythritol	5 / 1.7 / 1.7	
Roflam	0 - 20	

### Flammability performance and viscosity reduction

Formulation	Loadings [phr]	LOI [%]	UL-94	Viscosity at 25°C [mPa·s]
APP	5	24.0	no class	40 000
Roflam F5	10	25.2	V1	17 600
	20	28.1	V0	9 600
Roflam B7	10	25.0	V1	18 900
	20	27.5	V0	11 700
Roflam B7L	10	25.0	V1	22 500
	20	26.8	V0	15 700







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September 2025

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