Calcined Neuburg Siliceous Earth in white colored building profiles

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We supply material for good ideas

Contents

Status Quo

Calcined clays are being used in white colored building profiles because of their following properties:

- ✓ high brightness and color-neutrality
- ✓ good extrusion properties
- ✓ good mechanical properties

Neuburg Siliceous Earth is an excellent alternative regarding

- ✓ extrusion properties
- ✓ mechanical properties

Until now, it was only suitable for grey profiles due to its yellowish tint, whereas its use in white profiles was problematic regarding

- × color-neutrality

Objective

- Effect of Calcined Neuburg Siliceous Earth in grey-white building profiles regarding
  - base properties

    orientation to the standard for extruded sealing profiles of RAL GZ 716/1, elastomer class B II
  - color

    referring to RAL 9002
- Comparison to calcined clay
- Impact of the used polymer
- Influence of the filler loading and peroxide dosage

Fillers, Characteristics

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	Particle Size d$_{50}$ [µm]	Particle Size d$_{97}$ [µm]	Oil absorption [g/100g]	Specific surface area BET [m²/g]	Calcination / Surface treatment
Polestar 200 R	3.6	19	60	6.5	with / none
Sillitin Z 89	1.6	6.1	51	11	none / none
Silfit Z 91	1.9	8.6	52	6.5	with / none
Aktisil VM 56/89	1.8	7.4	45	7.3	none / vinyl
Aktifit VM	1.9	8.7	49	6.2	with / vinyl

Preparation and Curing of the Compound

- **Mixing**

  Open mill Ø 150 x 300 mm

  Batch volume: approx. 750 g

  Temperature: 50 °C

  Mixing time: approx. 15 min.

- **Curing**

  Press, 180 °C, 5 min.

Overview

Part 1: Filler comparison

Part 2: Formulation optimization –
Exploiting the potential of Aktifit VM

Summary

Formulation

	in phr
Keltan 778 Z – crystalline or Keltan 8340 A – amorphous	100.00
Zinkoxyd aktiv	5.00
Stearic acid	0.50
Vulkanox HS/LG	0.75
Lipoxol 3000	2.00
Kronos 2222	15.00
Kezadol GR	10.00
Aflux 42	2.00
Trigonox 29/40 B pd	3.00
Perkadox 14/40 B pd	3.00
Rhenofit TRIM/S	1.00
Primol 352	45.00
Mineral filler	200.00
Total	**387.25**

Mooney-Viscosity

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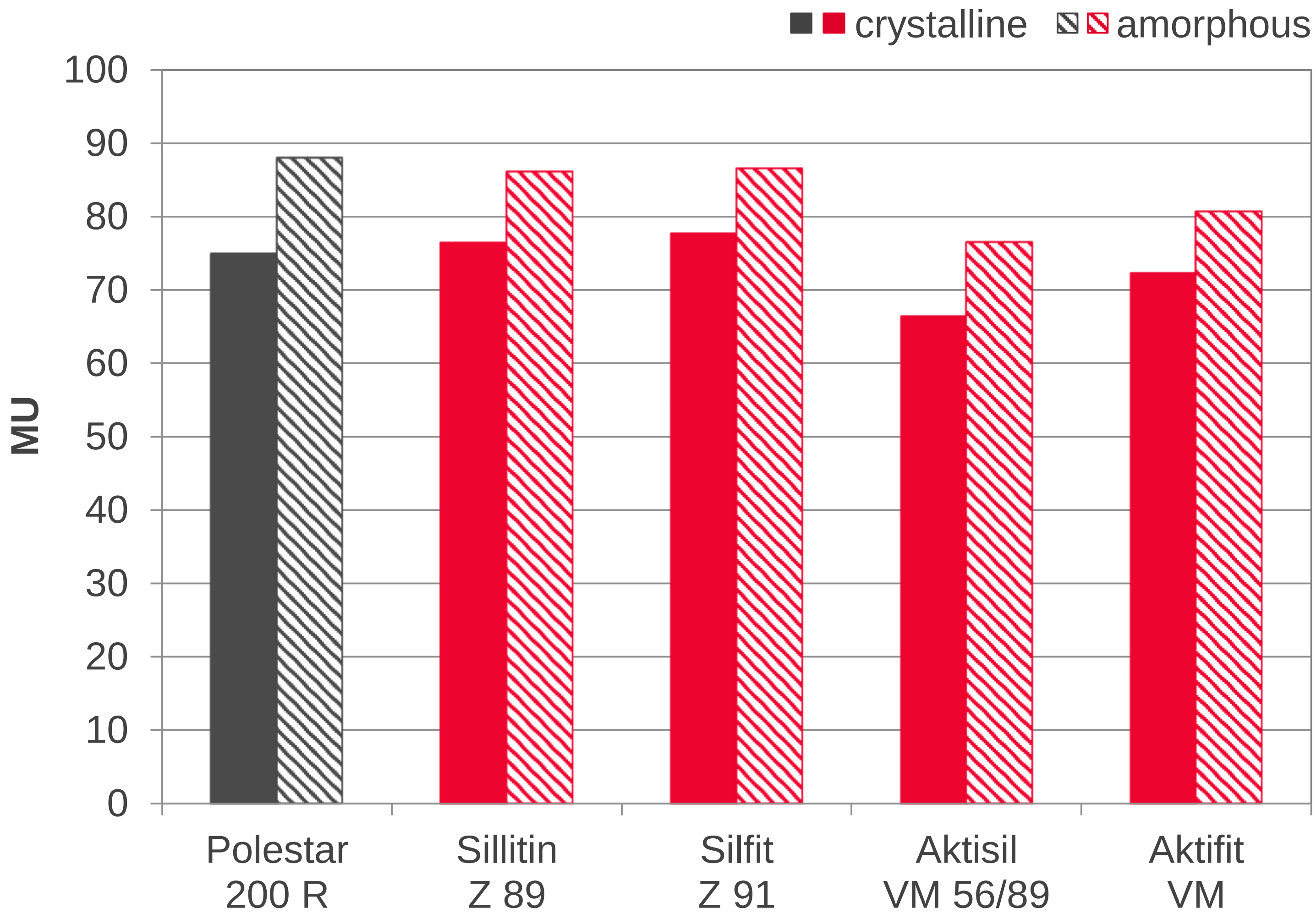
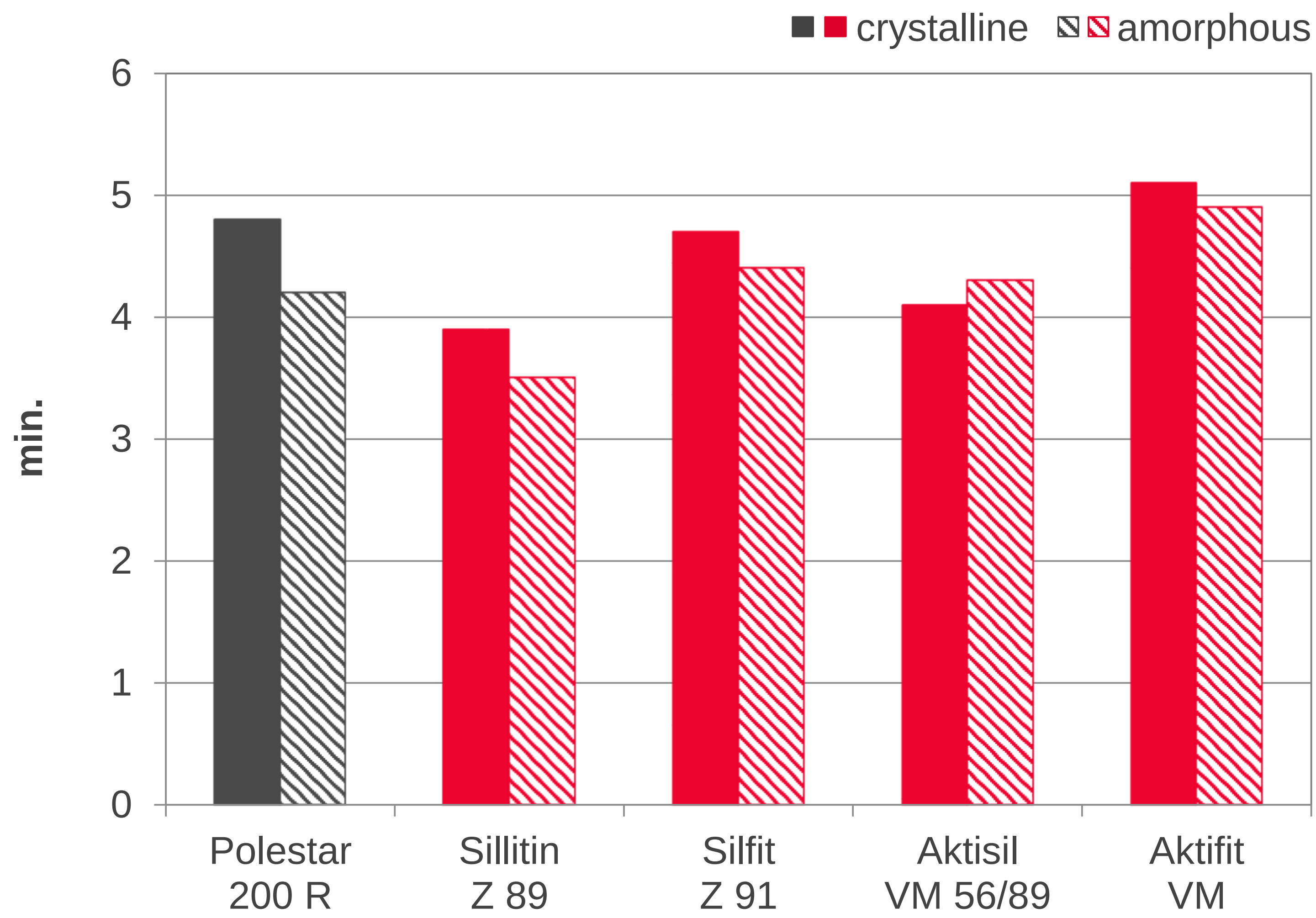
DIN 53 523 Part 3, ML +5, 120 °C



Mooney Scorch Time

DIN 53 523 Part 4, ML +5, 120 °C



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DIN 53 529-A3, 180 °C, 0,2° deflection – Göttfert Elastograph

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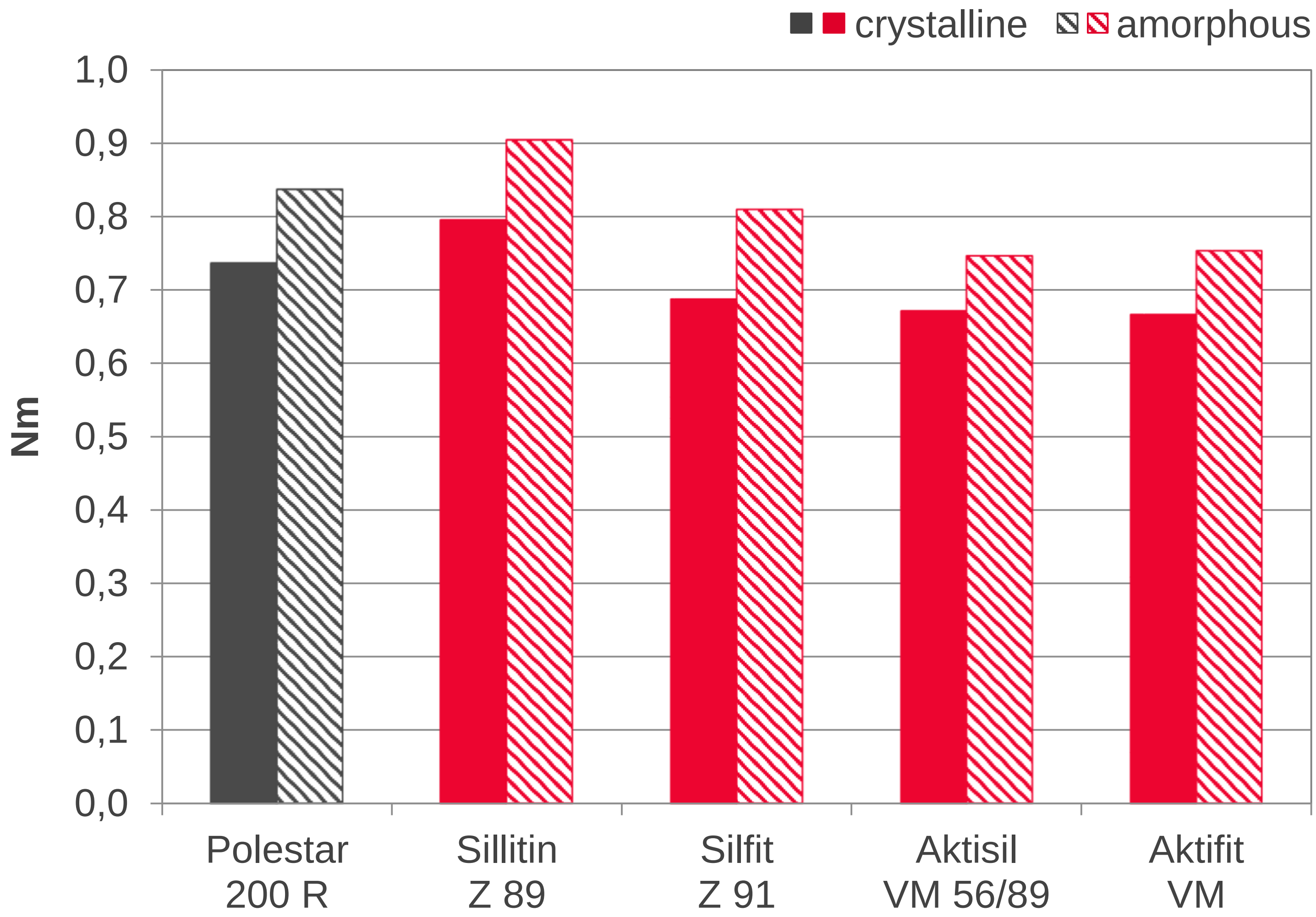

Conversion Time t_{90}

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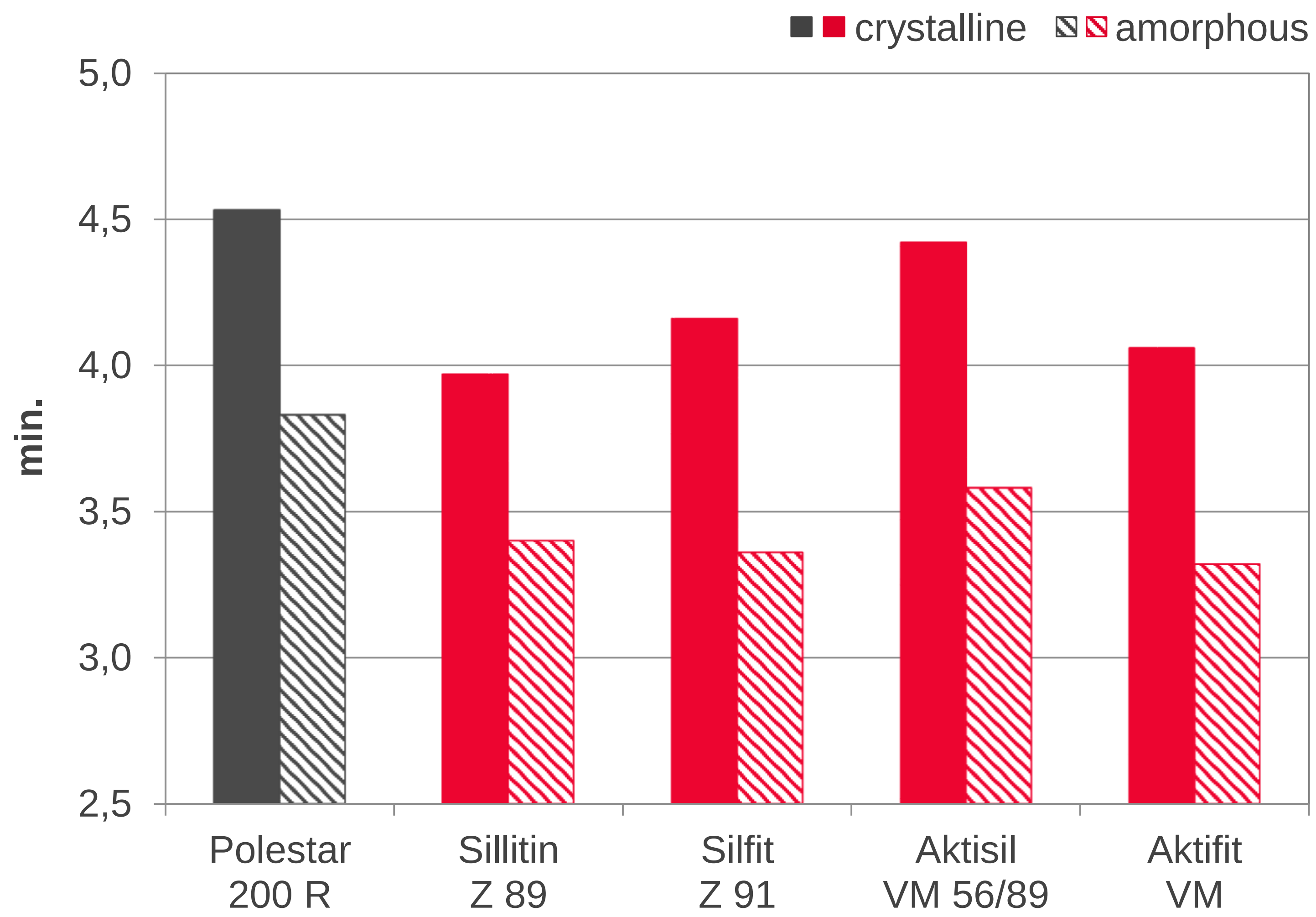
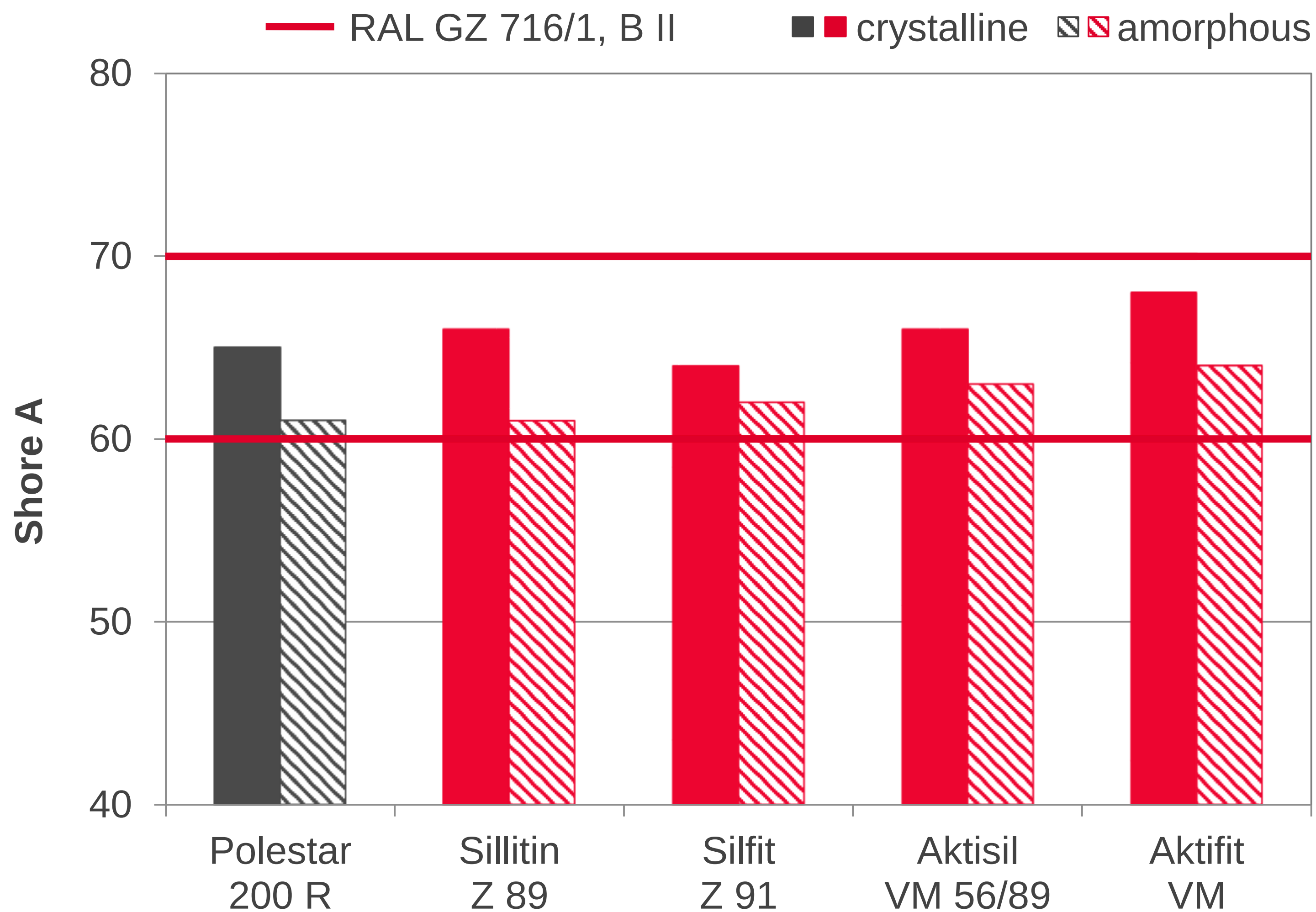
DIN 53 529-A3, 180 °C, 0,2° deflection – Göttfert Elastograph



Hardness

DIN 53 505-A, piled-up S2-dumbbells



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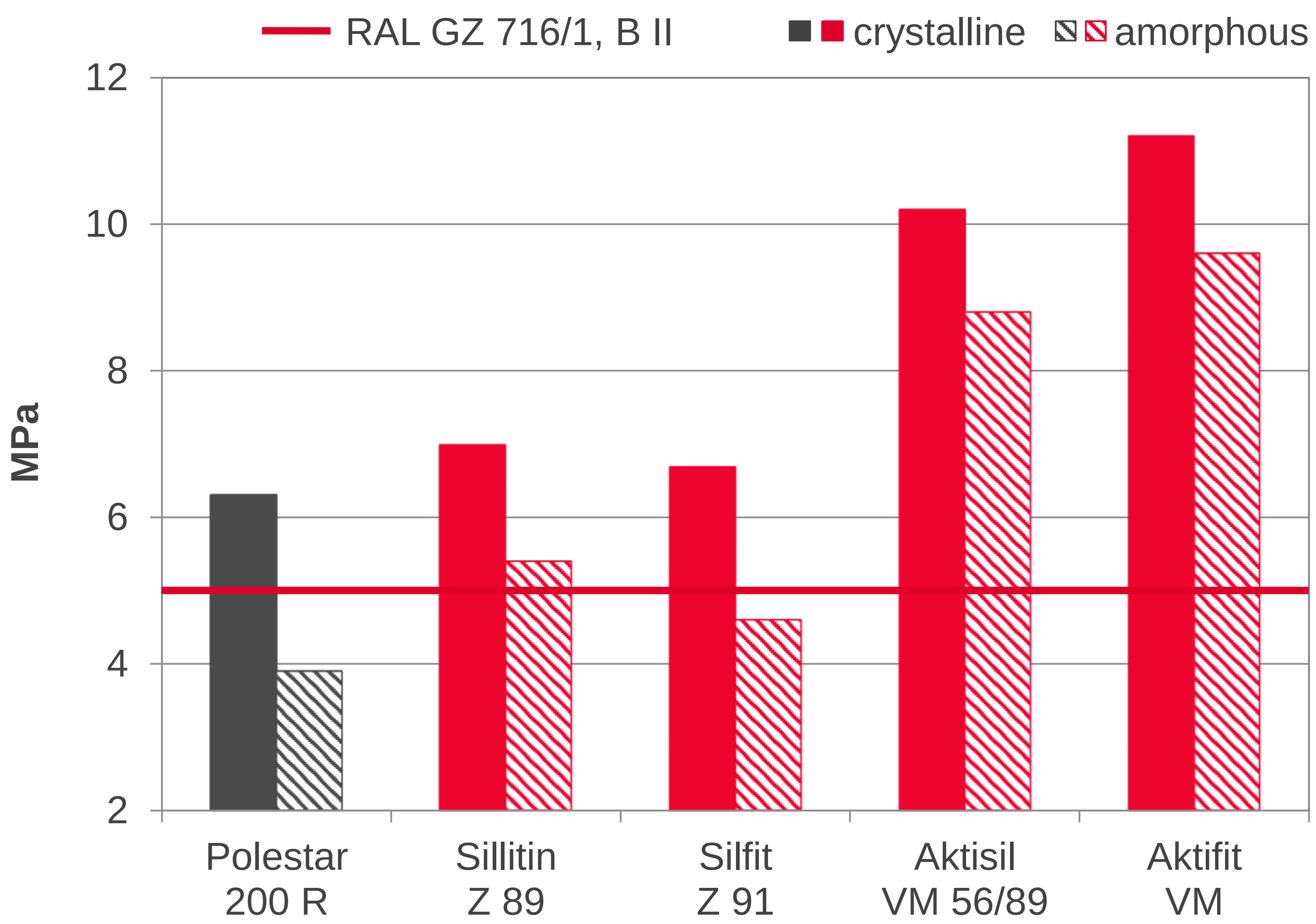
DIN 53 504, S2



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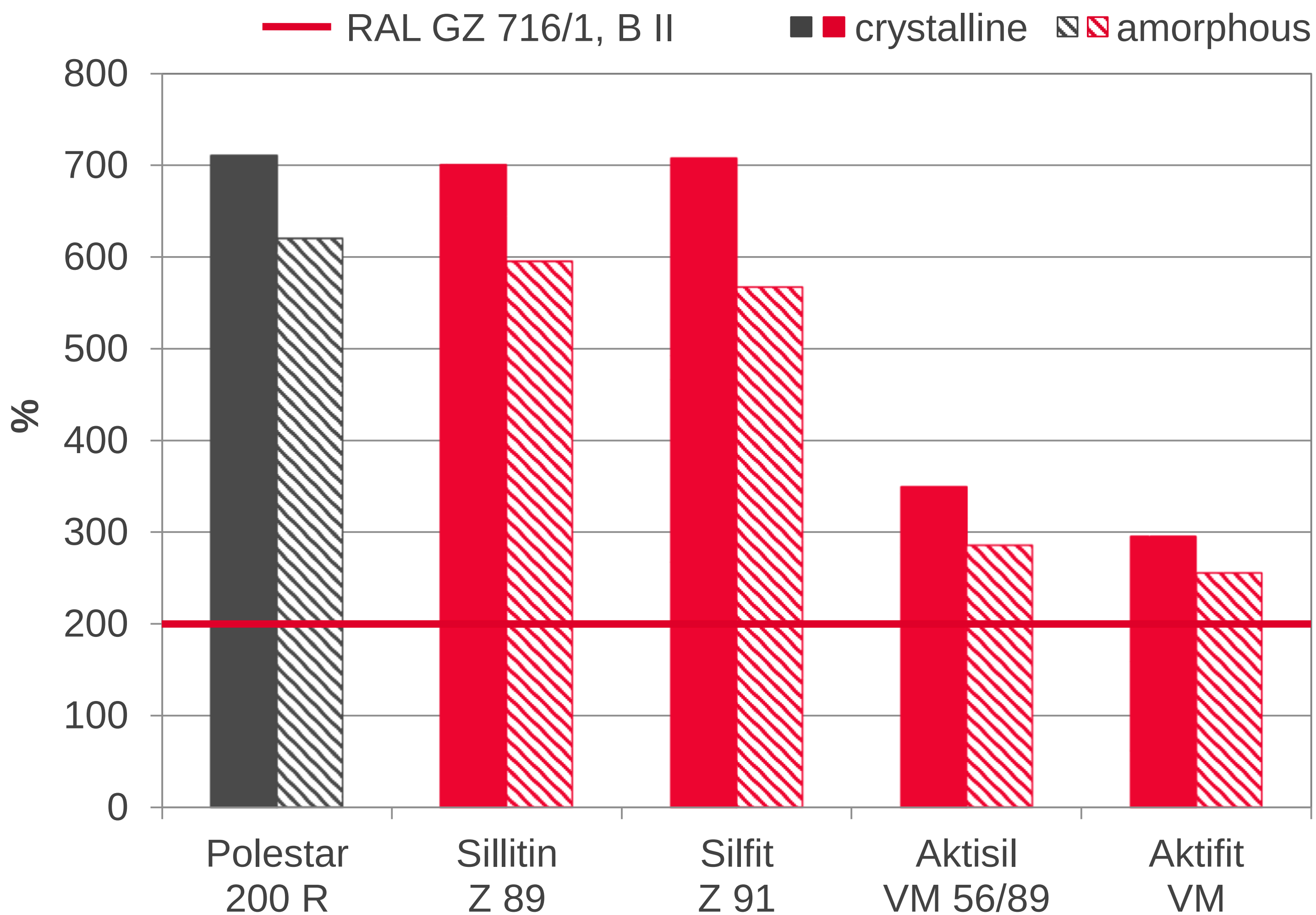
DIN 53 504, S2



Modulus 100 %

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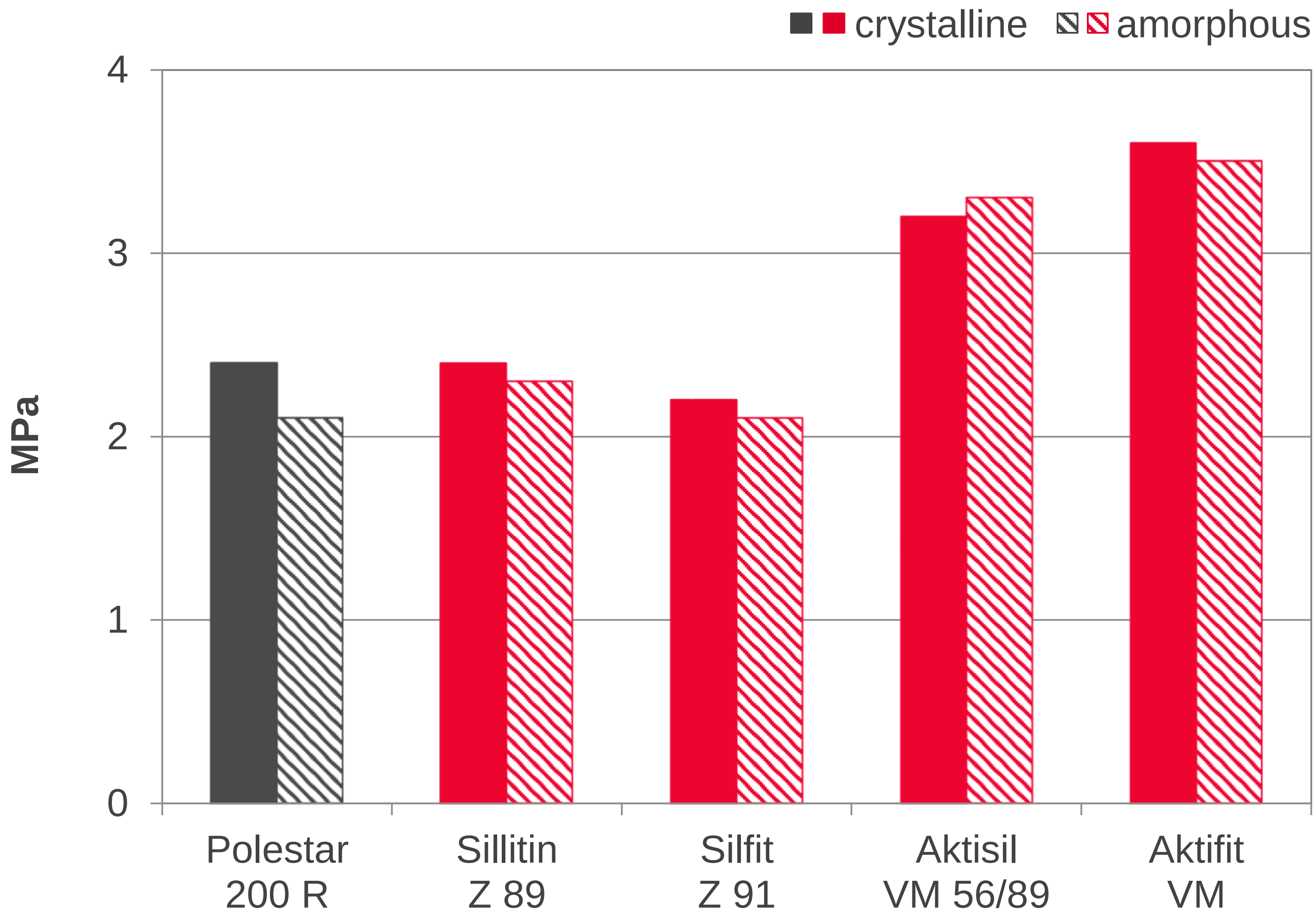
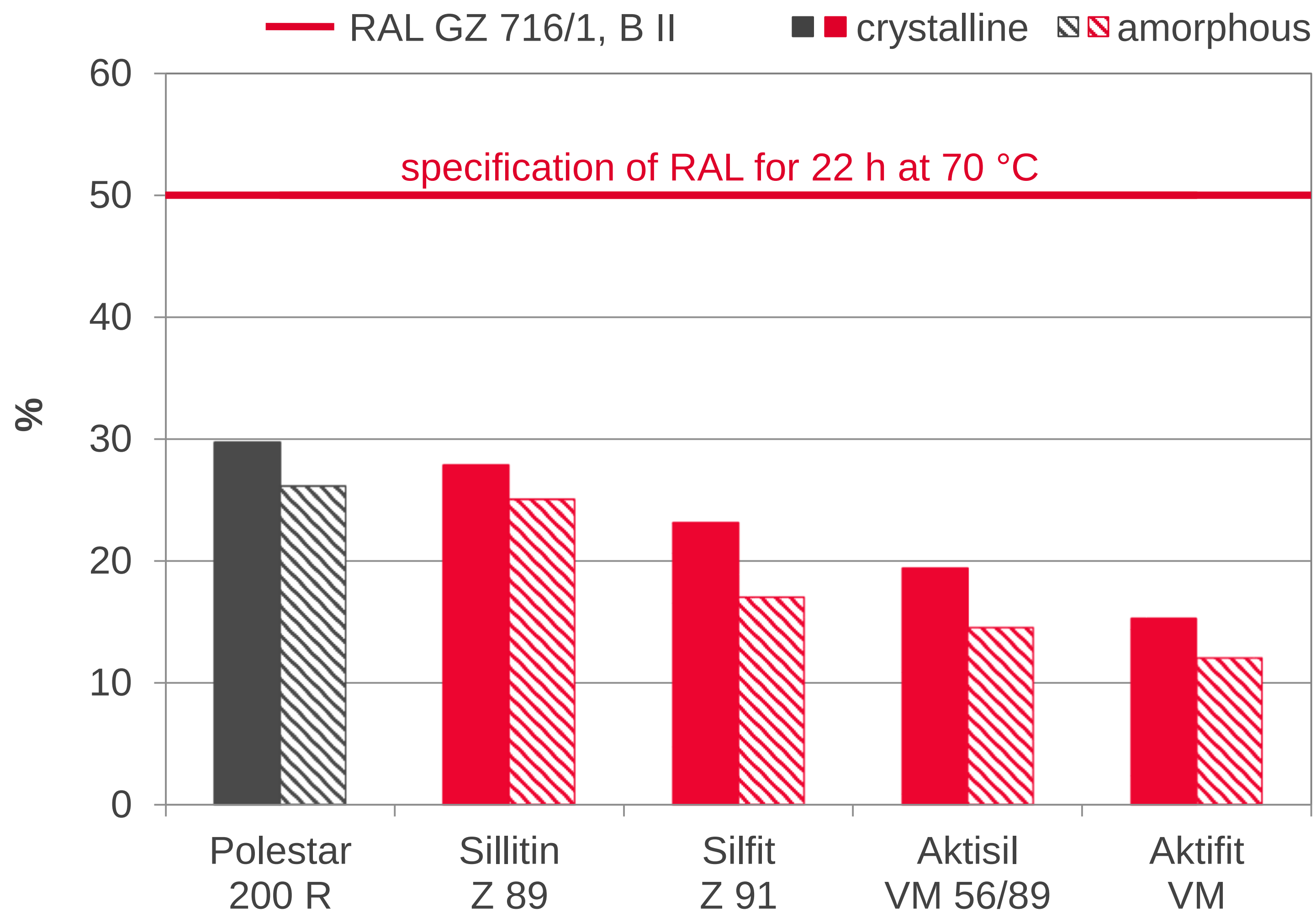


Compression Set
24 h / 125 °C

DIN ISO 815-1 B, cooling method A, 25 % defl.



Compression Set
22 h / 23 °C

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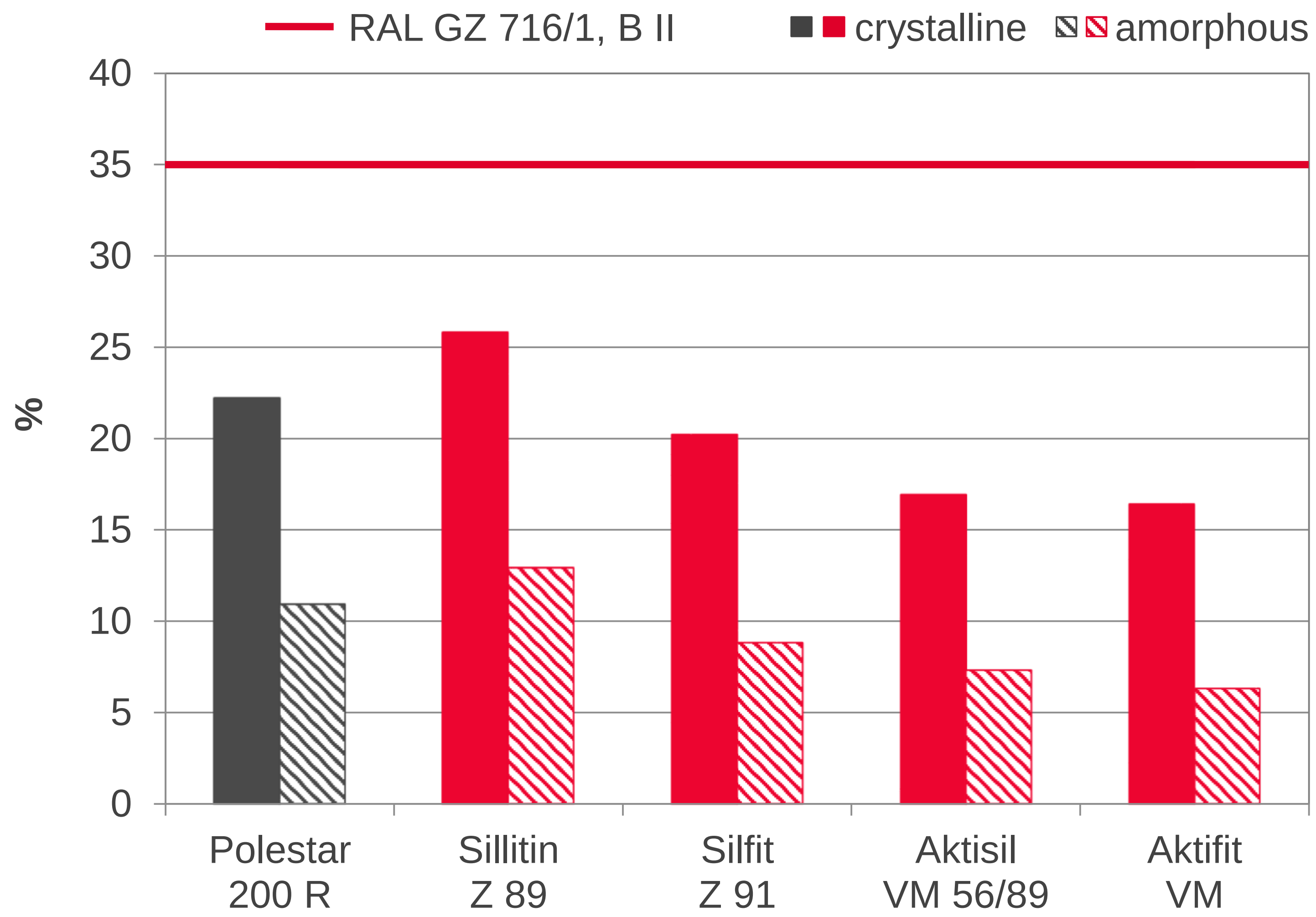
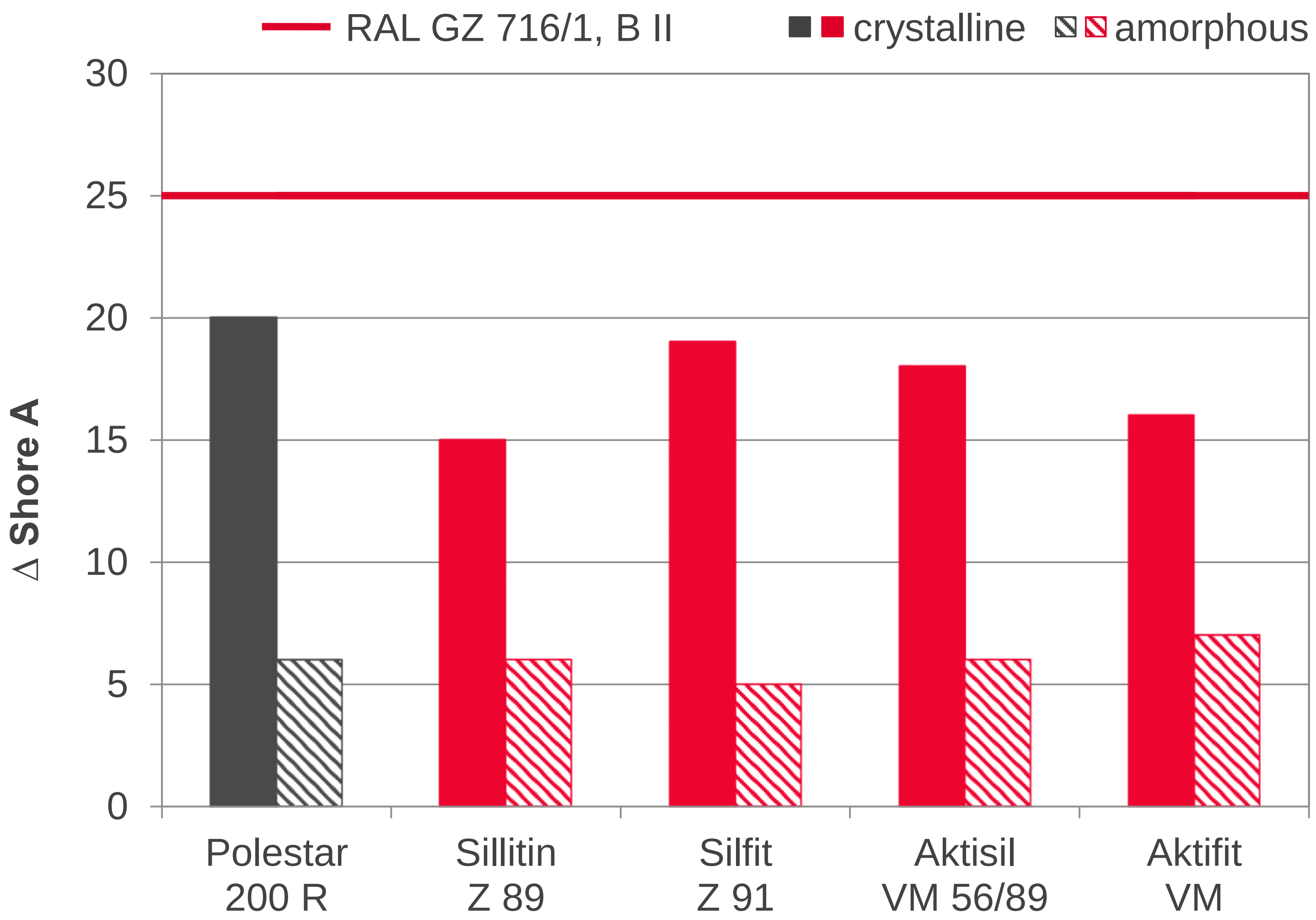
DIN ISO 815-1 B, cooling method A, 25 % defl.



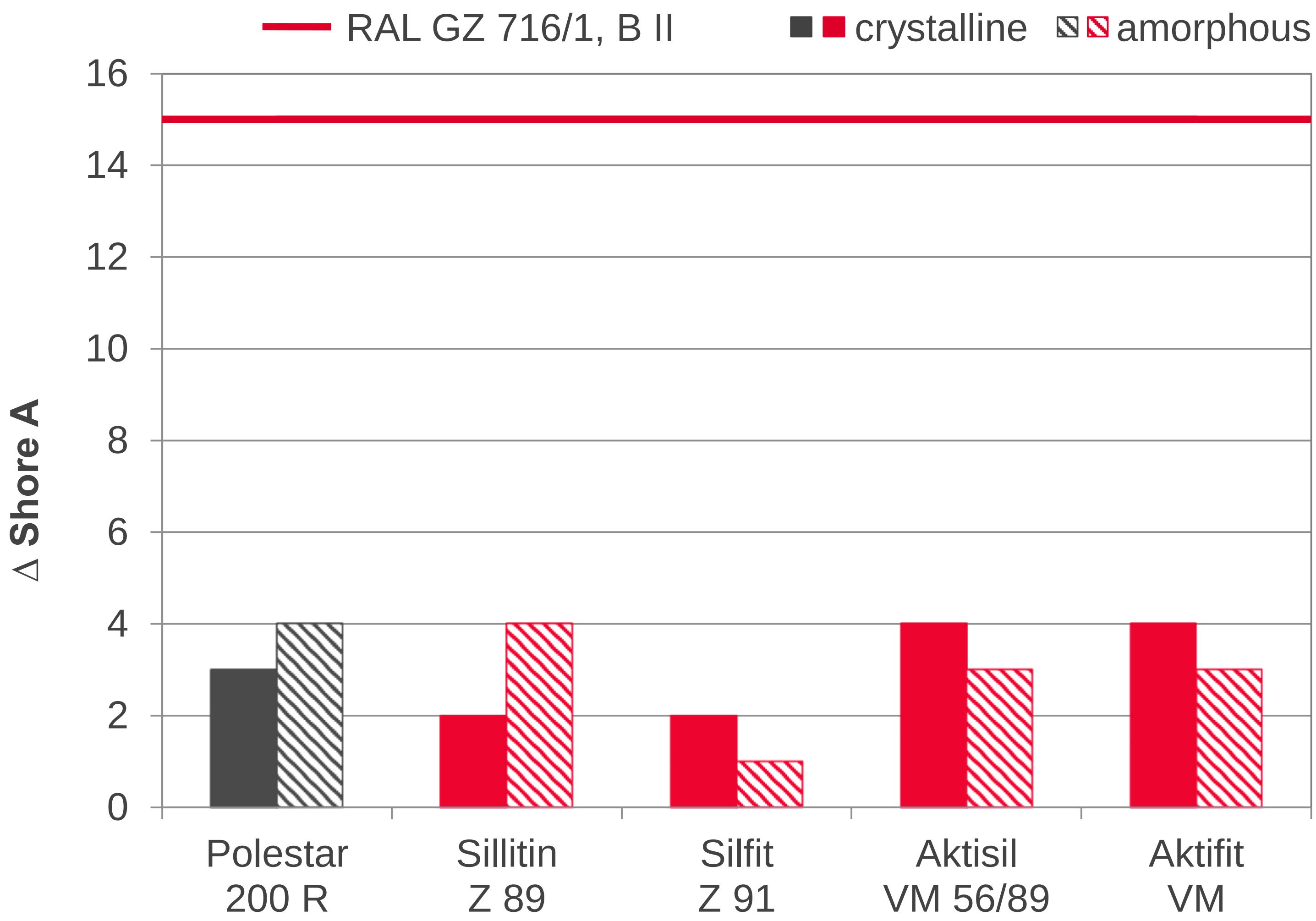
Low Temperature Exposure
Change of Hardness

22 h / -10 °C



Hot Air Aging
Change of Hardness

DIN 53 508, 168 h / 100 °C



Hot Air Aging
Change of Tensile Strength

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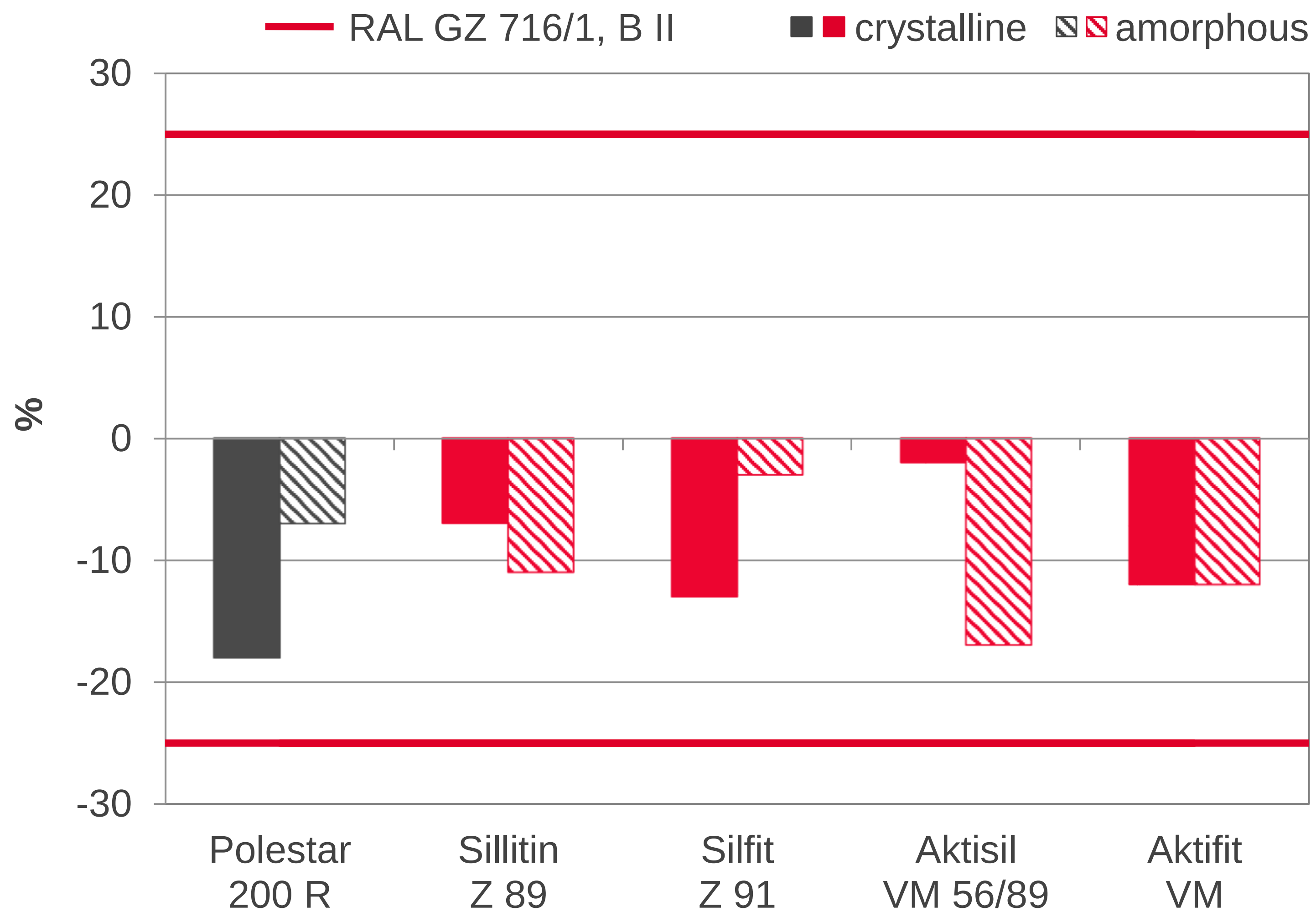
DIN 53 508, 168 h / 100 °C



Hot Air Aging
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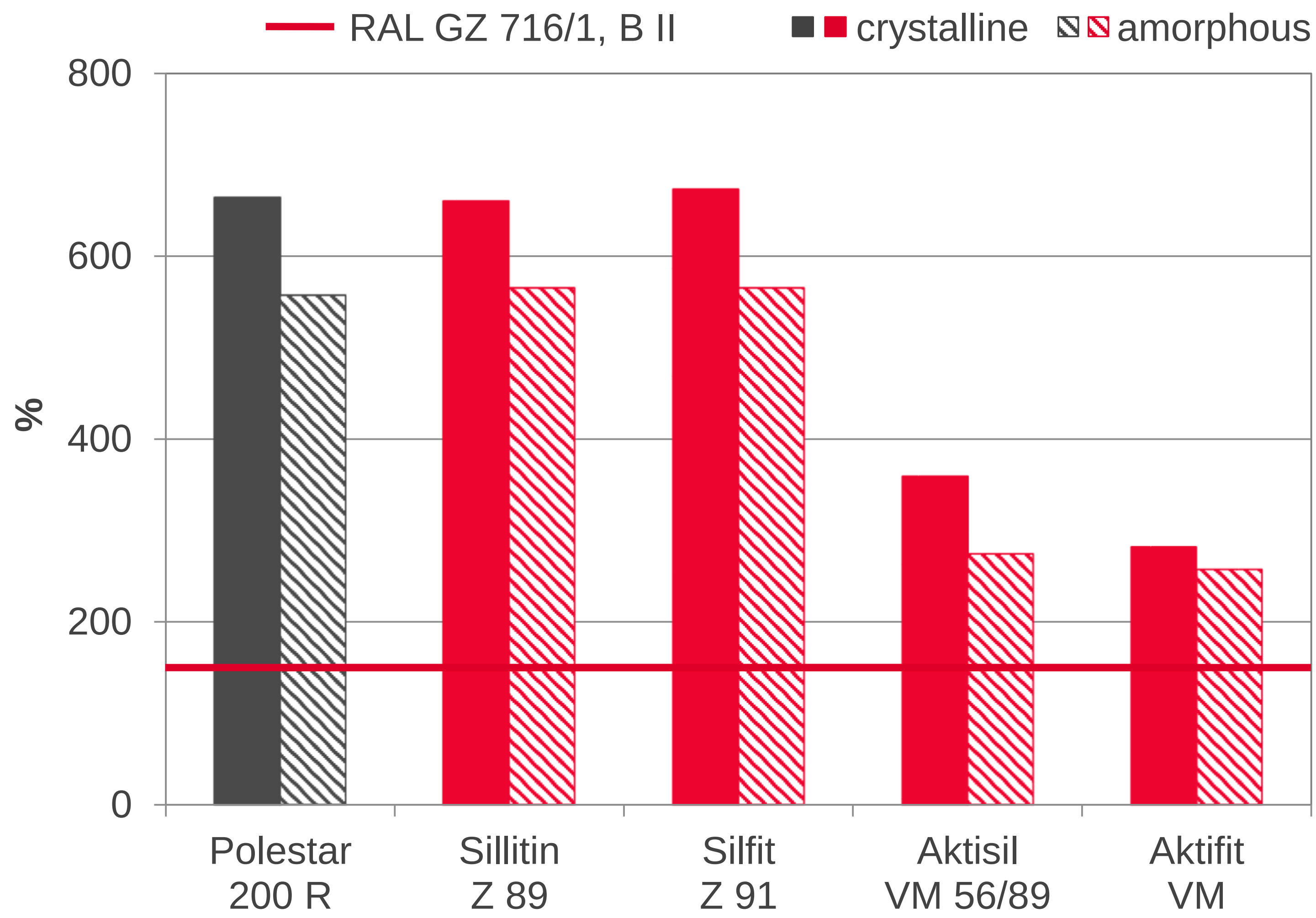


Measurement of Color

ISO 7724

- **Parameter**

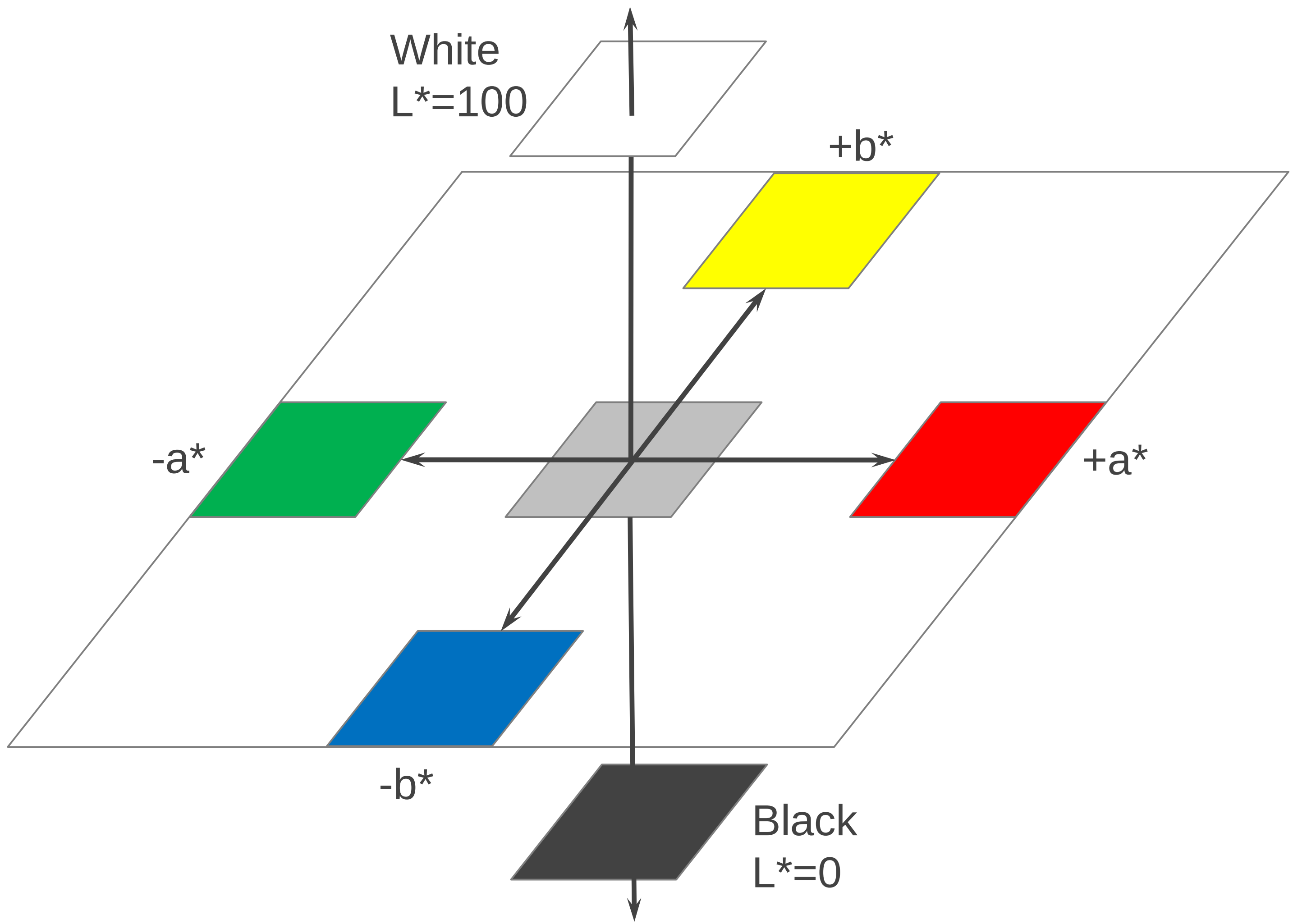
  Spectral photometer (Luci 100, Dr. Lange)

  Light D 65

  Geometry d/8°, without gloss trap

  Observation angle 10°

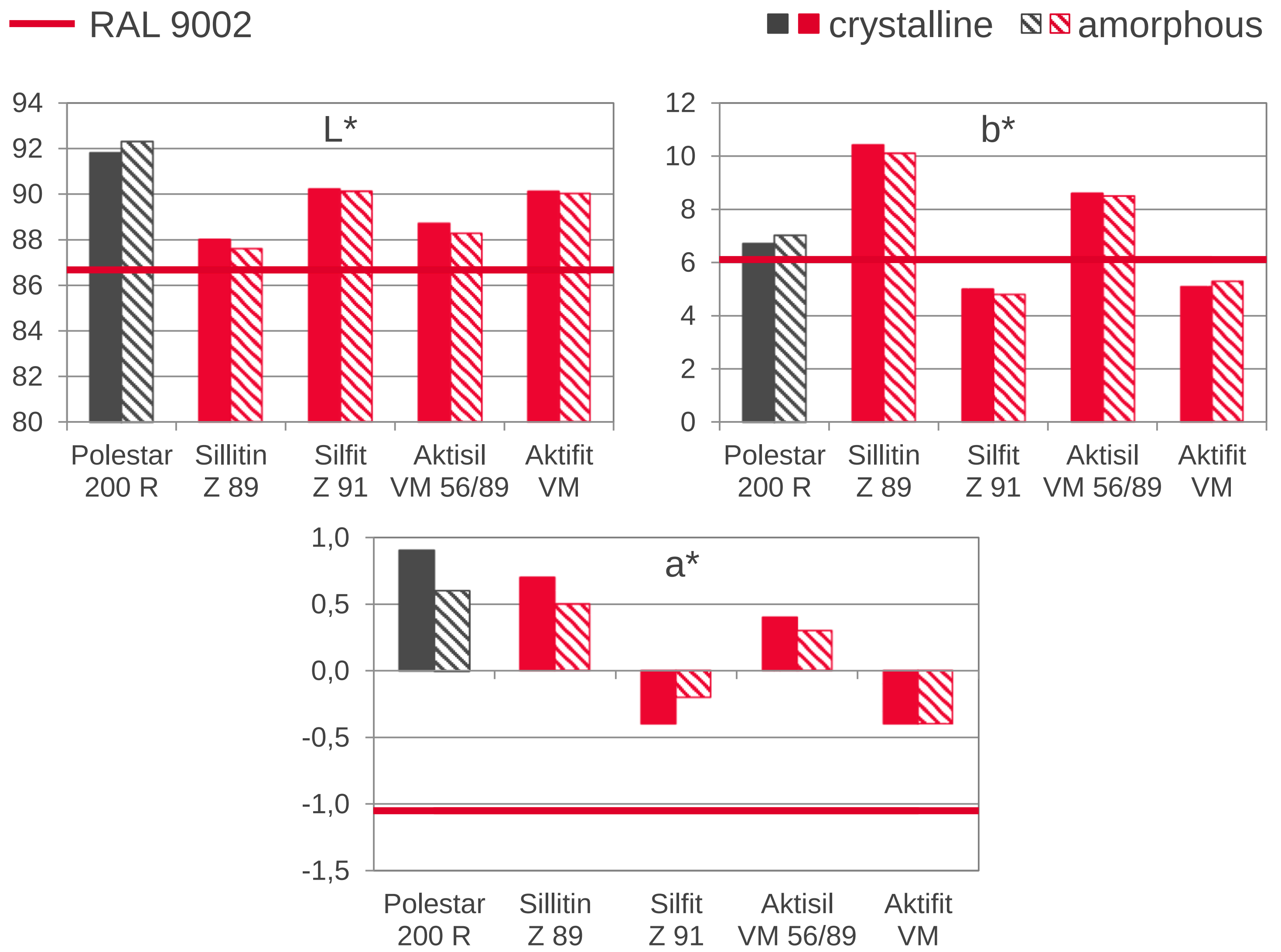
CIE-LAB-System



Color values – Filler comparison

Color values – Formulation optimization

Color Values



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Filler Comparison
Summary

Silfit Z 91:

- ✓ meets the tested requirements of RAL GZ 716/1, B II with a filler loading of 200 phr without any problems in combination with a crystalline polymer.
  With an amorphous polymer, an optimization is only necessary regarding tensile strength.

- ✓ results in very neutral color in comparison to Sillitin Z 89.

- ✓ leads to a reduced conversion time t_{90}, a slightly higher tensile strength by tendency and to a lower compression set in comparison to calcined clay at a filler loading of 200 phr.

Summary Part 1

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Filler comparison

Aktifit VM:

- ✓ meets the tested requirements of RAL GZ 716/1, B II with a filler loading of 200 phr.
  Even with an amorphous polymer all tested requirements can be fullfilled.

- ✓ results in a very neutral color in comparison to Aktisil VM 56/89.

- ✓ leads to a reduced conversion time t_{90} and to improved mechanical properties in comparison to calcined clay and Aktisil VM 56/89, especially to a higher tensile strength and a lower compression set at a filler loading of 200 phr.

Filler Comparison
Conclusion

- The very good properties leave a margin for further optimization:
  - a higher filler loading (e.g. 300 to 400 phr Aktifit VM with 70 to 95 phr plasticizer) and / or
  - a reduction of the peroxide dosage

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	in phr
Keltan 778 Z – crystalline or Keltan 8340 A – amorphous	100.00
Zinkoxyd aktiv	5.00
Stearic acid	0.50
Vulkanox HS/LG	0.75
Lipoxol 3000	2.00
Kronos 2222	15.00
Kezadol GR	10.00
Aflux 42	2.00
Trigonox 29/40 B pd	2 or 3
Perkadox 14/40 B pd	2 or 3
Rhenofit TRIM/S	1.00
Primol 352	45 - 95
Mineral filler	**200 - 400**

Formulation Variations

Loadings in phr

	crystalline			amorphous	
Polestar 200 R (Reference)	200				
Aktifit VM		400	300	300	300
Primol 352	45	95	70	70	70
Trigonox 29/40 B pd	3	3	2	3	2
Perkadox 14/40 B pd	3	3	2	3	2

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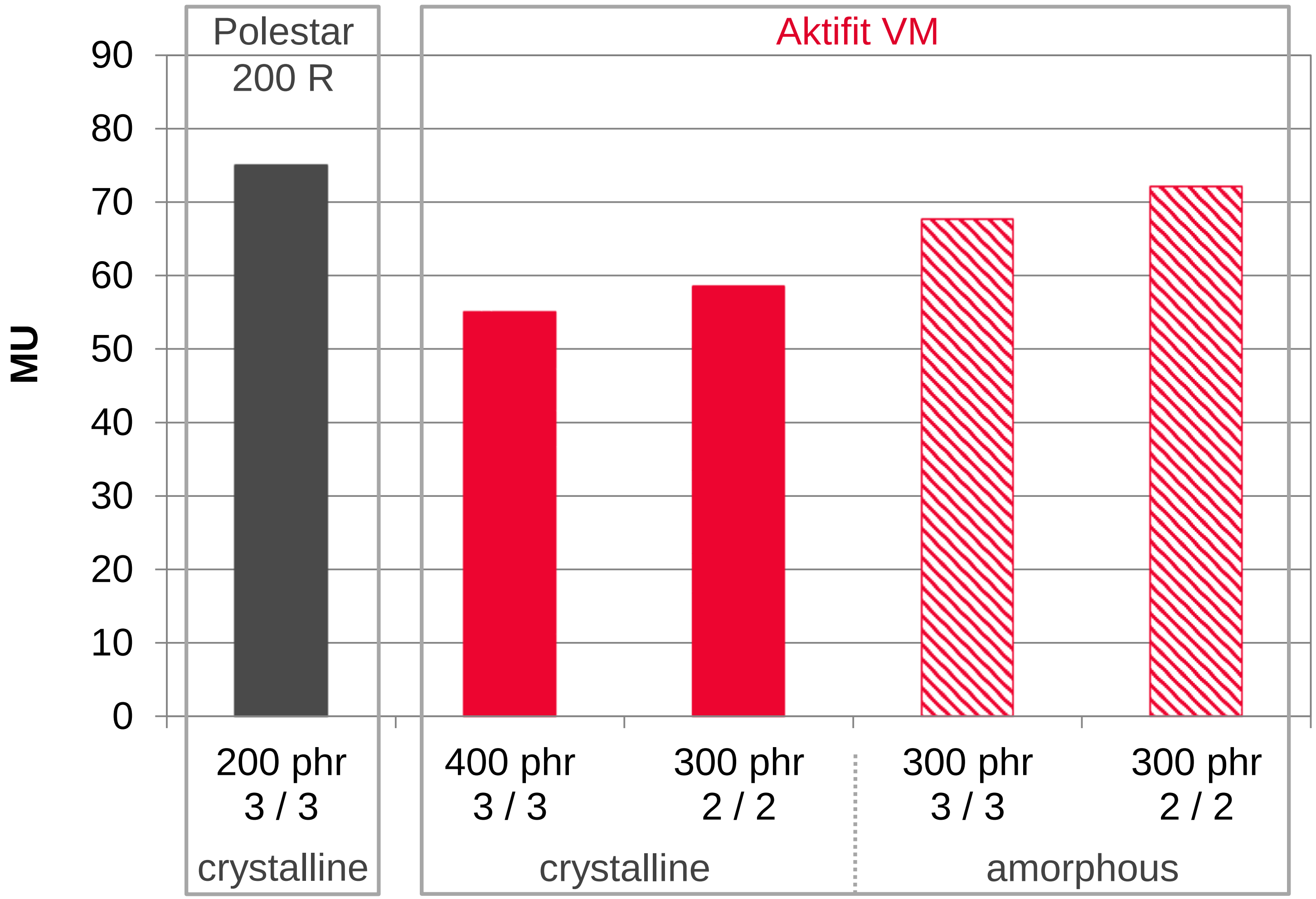
Mooney-Viscosity

DIN 53 523 Part3, ML 1+4, 100 °C



Mooney Scorch Time

DIN 53 523 Part 4, ML +5, 120 °C

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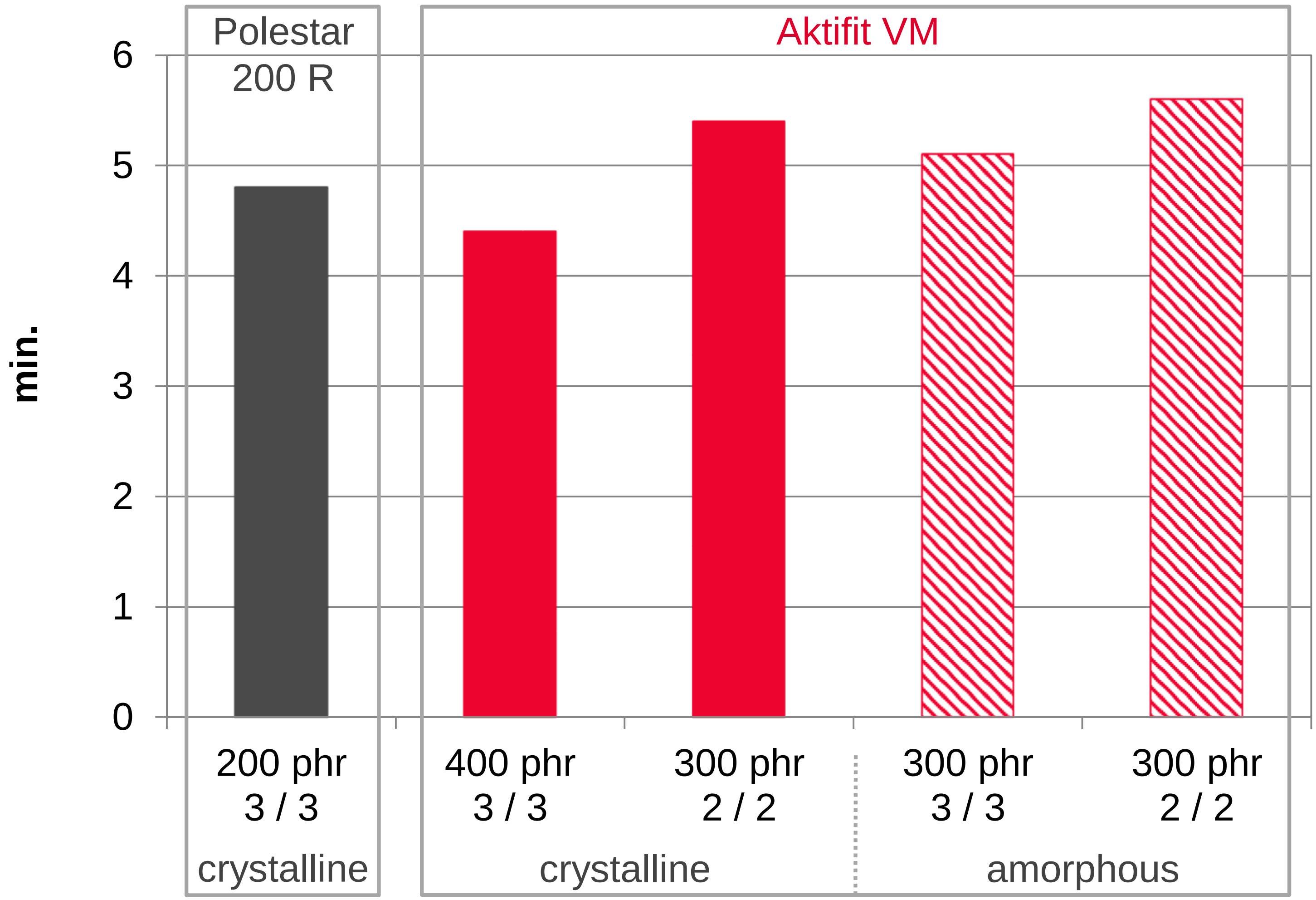

Torque Maximum

DIN 53 529-A3, 180 °C, 0,2° deflection – Göttfert Elastograph

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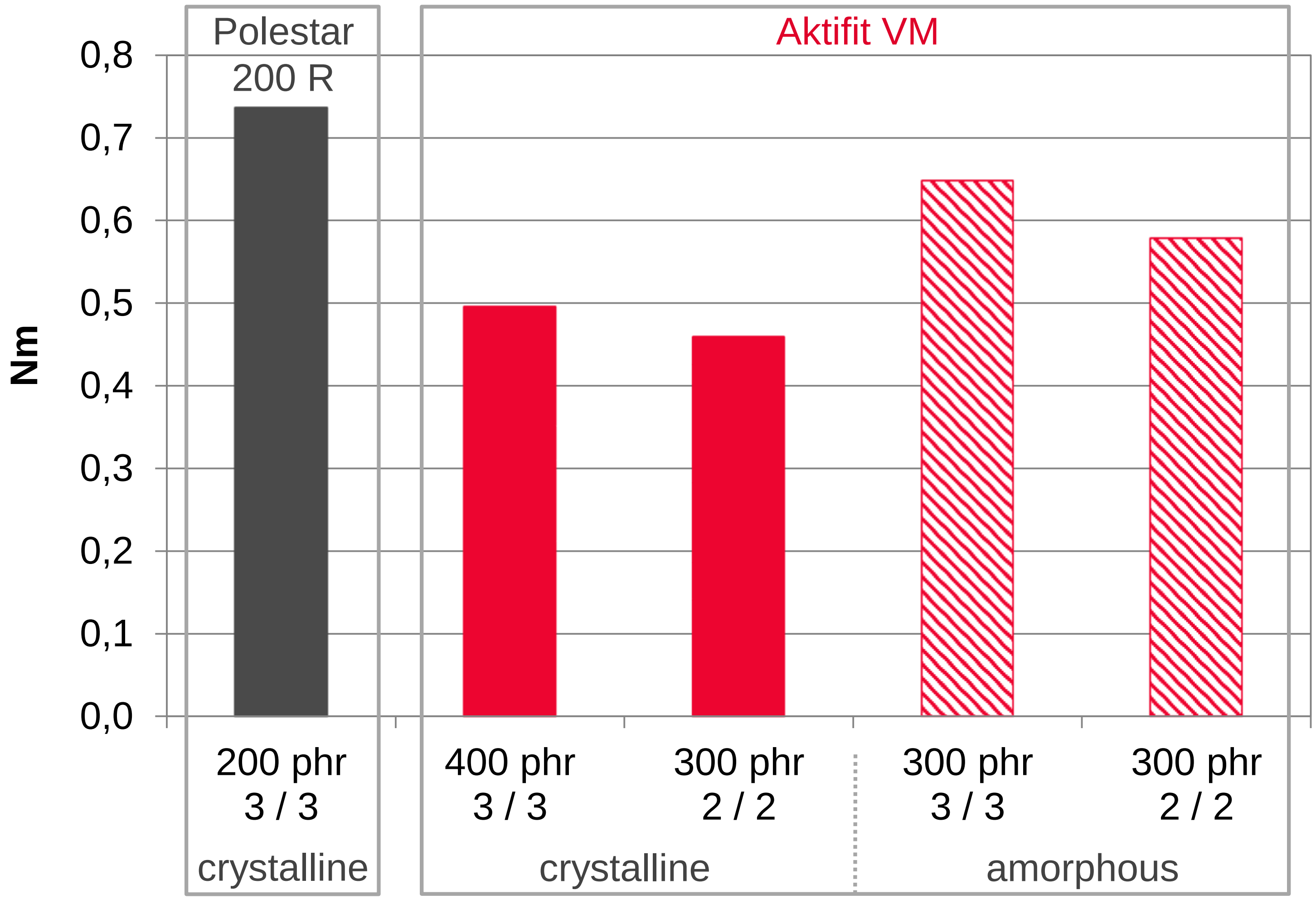
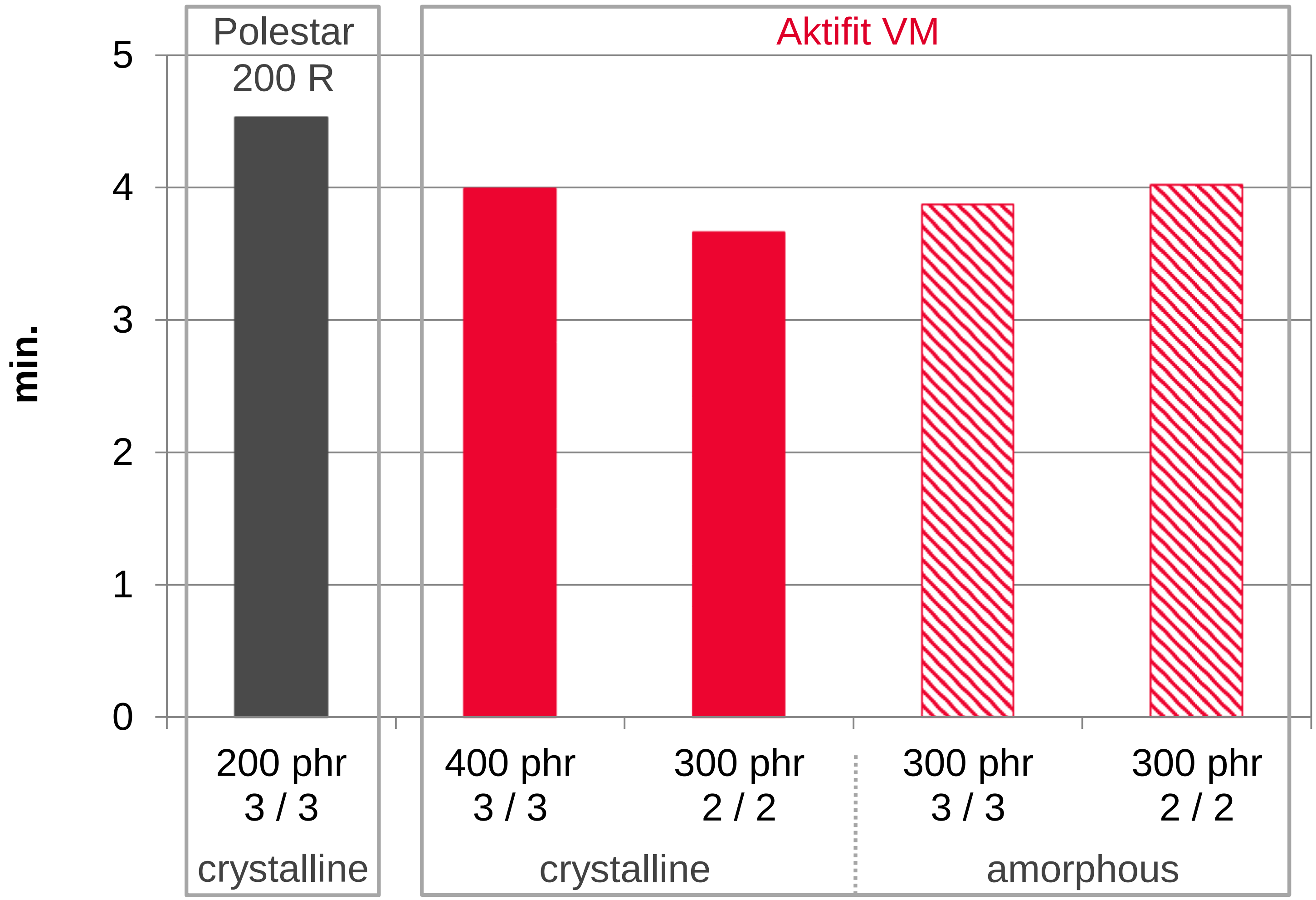


Conversion Time t_{90}

DIN 53 529-A3, 180 °C, 0,2° deflection – Göttfert Elastograph



Hardness

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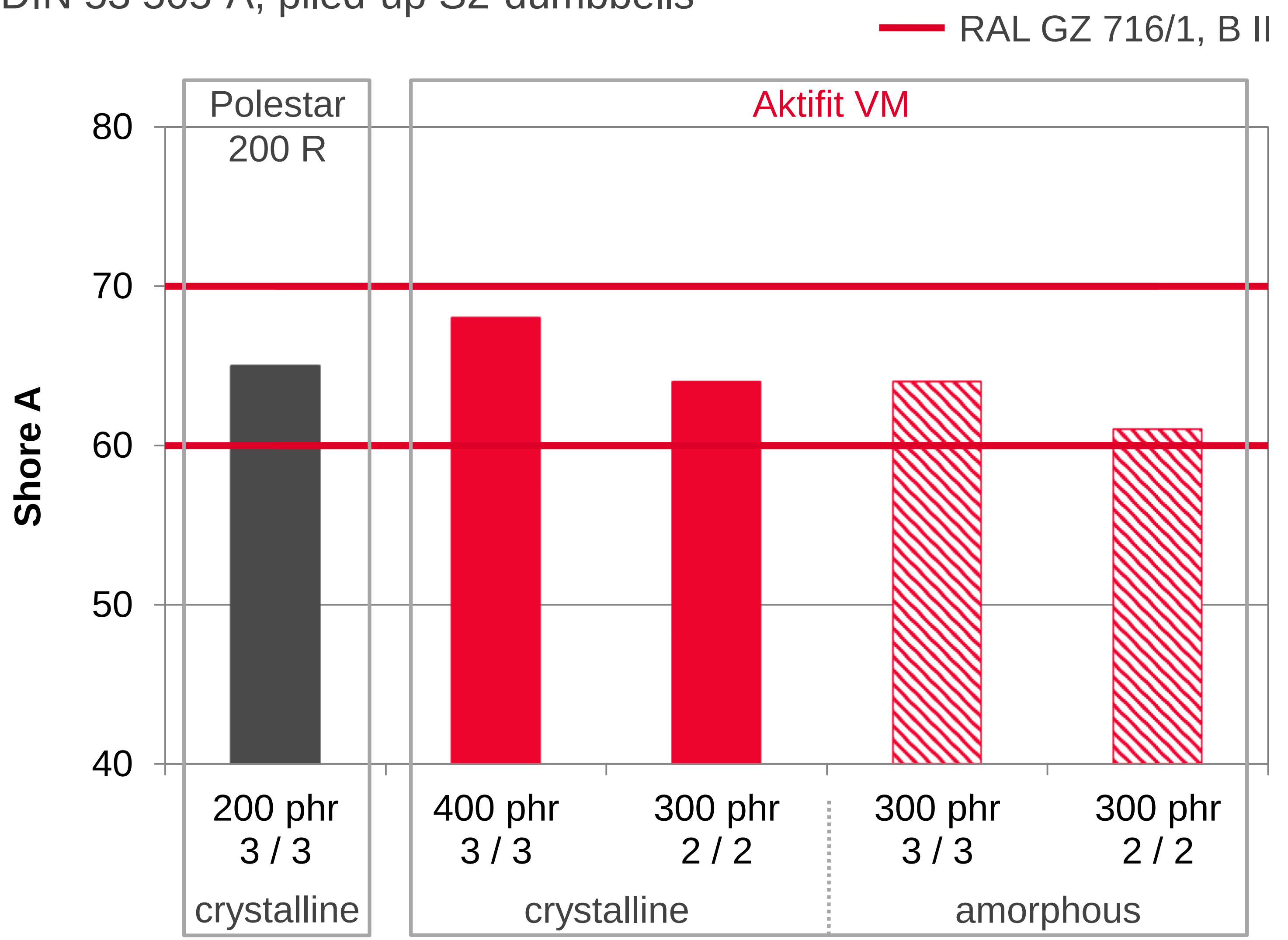
DIN 53 505-A, piled-up S2-dumbbells



Tensile Strength

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DIN 53 504, S2

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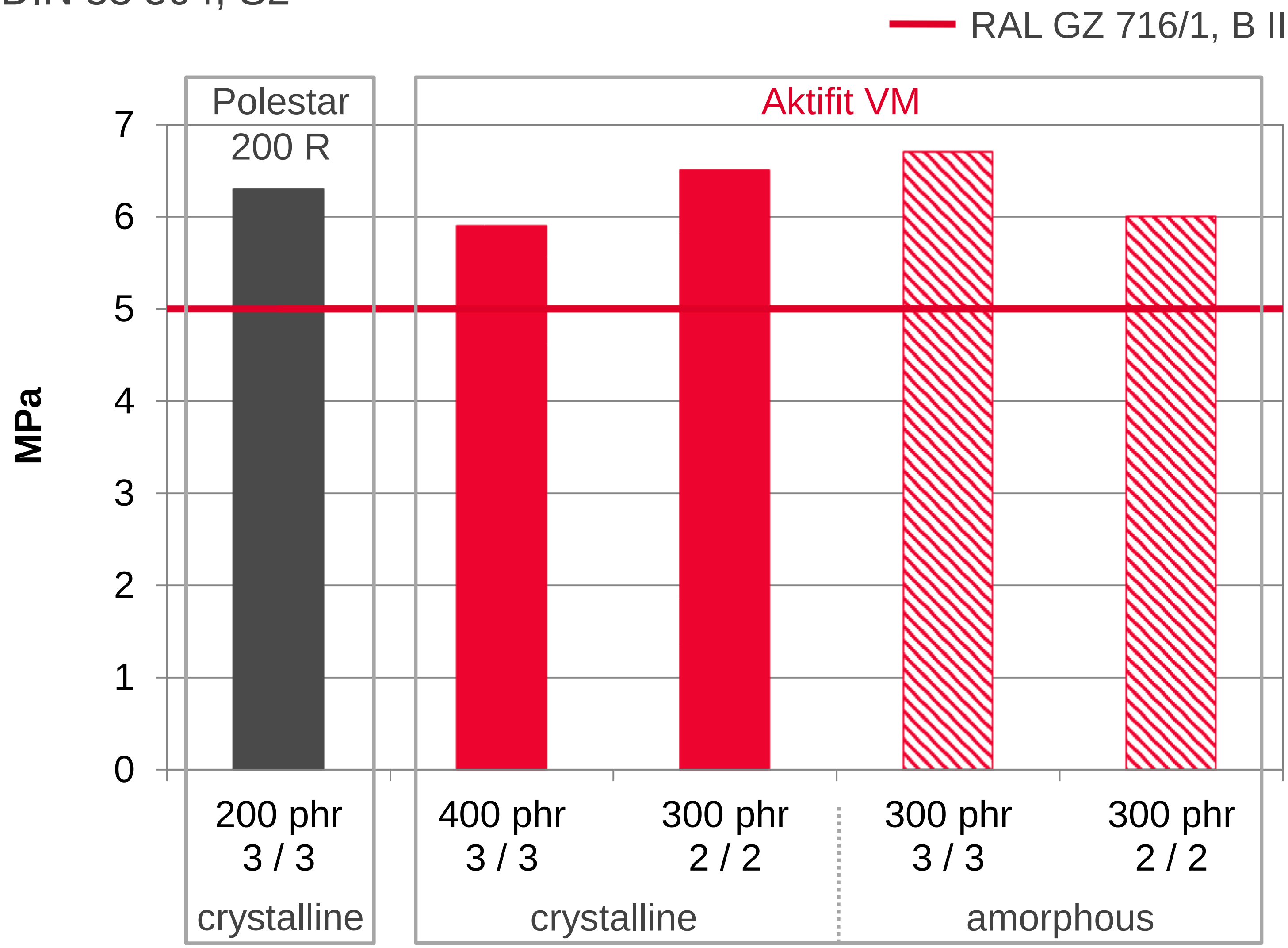
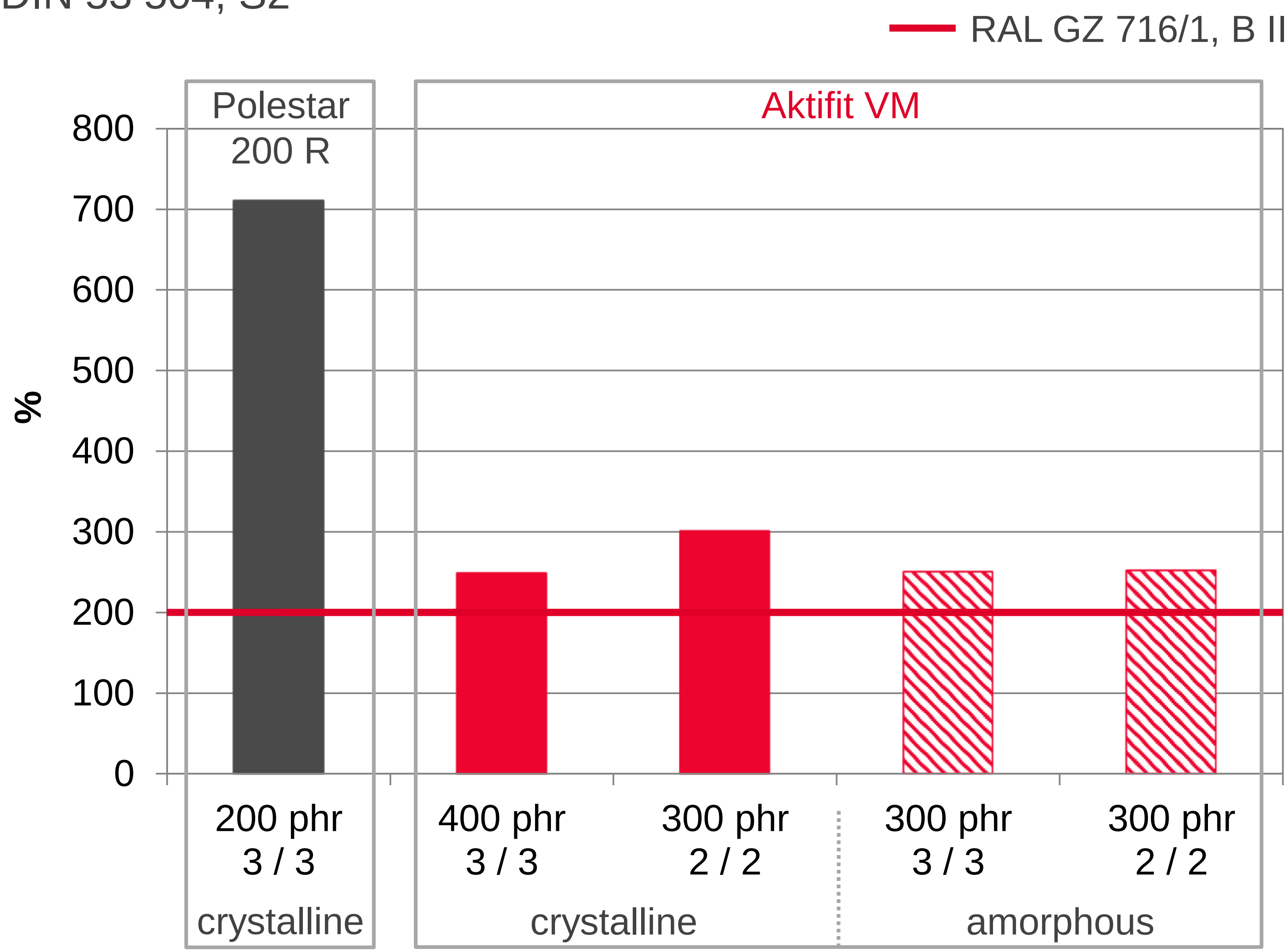


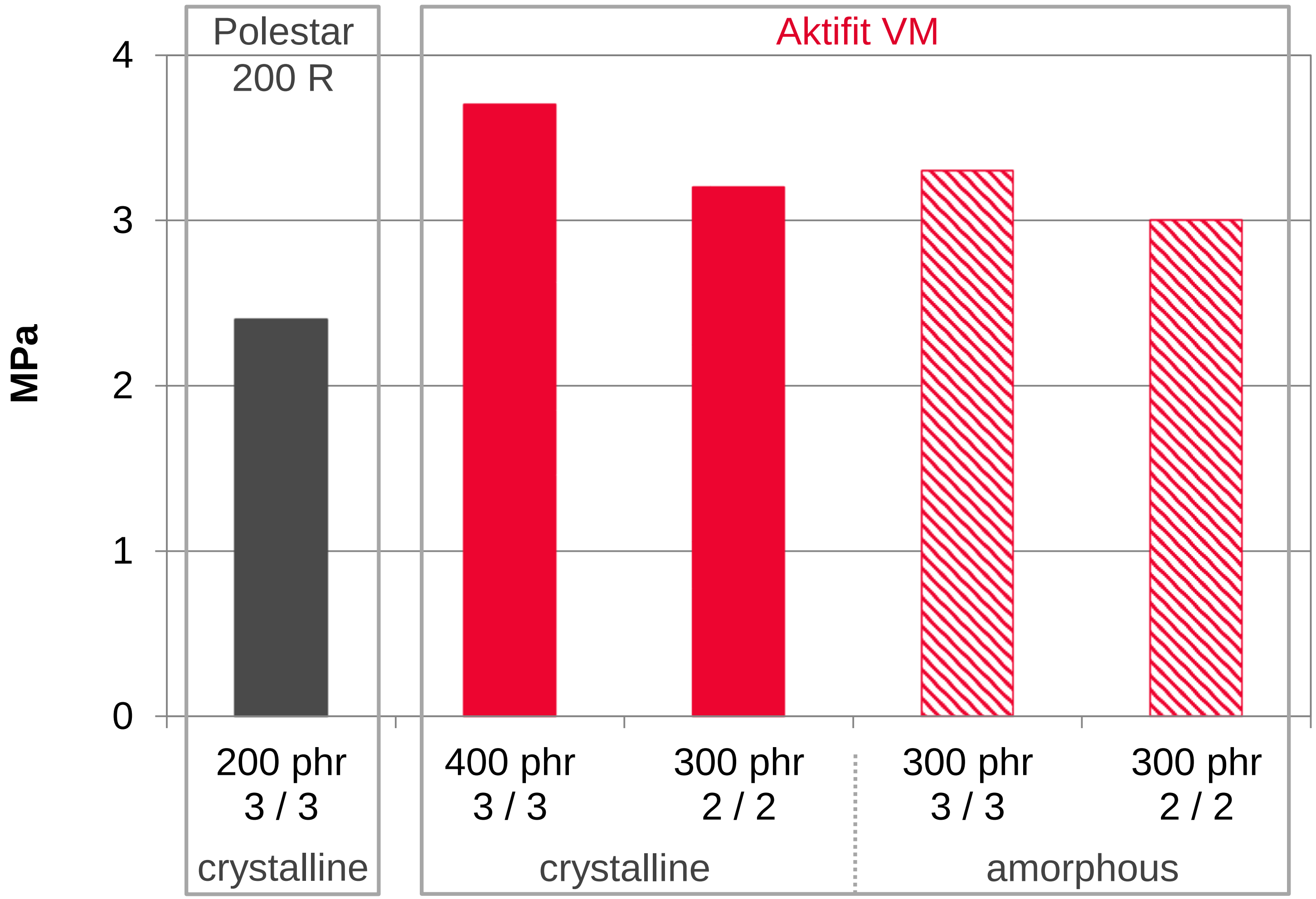
Elongation at Break

DIN 53 504, S2



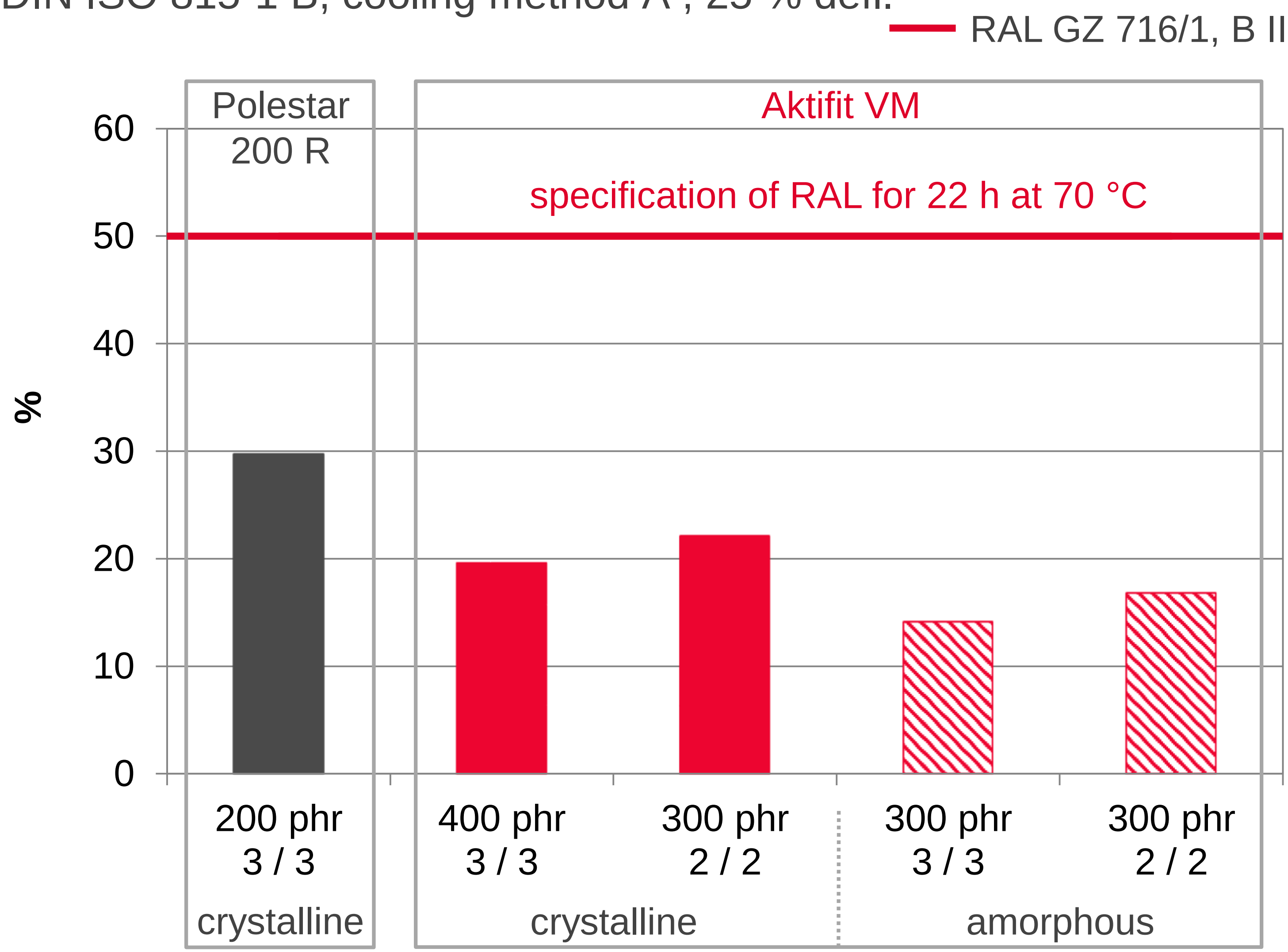
Modulus 100 %

DIN 53 504, S2



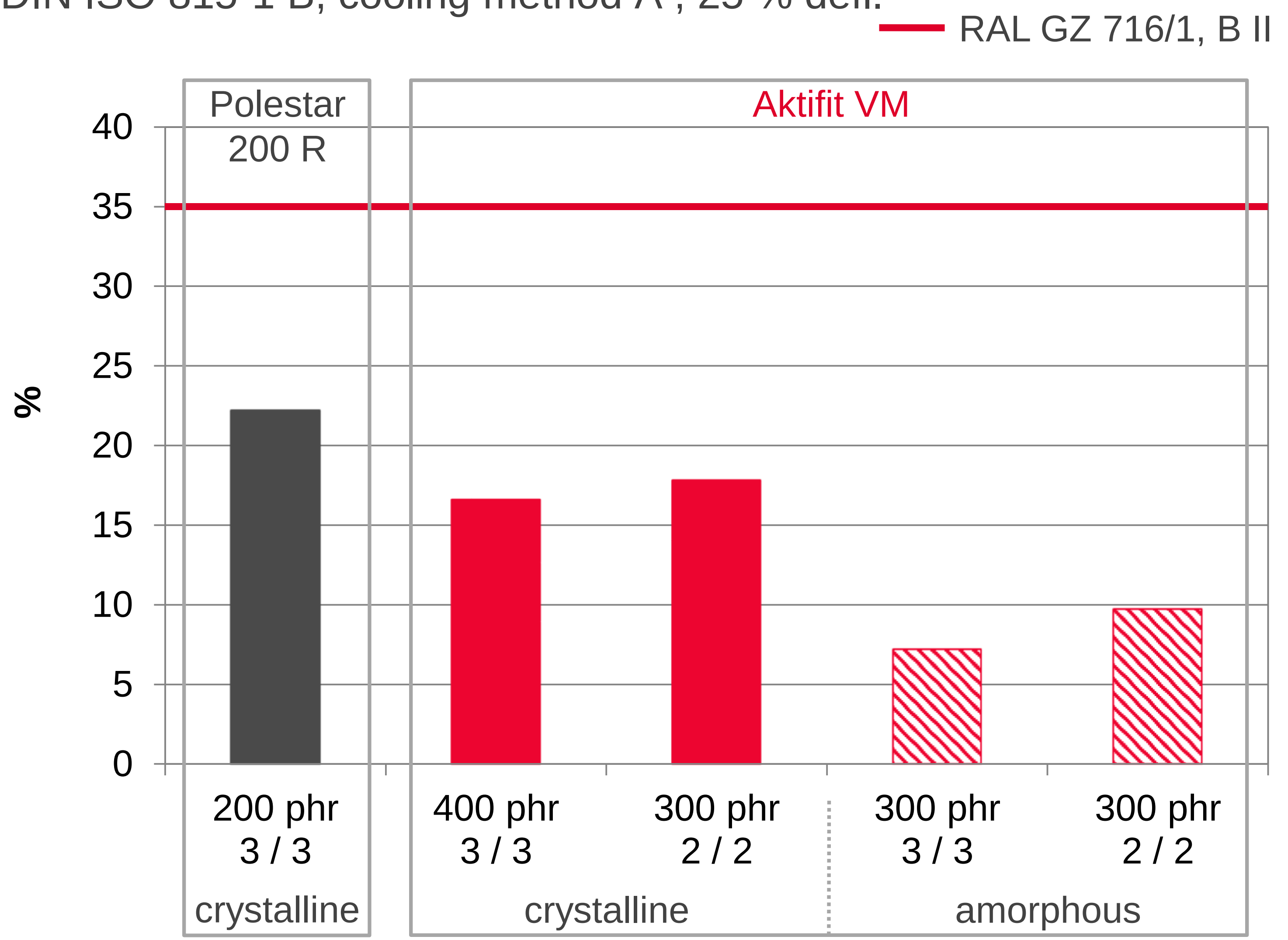
Compression Set
24 h / 125 °C

DIN ISO 815-1 B, cooling method A , 25 % defl.



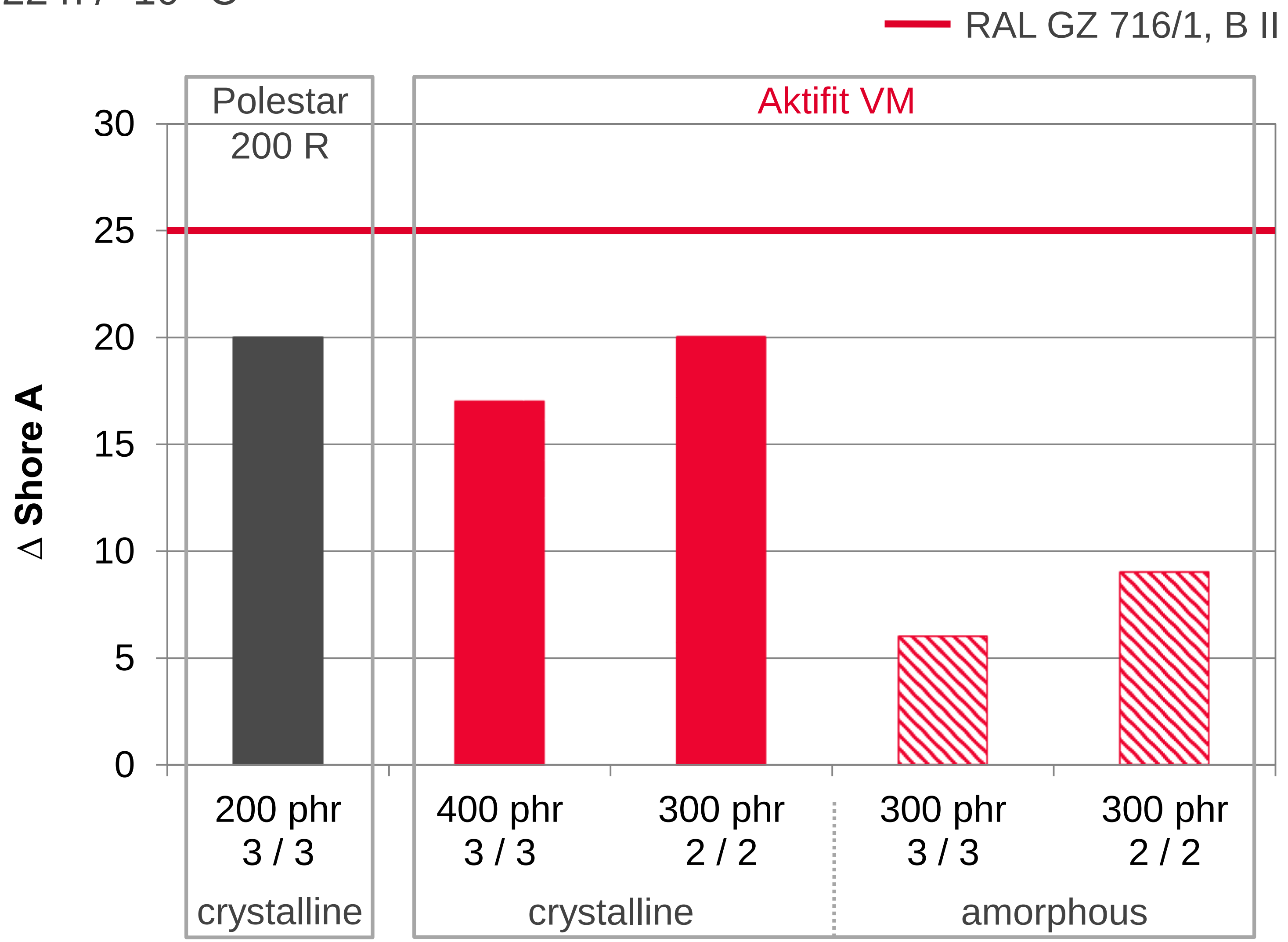
Compression Set
22 h / 23 °C

DIN ISO 815-1 B, cooling method A , 25 % defl.



Low Temperature Exposure
Change of Hardness

22 h / -10 °C



Hot Air Aging
Change of Hardness

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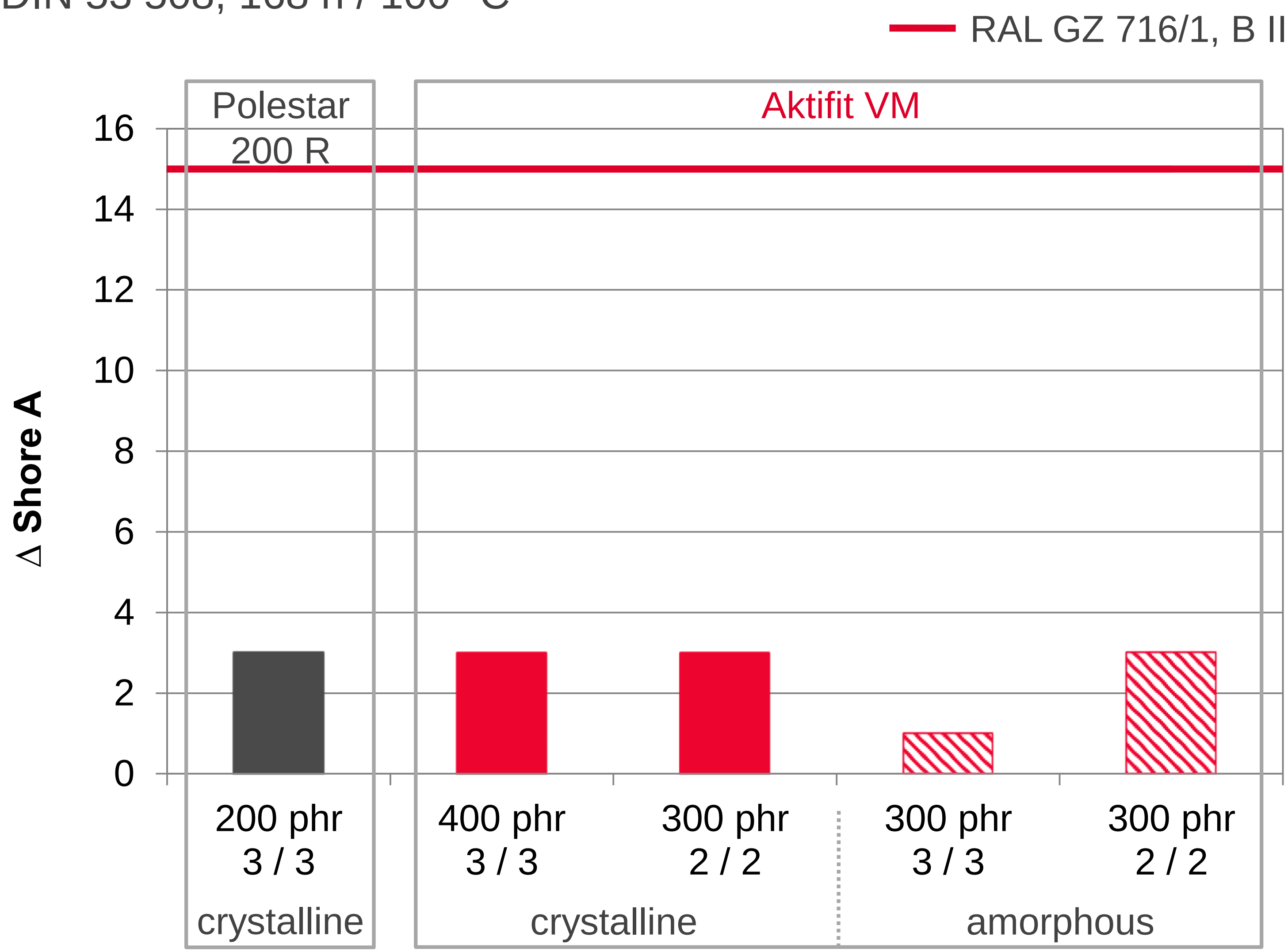
DIN 53 508, 168 h / 100 °C



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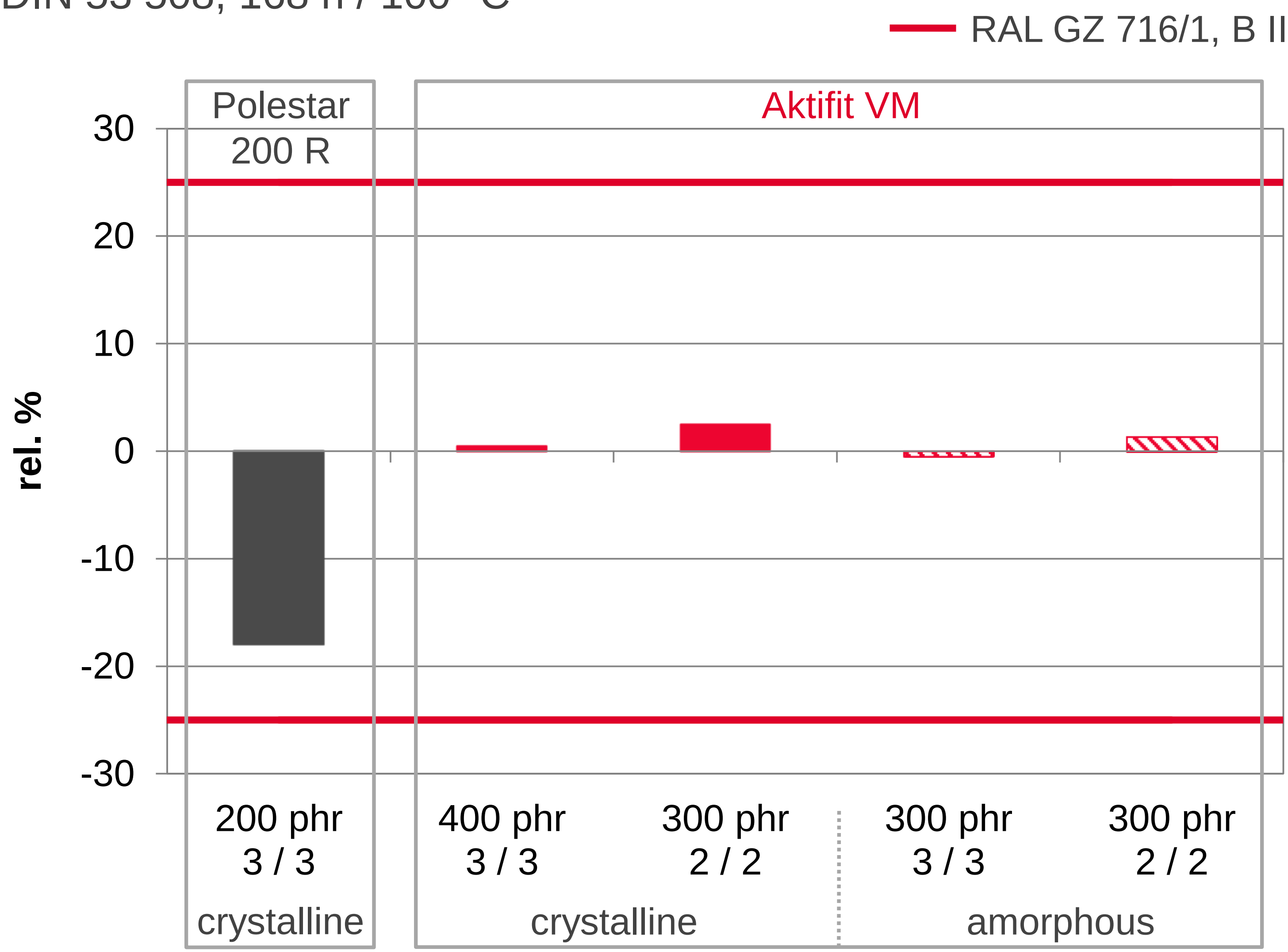

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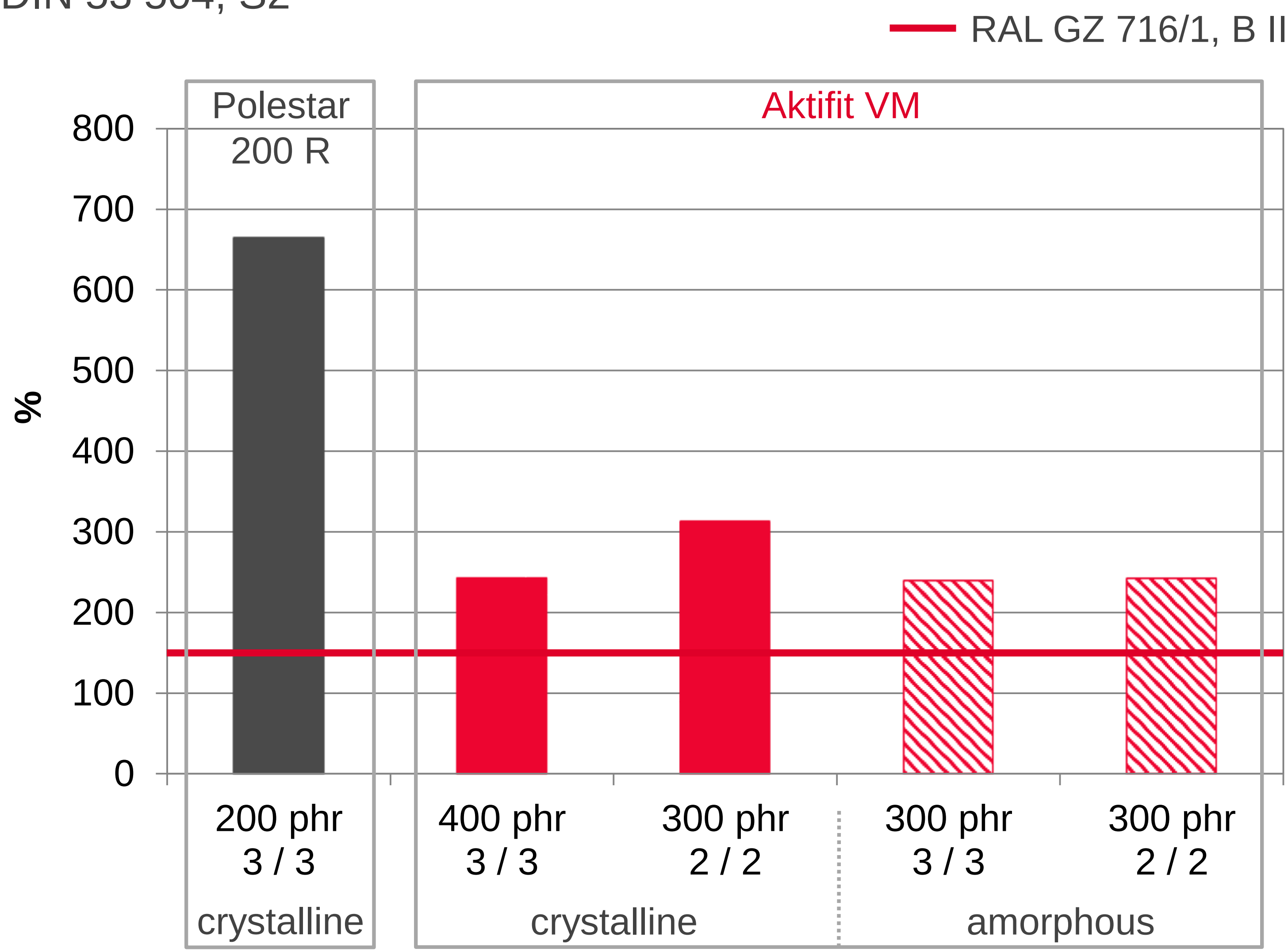
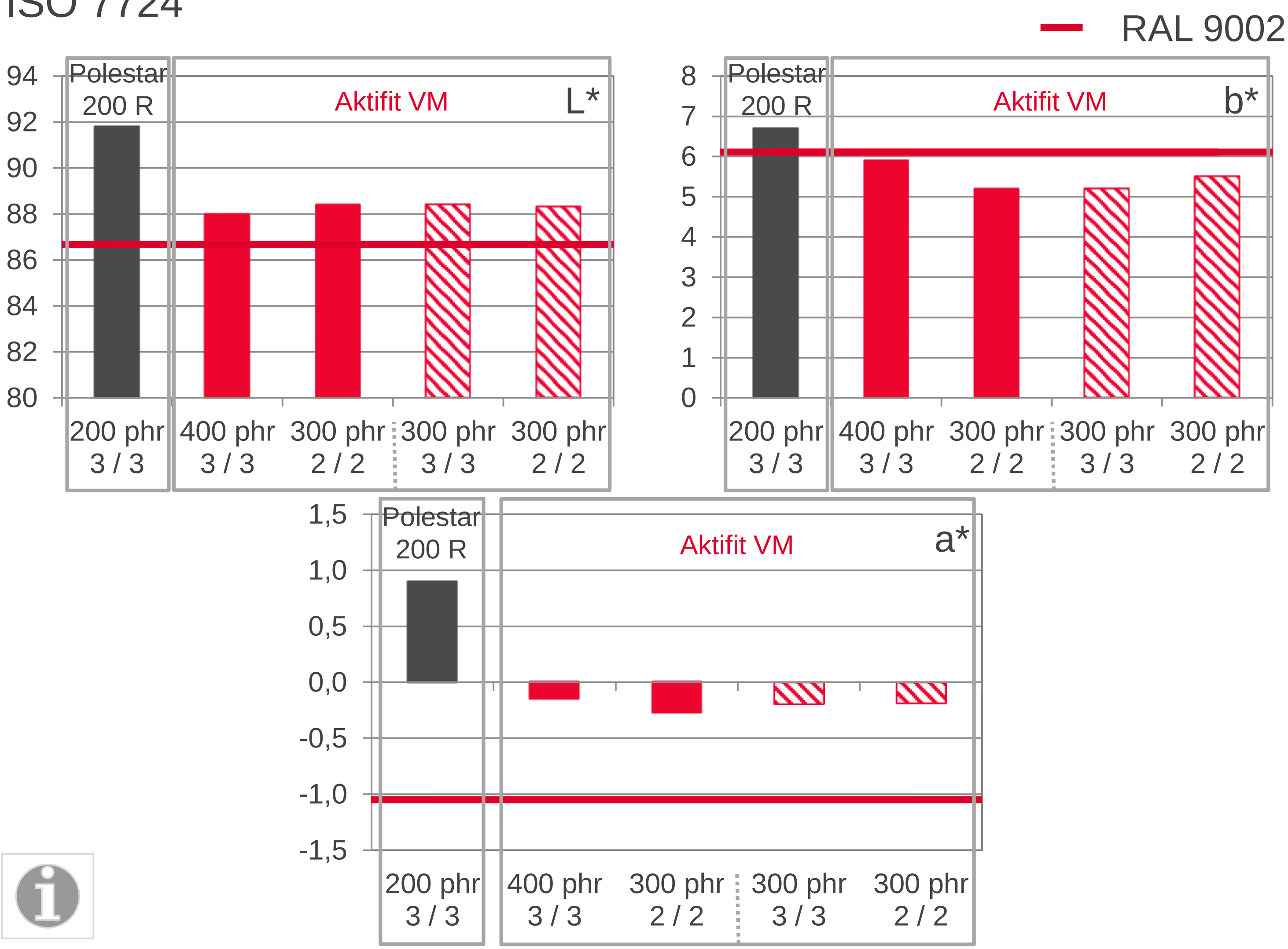


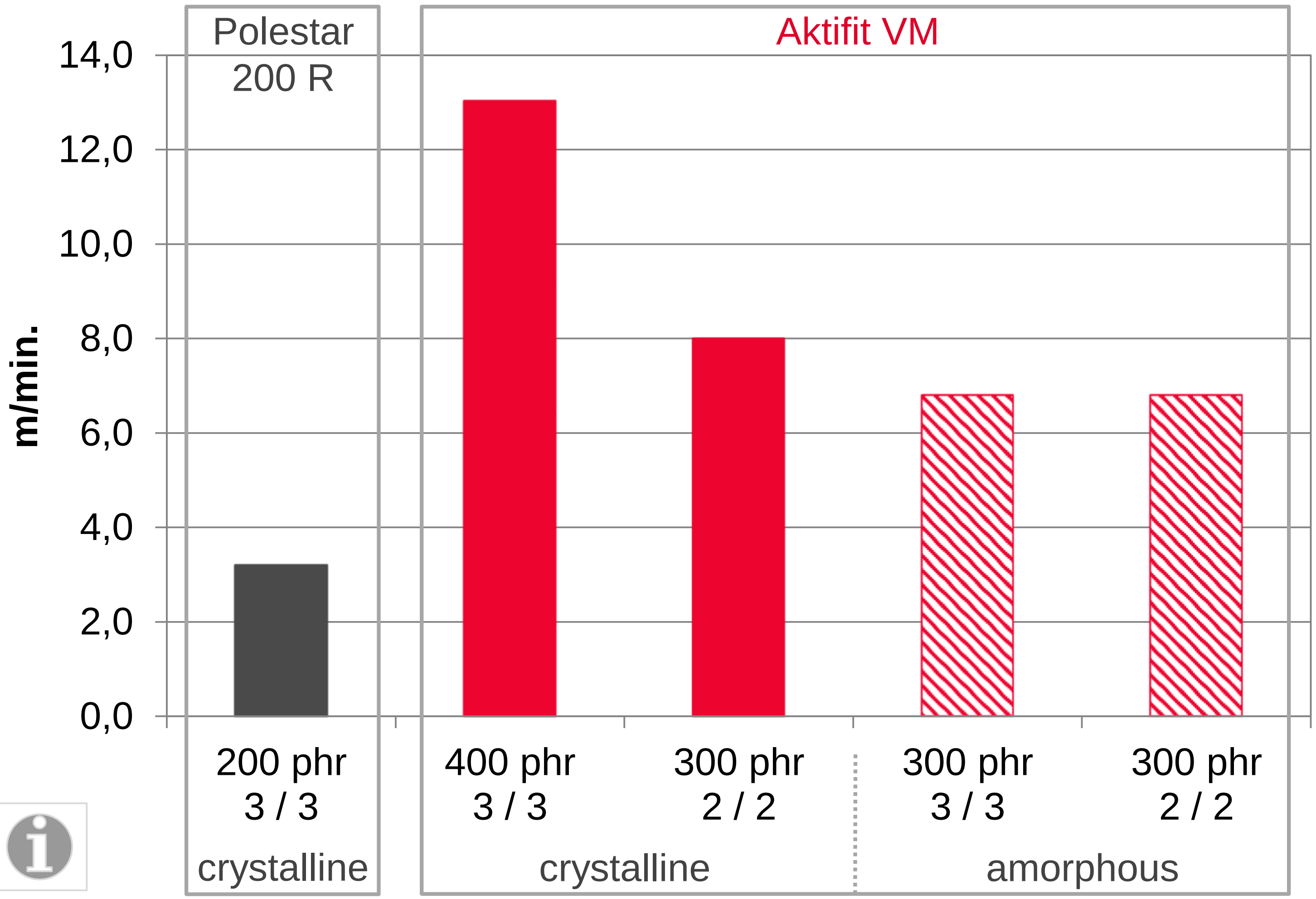
Color Values

ISO 7724



Garvey Extrusion

ASTM D 2230, rating 4 4 4 4



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Volume related, Germany 2011

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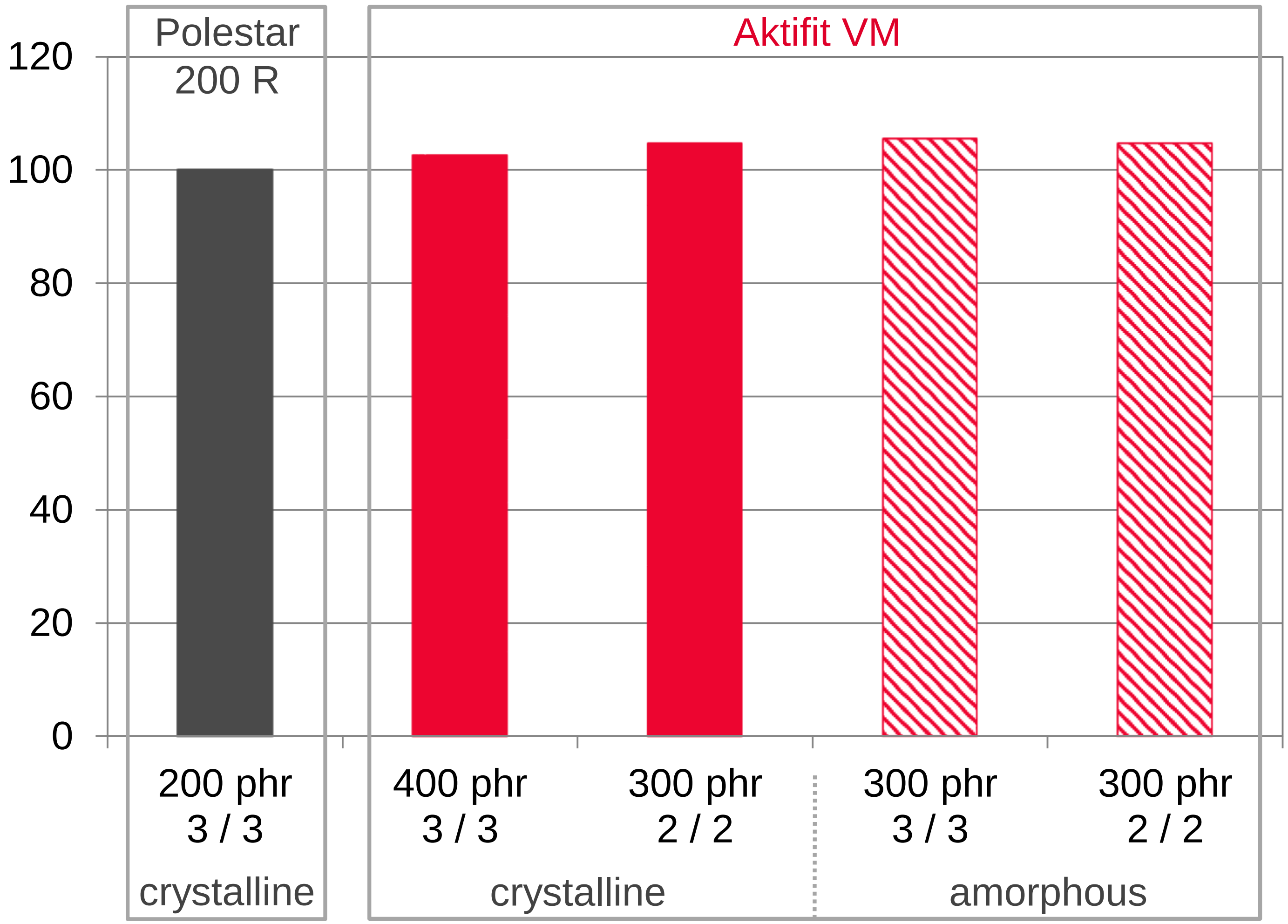

Summary Part 2

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Aktifit VM 300 phr, peroxide combination 2 / 2, both polymers

- ✓ compared to reference compound with Polestar 200 R improved mechanical properties, especially compression set
- ✓ higher approach to color values of RAL 9002 with lower red and yellow tint than reference compound with Polestar 200 R
- ✓ in comparison to reference compound with Polestar 200 R doubled haul-off speed
- ✓ increased volume related compound costs only of approx. 5 % in comparison to reference compound with Polestar 200 R

Summary Part 2

Aktifit VM 300 phr, peroxide combination 3 / 3, amorphous polymer

- ✓ best compression set
- ✓ lowest change of hardness after storage at low temperature
- ✓ higher approach to color values of RAL 9002 with lower red and yellow tint than reference compound with Polestar 200 R
- ✓ in comparison to reference compound with Polestar 200 R doubled haul-off speed
- ✓ increased volume related compound costs only of approx. 5 % in comparison to reference compound with Polestar 200 R

Summary Part 2

Aktifit VM 400 phr, peroxide combination 3 / 3, crystalline polymer

- ✓ better compression set than reference compound with Polestar 200 R
- ✓ slight improvement of change of hardness after storage at low temperature compared to reference compound with Polestar 200 R
- ✓ higher approach to color values of RAL 9002 with lower red and yellow tint than reference compound with Polestar 200 R despite of doubled filler loading
- ✓ haul-off speed increase fourfold compared to reference compound with Polestar 200 R
- ✓ increased volume related compound costs only of approx. 2.5 % in comparison to reference compound with Polestar 200 R

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Final Conclusion

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For the replacement of Polestar 200 R by Aktifit VM speak:

- ✓ improved mechanical properties
- ✓ higher color neutrality
- ✓ markedly improved extrusion behavior

➢ **Calcined Neuburg Siliceous Earth is excellently suitable for the application in grey-white colored building profiles.**

We supply material for good ideas!

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