Calcined Neuburg Siliceous Earth in polybutylene terephthalate (PBT)

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Status Quo

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- PBT is used in a multitude of application areas, above all in the automotive and electrical industries.
- Important properties are – apart from easy processing, high strength and stiffness – high dimensional stability, good friction and wear behavior as well as good chemical resistance to many solvents.
- For low-warping parts with good surface glass beads are often used to customize properties.
- Mineral filled compounds have been hardly available because of their weak property profile.

Objective

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Assessment of the performance of Aktifit VM, a calcined and surface treated Neuburg Siliceous Earth grade, versus **surface treated glass beads** in PBT regarding

- » Flow
- » Heat deflection
- » Mechanical properties
  - – Tensile test
  - – Flexural test
  - – Impact strength

Calcined Neuburg Siliceous Earth

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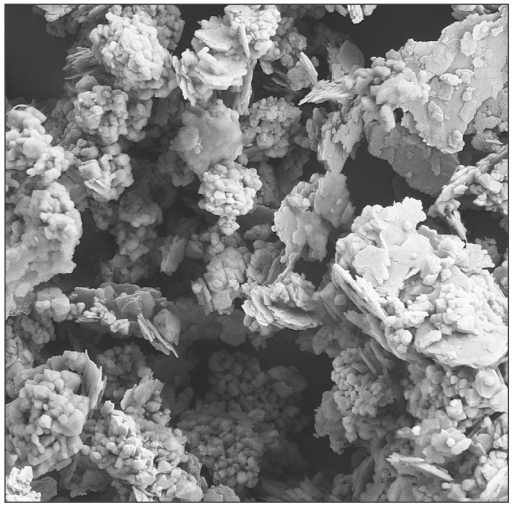
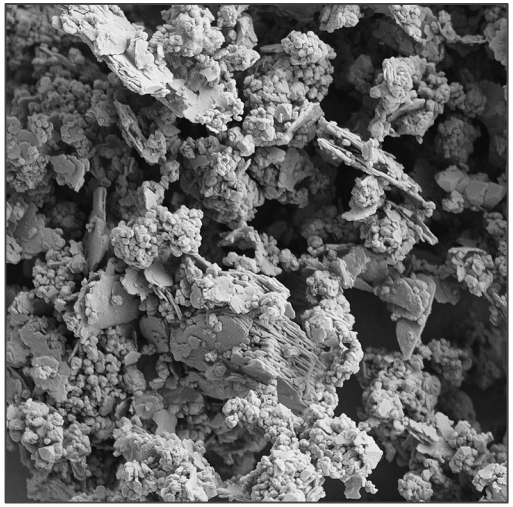
A downstream thermal process leads to the calcined products Silfit and Aktifit, based on SILLITIN Z 86.



Neuburg Siliceous Earth

Calcination Process



Calcined Neuburg Siliceous Earth

Additional application benefits, as well as the removing of crystal water included in the kaolinite. The silica part remains inert.

Fillers and Characteristics

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Filler	Description	Functionalization
Glass beads	d_{50}: 15-30 µm, d_{90}: 30-80 µm	Suitable for PBT
Aktifit VM	Calcined Neuburg Siliceous Earth d_{50}: 2 µm, d_{97}: 10 µm Hydrophobic Moisture less or equal 0.1 %, even with high air humidity No pre-drying necessary	Vinyl

Compounding
Injection Molding

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Composition	70 % PBT 30 % Filler
Compounding	Twin screw extruder ZSK 30
Injection molding of test specimens acc. to ISO 1874	Mold acc. to ISO 294 Mold temperature: 80 °C Melt temperature: 260 °C

Color of Specimens

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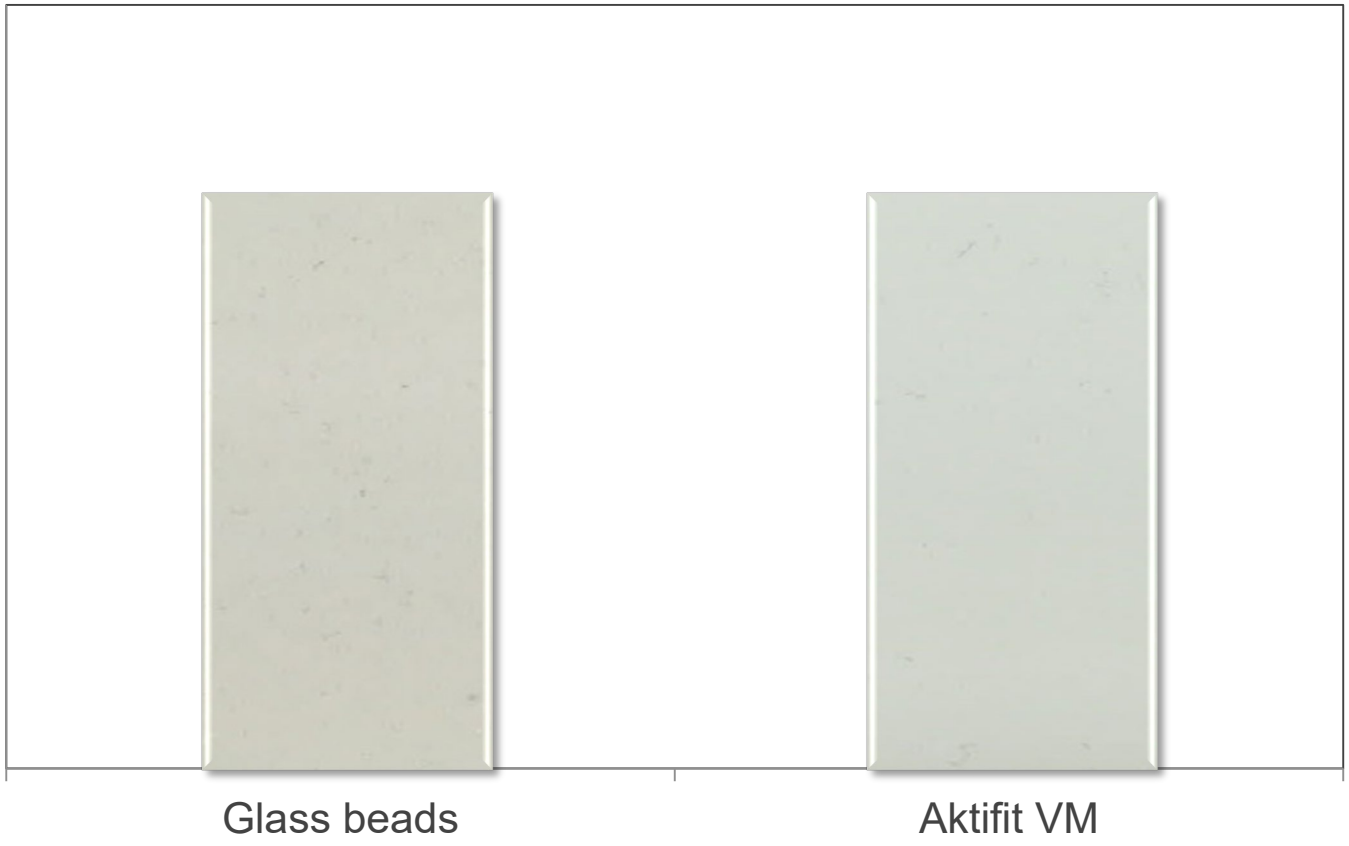

Melt Volume-flow Rate

DIN ISO 1133; 250 °C, 2.16 kg

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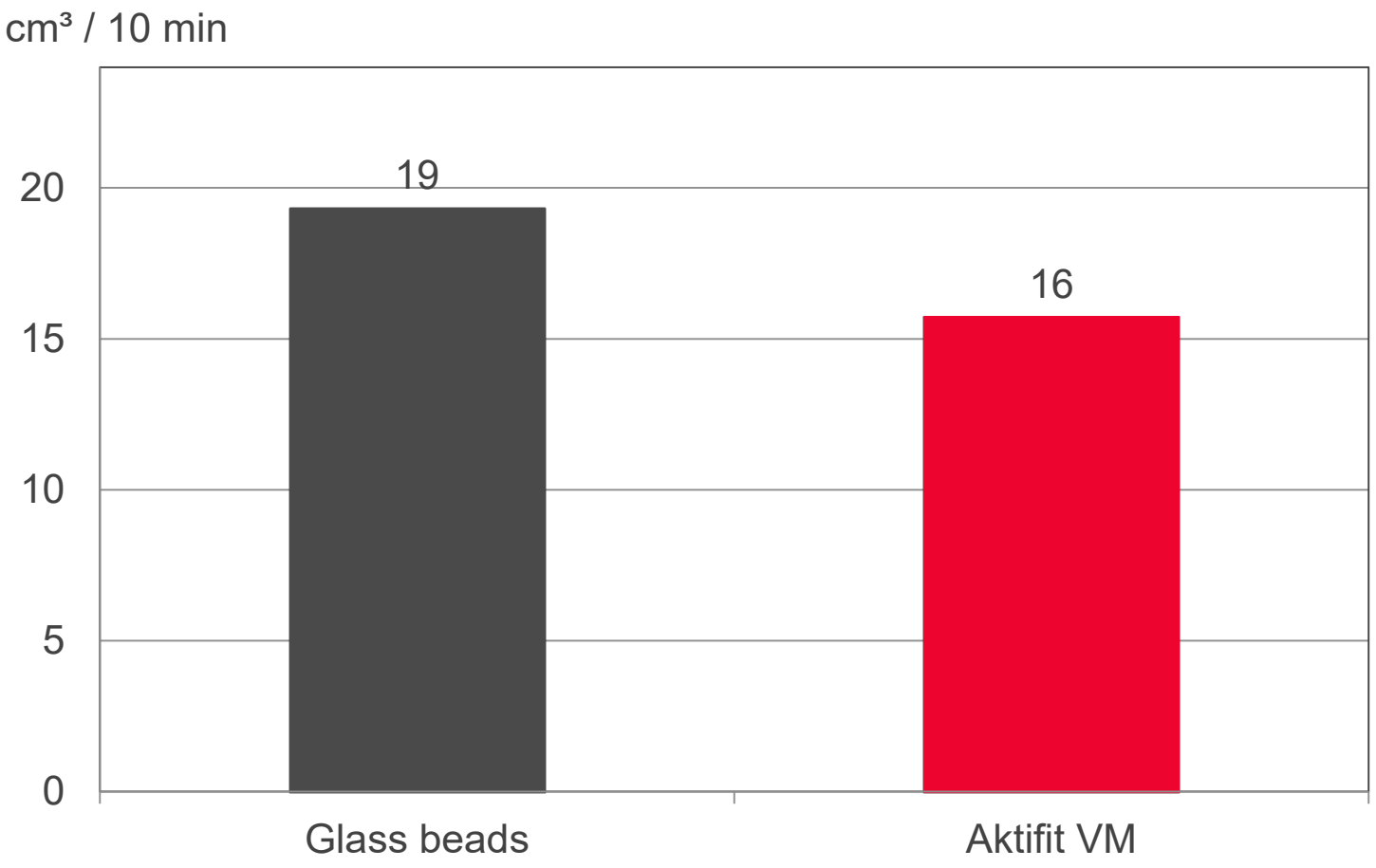

Heat Deflection
Heat Distortion Temperature

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DIN EN ISO 75-1, -2; Method Af (1.8 MPa)

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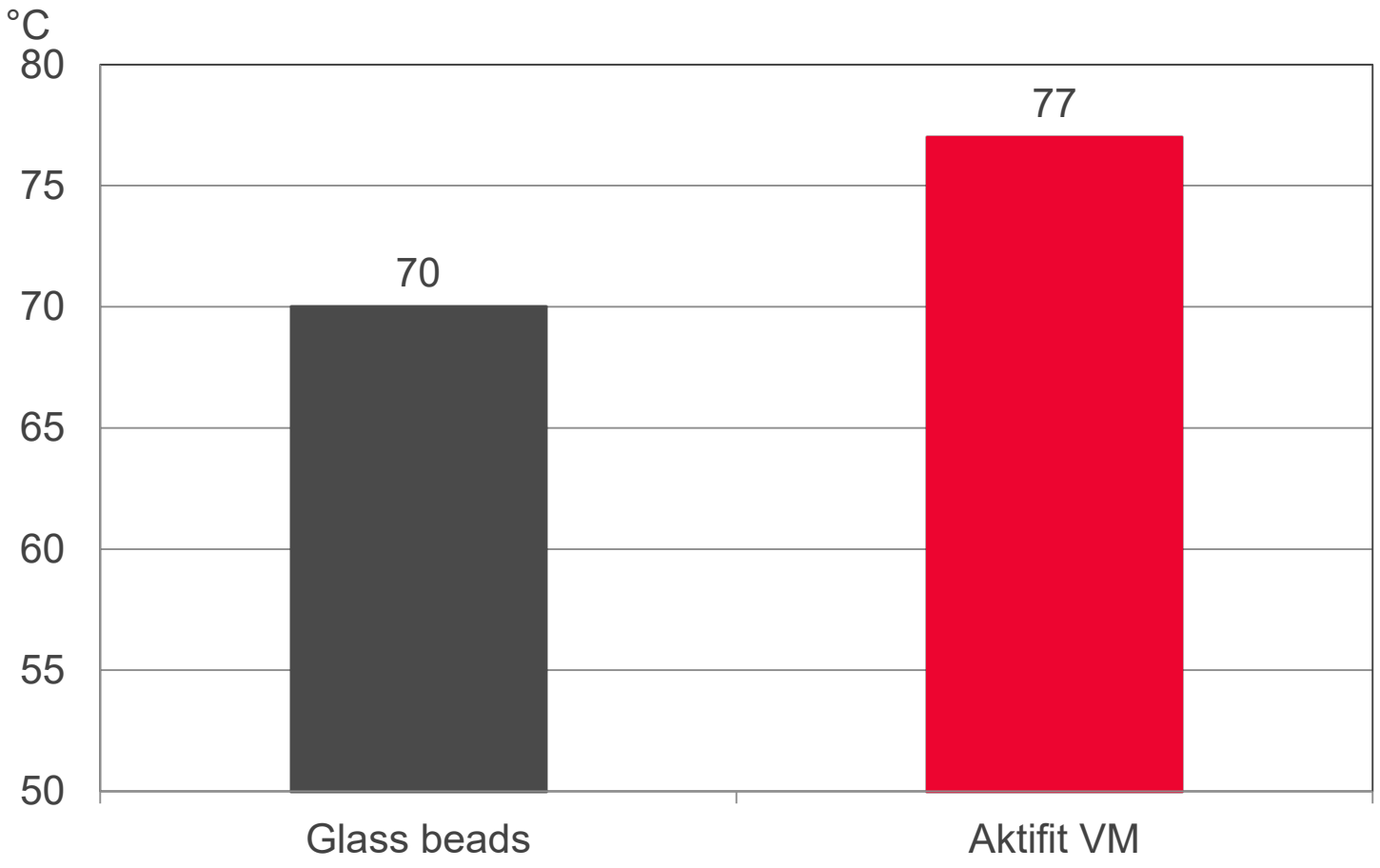

Tensile Modulus

DIN EN ISO 527-1,-2; 1 mm/min

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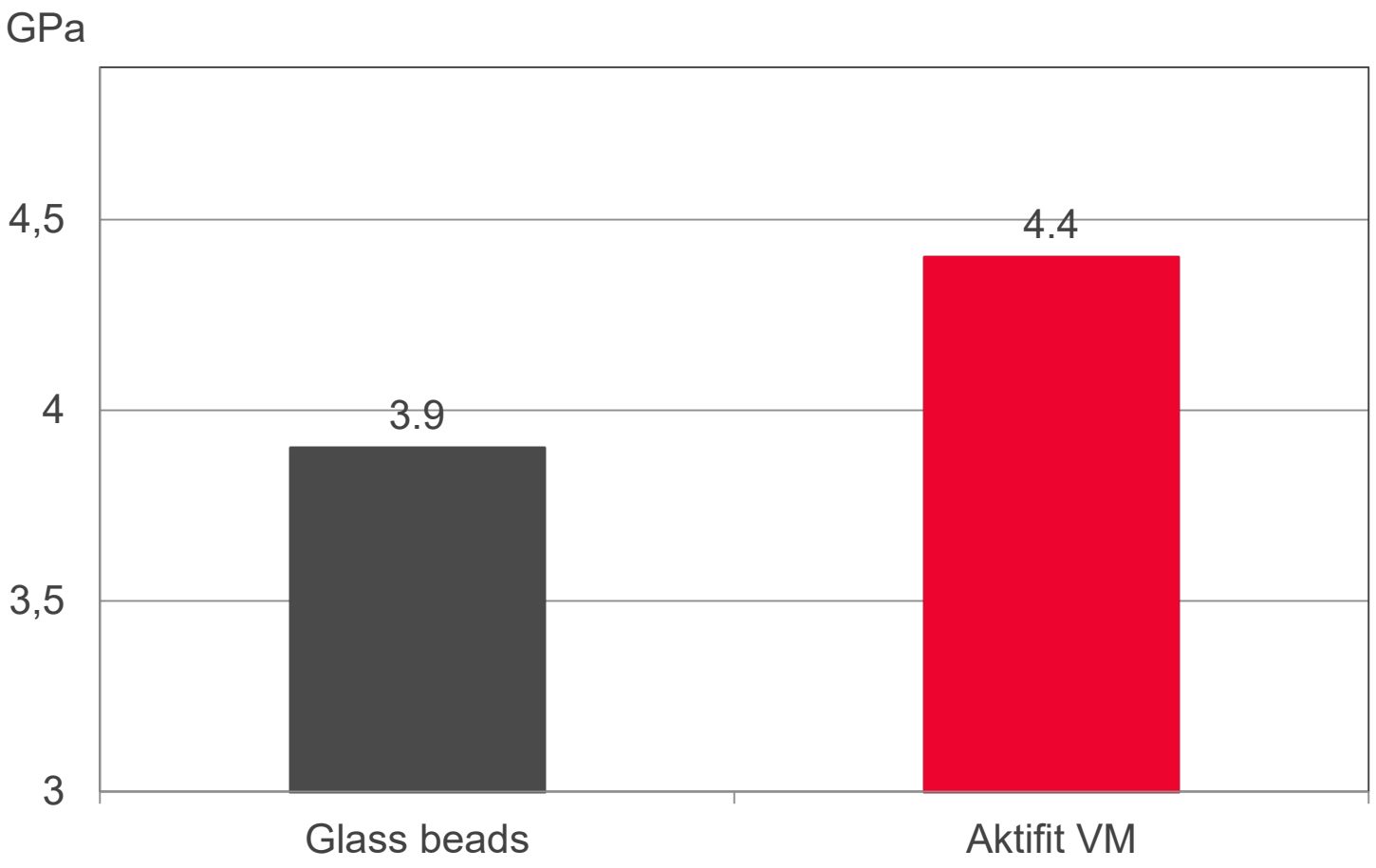

Tensile Strength

DIN EN ISO 527-1,-2; 5 mm/min

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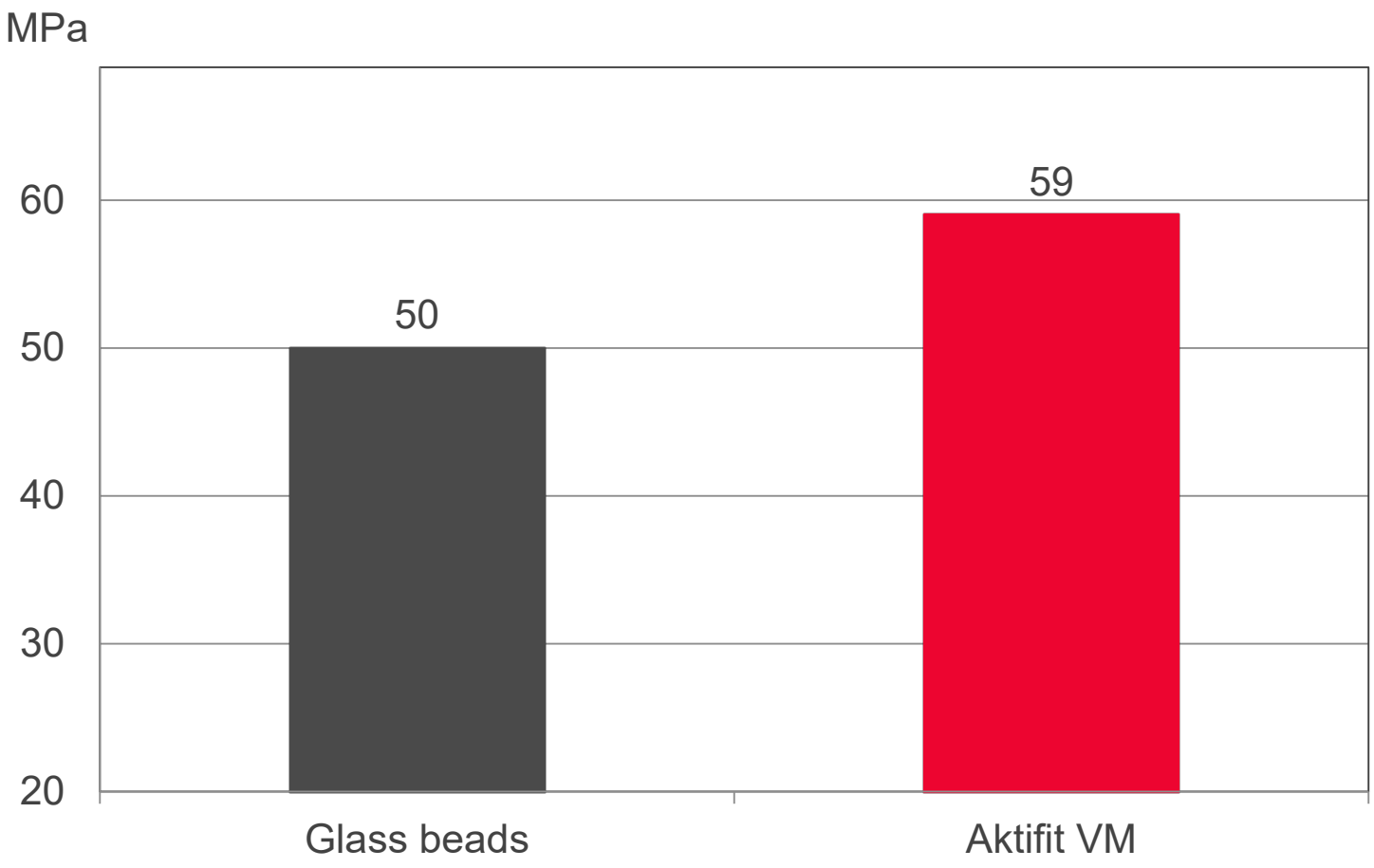

Tensile Strain at Break

DIN EN ISO 527-1,-2; 5 mm/min

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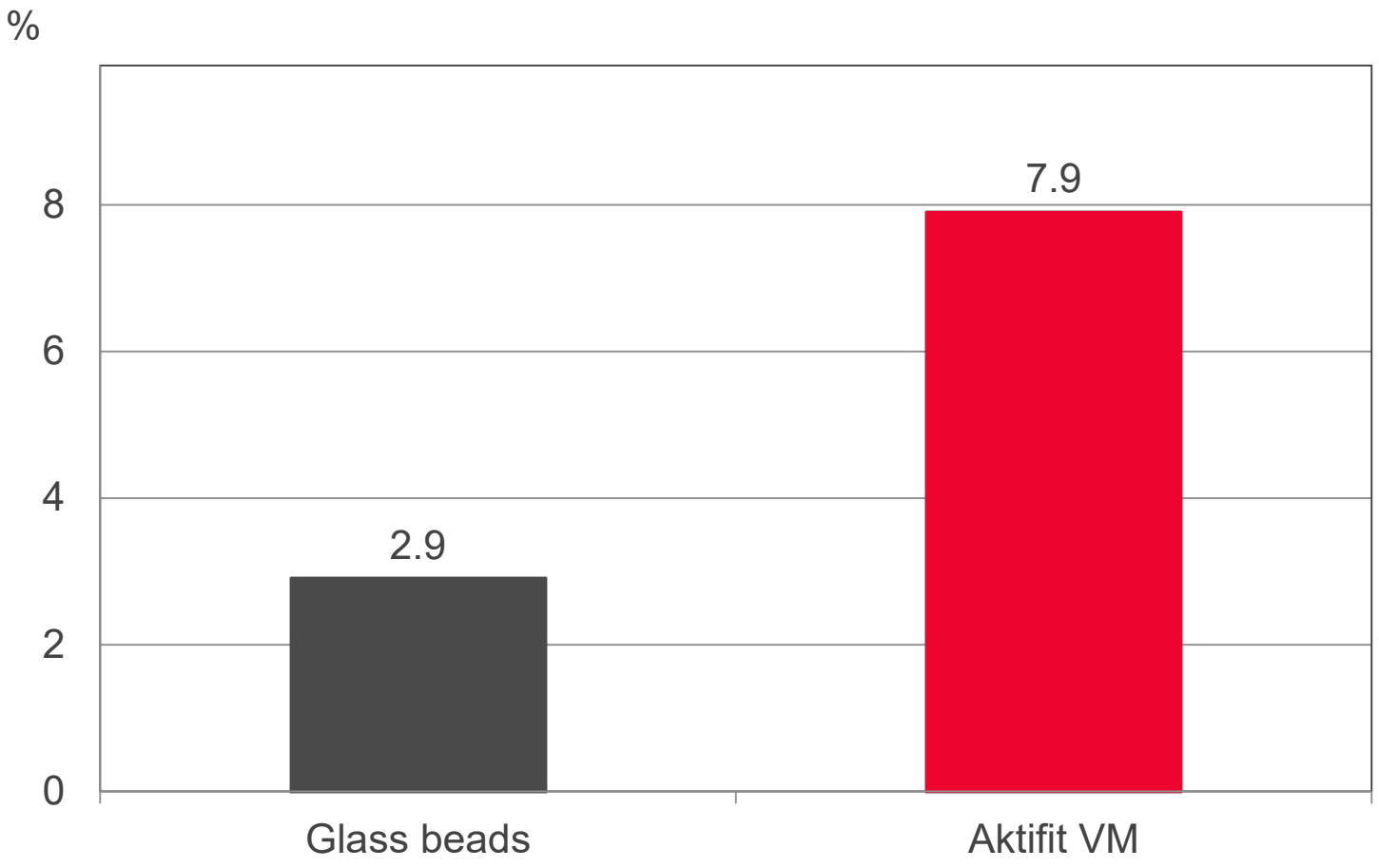

Flexural Modulus

DIN EN ISO 178

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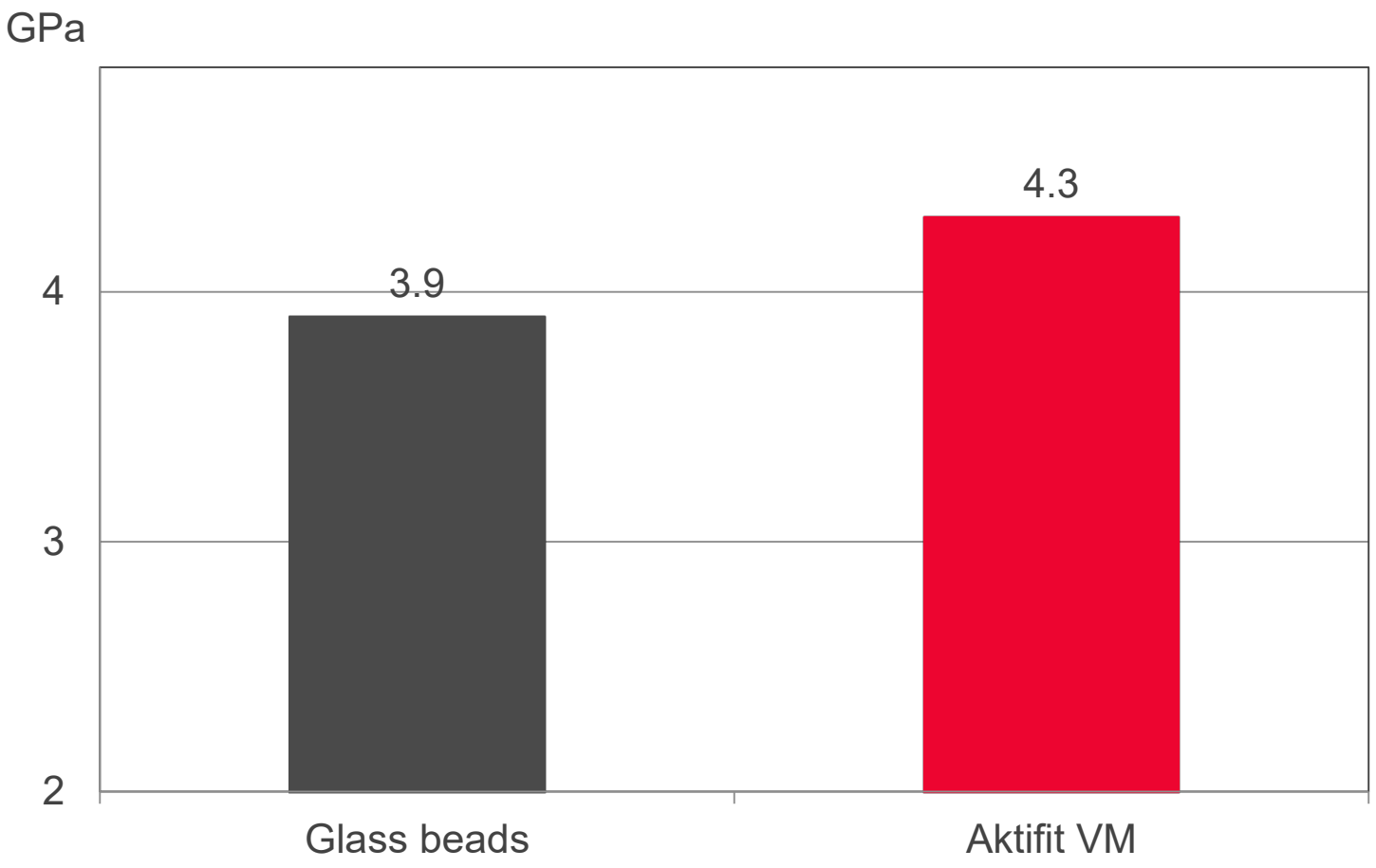

Flexural Strength

DIN EN ISO 178

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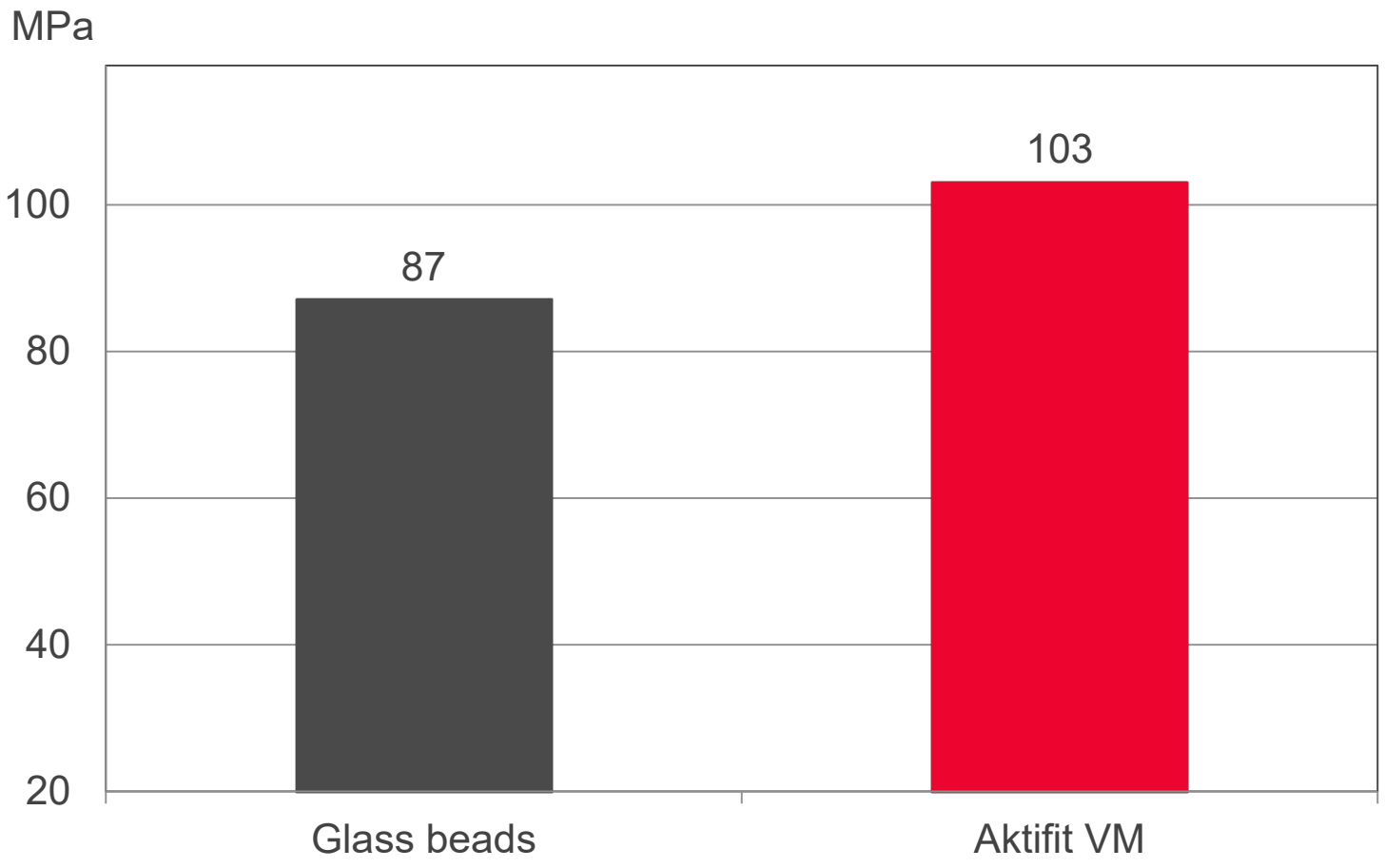

Flexural Strain at Break

DIN EN ISO 178

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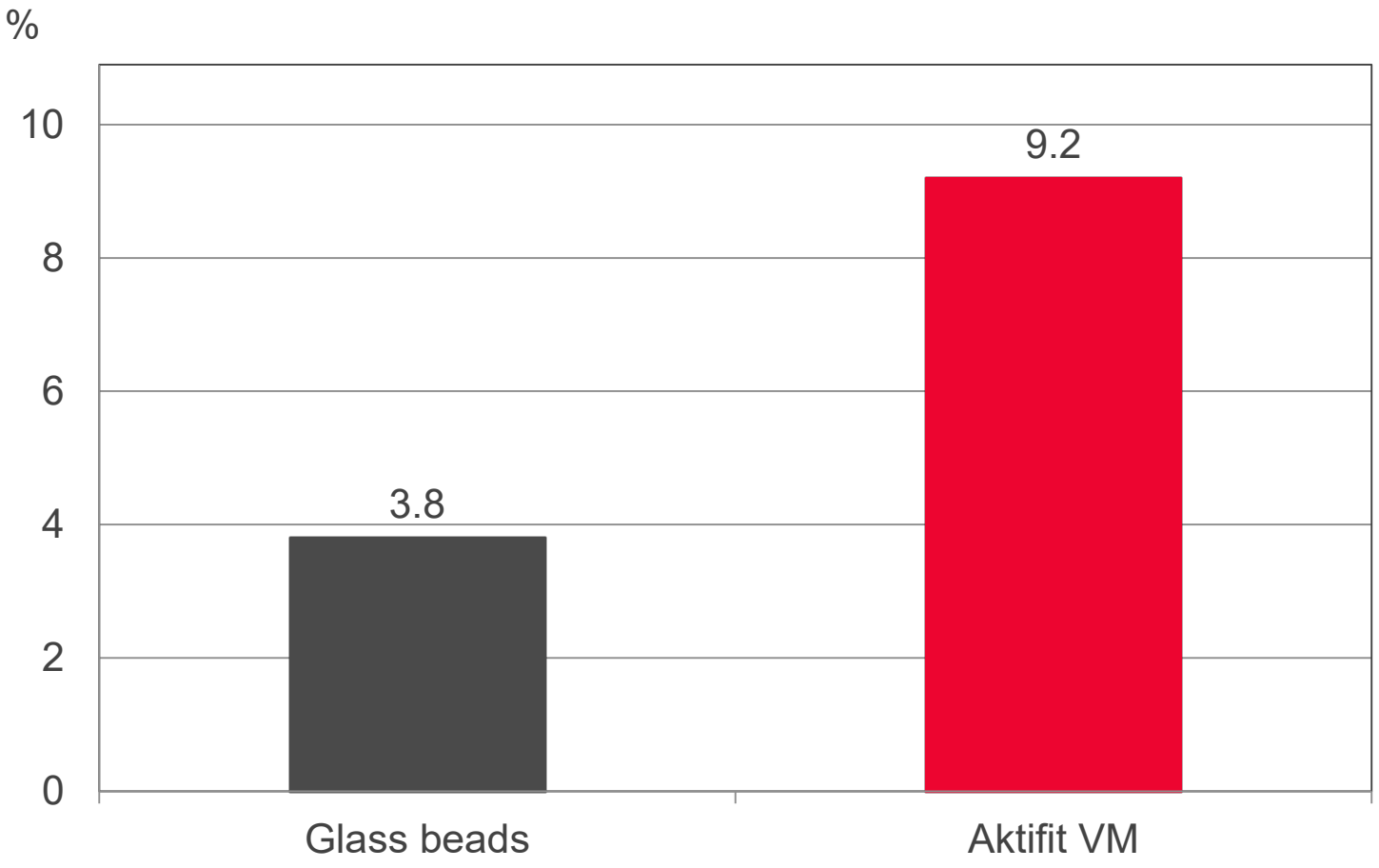

Charpy
Notched Impact Strength, 23 °C

DIN EN ISO 179-1/1eA

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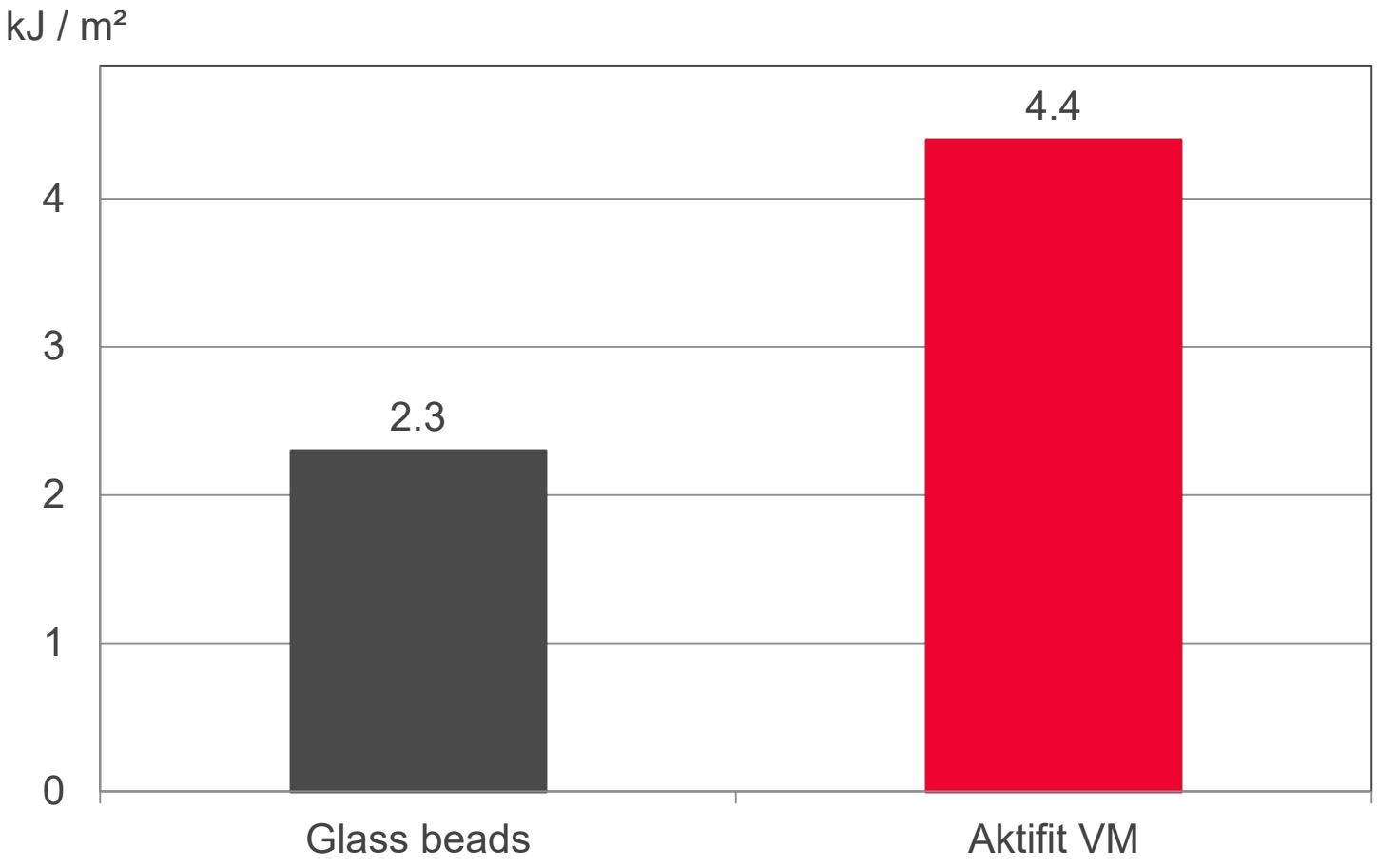

Charpy
Notched Impact Strength, -30 °C

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DIN EN ISO 179-1/1eA

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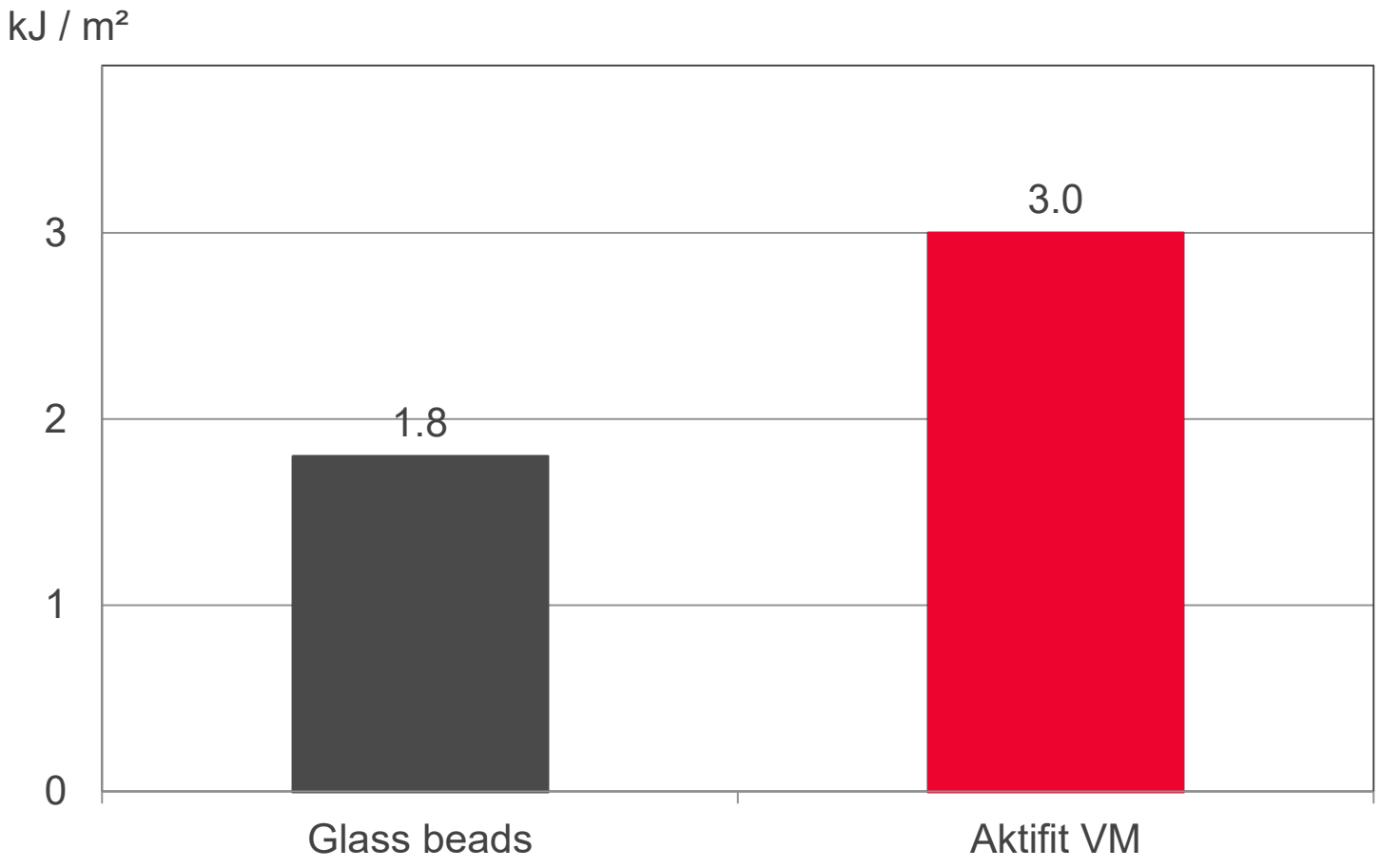

Charpy
Impact Strength, 23 °C

DIN EN ISO 179-1/1eU

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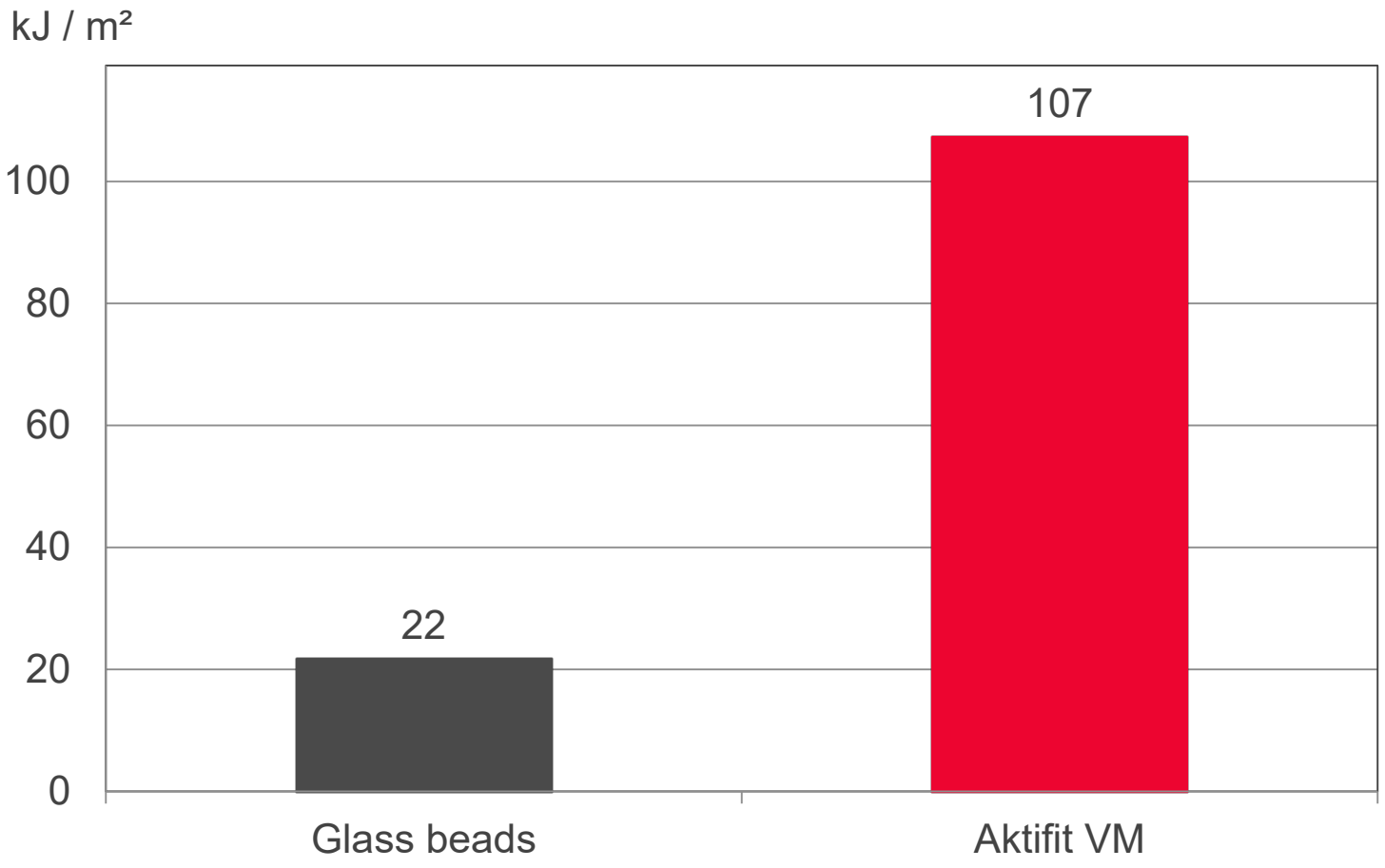

Charpy
Impact Strength, -30 °C

DIN EN ISO 179-1/1eU

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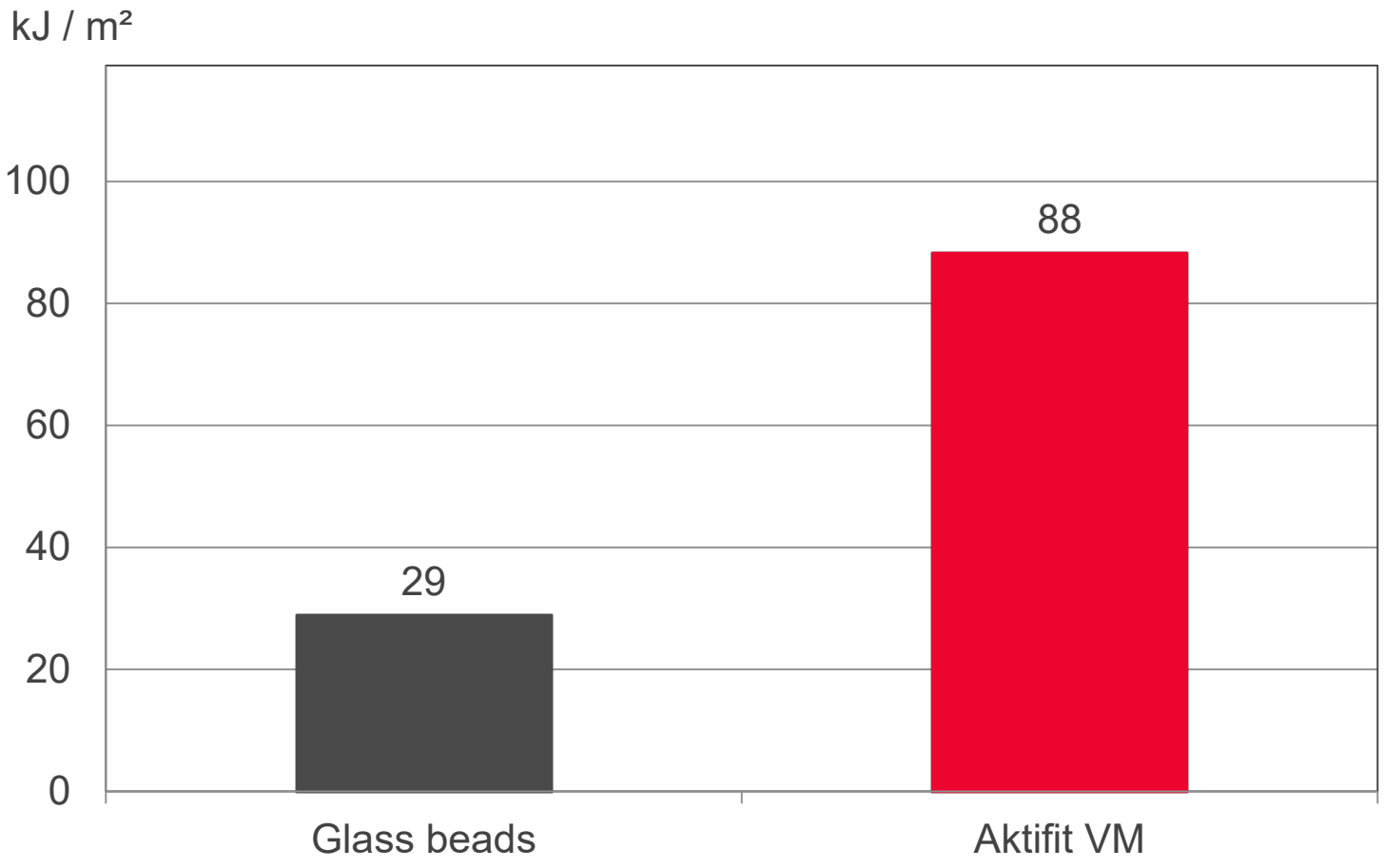

Black Compounds

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Coloring the compounds with carbon black often causes a loss of mechanical properties.

Aktifit VM was therefore also compounded in combination with a black color batch.

Aktifit VM reached results approximately comparable to the natural-colored compound, no significant difference was noted.

Performance PBT

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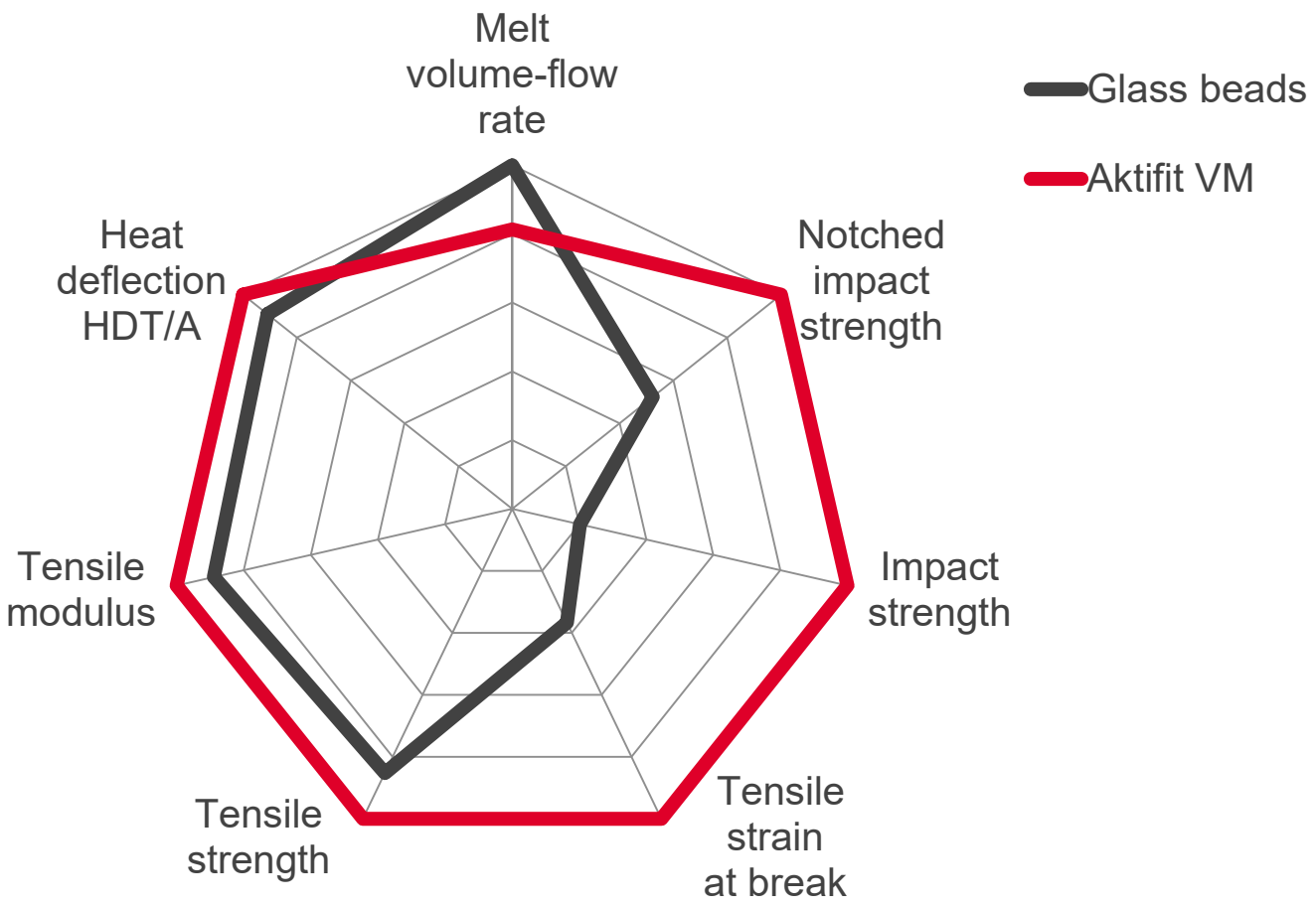

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Aktifit VM vs. surface treated glass beads in PBT:

- Lighter and more neutral natural color of the compound
- Somewhat lower melt flow rate
- Higher heat deflection temperature
- Higher stiffness
- Higher strength
- Very high strain at break
- Excellent (notched) impact strength, even at low temperature

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Not shown here:

compared to 15 % glass fibers, Aktifit VM gives:

- Lower warpage
- Lighter and more neutral color
- Significant higher impact strength and elongation at break

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Table of Results

			Glass beads	Aktifit VM
Melt Volume-flow Rate		cm³/10 min	19	16
Heat Distortion Temp. HDT/A		°C	70	77
Tensile Modulus		GPa	3.9	4.4
Tensile Strength		MPa	50	59
Tensile Strain at Break		%	2.9	7.9
Flexural Modulus		GPa	3.9	4.3
Flexural Strength		MPa	87	103
Flexural Stress 3.5 %		MPa	87	98
Flexural Strain at Break		%	3.8	9.2
Impact Strength	23 °C	kJ/m²	22 C	107 C
Charpy, 1eU	-30 °C		29 C	88 C
Notched Impact Strength	23 °C	kJ/m²	2.3 C	4.4 C
Charpy, 1eA	-30 °C		1.8 C	3.0 C