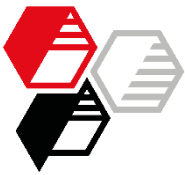




Air intake hose EPDM

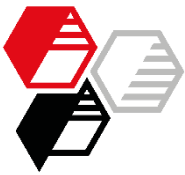
Replacement of carbon black N 990 with Neuburg Siliceous Earth



Content

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- Introduction
- Experimental
- Results
- Summary



Status Quo

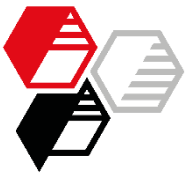
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- For the present study on the example of a highly loaded molding formulation, an automotive air intake hose was chosen.
- In order to arrive at a loading as high as possible along with acceptable properties, traditionally the compounds are partly filled with N990 (MT) carbon black.
- Following the prices of fossil raw materials, carbon black prices also suffer from large fluctuations. The long time trend, however, clearly goes upwards.
- The price of mineral fillers is only marginally affected by fossil raw materials; there rather is a very slow increase over the long term without any fluctuations.
- The rather frequent supply problems with carbon black N990 can be avoided by working with **siliceous earth fillers**.
- Hoffmann Mineral assures reliable short delivery times and a high degree of availability of the **Neuburg Siliceous Earth** product portfolio.



Objective

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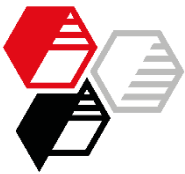
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Carbon black N990 should be replaced with
Neuburg Siliceous Earth
fillers in order to reduce costs while maintaining the technical
property profile.



Base Formulation

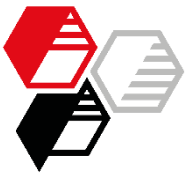
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		phr
Keltan 5469	EPDM crystalline + 100 phr mineral oil	200.0
Zinkoxyd aktiv	zinc oxide acitive	5.0
Stearic Acid	processing aid	1.0
Corax N550	FEF carbon black	115.0
Carbon black N990	MT carbon black	150.0
Omya BSH	whiting surface treated	50.0
Triethanolamine 98 %	filler deactivator	0.9
Sunthene 4240	naphthenic oil, plasticizer	25.0
Rhenogran DPG-80	accelerator	0.5
Rhenogran TP-50	accelerator	2.0
Rhenogran ZBEC-70	accelerator	2.0
Rhenogran MBTS-80	accelerator	1.3
Rhenogran CLD-80	accelerator	1.0
Vulkalent E/C	cure retarder	0.5
Rhenogran TBBS-80	accelerator	0.63
Rhenogran S-80	sulfur, curing agent	0.75
Summary		555.58



Design of Experiments

Dosage in phr for equivalent hardness

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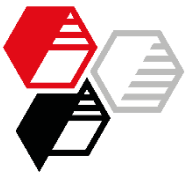
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Control	Calcined Neuburg Siliceous Earth		Neuburg Siliceous Earth	
Carbon black N990	Aktifit AM	Silfit Z 91	Sillitin Z 86	Sillitin N 75*
150	180			

*The tests were carried out with Sillitin N 82. This product is no longer available.
Recommended: Sillitin N 75.



Fillers, Characteristics

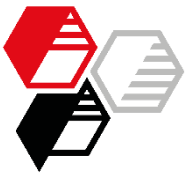
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		Carbon black N990	Aktifit AM	Silfit Z 91	Sillitin Z 86	Sillitin N 75
Density	[g/cm ³]	1,8	2,6	2,6	2,6	2,6
Particle size d ₅₀	[μm]		2,0	2,0	1,9	3,0
Particle size d ₉₇	[μm]		10,0	10,0	9,0	16,0
Sieve residue > 40 μm	[mg/kg]		10	10	20	25
Sieve residue 45 μm (Sieve Nr. 325)	ppm	18				
Oil absorption	[g/100g]		55	55	55	45
DBP absorption	[ml/100 g]	38				
Specific surface area BET	[m ² /g]		7	8	12	12
CTAB Surface area	[m ² /g]	7				
Funktionalization		none	Amino	none	none	none



Preparation and Curing of the Compound

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- **Mixing**

Open mill Ø 150 x 300 mm

Batch volume: approx. 600 cm³

Temperature: 50 °C

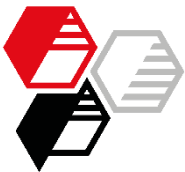
Mixing time: approx. 20 min.

- **Curing**

Press: 180 °C

2 mm sheet: 5 min.

Compression set and rebound specimen: 10 min.



Mooney Viscosity

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DIN 53 523 Part 3, ML 1+4 100 °C

MU

0 20 40 60 80 100

Carbon black
N990



Aktifit AM



Silfit Z 91

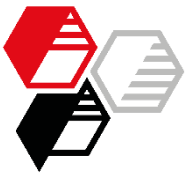


Sillitin Z 86



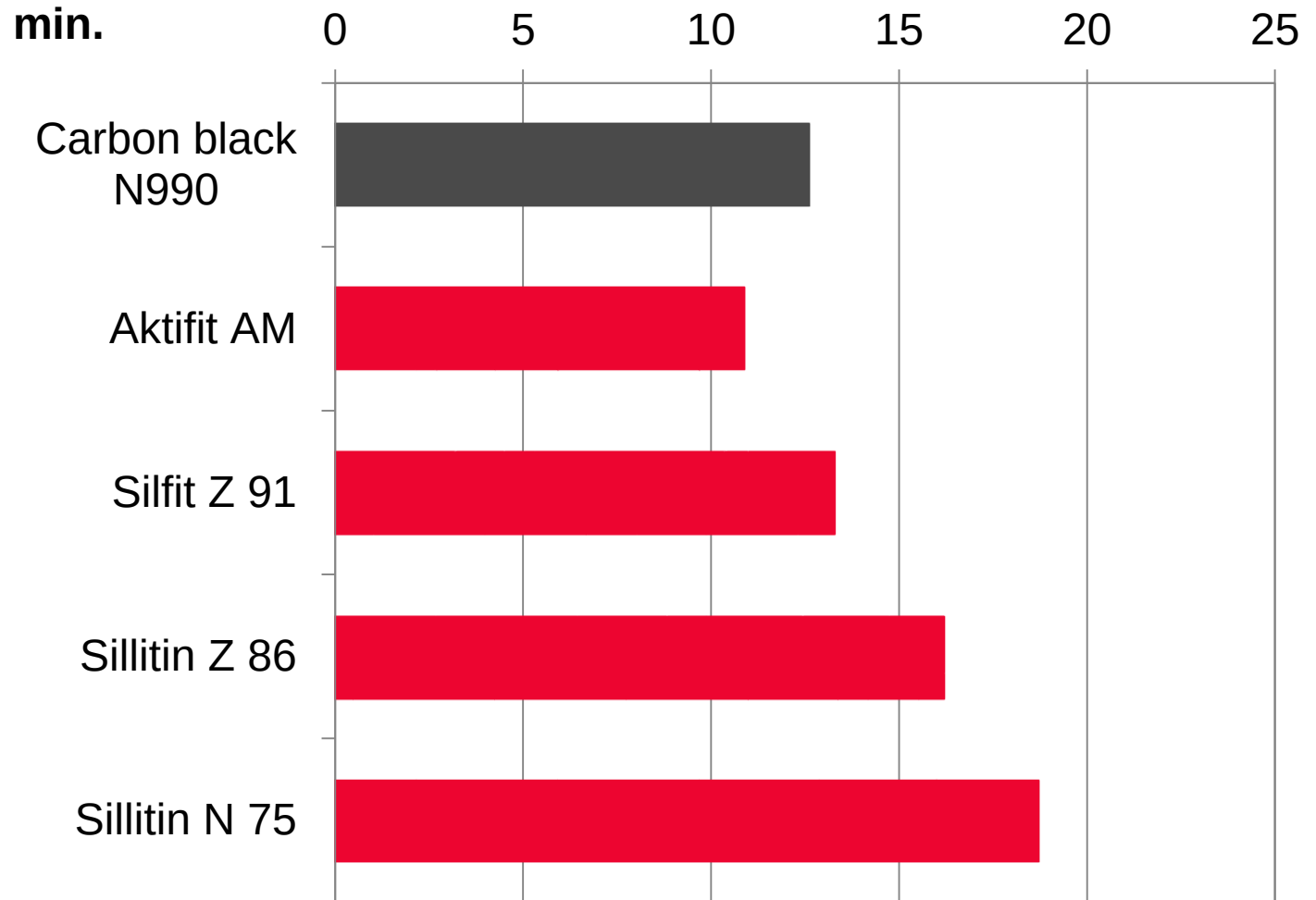
Sillitin N 75

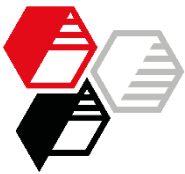




Mooney Scorch Time

DIN 53 523 Part 4, ML +5 120 °C





Torque Minimum

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

Nm 0,00 0,05 0,10 0,15 0,20

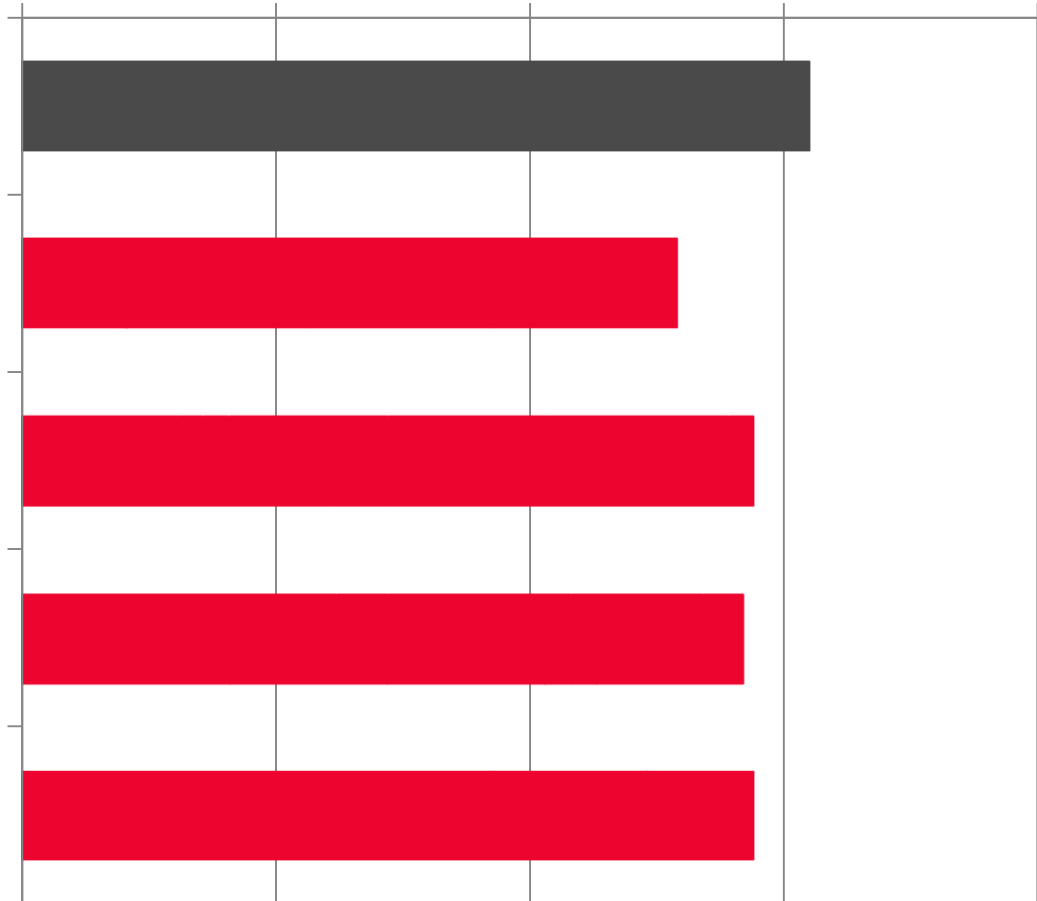
Carbon black
N990

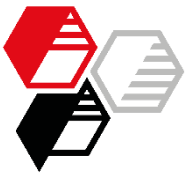
Aktifit AM

Silfit Z 91

Sillitin Z 86

Sillitin N 75

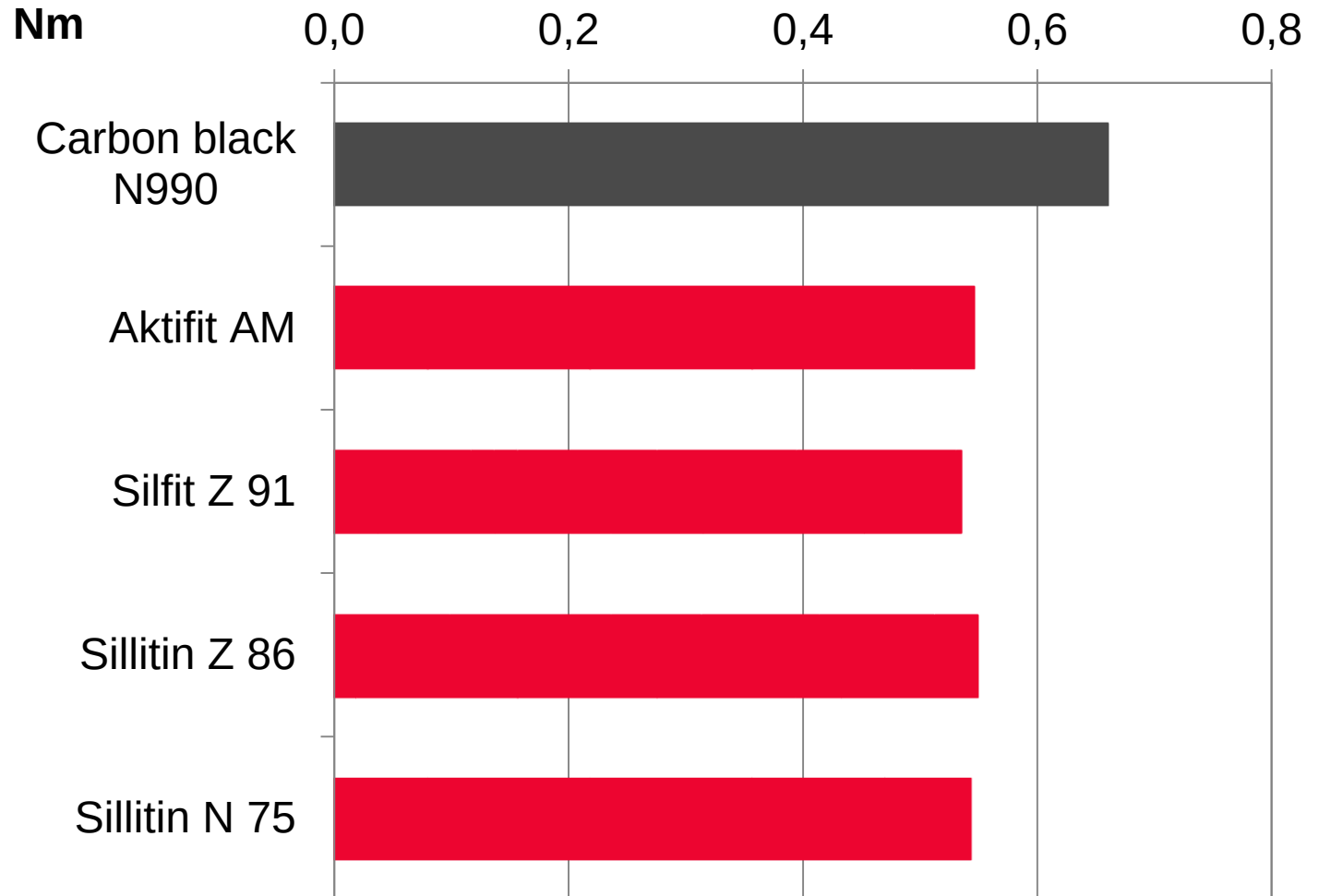


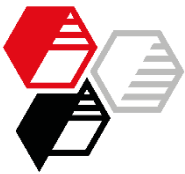


Torque Maximum

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





Maximum Cure Rate

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

Nm/min. 0,0 0,1 0,2 0,3 0,4 0,5 0,6

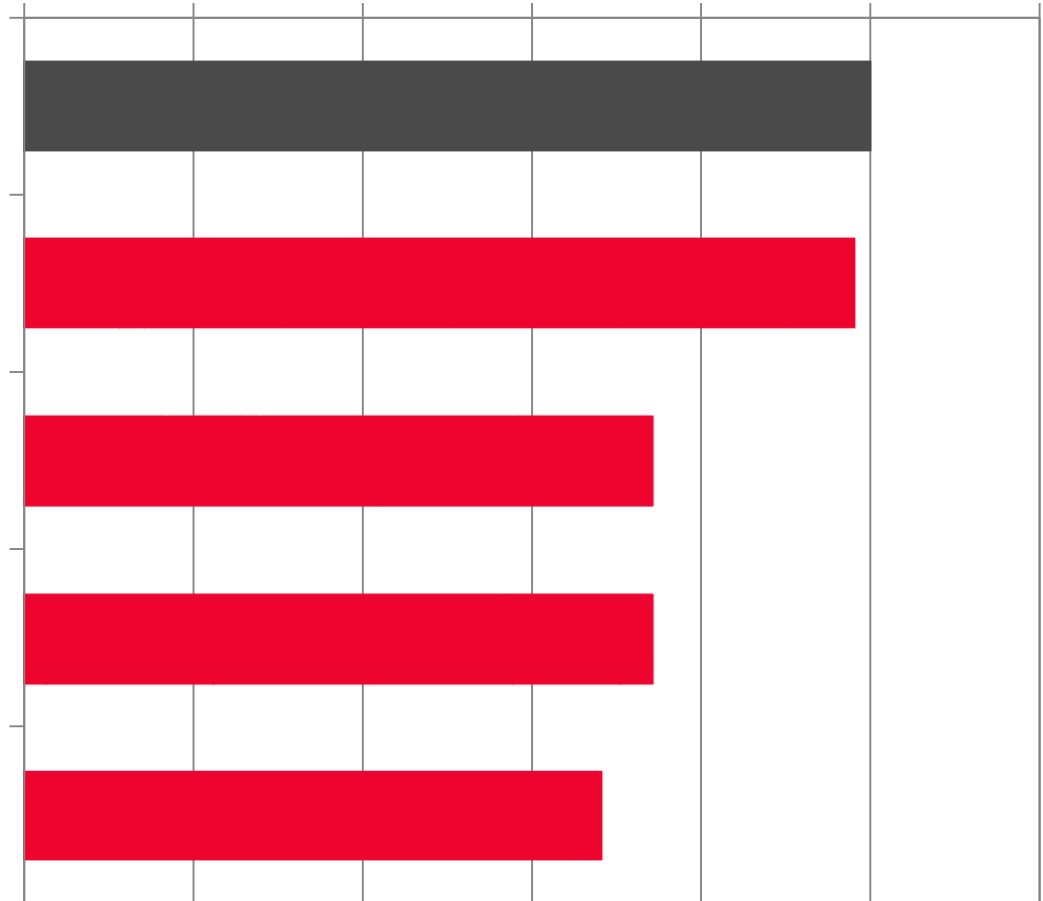
Carbon black
N990

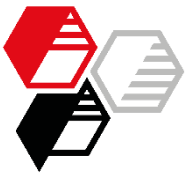
Aktifit AM

Silfit Z 91

Sillitin Z 86

Sillitin N 75





Time of Maximum Cure Rate

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

min. 0,0 0,4 0,8 1,2 1,6

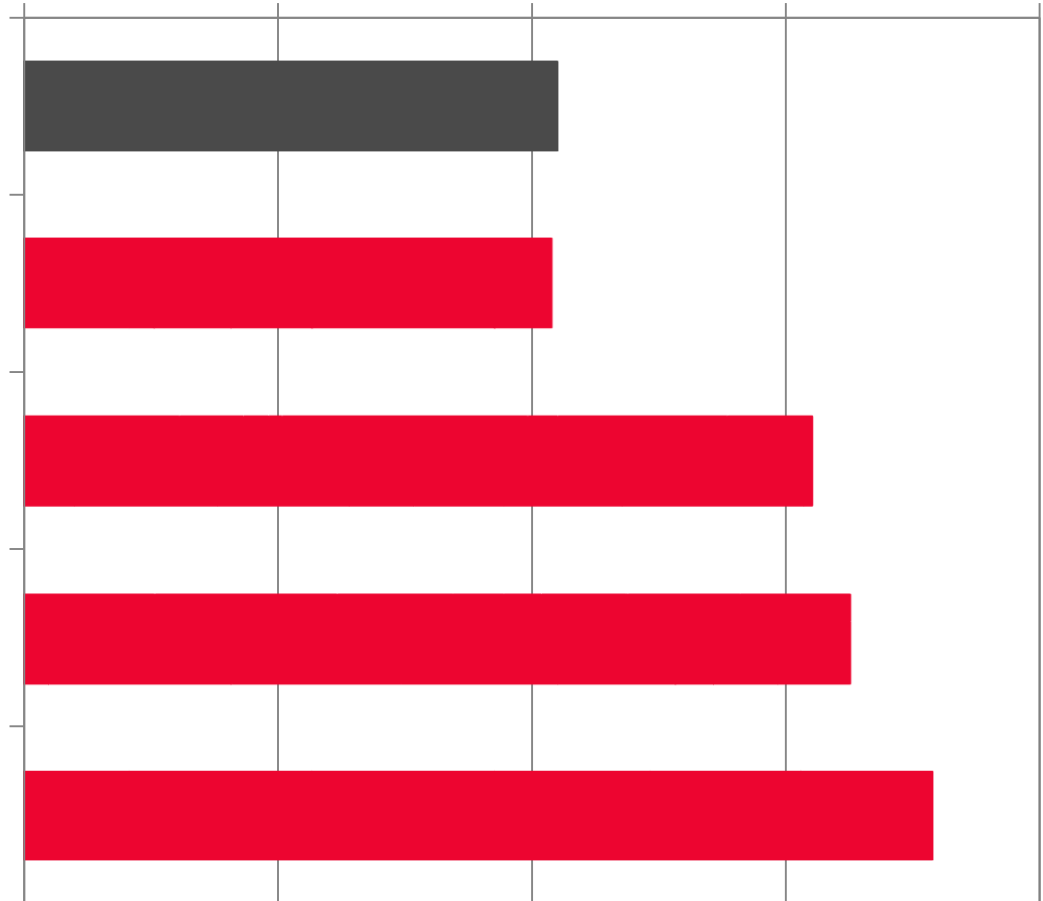
Carbon black
N990

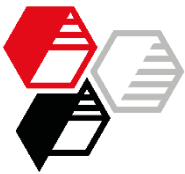
Aktifit AM

Silfit Z 91

Sillitin Z 86

Sillitin N 75





Conversion Time t_5

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

min. 0,0 0,2 0,4 0,6 0,8

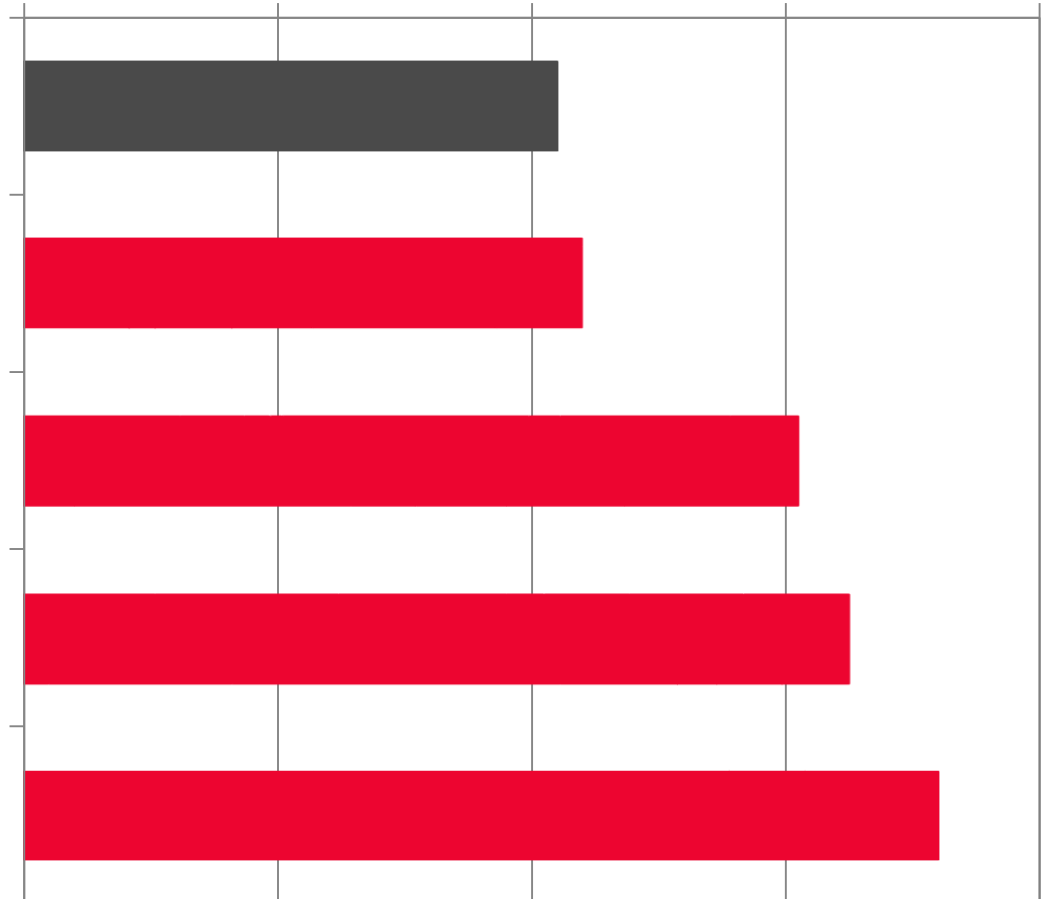
Carbon black
N990

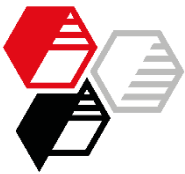
Aktifit AM

Silfit Z 91

Sillitin Z 86

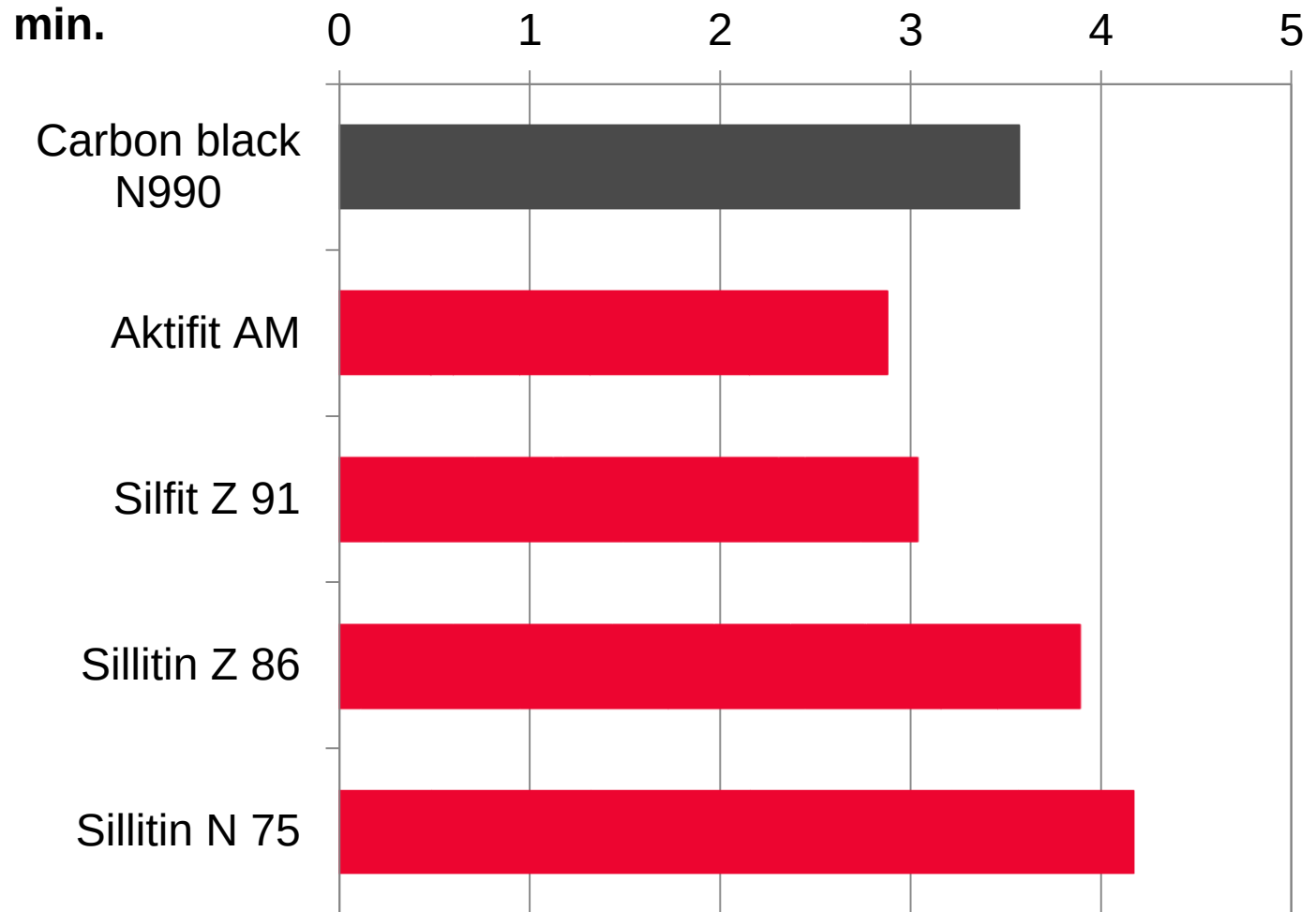
Sillitin N 75

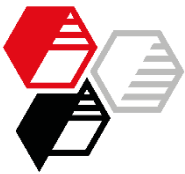




Conversion Time t_{90}

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





Hardness

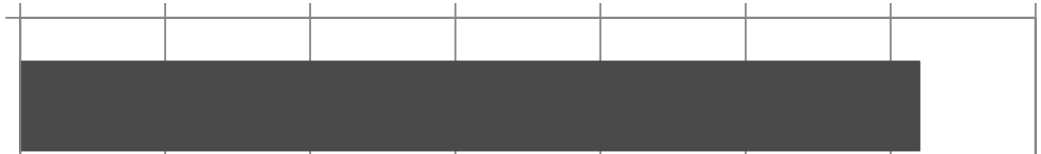
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DIN 53 505-A, piled-up S2 dumbbells

Shore A

0 10 20 30 40 50 60 70

Carbon black
N990



Aktifit AM



Silfit Z 91

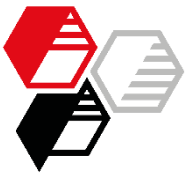


Sillitin Z 86



Sillitin N 75





Tensile Strength

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DIN 53 504, S2

MPa

0 2 4 6 8 10

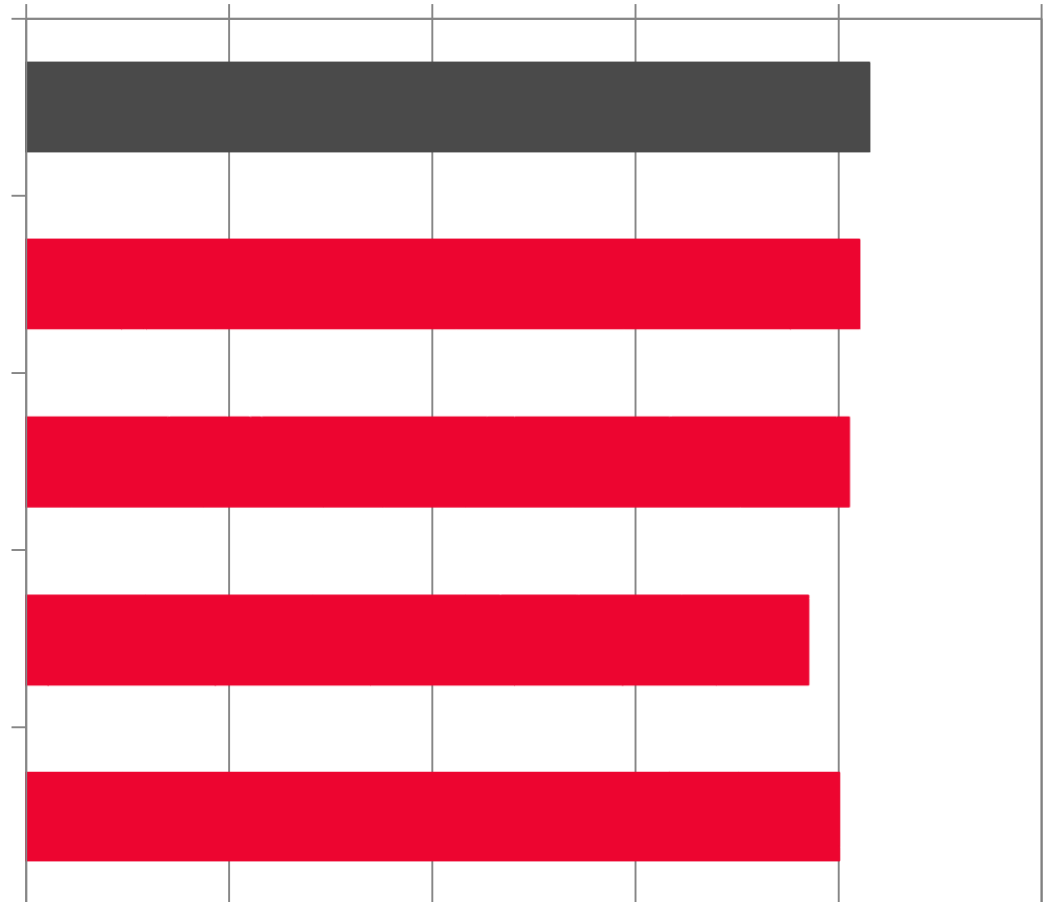
Carbon black
N990

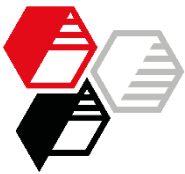
Aktifit AM

Silfit Z 91

Sillitin Z 86

Sillitin N 75





Elongation at Break

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DIN 53 504, S2

% 0 100 200 300 400 500 600

Carbon black
N990

Aktifit AM

Silfit Z 91

Sillitin Z 86

Sillitin N 75

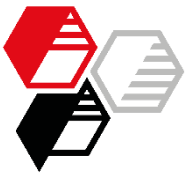


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Modulus 100 %

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DIN 53 504, S2

MPa

0 1 2 3 4

Carbon black
N990



Aktifit AM



Silfit Z 91

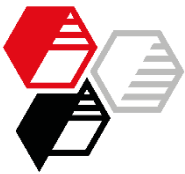


Sillitin Z 86



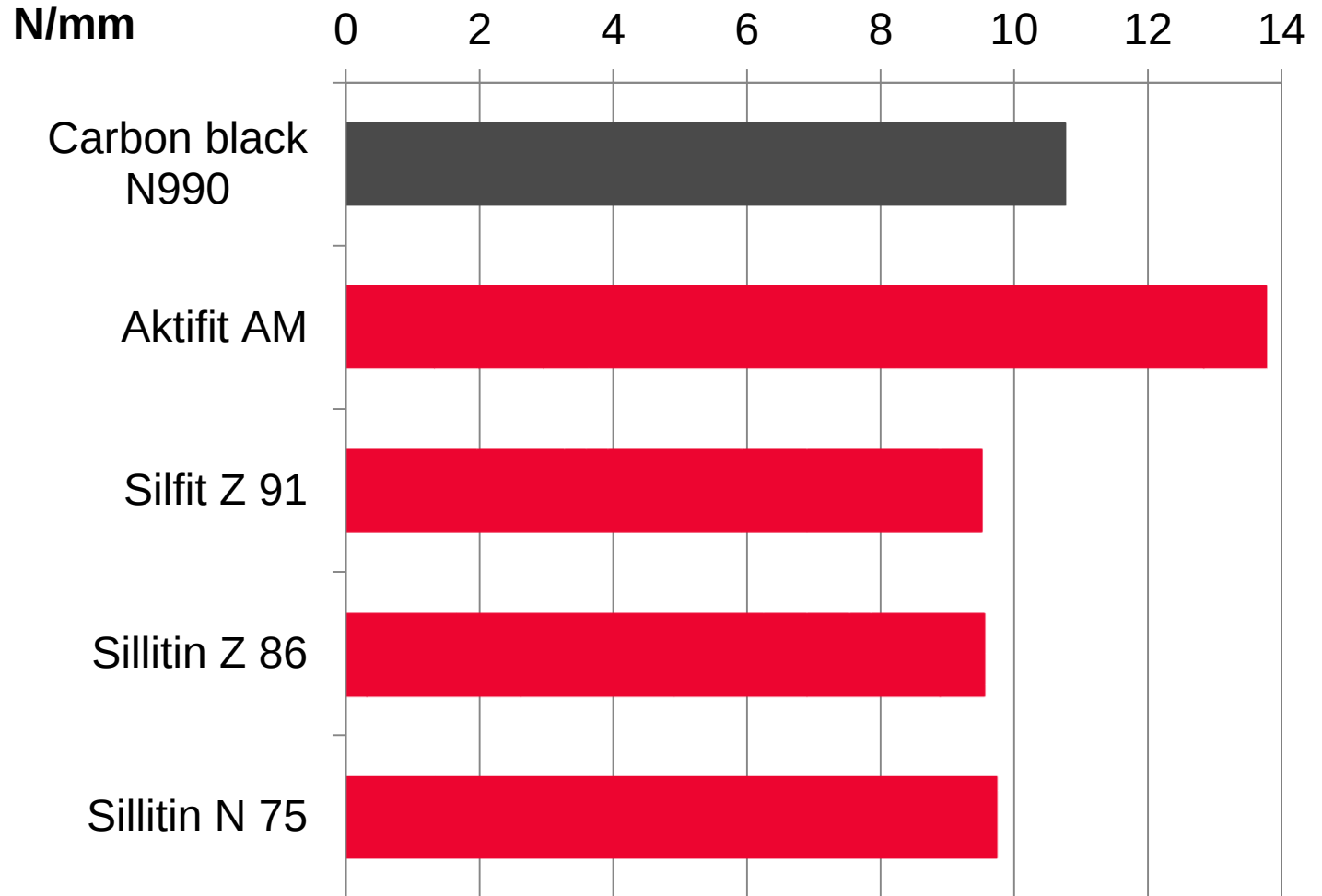
Sillitin N 75

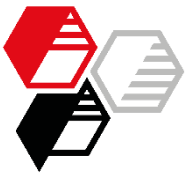




Tear Resistance

DIN ISO 34-1, trouser specimen

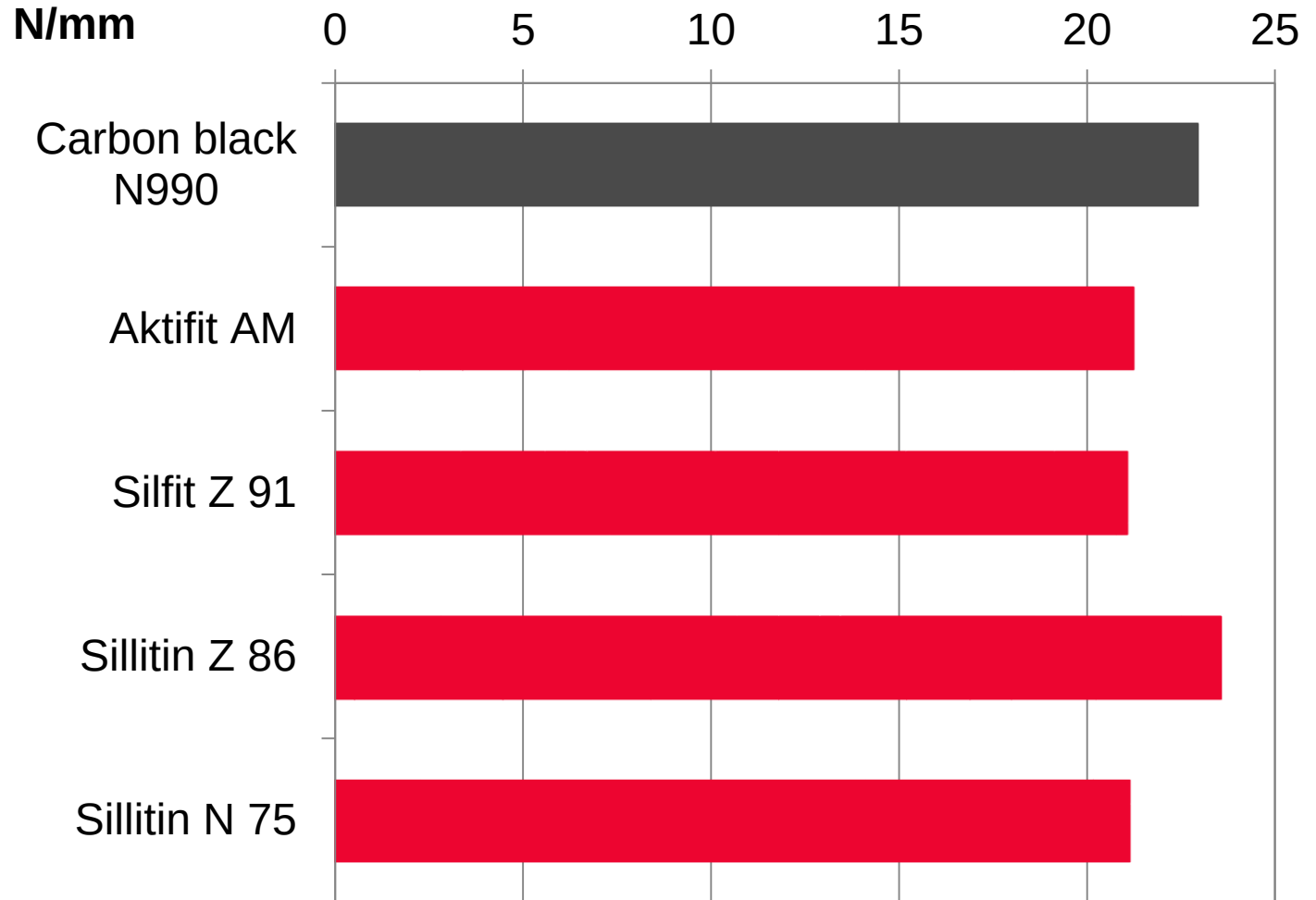




Tear Resistance



DIN 53 515-A, Graves

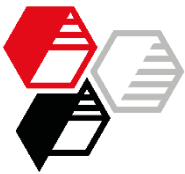


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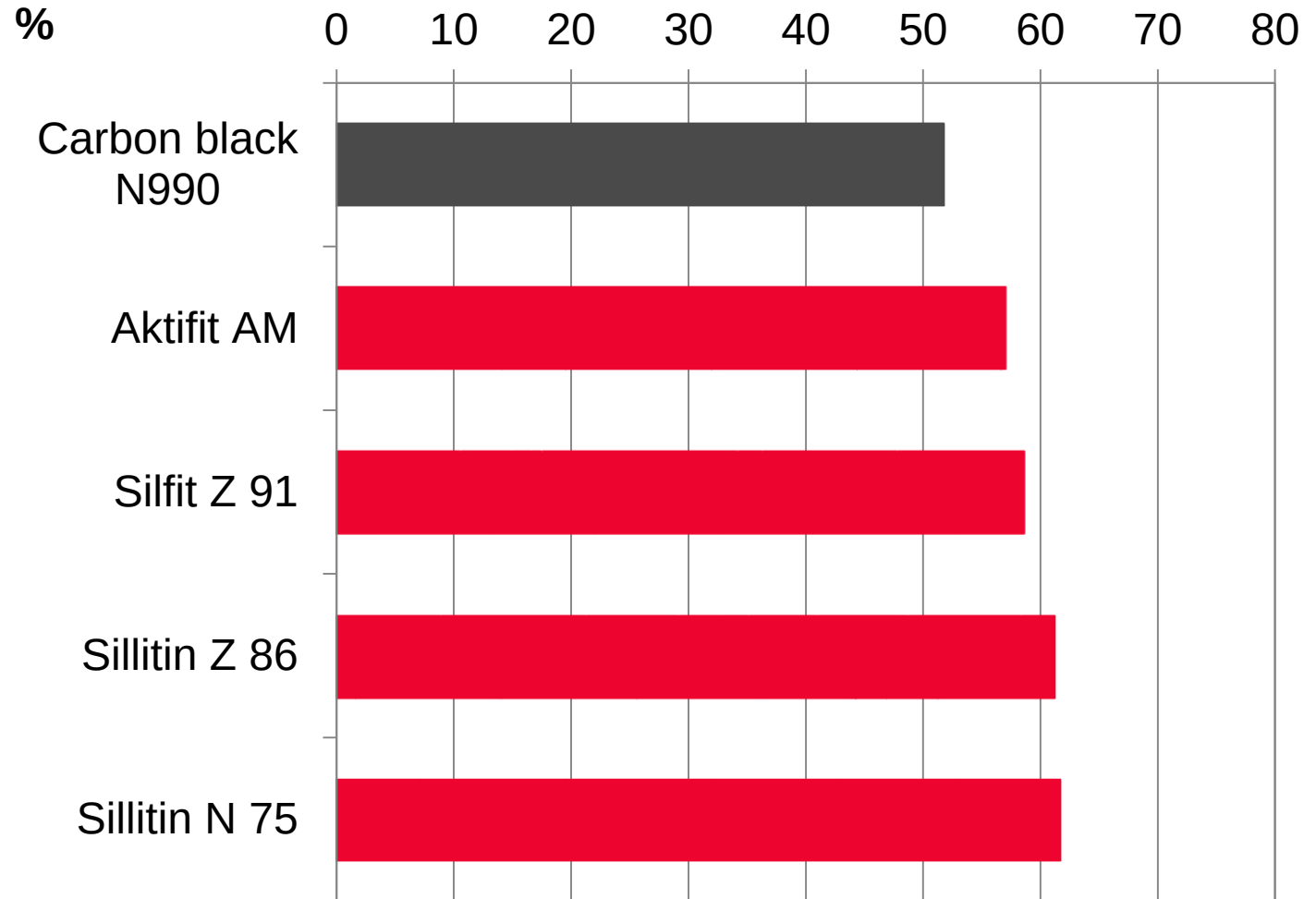
SUMMARY



Compression Set

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DIN 53 517 I, 70 h / 120 °C

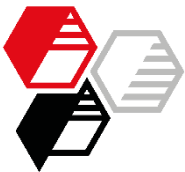


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Compression Set

HOFFMANN
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DIN 53 517 I, 70 h / 23 °C

% 0 2 4 6 8 10 12 14

Carbon black
N990



Aktifit AM



Silfit Z 91



Sillitin Z 86



Sillitin N 75

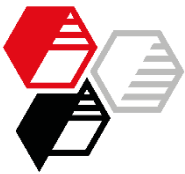


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Immersion in Oil IRM 903

Change of Hardness

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168 h / 130 °C

Shore A

-50 -40 -30 -20 -10 0

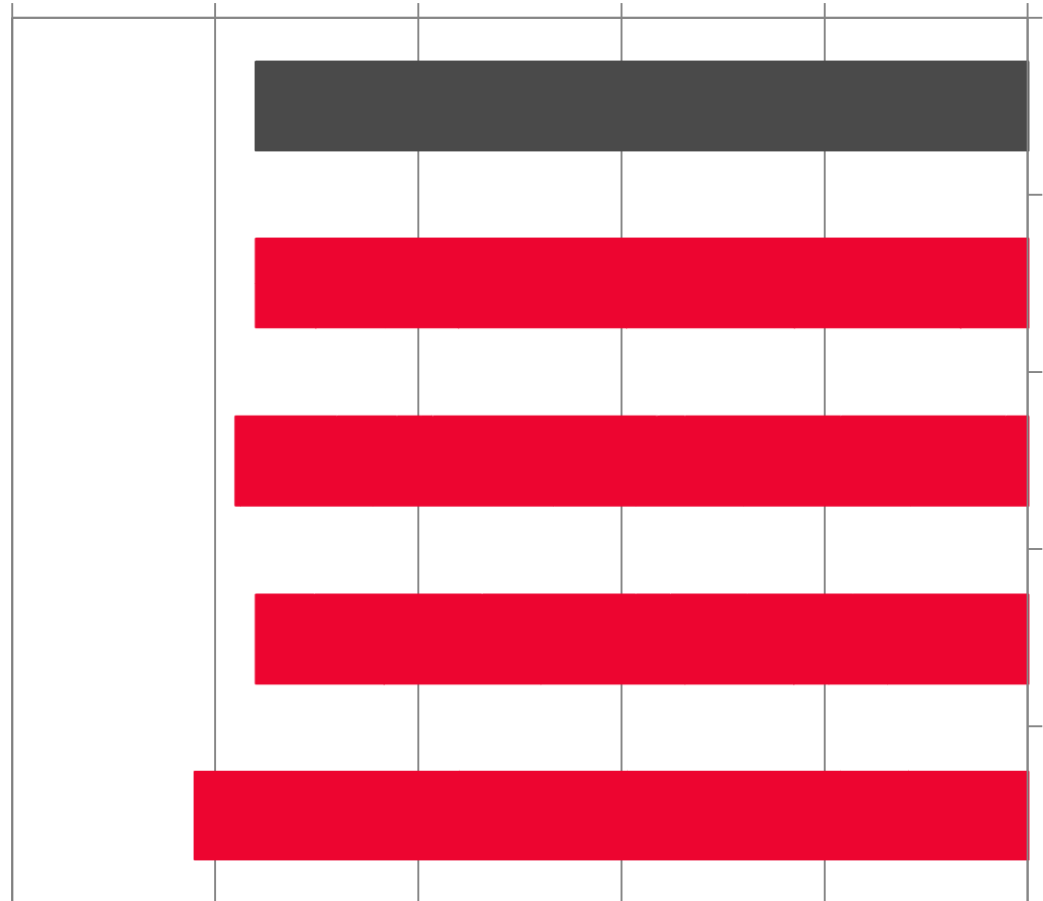
Carbon black
N990

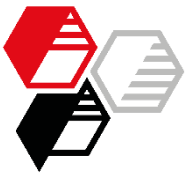
Aktifit AM

Silfit Z 91

Sillitin Z 86

Sillitin N 75



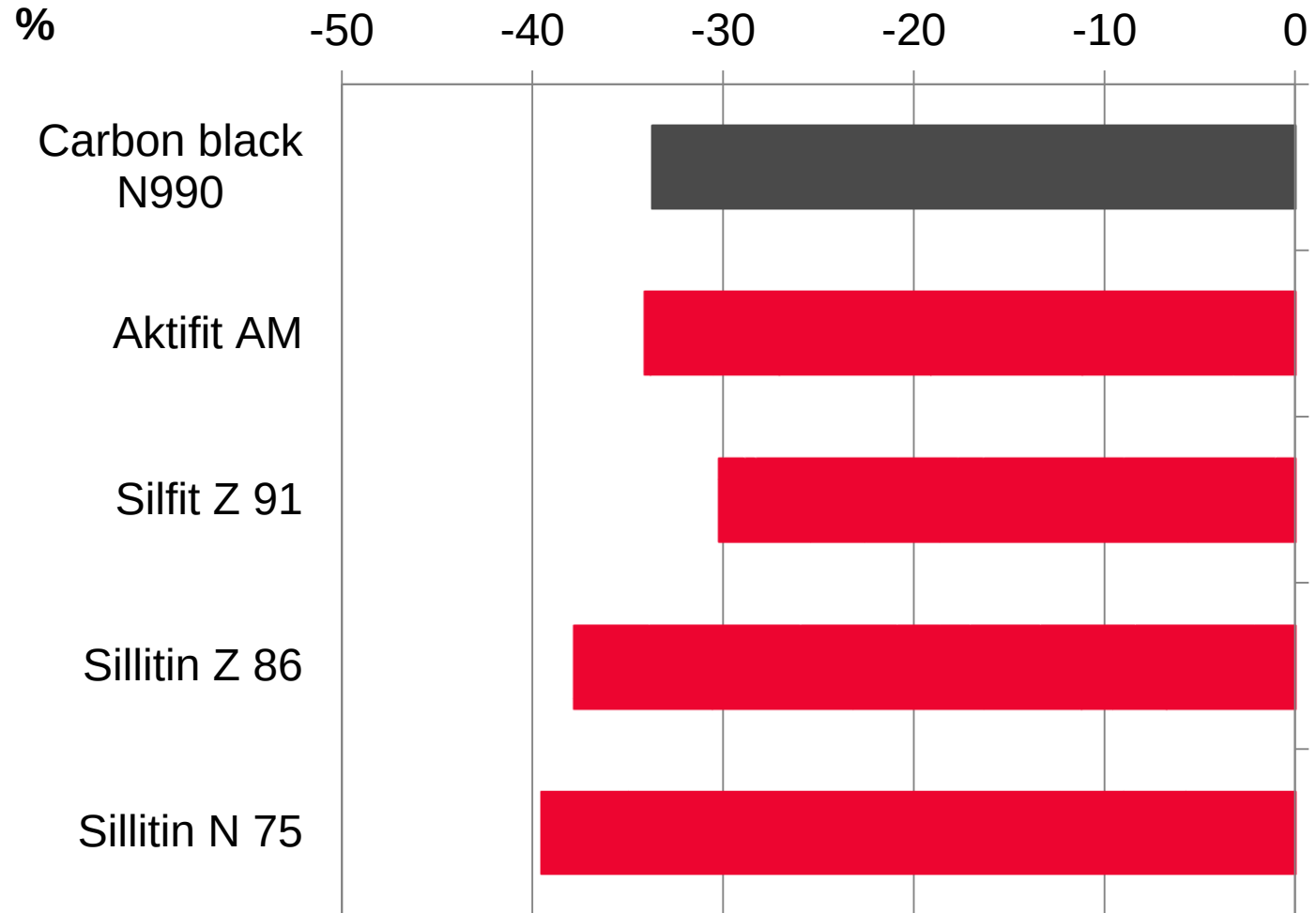


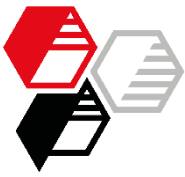
Immersion in Oil IRM 903

Change of Tensile Strength

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MINERAL®

168 h / 130 °C



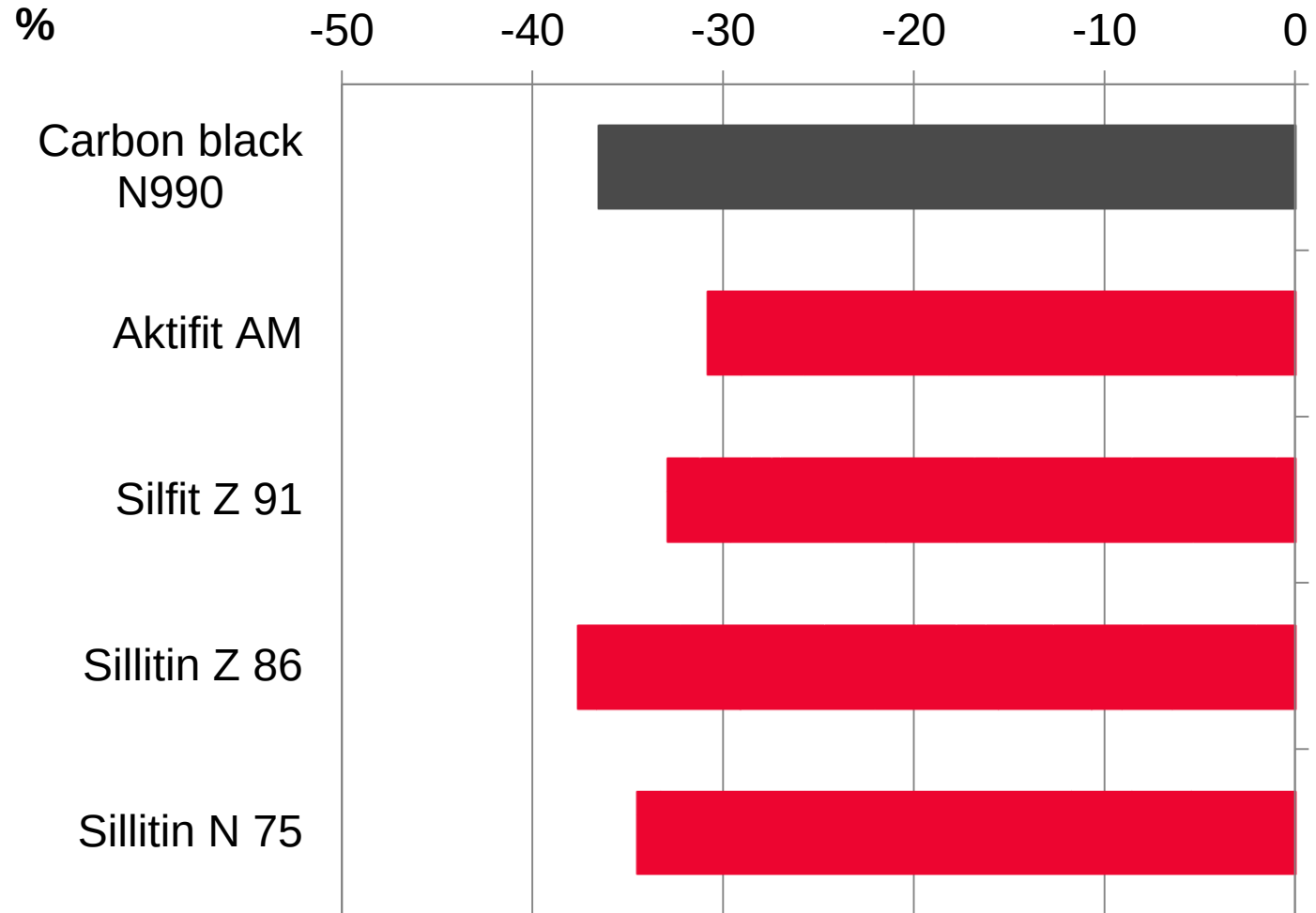


Immersion in Oil IRM 903

Change of Elongation at B.

HOFFMANN
MINERAL®

168 h / 130 °C

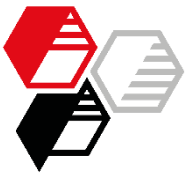


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Immersion in Oil IRM 903

Change of Volume

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168 h / 130 °C

% 0 20 40 60 80 100 120 140 160

Carbon black
N990

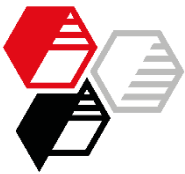
Aktifit AM

Silfit Z 91

Sillitin Z 86

Sillitin N 75





Hot Air Aging Change of Hardness

HOFFMANN
MINERAL®

168 h / 130 °C

Shore A

0 5 10 15 20

Carbon black
N990



Aktifit AM



Silfit Z 91



Sillitin Z 86



Sillitin N 75

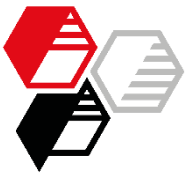


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Hot Air Aging

Change of Tensile Strength



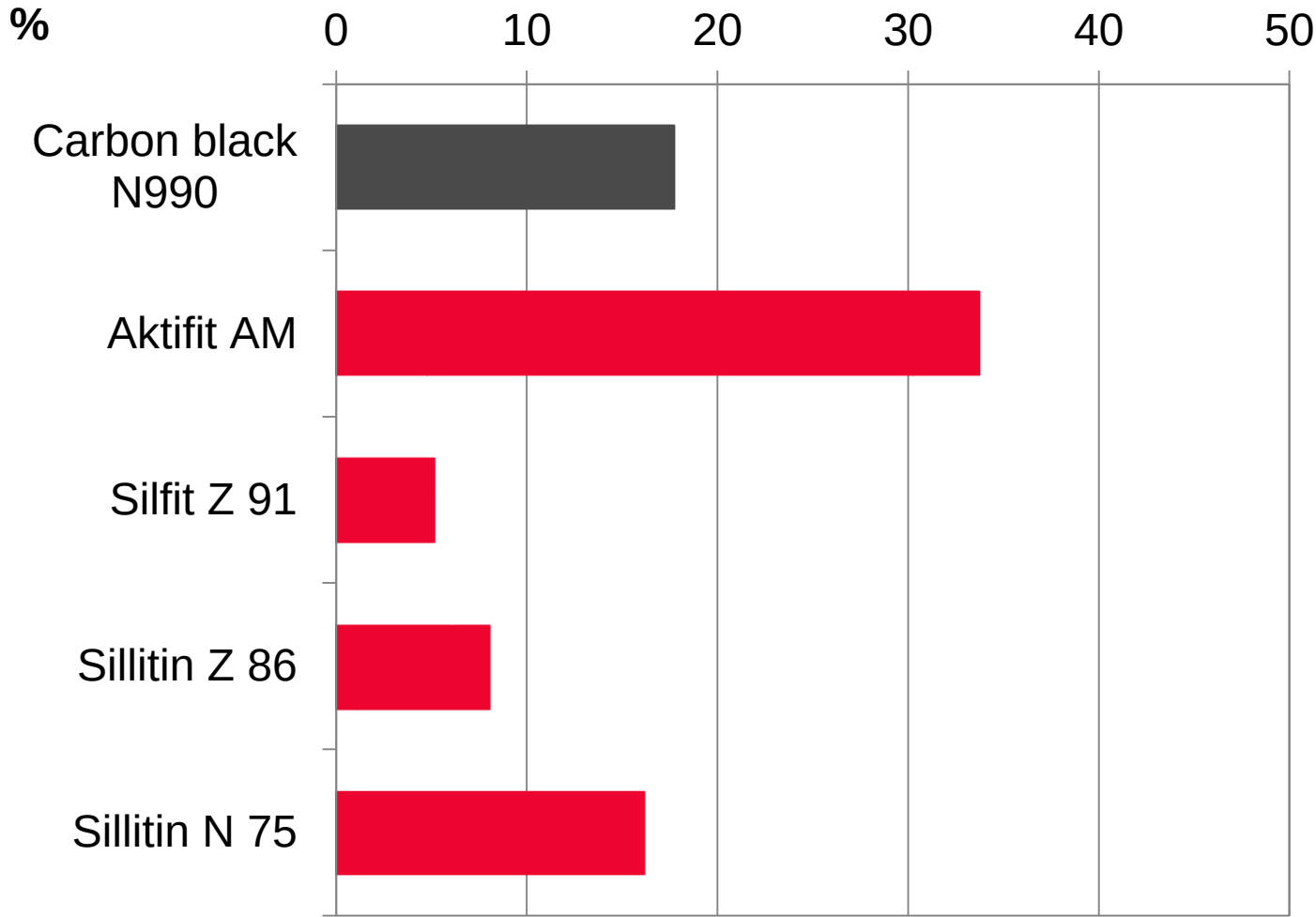
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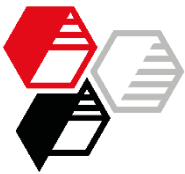
EXPERIMENTAL

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168 h / 130 °C





Hot Air Aging Change of Elongation at B.

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168 h / 130 °C

% -70 -60 -50 -40 -30 -20 -10 0

Carbon black
N990

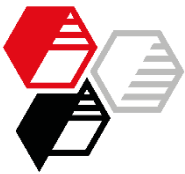
Aktifit AM

Silfit Z 91

Sillitin Z 86

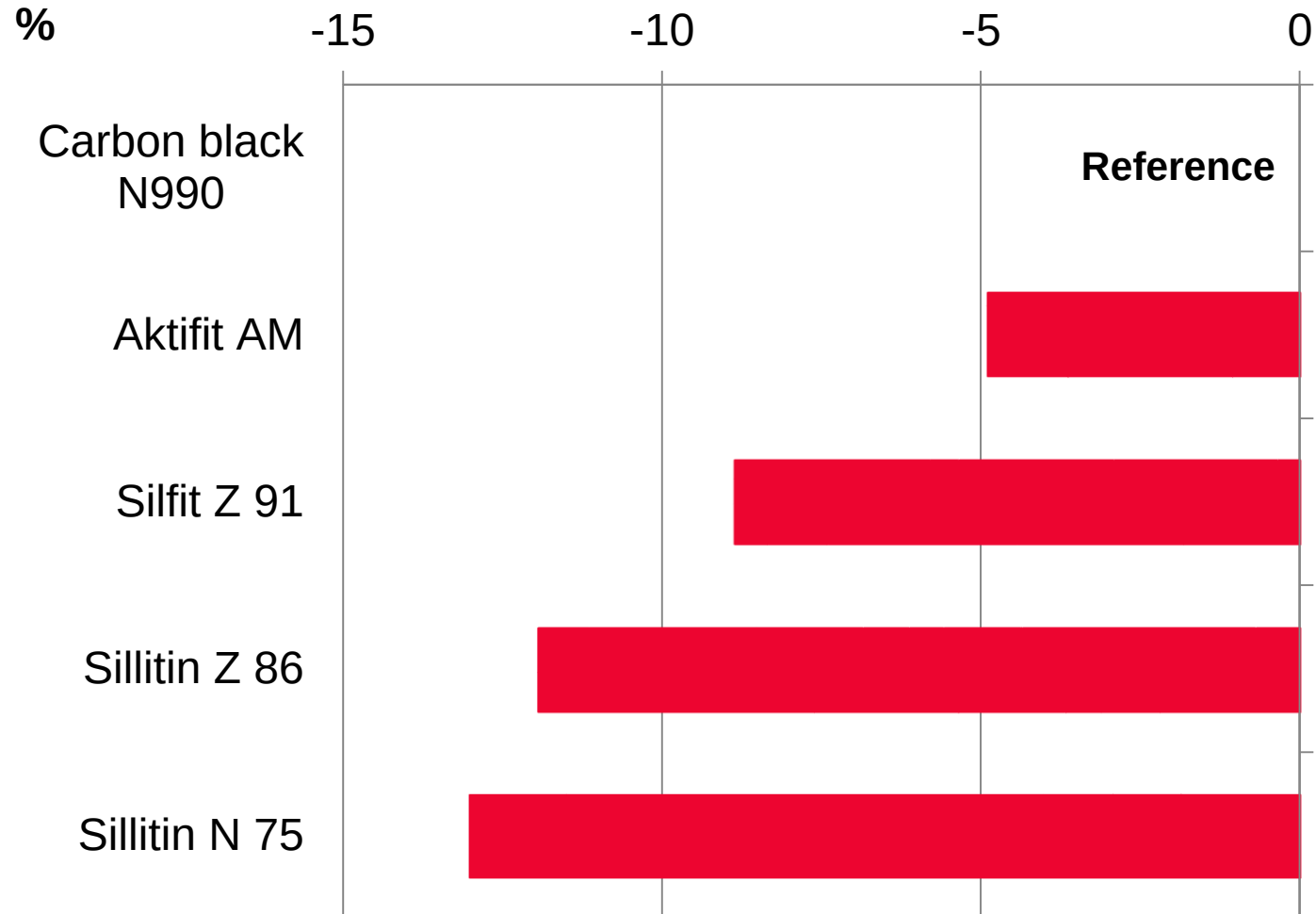
Sillitin N 75

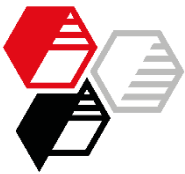




Cost Aspects

Compound volume based, Prices Germany 2014

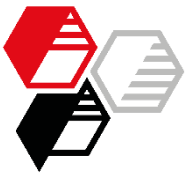




Summary

- The replacement of Carbon Black N990 in the EPDM air intake compound by **Neuburg Siliceous Earth** fillers leads to a very similar property profile.
- **Aktifit AM** allows to exactly reproduce the scorch behavior of Carbon Black N990, and in addition to obtain a shorter time to full cure along with a cost reduction of 5 %.
- **Silfit Z 91** as well as **Sillitin Z 86** and **Sillitin N 75** lead to a cost reduction of 9 % and more.
- **Aktifit AM** and **Silfit Z 91** impress by good processing properties and the absence of mold fouling.
- The **Neuburg Siliceous Earth** fillers offer the advantage of unlimited availability and reliable delivery.

Conclusion: Carbon Black N990 can be replaced in the air intake hose compound by **Neuburg Siliceous Earth** with cost advantages and without technical drawbacks.



We supply material for good ideas!

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