Filler comparison

Non black fillers in sulfur cured EPDM rubber – molding application

Author: Meier Julia

HOFFMANN MINERAL®
We supply materials for good ideas

Contents

Status Quo

Aim of the investigation:

Presentation of the performance of Neuburg Siliceous Earth grades compared to competitors in a sulfur-cured EPDM formulation for molding applications.

The components of the formulation have been adapted to the latest specifications regarding raw materials and the accelerator system.

A hardness of approx. 70 Shore A was targeted.

Experimental

- Formulation
- Fillers
  - Neuburg Siliceous Earth (NSE)
  - Competitors
- Compounding and vulcanization
- Test standards - overview

Formulation

Ingredients	Description	phr
Keltan 2650	Ethylene propylene diene rubber, amorphous ML 1+4 (125 °C): 25 MU	100
Zinkoxyd activ	Zinc oxide active	3
Edenor C18 98-100 GW	Stearic acid	0,5
Filler	*Please see slides „Fillers“*	variable 120 / 80 / 70 / 60 / 45 / 40
PEG 4000	Polyethylene glycol	1
Process Oil P 460	Paraffinic mineral oil, plasticizer	5
Rhenogran CBS-80	N-Cyclohexylbenzothiazole-2-sulfenamide, 80 %, accelerator	0,5
Rhenogran ZBEC-70	Zinc-dibenzyl-dithiocarbamate, 70 %, accelerator	2
Rhenogran TP-50	Zinc-dithiophosphate, 50 %, accelerator	2
Rhenogran CLD-80	Caprolactam disulfide, 80 %, crosslinking agent	1
Rhenogran S-80	Sulfur, 80 %, crosslinking agent	0,75
Rhenogran MBTS-80	2-Mercaptobenzothiazole disulfide, 80 %, accelerator	1,3
Total:		**max. 237,05 / min. 157,05**

Fillers – Neuburg Siliceous Earth (NSE)

	phr
Sillitin V 85	120
Sillitin V 88	120
Sillitin N 82*	120
Sillitin N 85	120
Sillitin Z 86	120
Sillitin Z 89	120
Sillikolloid P 87	120

***Sillitin N 82 will be replaced by Sillitin N 75**

	Basic material	Calcination	Functionalization	phr
Silfit Z 91	Sillitin Z 86	✓	-	120
Aktifit AM	Silfit Z 91	✓	Amino	120
Aktisil AM	Sillitin Z 86	-	Amino	120
Aktisil PF 216	Sillitin Z 86	-	Tetrasulfan	120
Aktisil VM 56	Sillitin Z 86	-	Vinyl	120
Aktisil VM 56/89	Sillitin Z 89	-	Vinyl	120
Aktisil Q	Sillitin V 90 *Internal product quality	-	Methacrylic	120
Aktisil PF 777	Sillitin Z 86	-	Alkyl	120

Fillers – Competitors

	Calcination	Functionalization	phr
Carbon black N 550	-	-	60
Precipitated silica 180 m²/g	-	-	40
Precipitated silica 130 m²/g	-	-	45
Precipitated aluminum silicate	-	-	70
Precipitated calcium silicate	-	-	80
French Hard Clay	-	-	120
English Hard Clay	-	-	120
English Clay	-	-	120
English Soft Clay	-	-	120
English calcined Clay	✓	-	120
American calcined Clay	✓	-	120
American calcined Clay, amino functionalized	✓	Amino	120
American calcined Clay, vinyl functionalized	✓	Vinyl	120
Whiting	-	-	120
Whiting, stearate functionalized	-	Stearic acid	120
American Talc	-	-	120
American coated Talc, amino functionalized	-	Amino	120

Compounding and vulcanization

Compounding	
Open mill	Ø 150 x 300 mm
Batch weight	approx. 710 g
Mill temperature	50 °C
Mixing time	approx. 10 bis 15 min.

Vulcanization	
The curing was carried out in a press at 180 °C	
Curing time	5 min. or t_{90} + 10 %

Test standards – overview

Testing	Standard
Mooney Viscosity ML 1+4 (100 °C)	DIN ISO 289-1
Mooney Scorch ML +5 (120 °C)	DIN ISO 289-2
Cure characteristics	DIN 53 529, part 1 – 4
Tensile test	DIN 53 504, S2
Compression set	DIN ISO 815-1, Type B
Abrasion loss	DIN ISO 4649, A
Hardness	DIN ISO 7619-1
Rebound elasticity	DIN 53 512
Tear resistance - Trousers specimen	DIN ISO 34-1, A
Tear resistance - Graves specimen	DIN ISO 34-1, Bb
Resistance to liquid media	DIN ISO 1817
Resistance to air	ISO 188, D

Results

→ back to contents

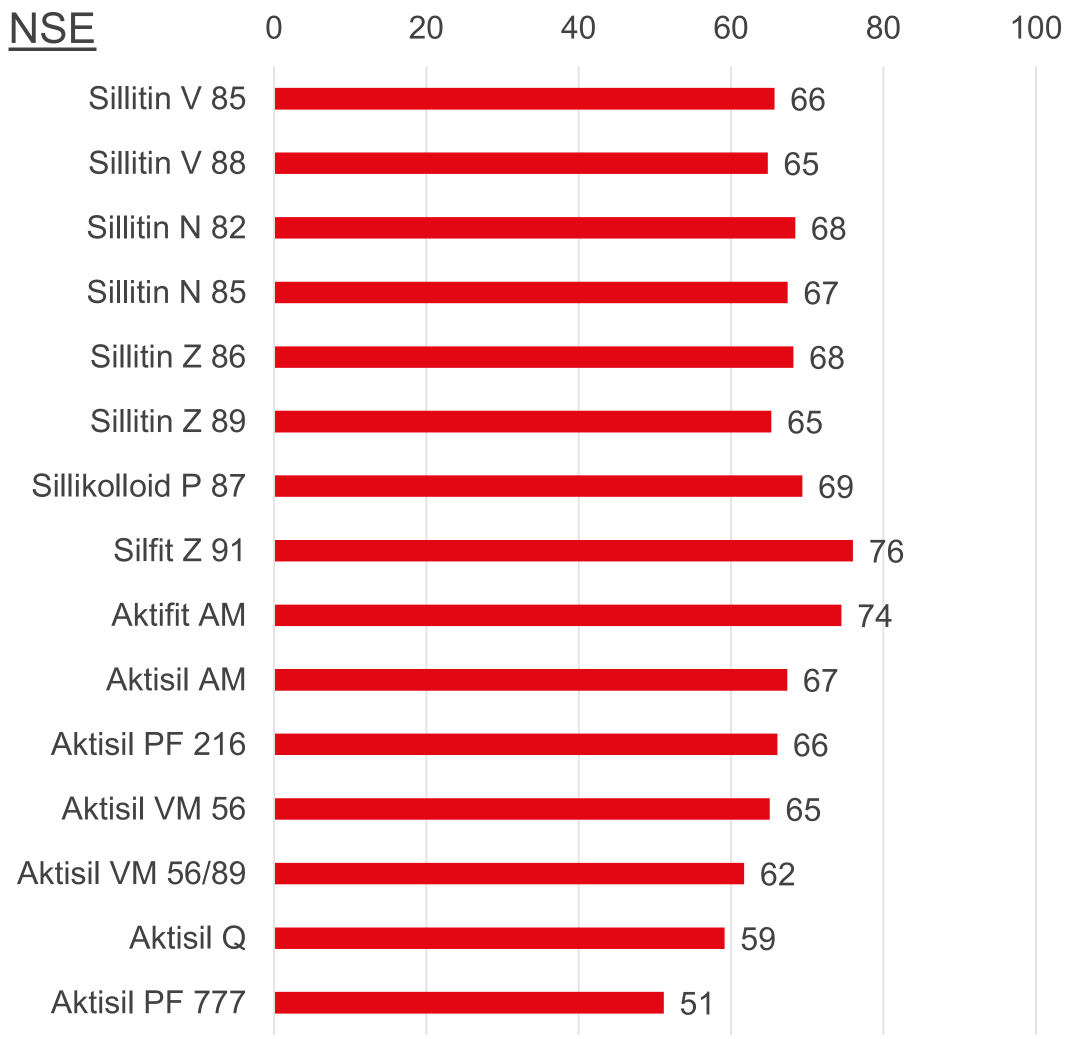
→ back to results

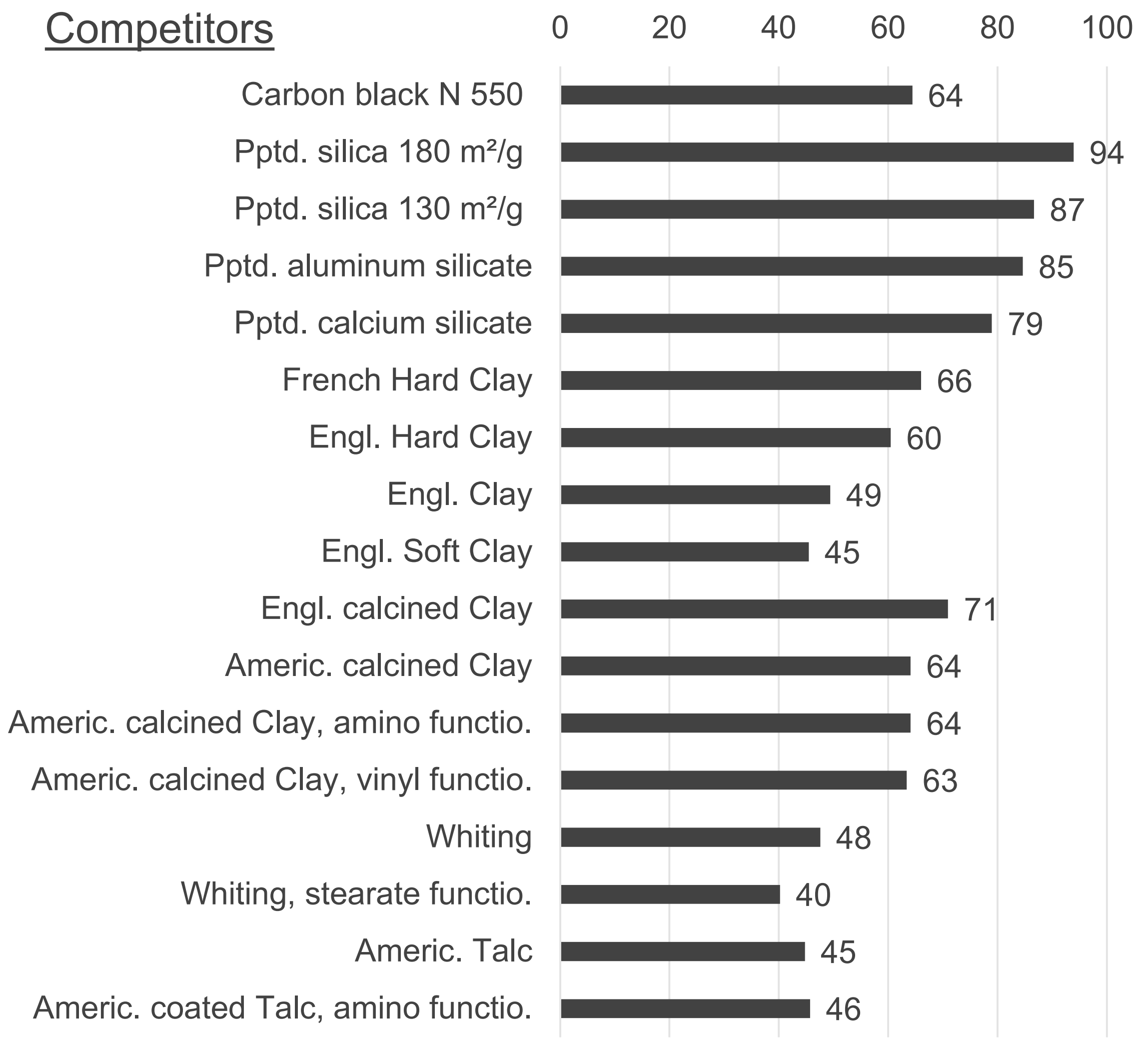
Properties of raw compound

DIN ISO 289-1
DIN ISO 289-2
DIN 53 529, part 1 – 4

Mooney Viscosity ML 1+4 (100 °C) in MU

DIN ISO 289-1

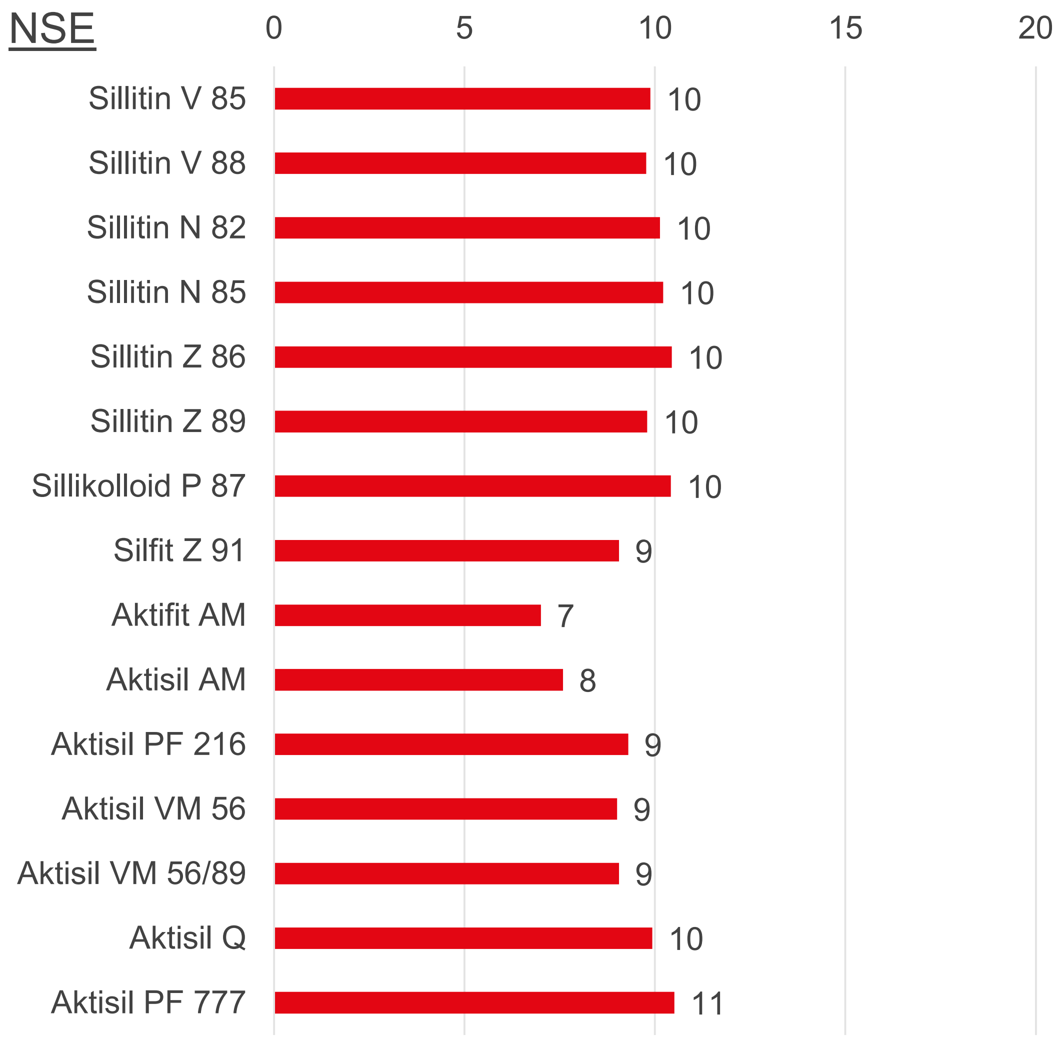


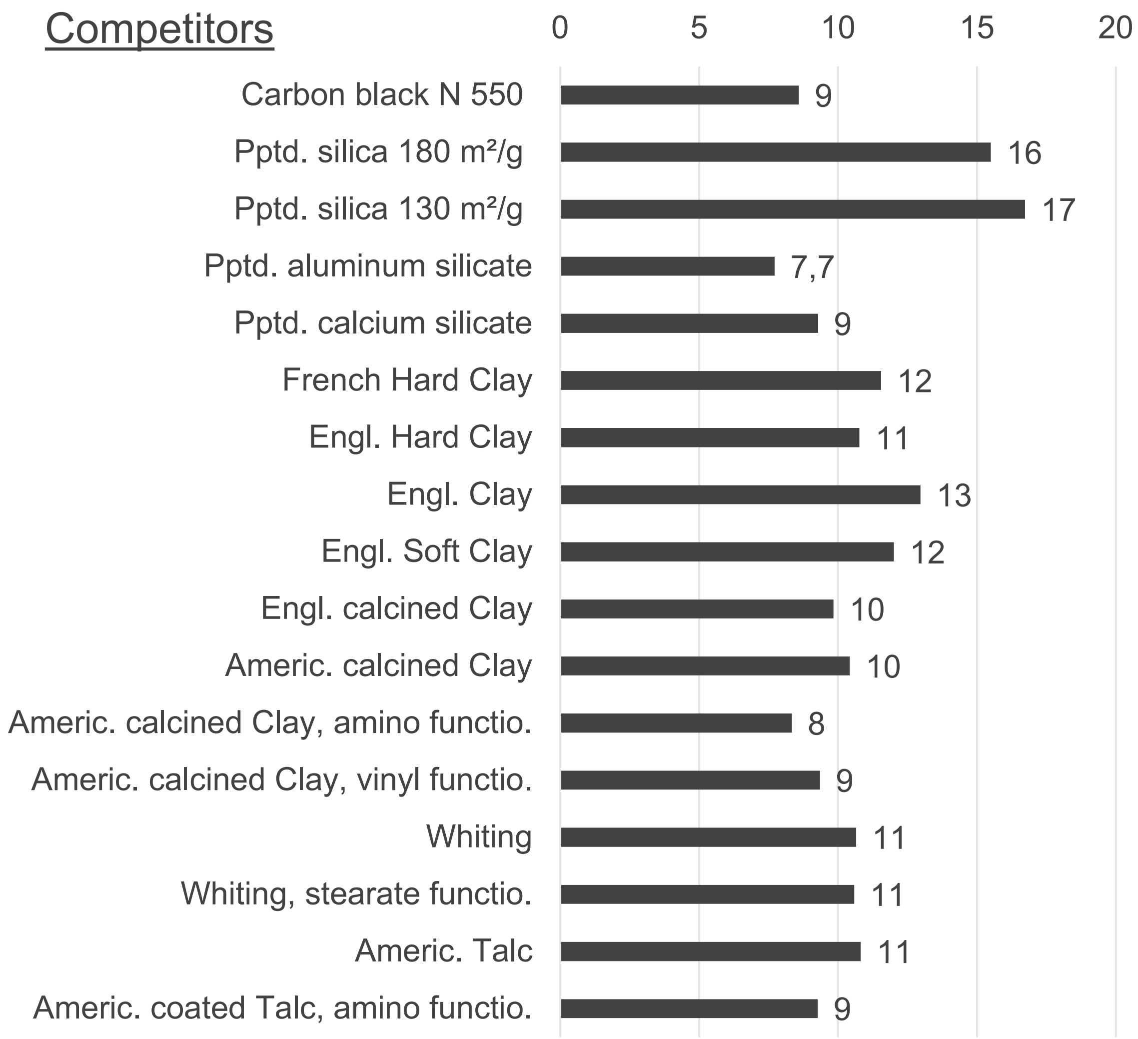


Note: Sillitin N 82 will be replaced by Sillitin N 75

Mooney Scorch ML +5 (120 °C) in min.

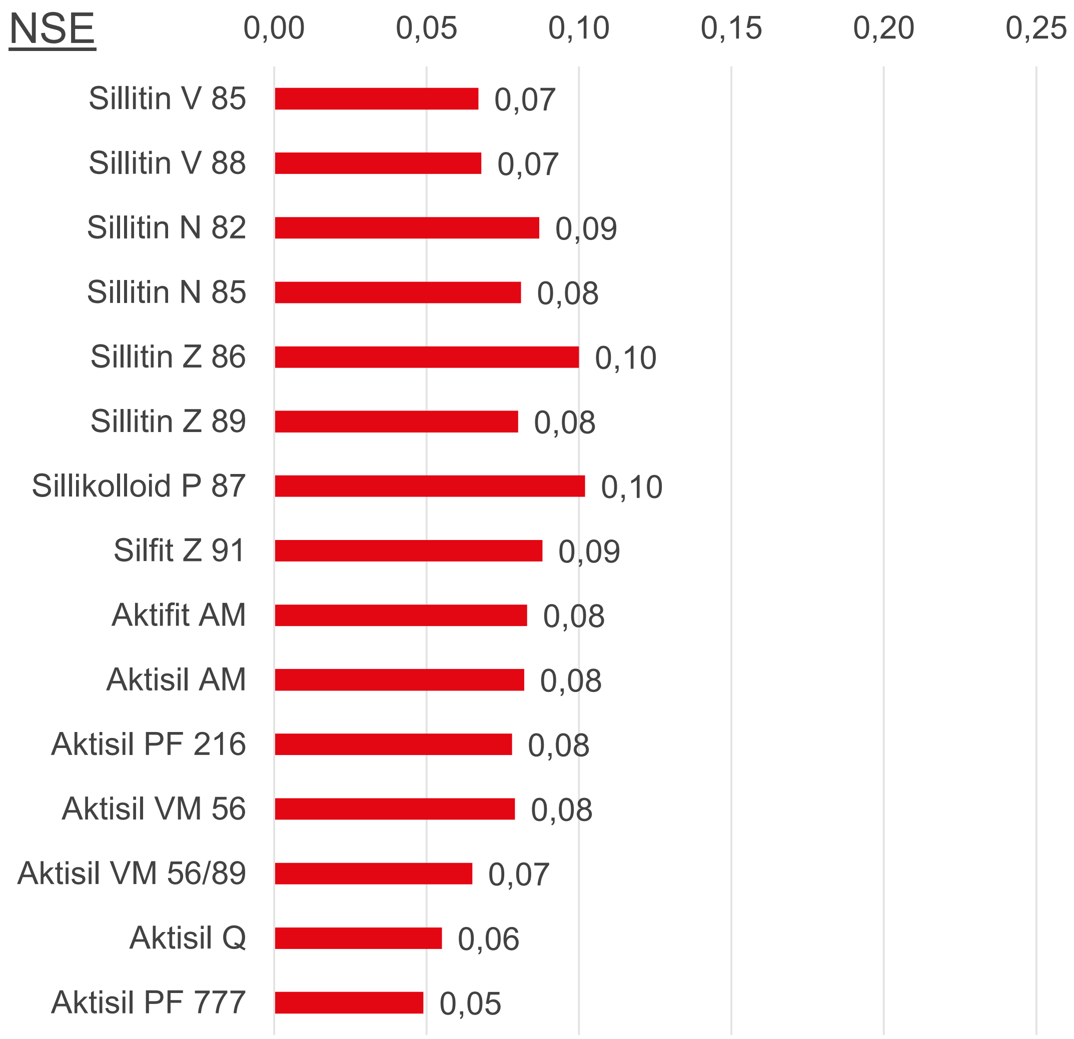
DIN ISO 289-2

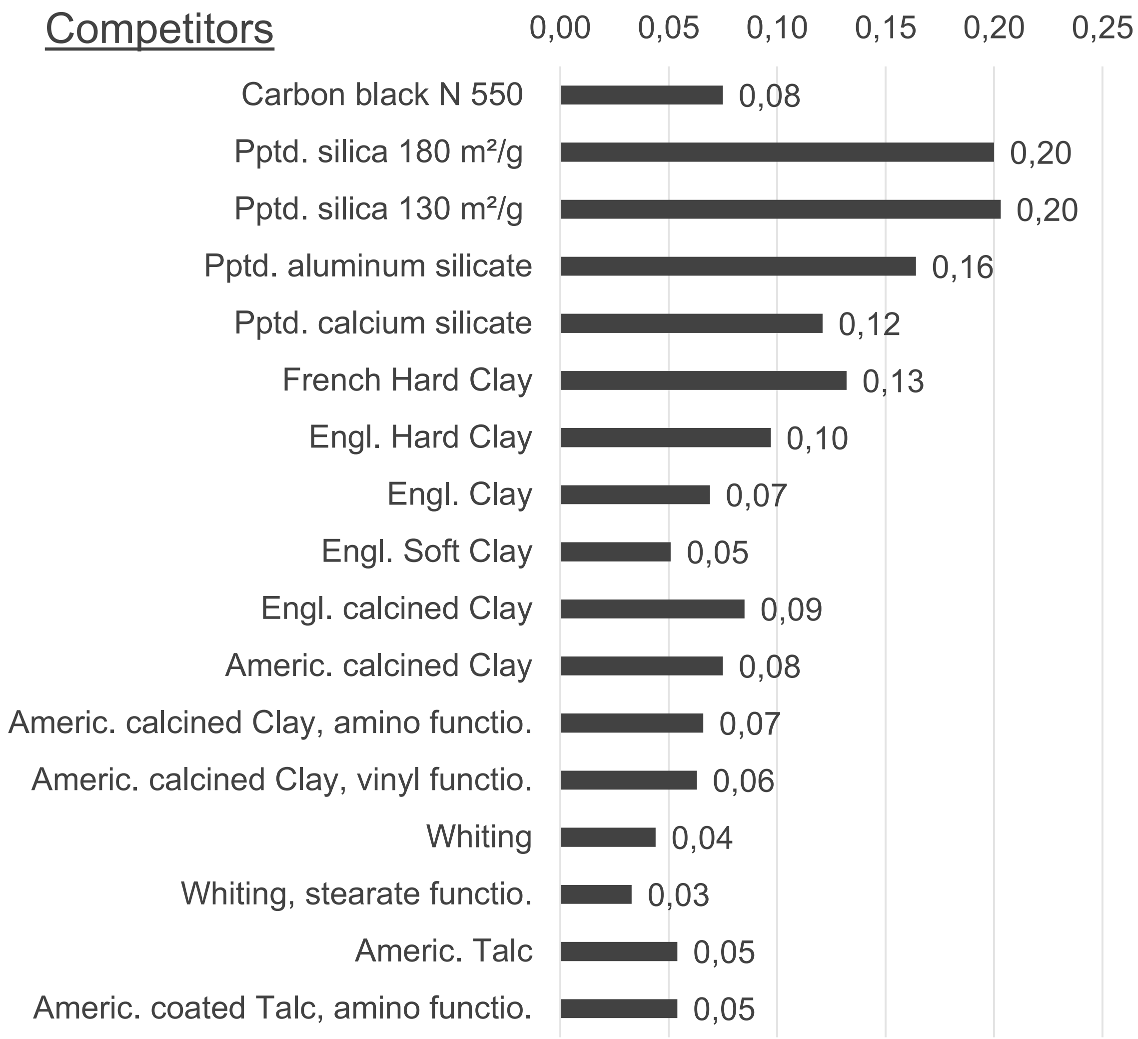




Note: Sillitin N 82 will be replaced by Sillitin N 75

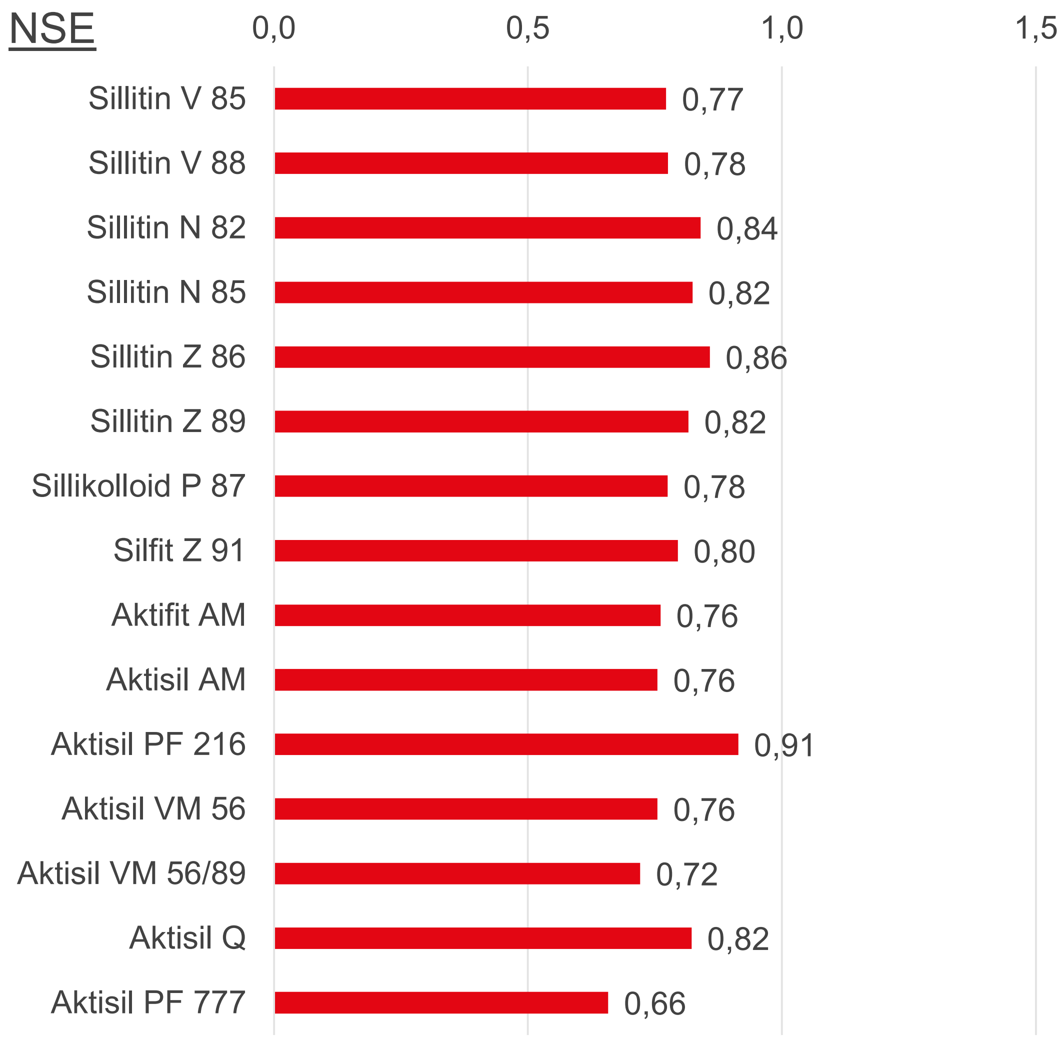
Rotorless curemeter, 180 °C
Torque minimum in Nm

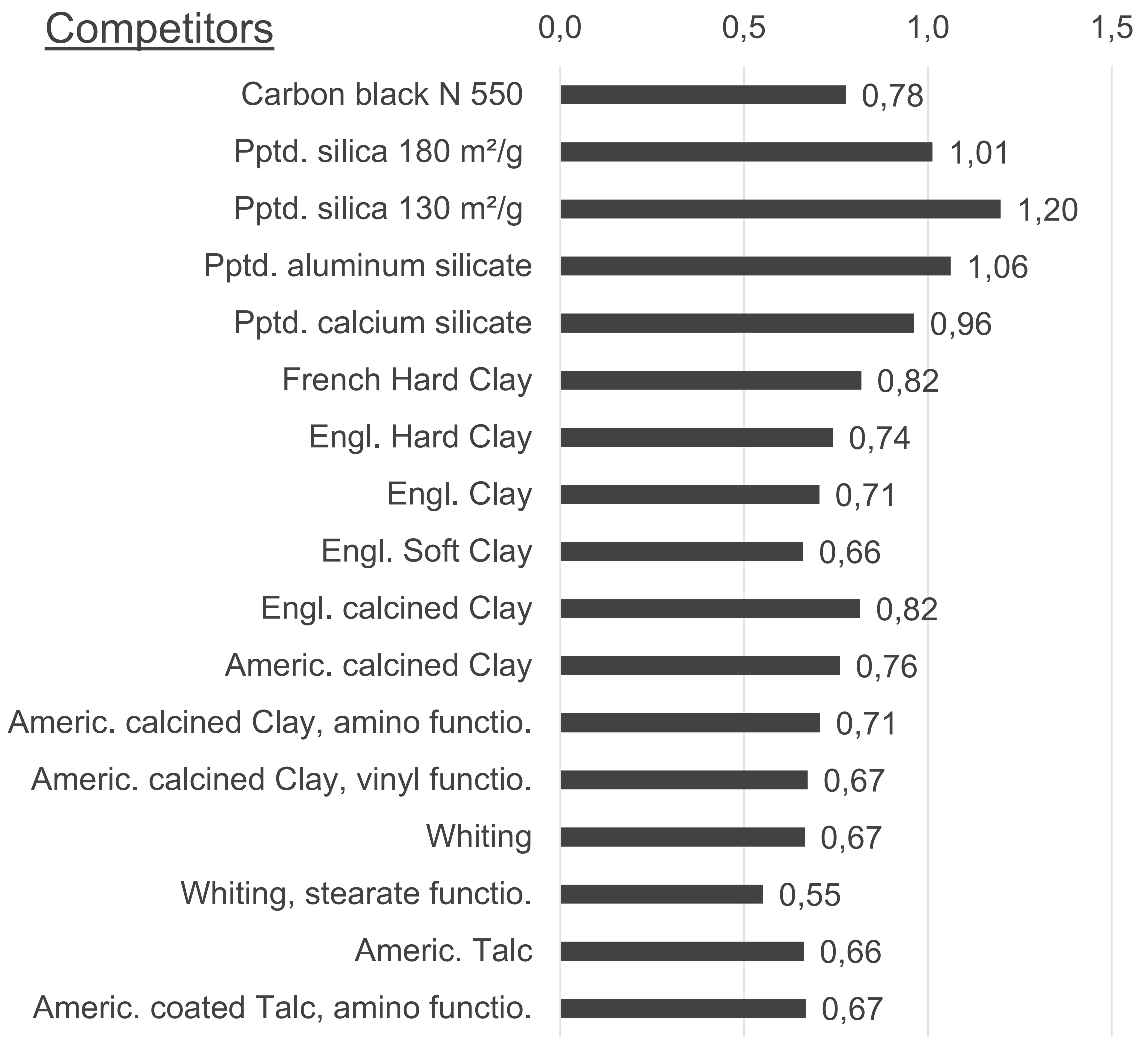




Note: Sillitin N 82 will be replaced by Sillitin N 75

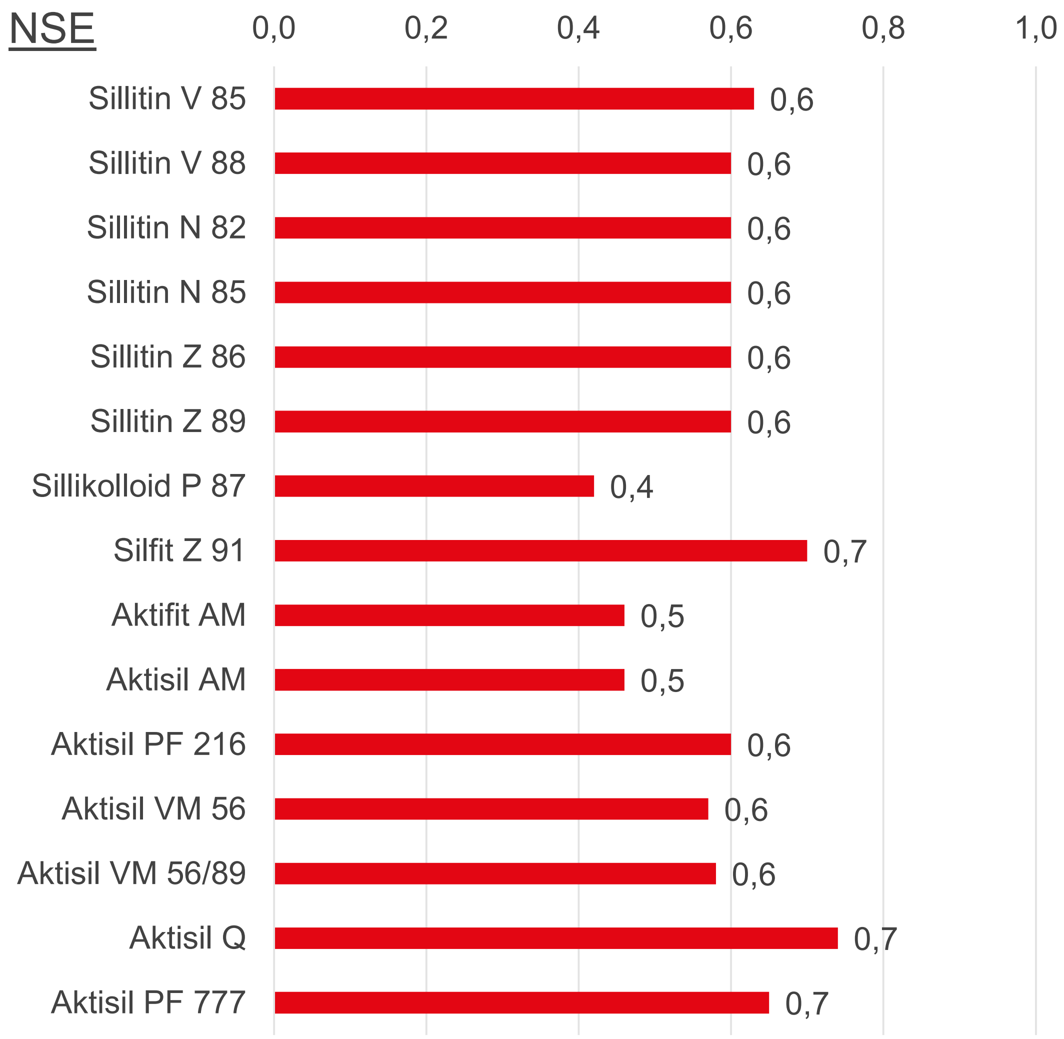
Rotorless curemeter, 180 °C
Cure yield in Nm

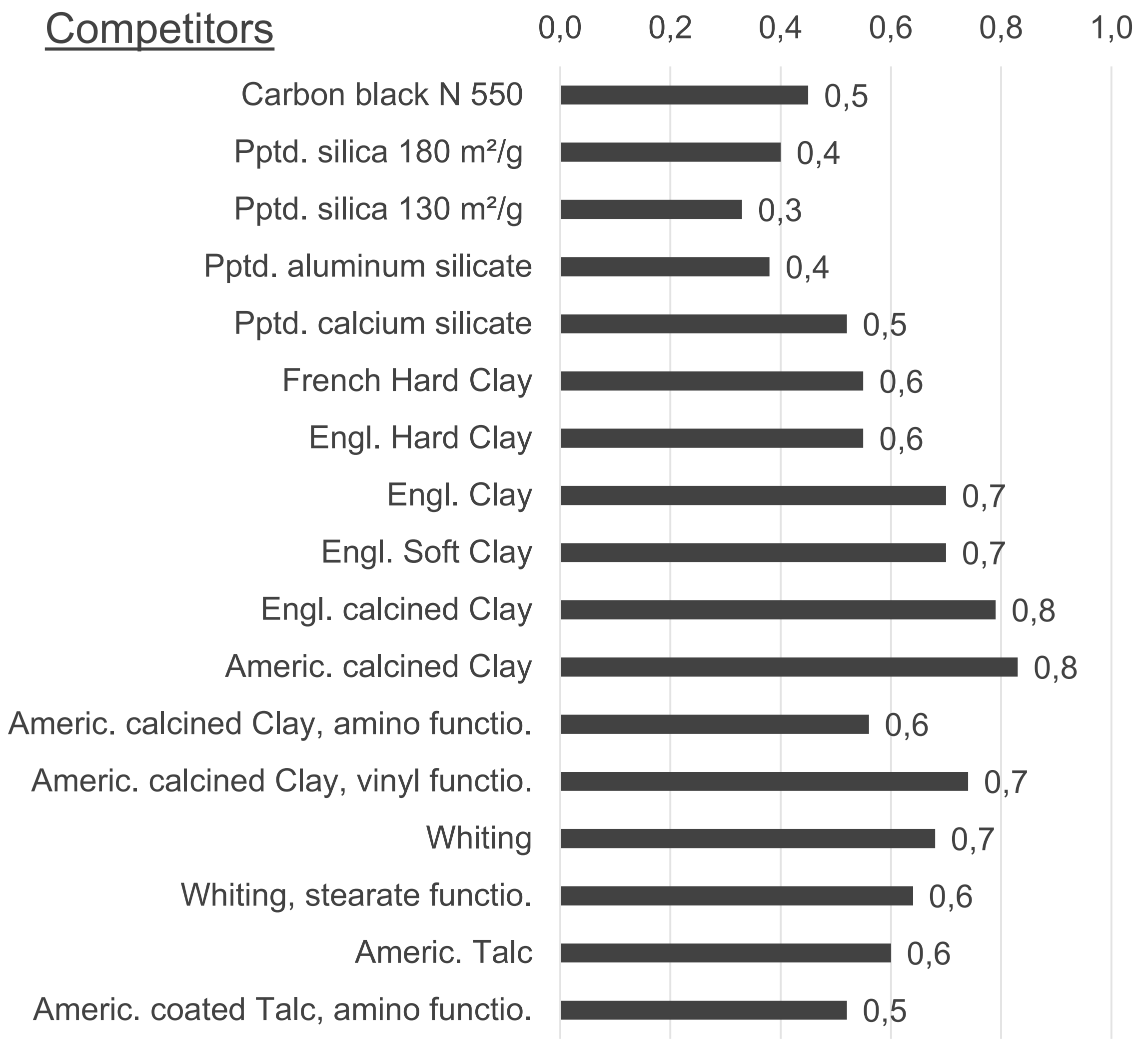




Note: Sillitin N 82 will be replaced by Sillitin N 75

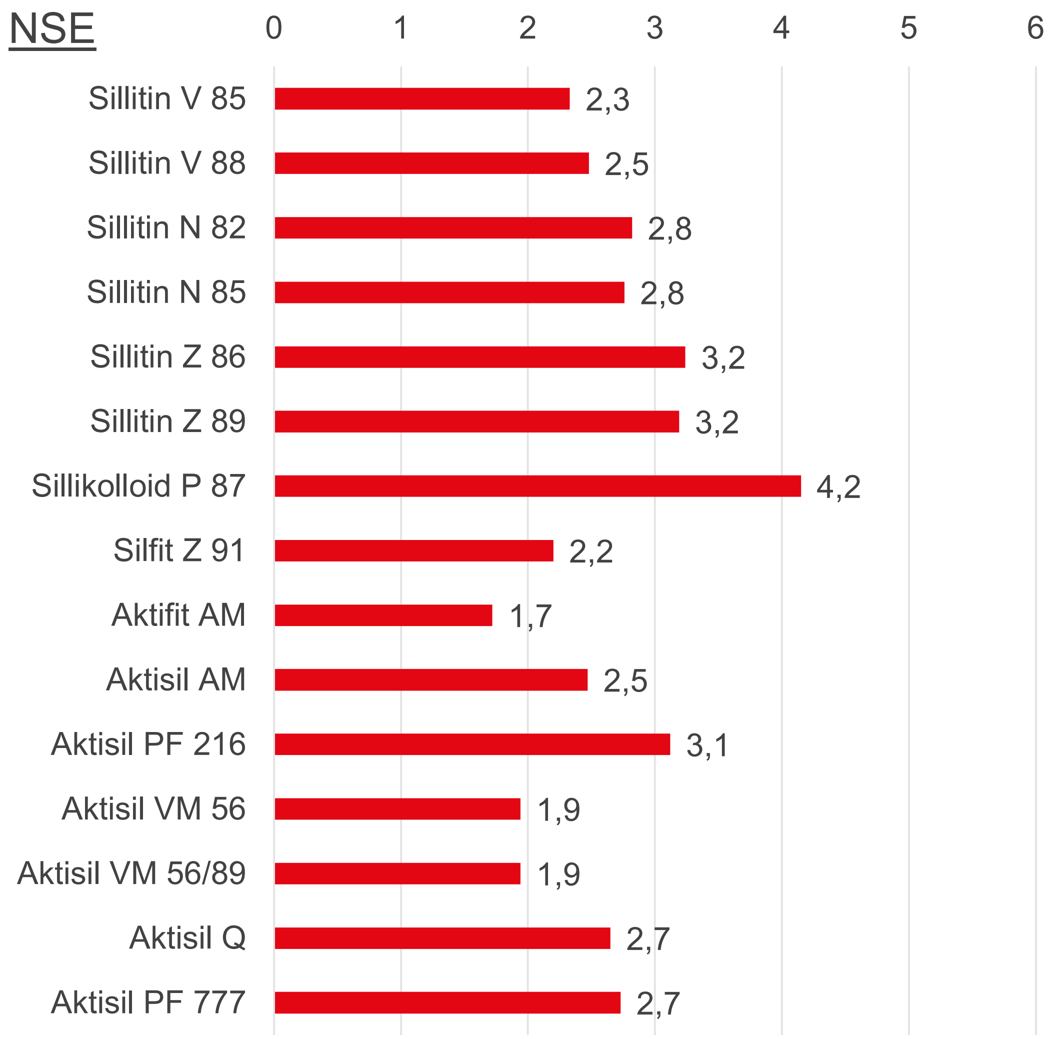
Rotorless curemeter, 180 °C
Conversion time t_5 in min.

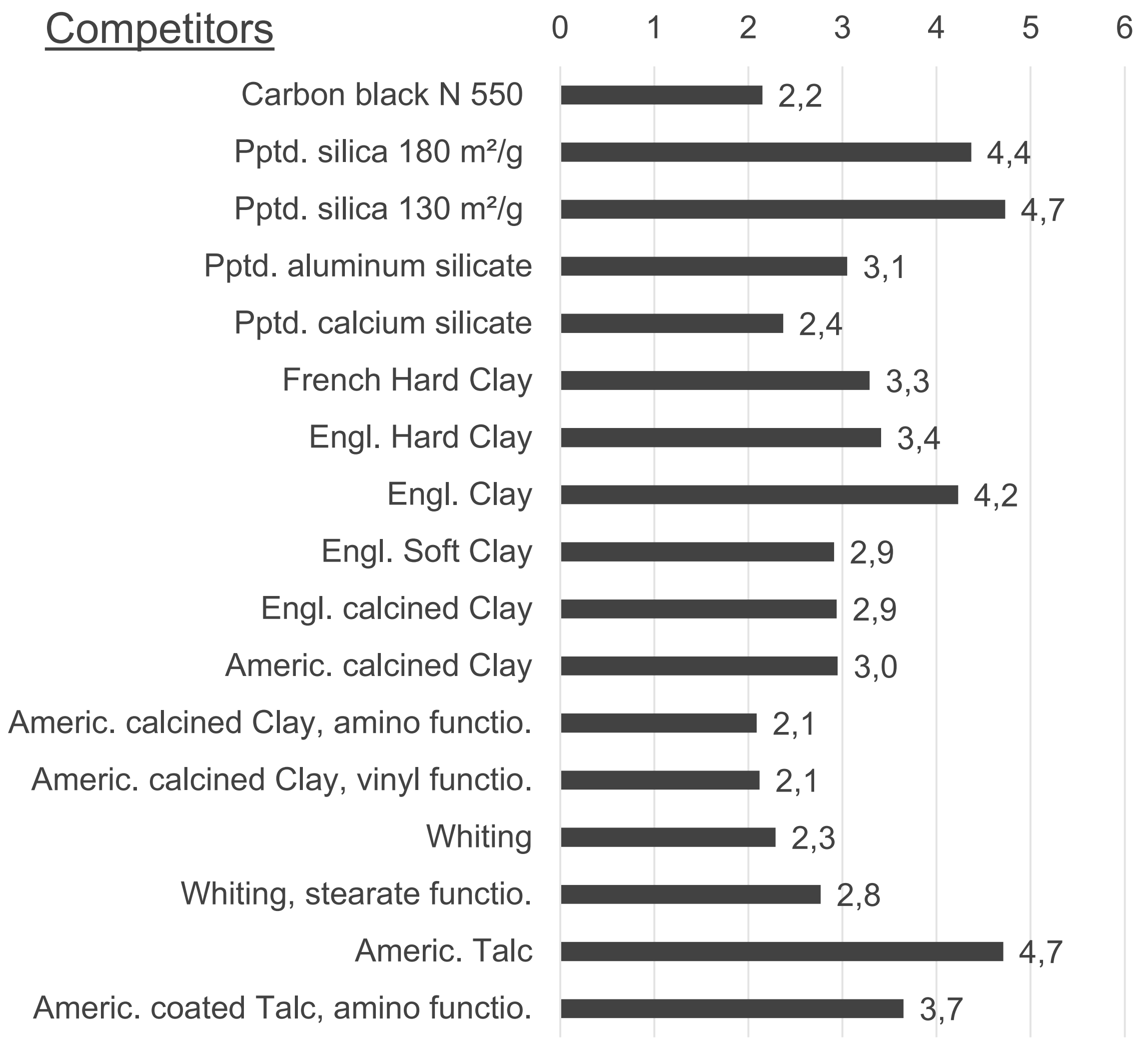




Note: Sillitin N 82 will be replaced by Sillitin N 75

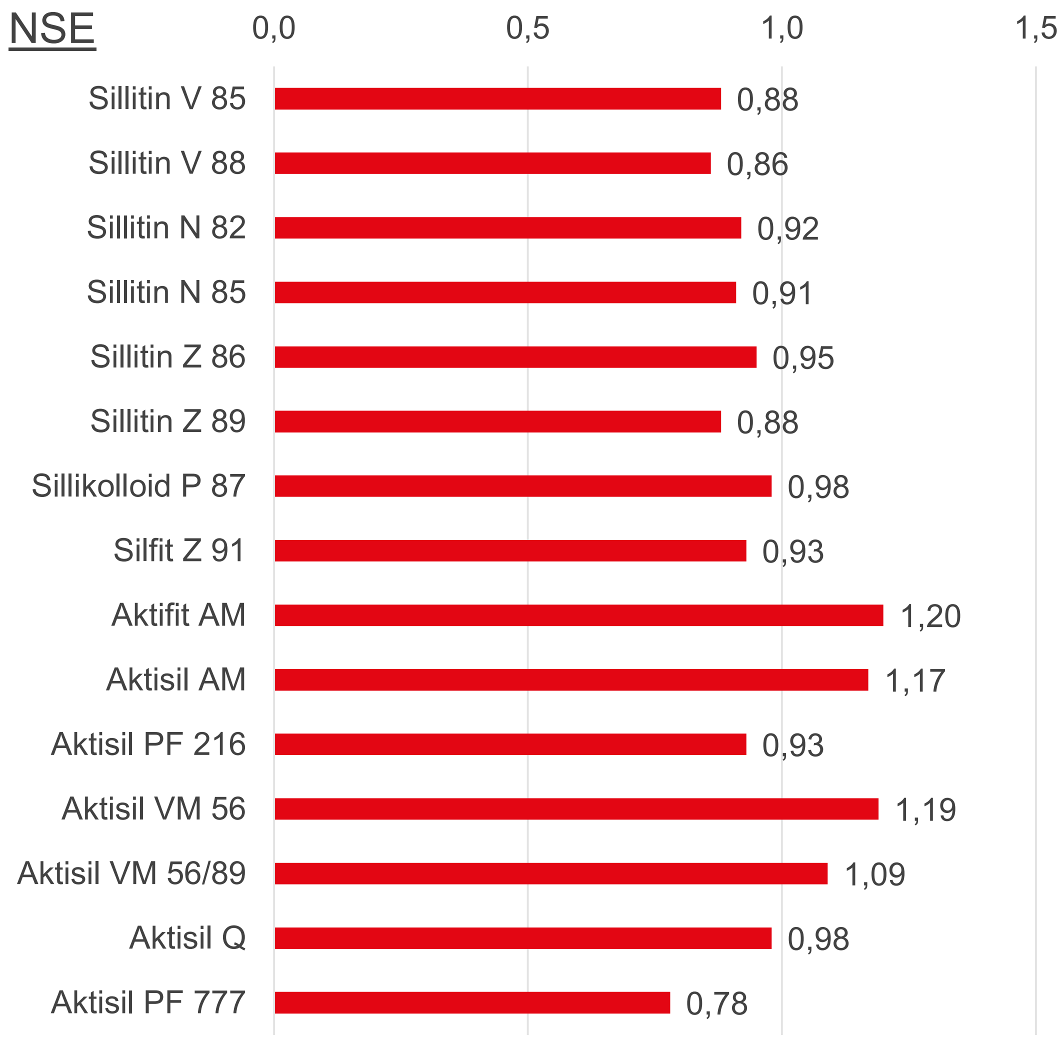
Rotorless curemeter, 180 °C
Conversion time t_{90} in min.

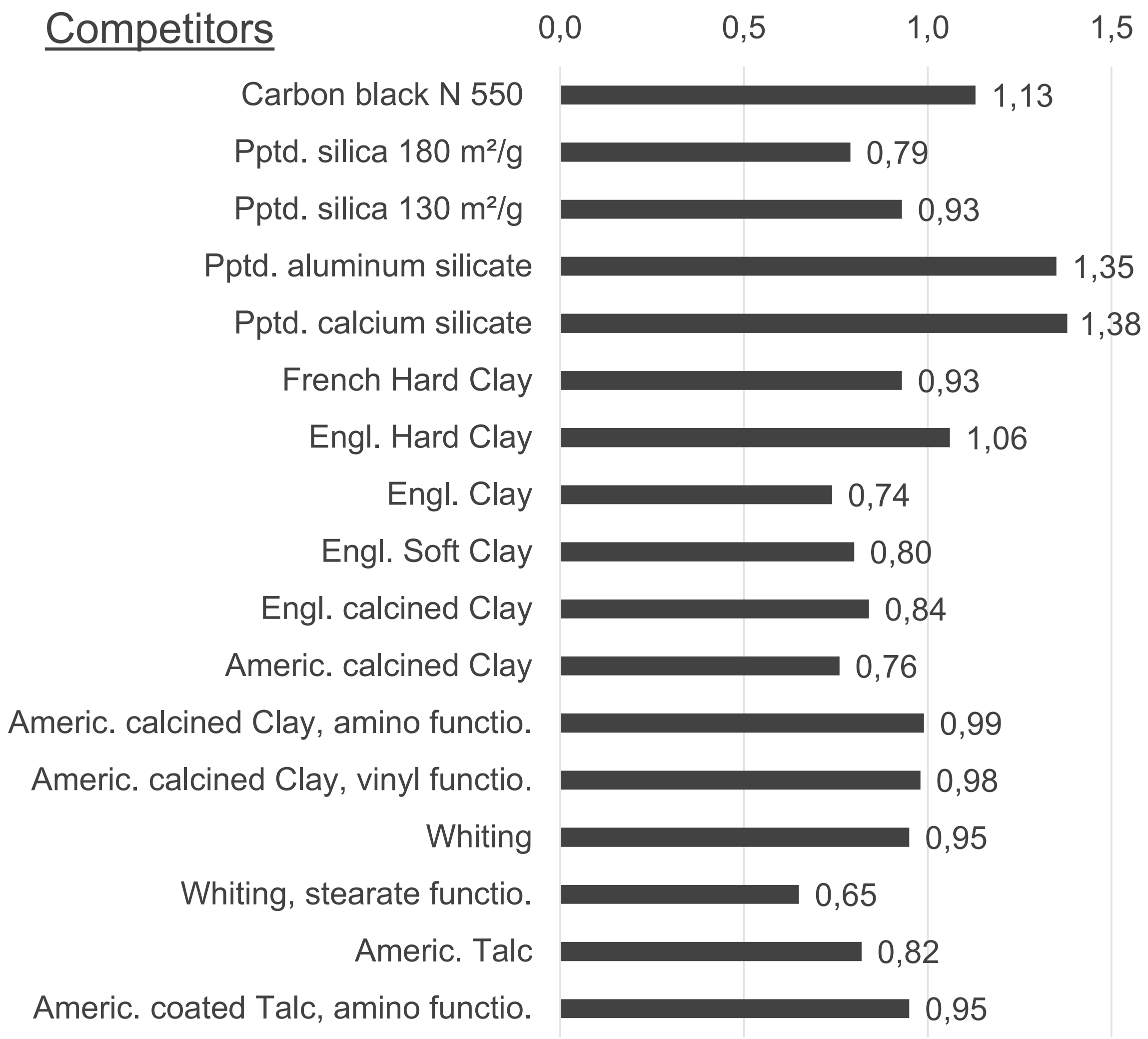




Note: Sillitin N 82 will be replaced by Sillitin N 75

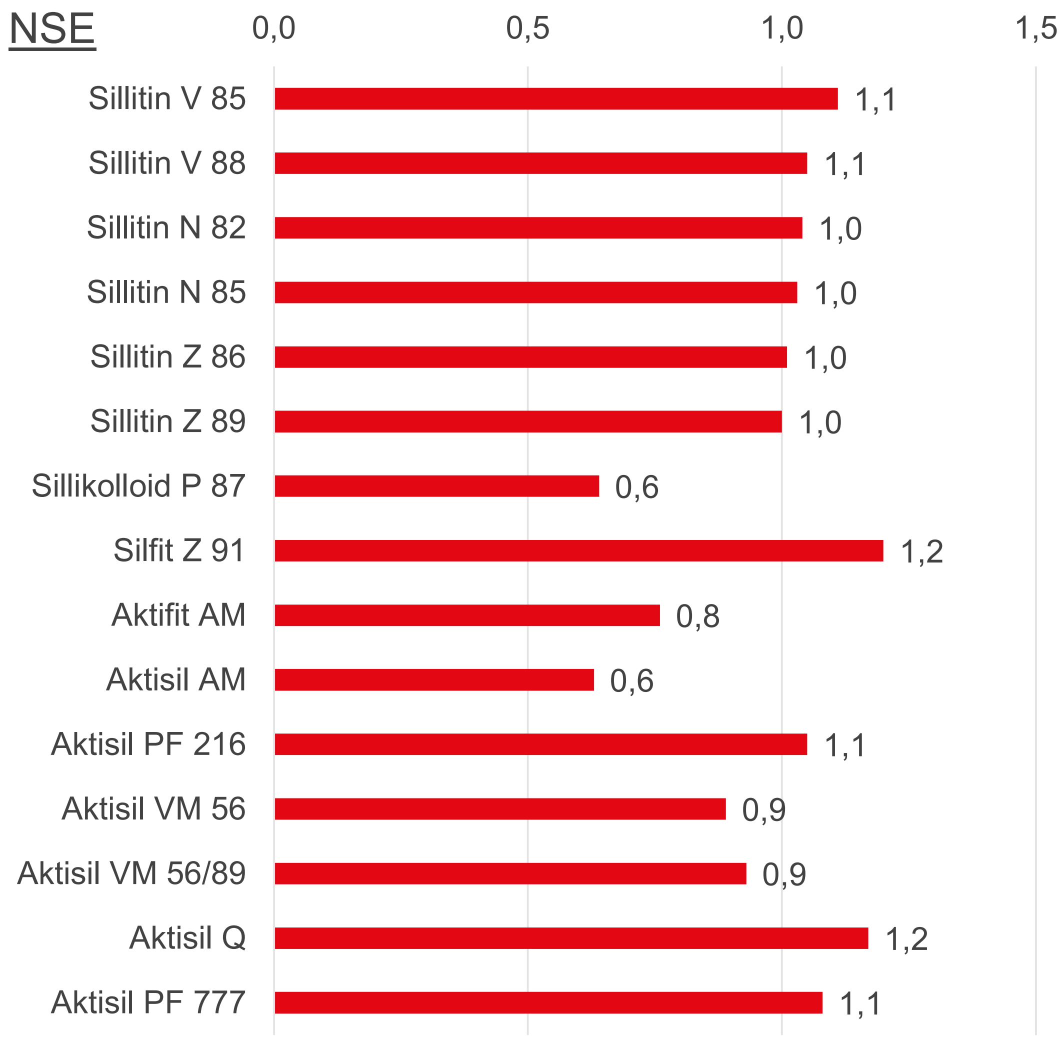
Rotorless curemeter, 180 °C
Max. speed of cure in Nm/min.

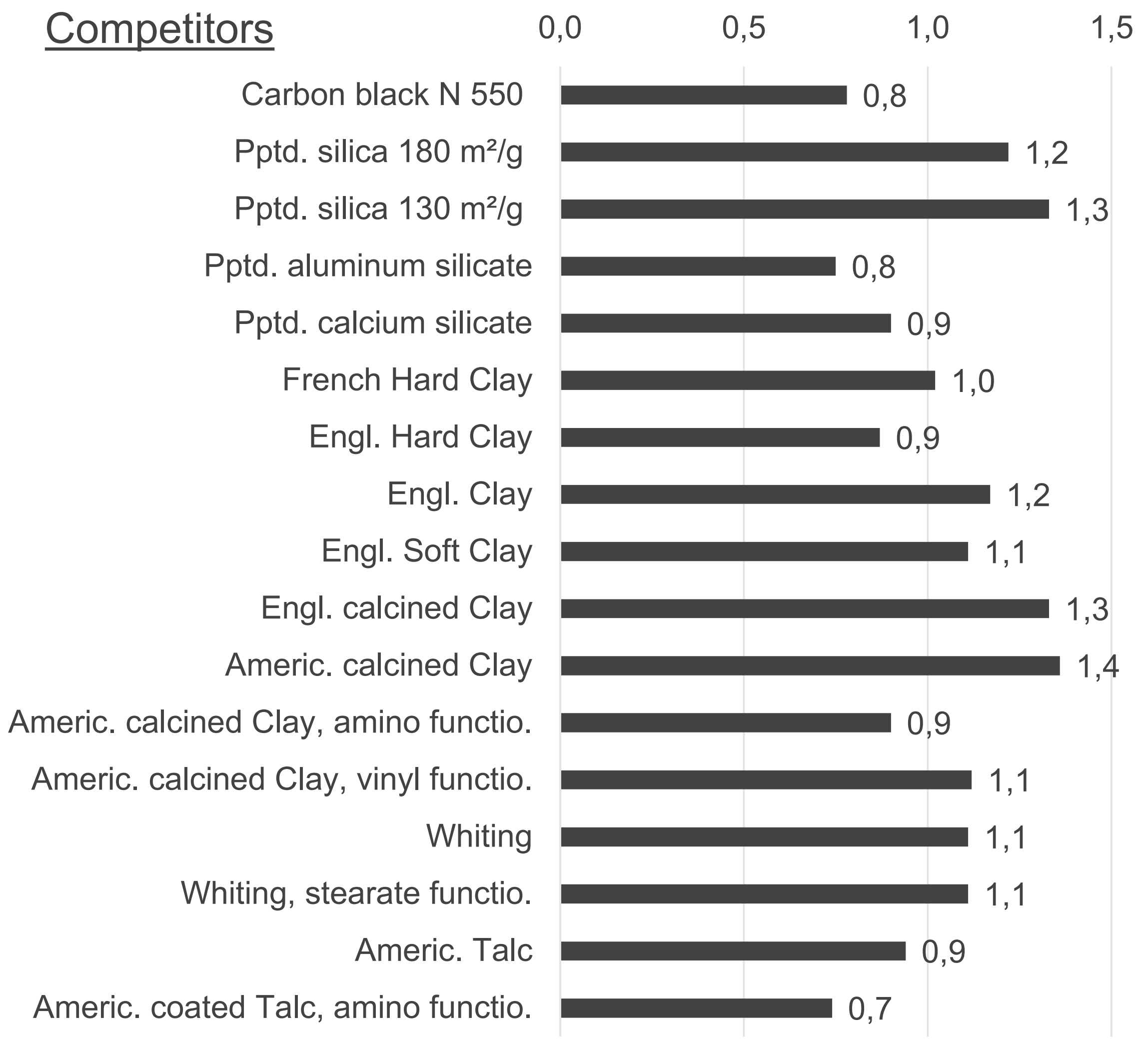




Note: Sillitin N 82 will be replaced by Sillitin N 75

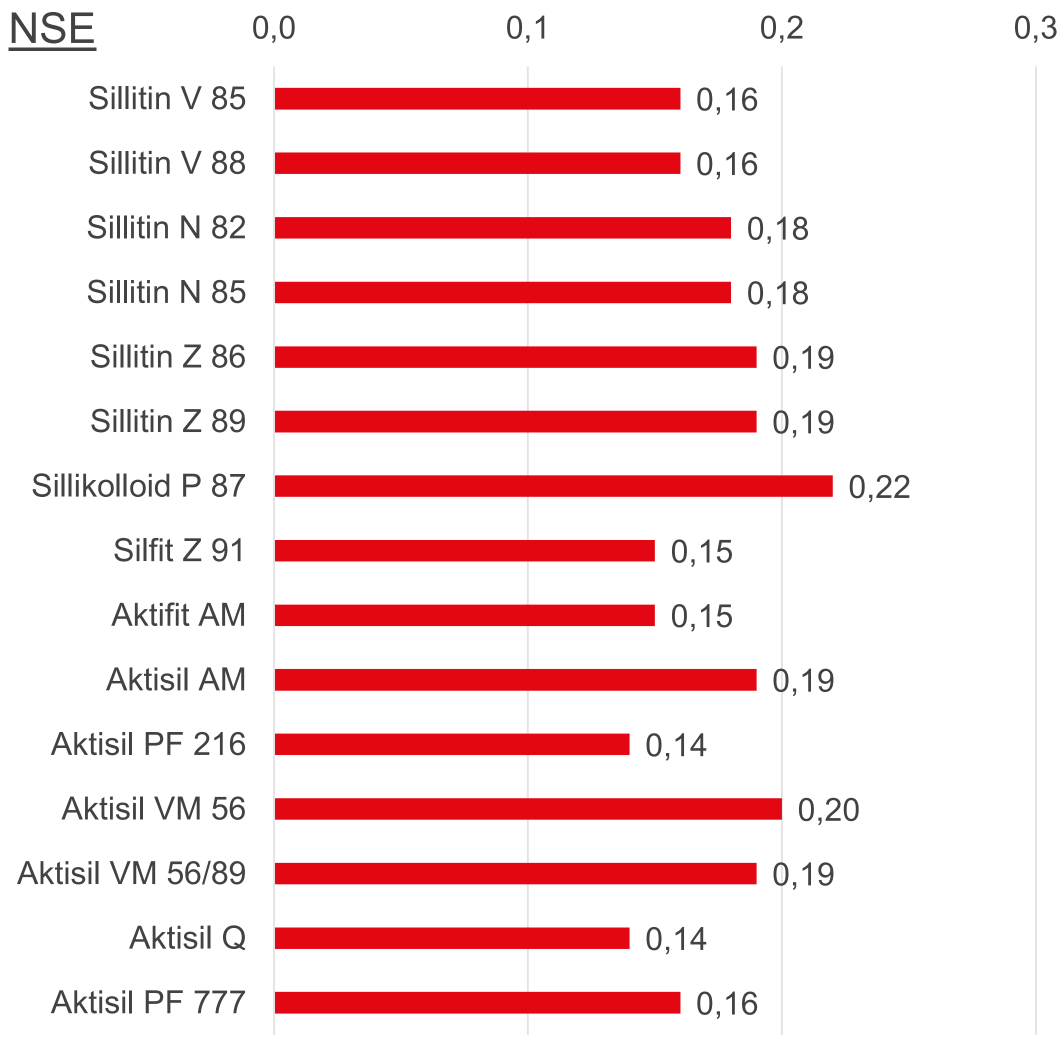
Rotorless curemeter, 180 °C
Time until max. speed of cure in min.

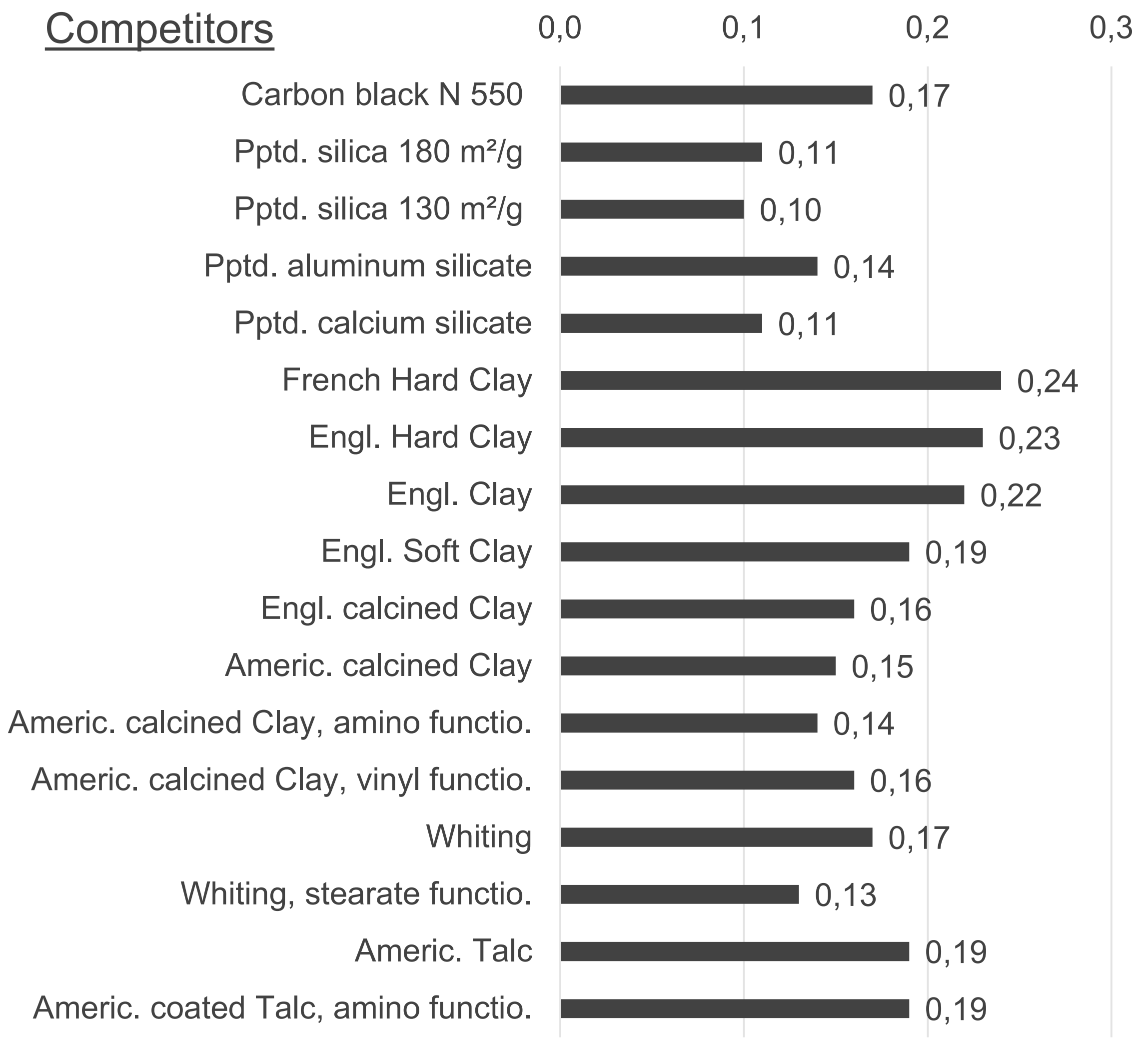




Note: Sillitin N 82 will be replaced by Sillitin N 75

Rotorless curemeter, 180 °C
tan δ, end of test





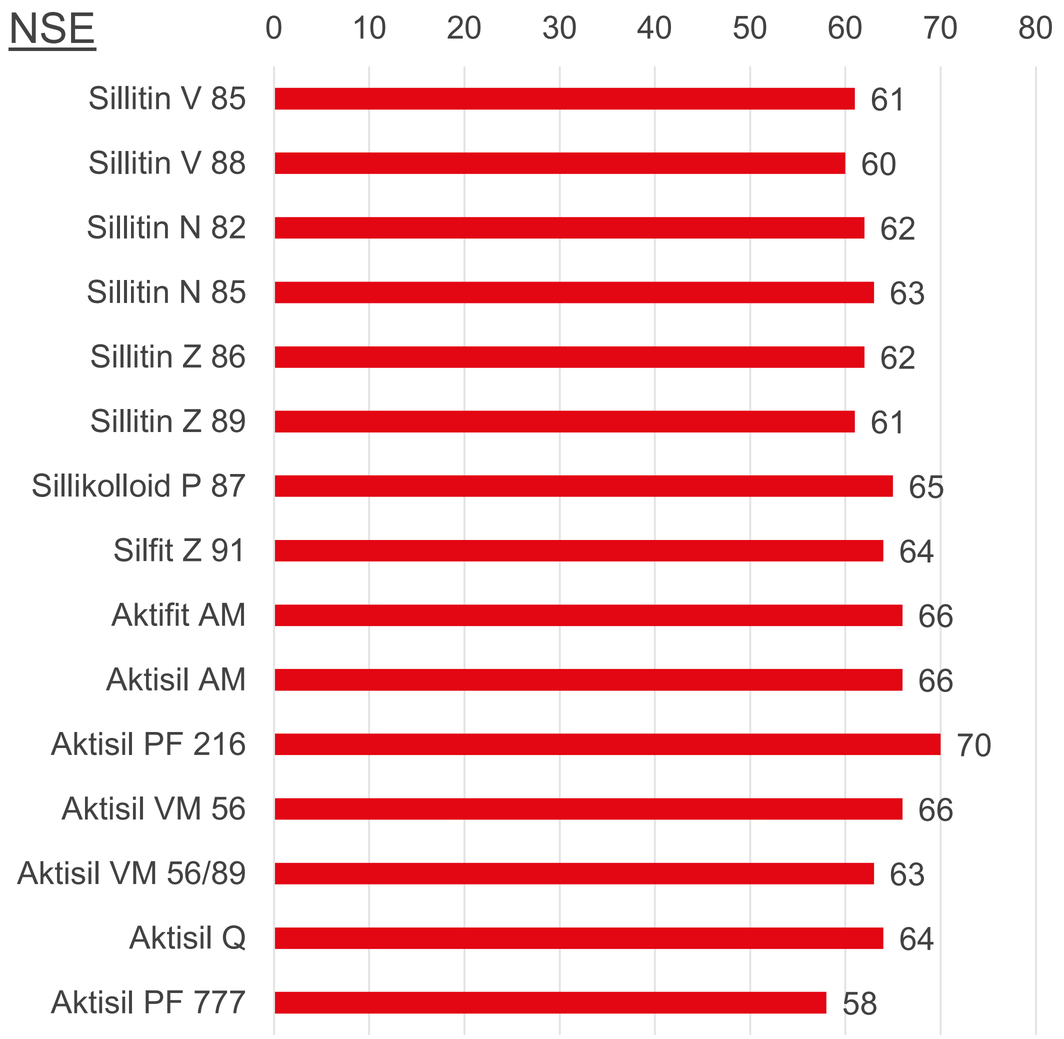
Note: Sillitin N 82 will be replaced by Sillitin N 75

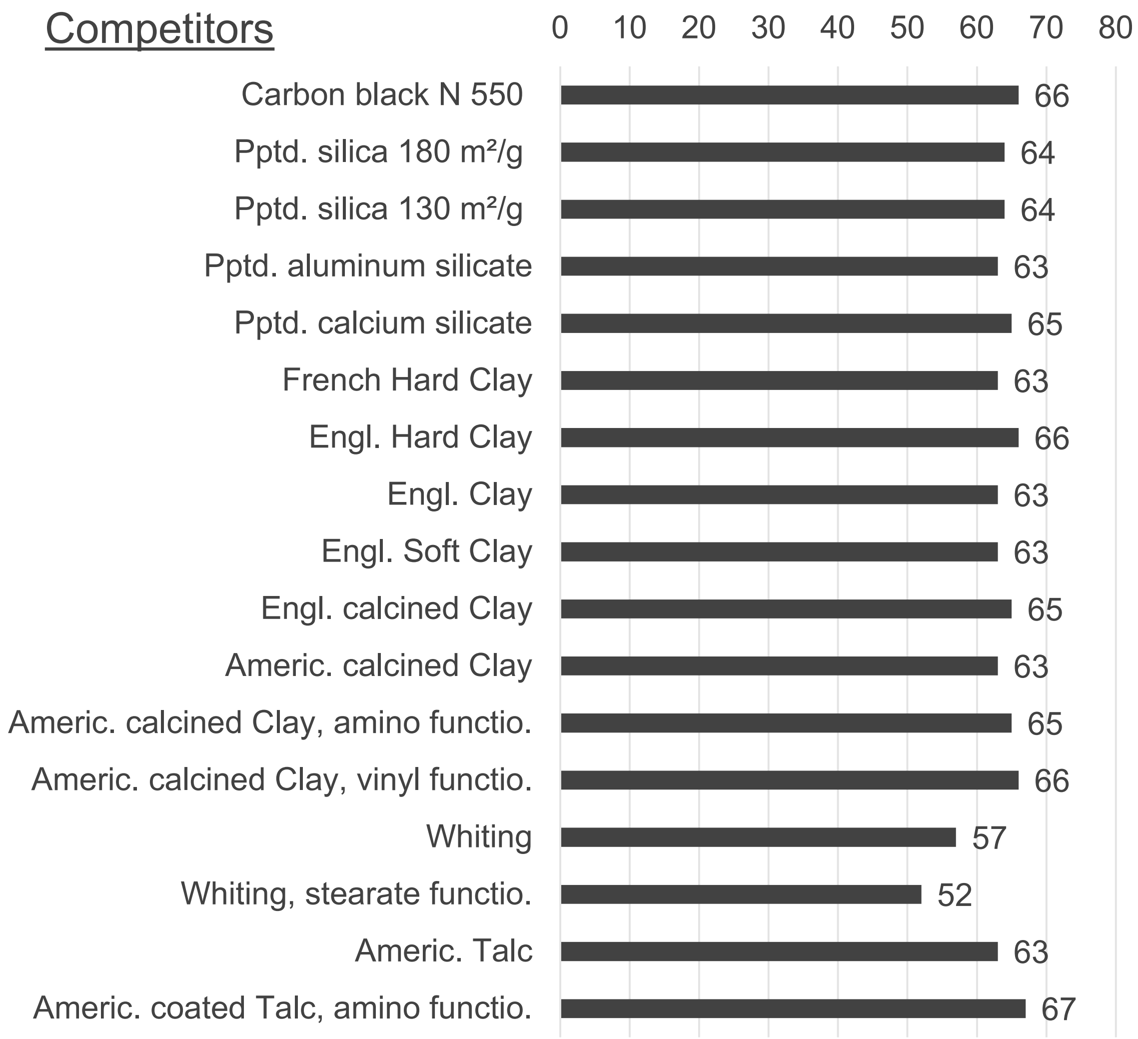
→ back to results

Properties of vulcanizate

Hardness – piled-up S2 dumbbells

DIN ISO 7619-1

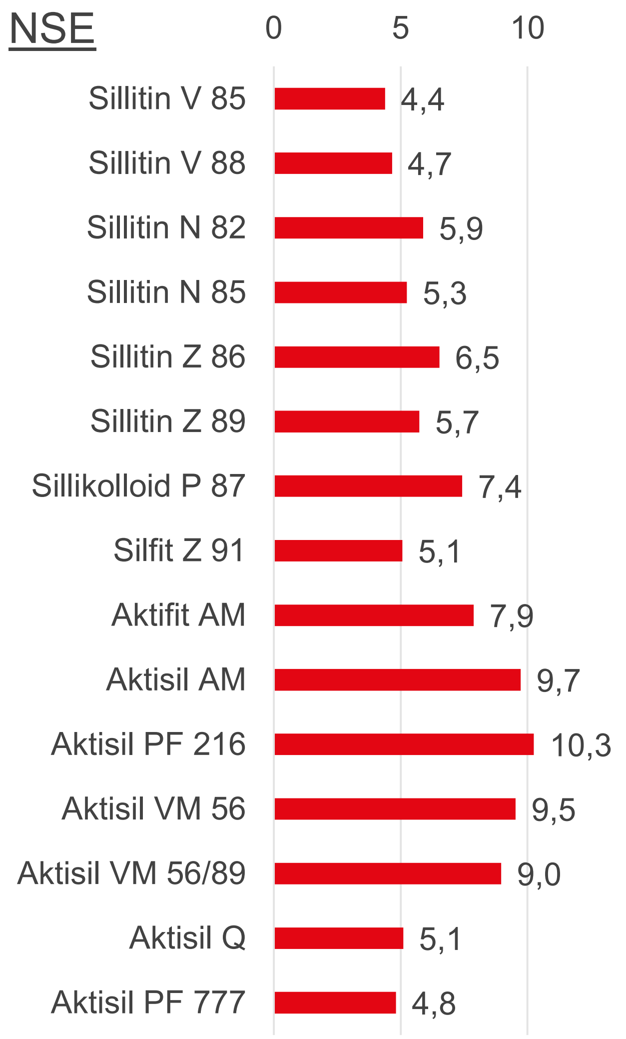


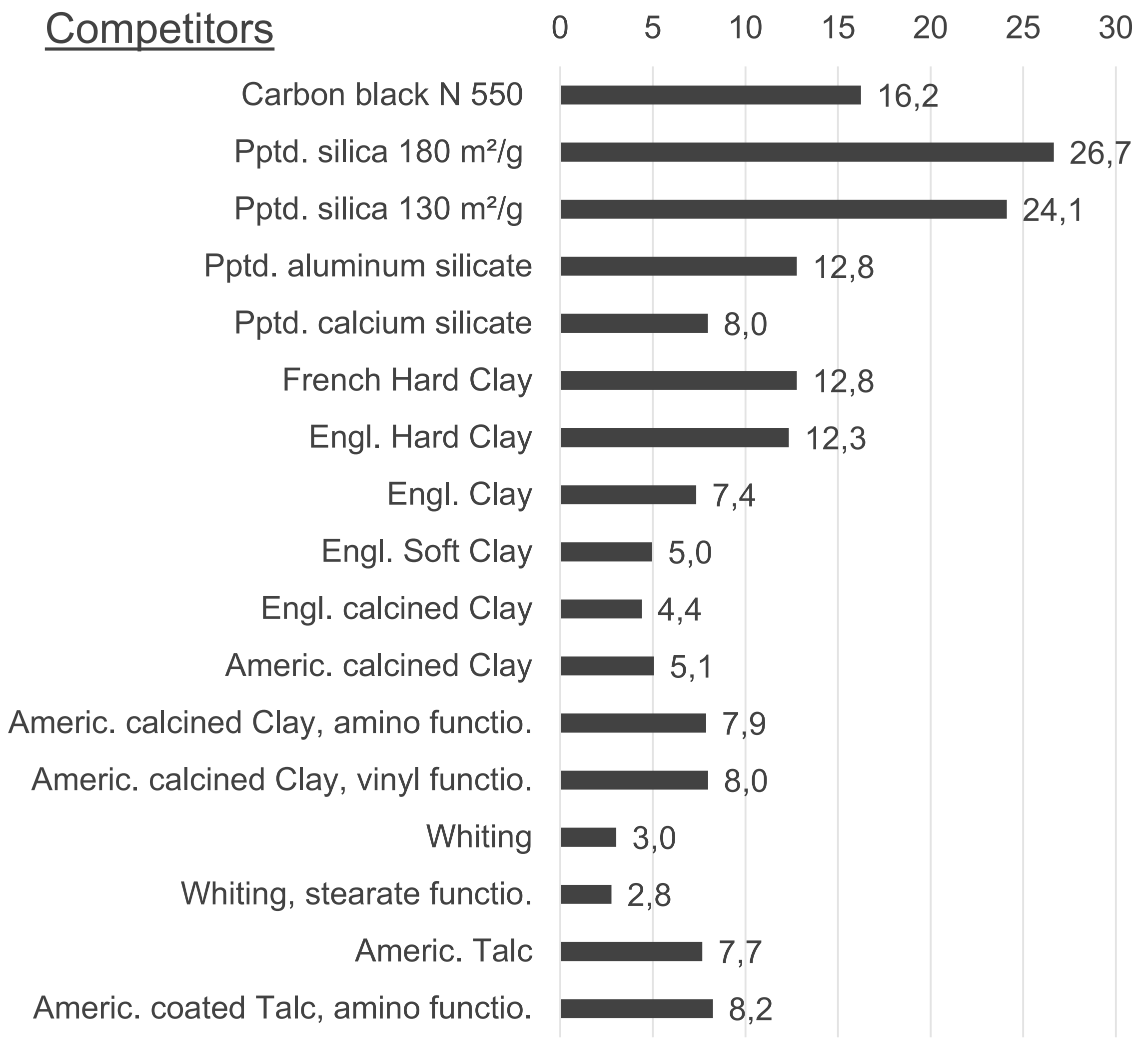


Note: Sillitin N 82 will be replaced by Sillitin N 75

Tensile strength in MPa

DIN 53 504, S2

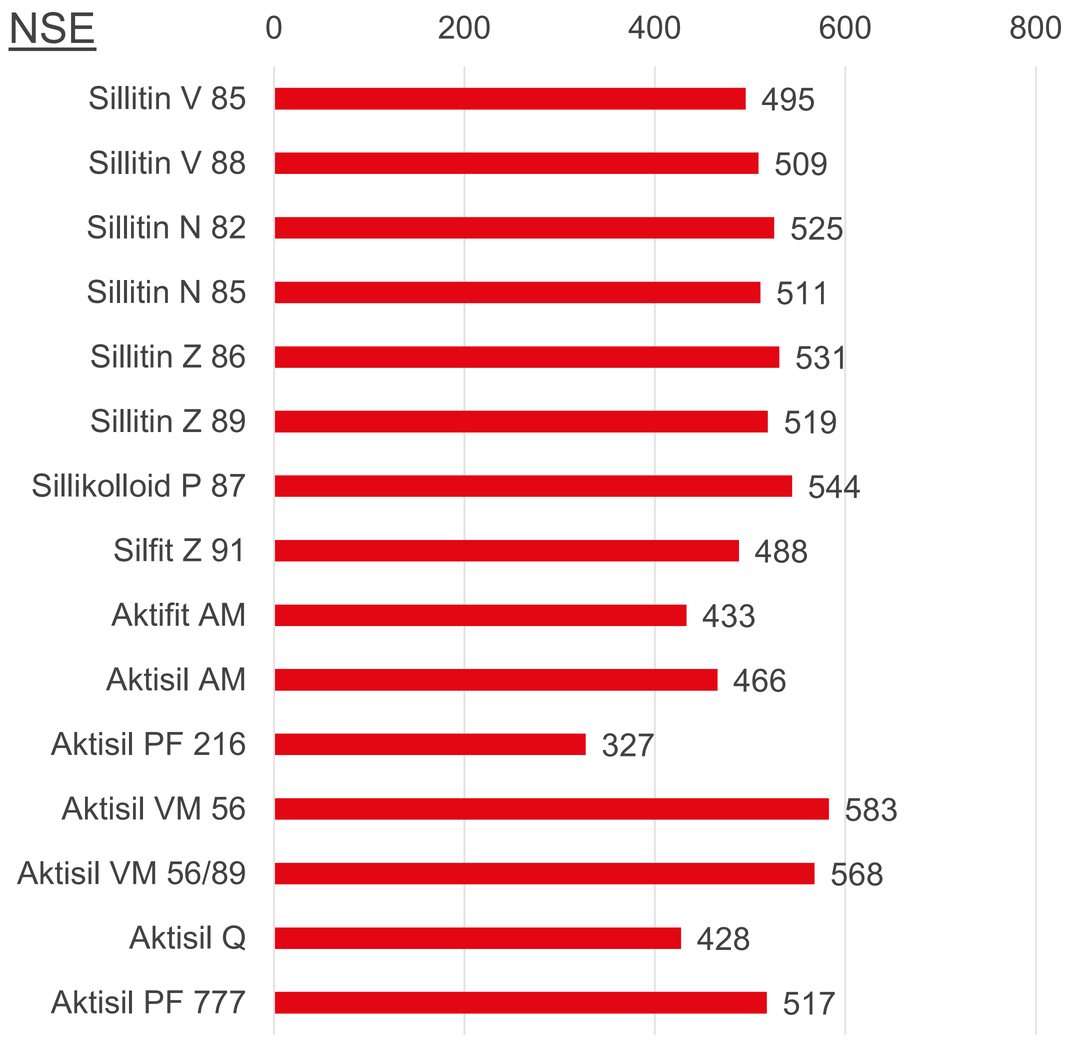


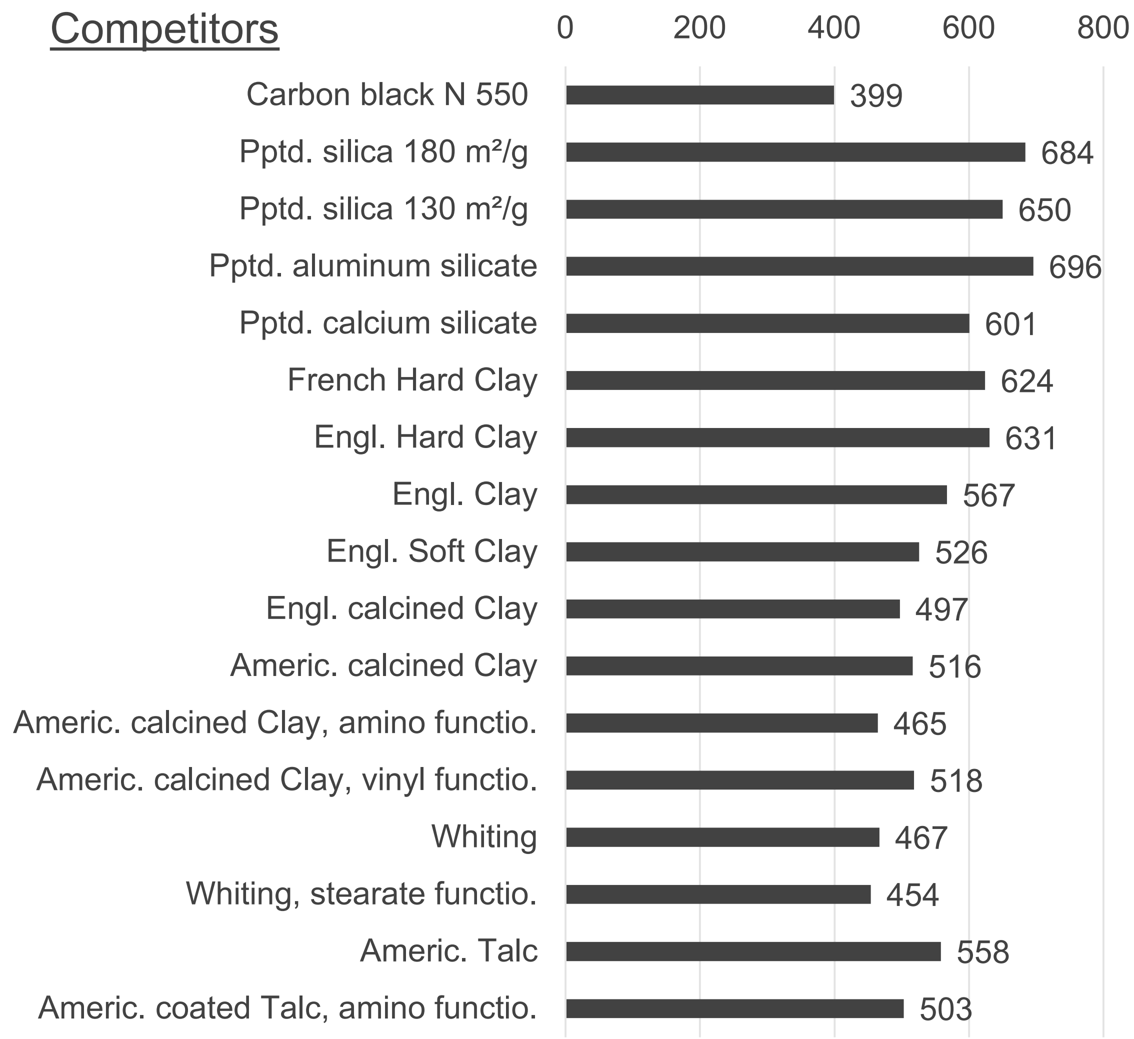


Note: Sillitin N 82 will be replaced by Sillitin N 75

Elongation at break in %

DIN 53 504, S2

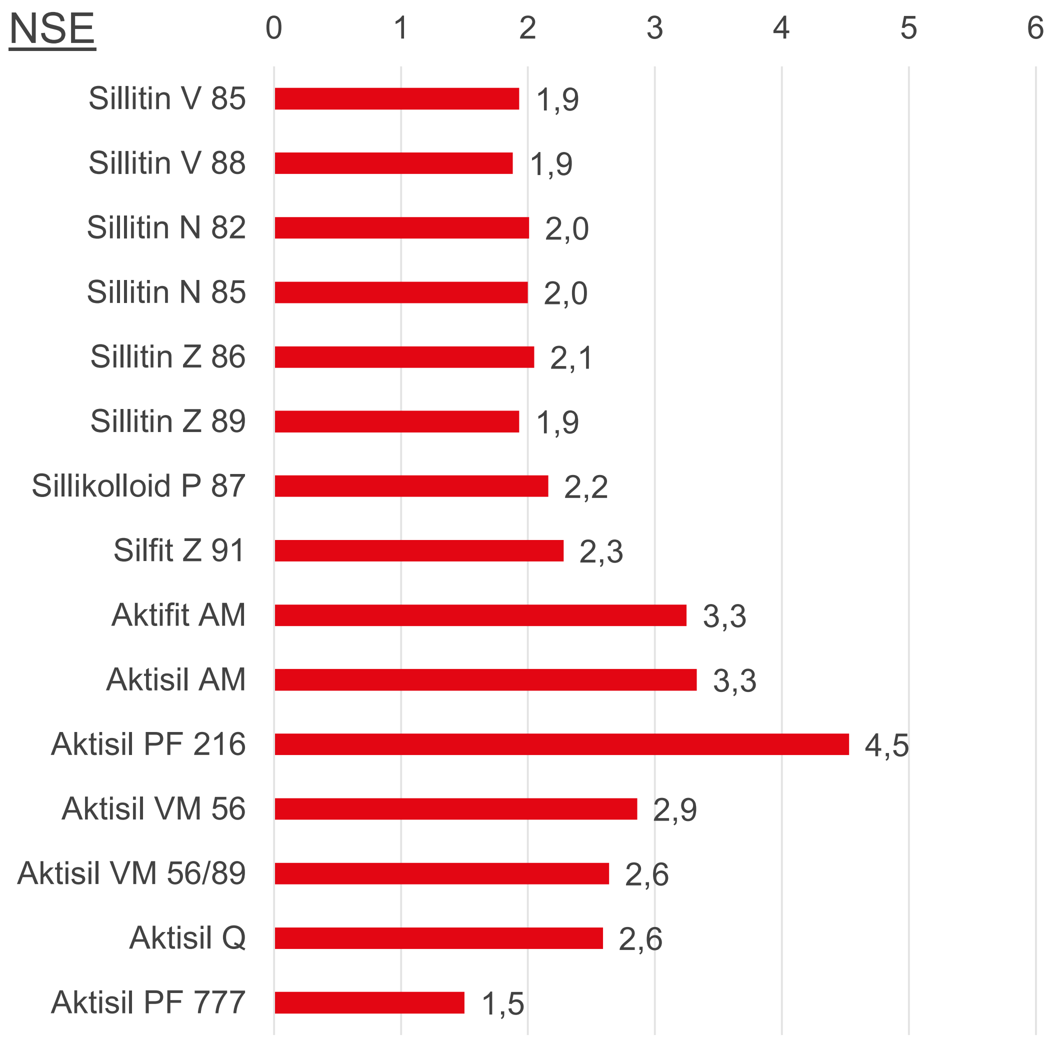


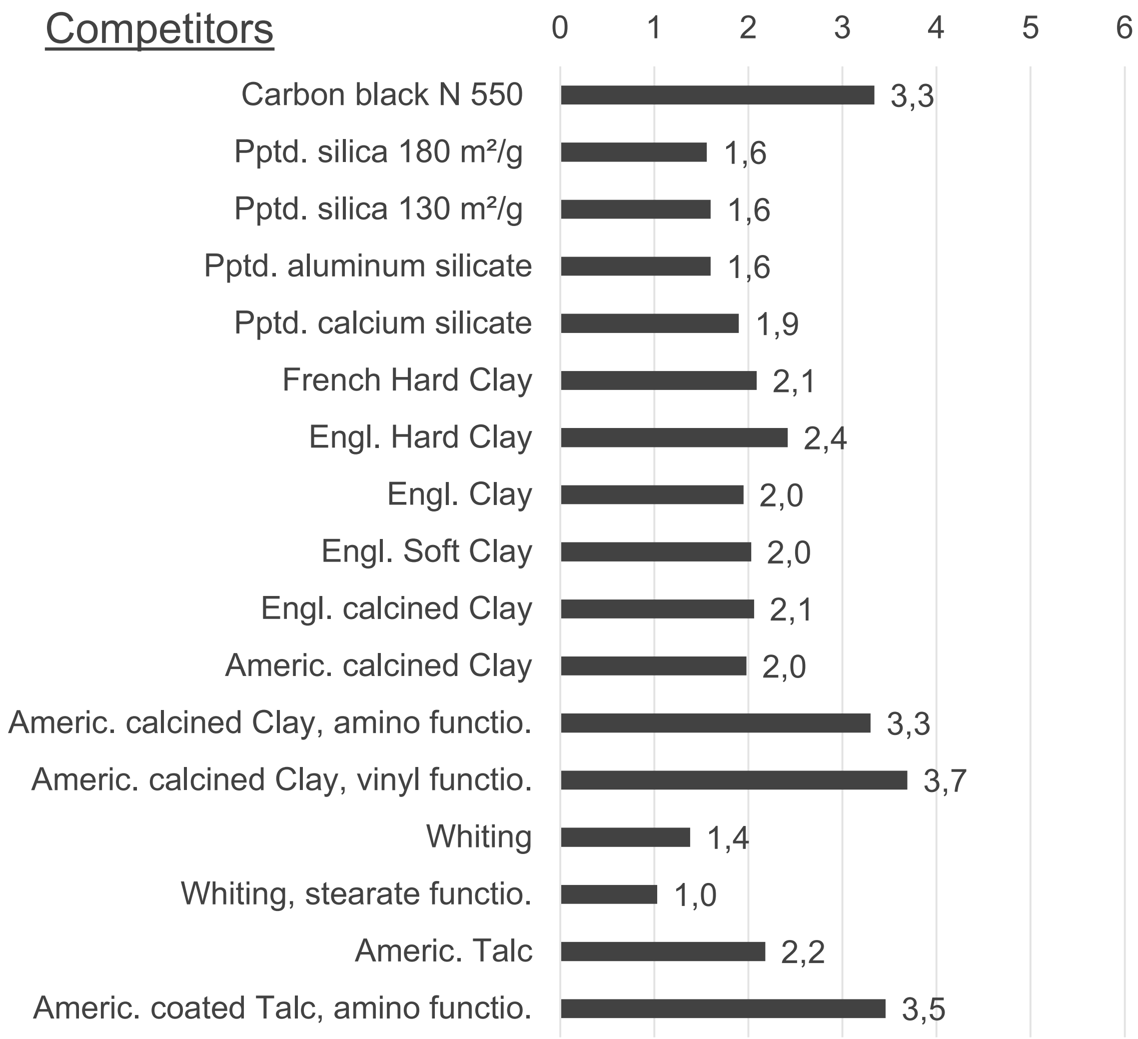


Note: Sillitin N 82 will be replaced by Sillitin N 75

Modulus 100 % in MPa

DIN 53 504, S2

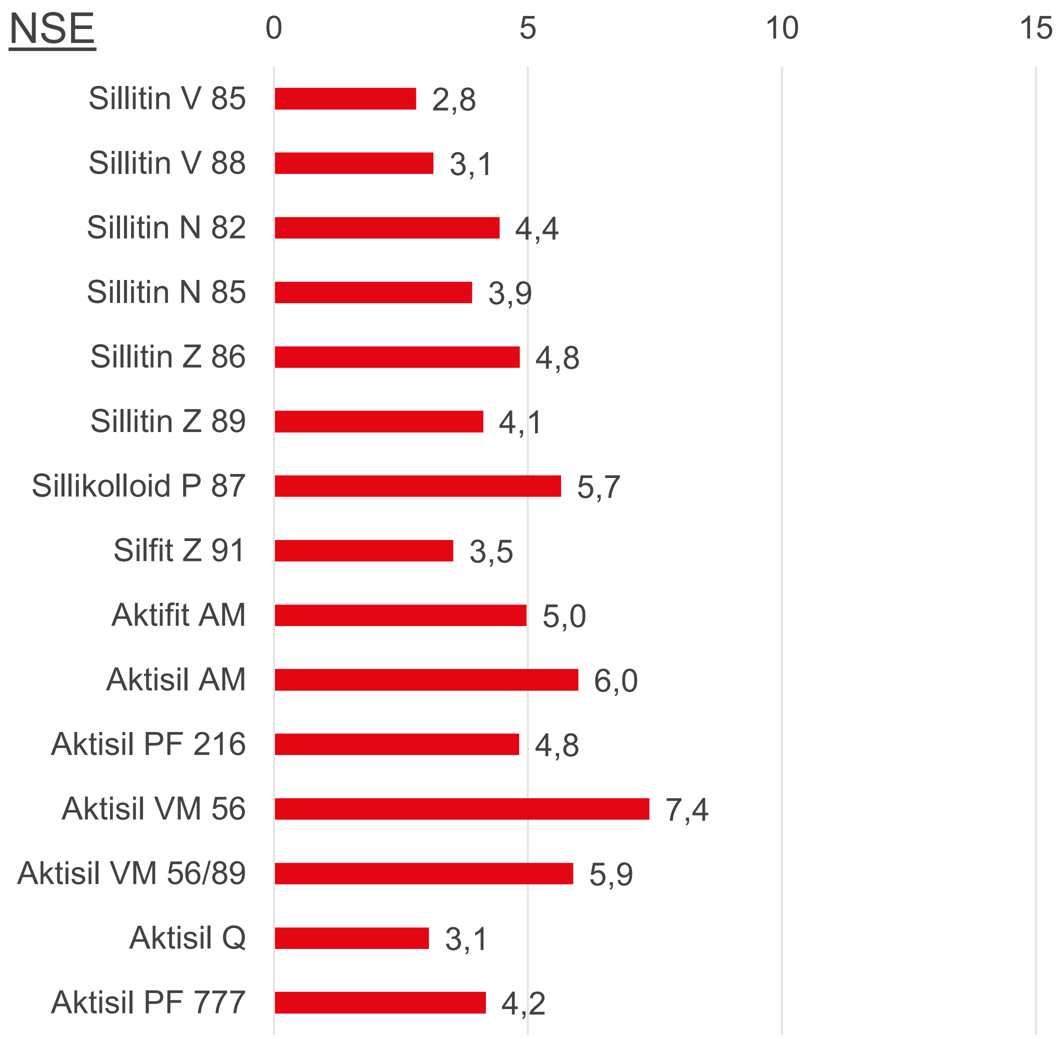


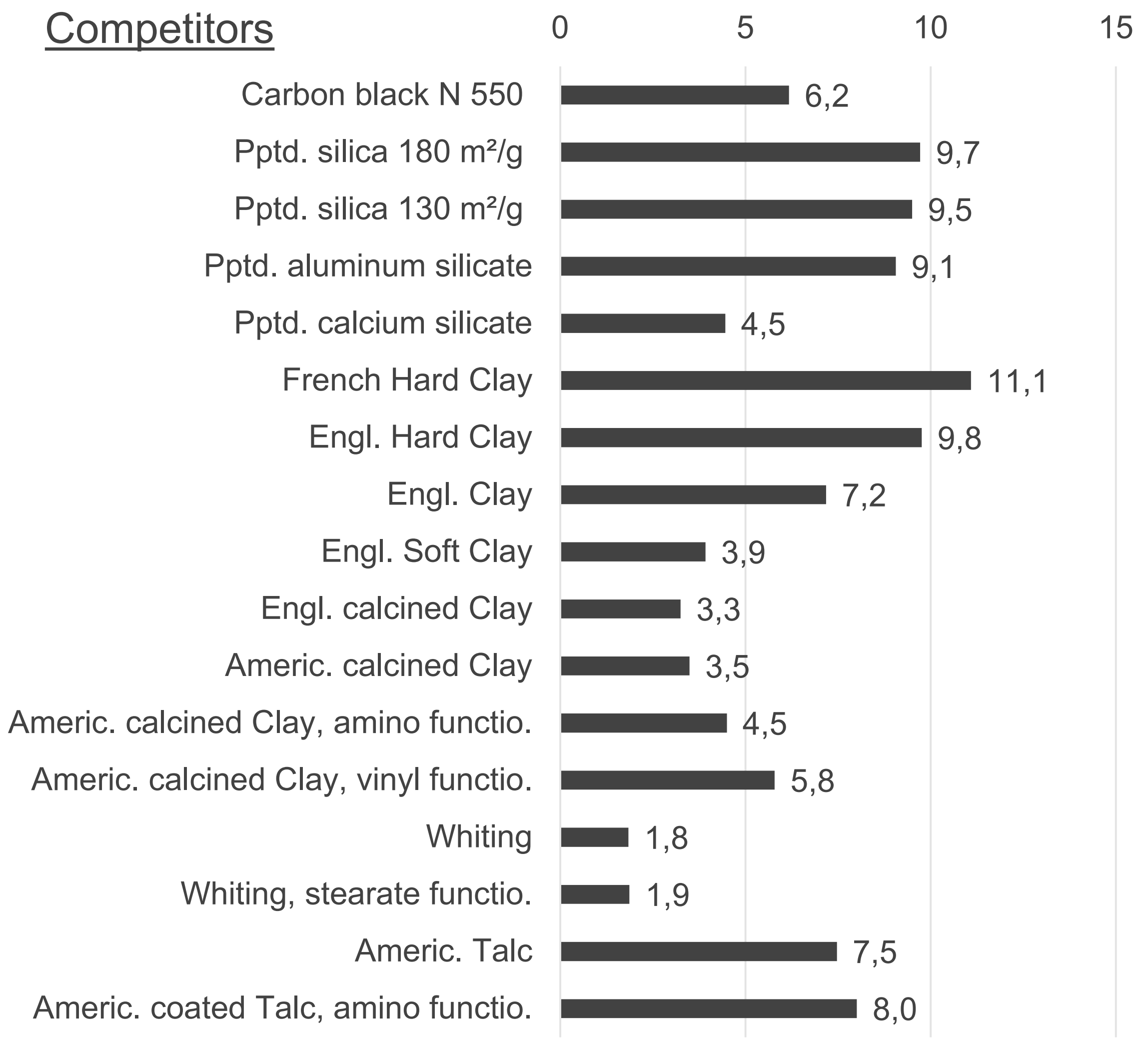


Note: Sillitin N 82 will be replaced by Sillitin N 75

Tear resistance in N/mm – Trousers specimen

DIN ISO 34-1, A

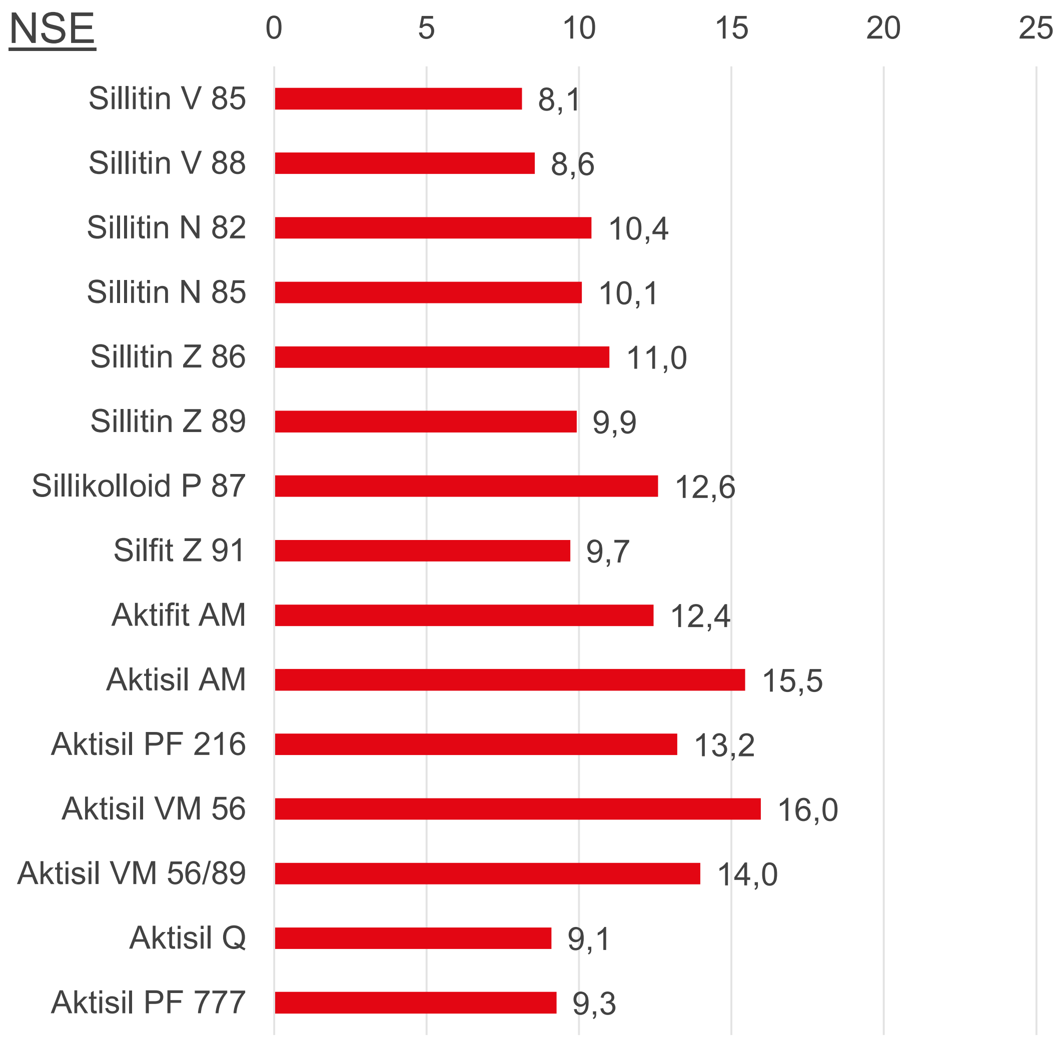


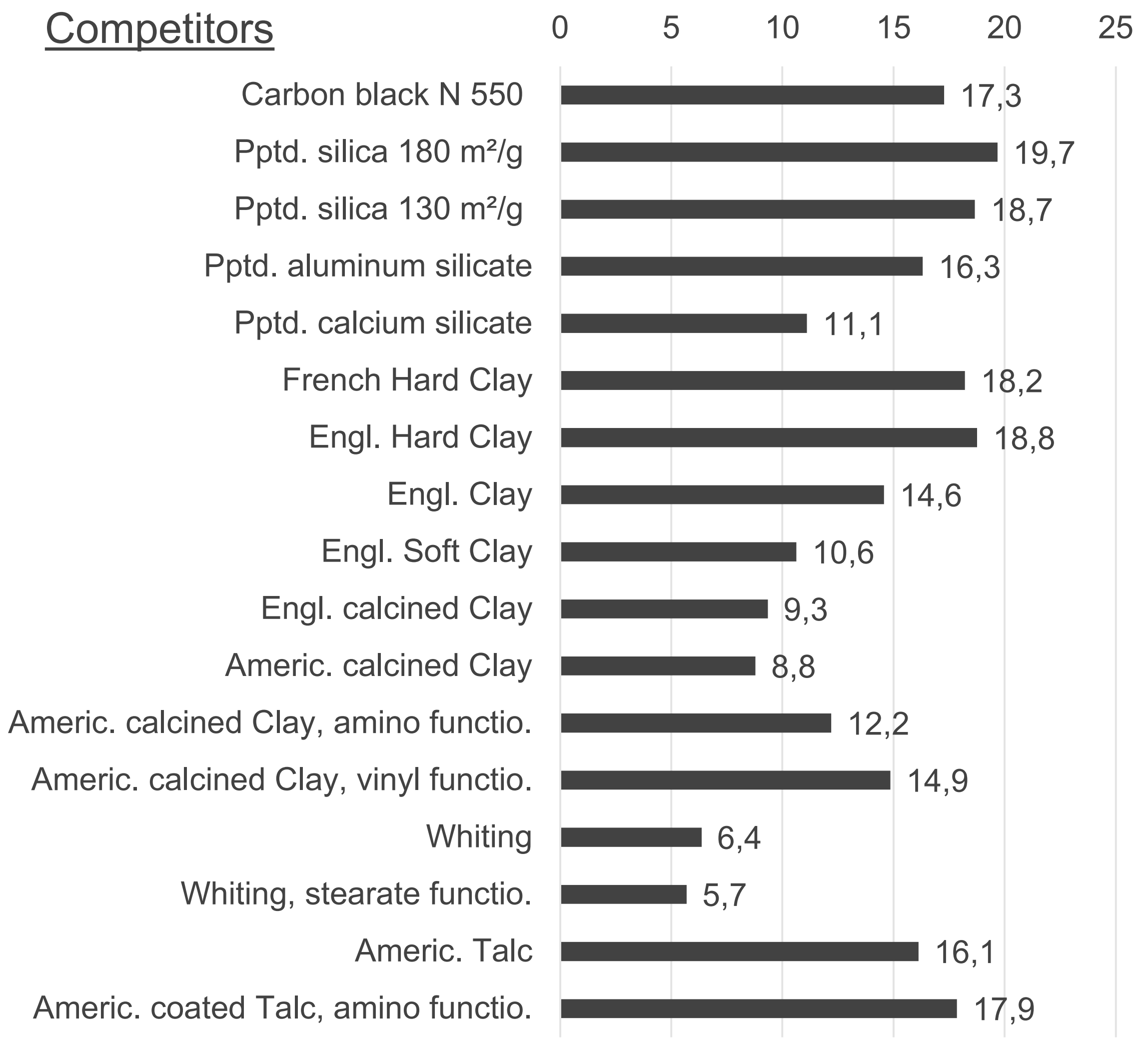


Note: Sillitin N 82 will be replaced by Sillitin N 75

Tear resistance in N/mm – Graves specimen

DIN ISO 34-1, Bb

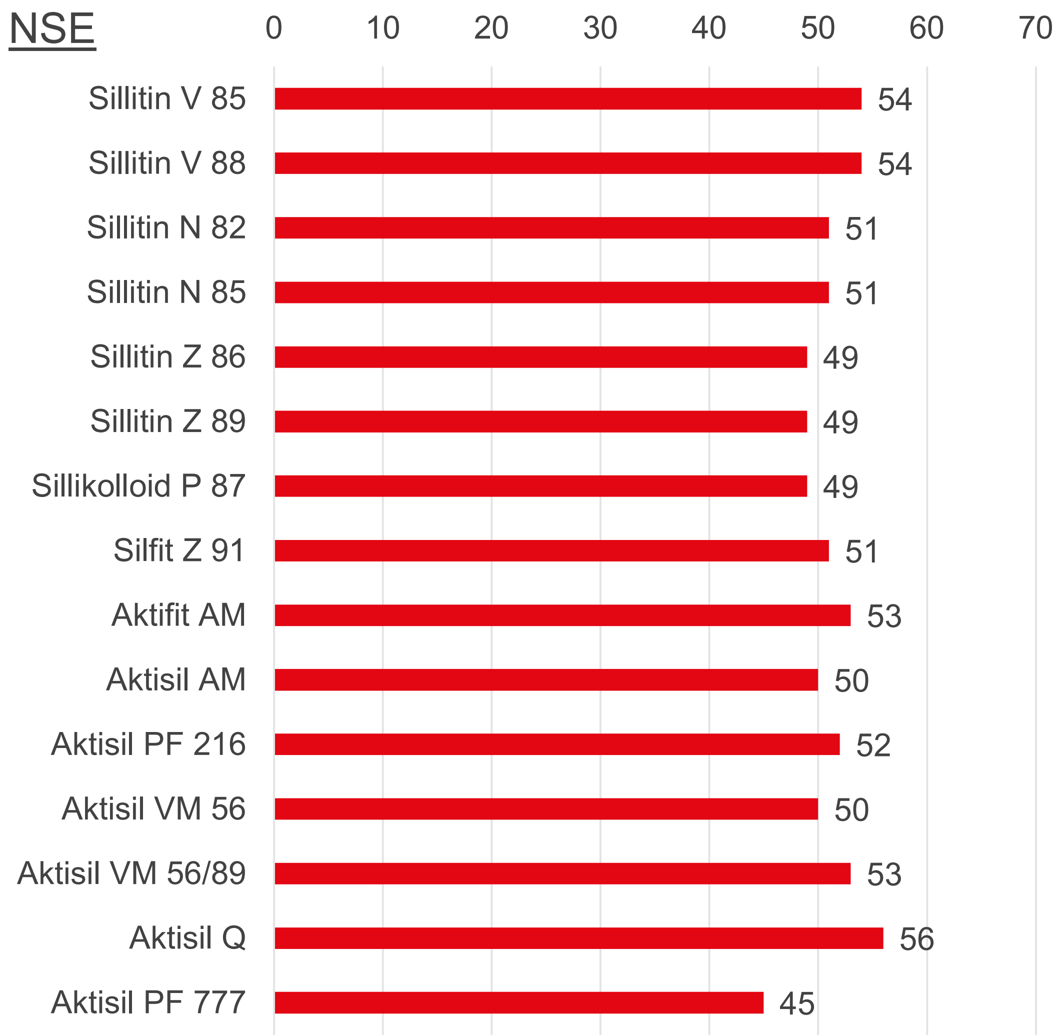


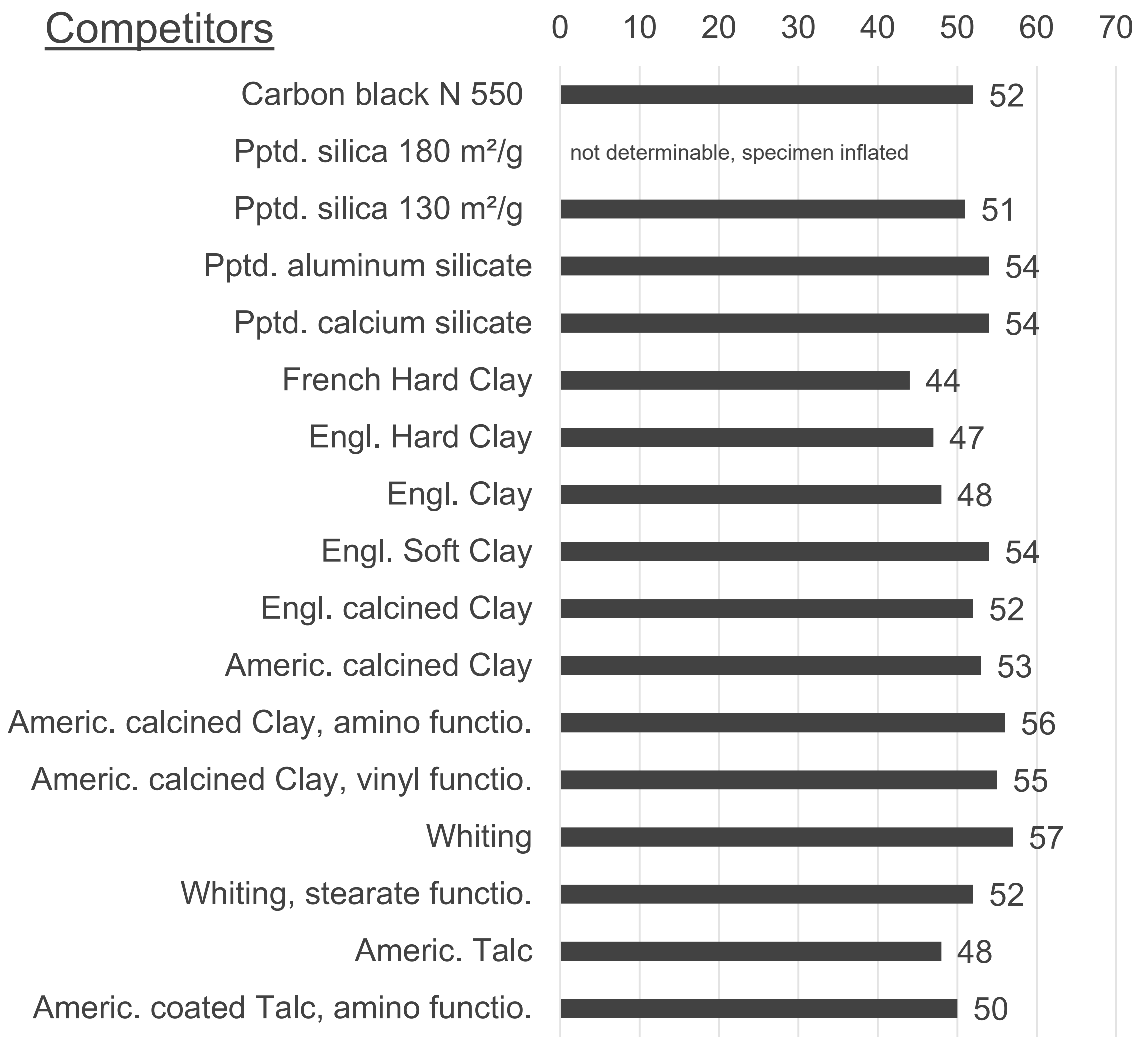


Note: Sillitin N 82 will be replaced by Sillitin N 75

Rebound elasticity in %

DIN 53 512

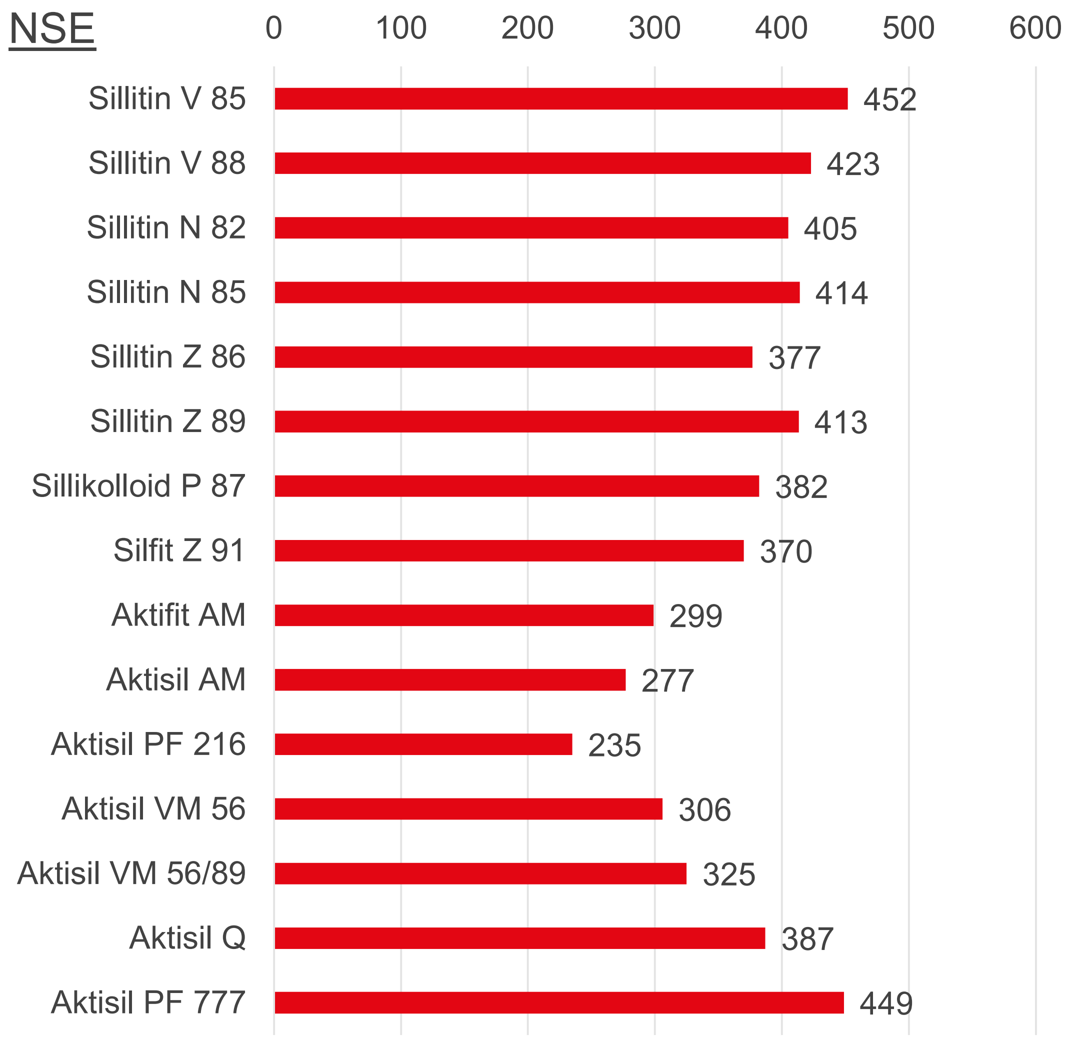


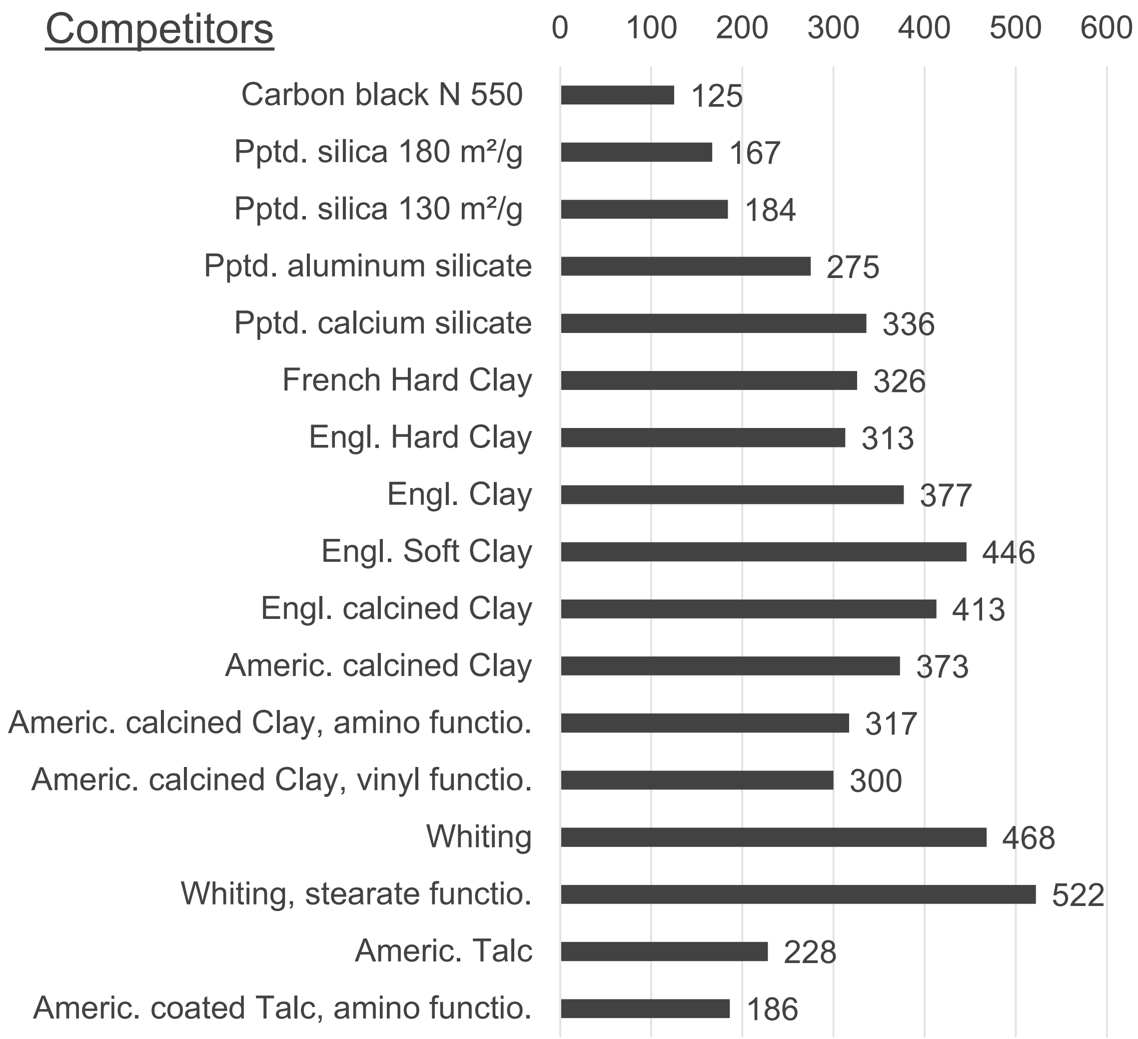


Note: Sillitin N 82 will be replaced by Sillitin N 75

Abrasion loss in mm³

DIN ISO 4649, A

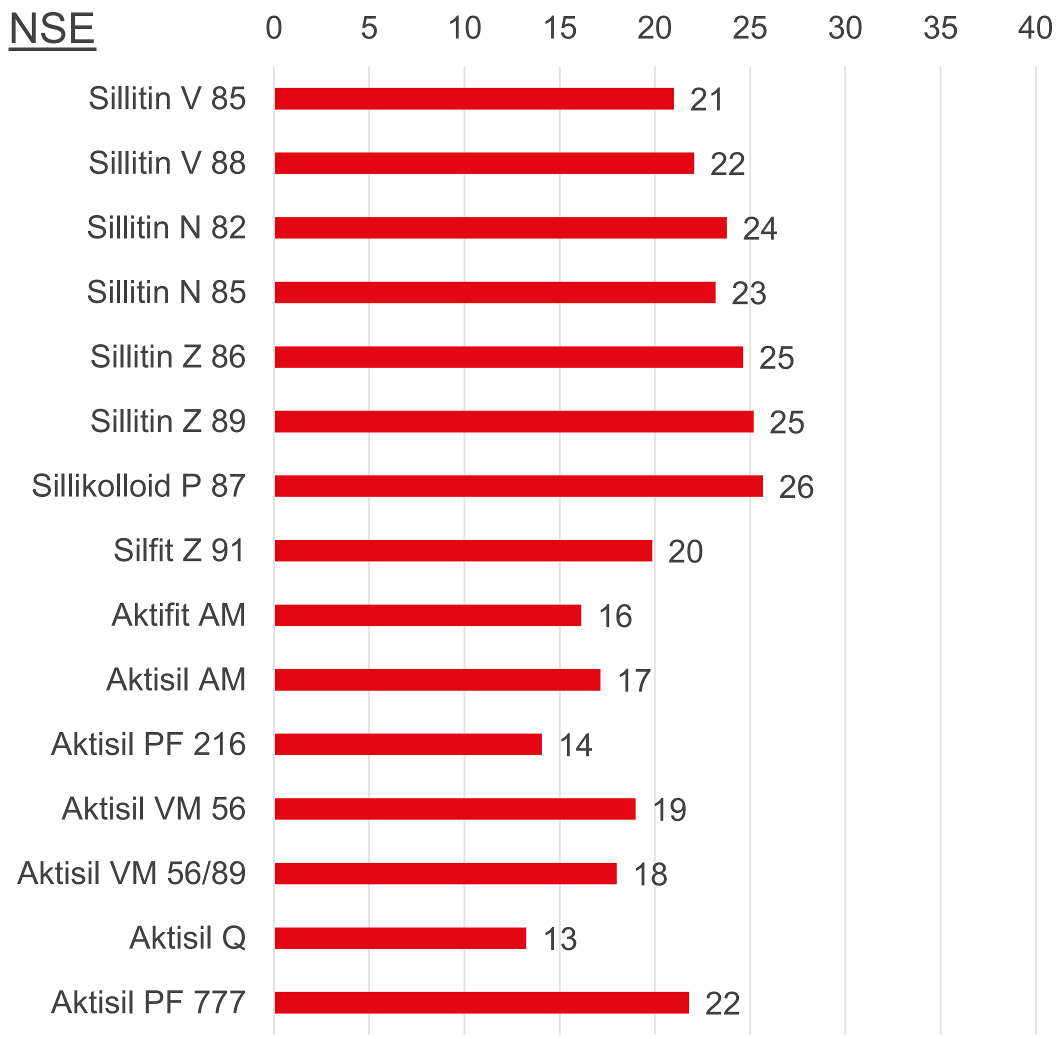


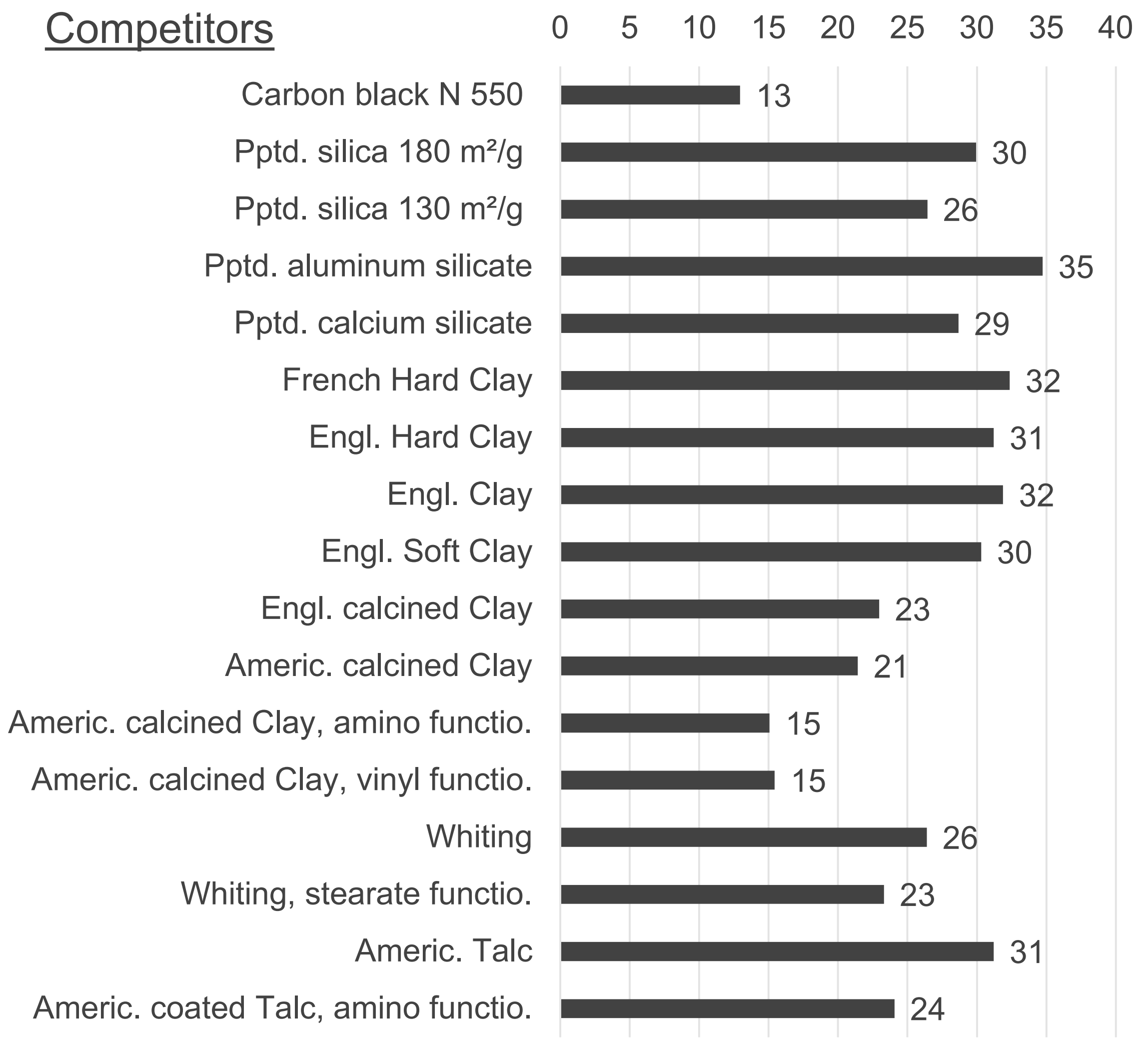


Note: Sillitin N 82 will be replaced by Sillitin N 75

Compression set in % (24 h / 70 °C / 25 % Def.)

DIN ISO 815-1, Type B





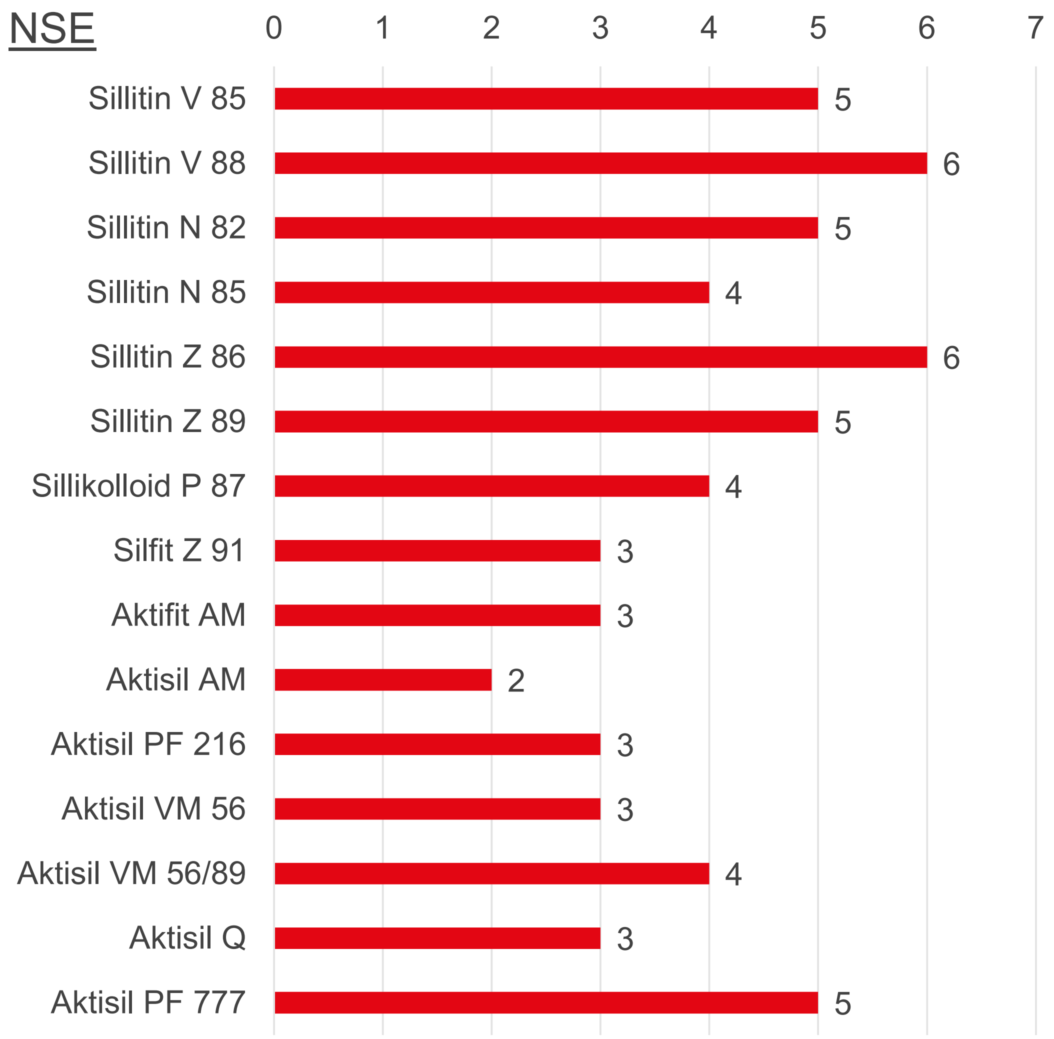
Note: Sillitin N 82 will be replaced by Sillitin N 75

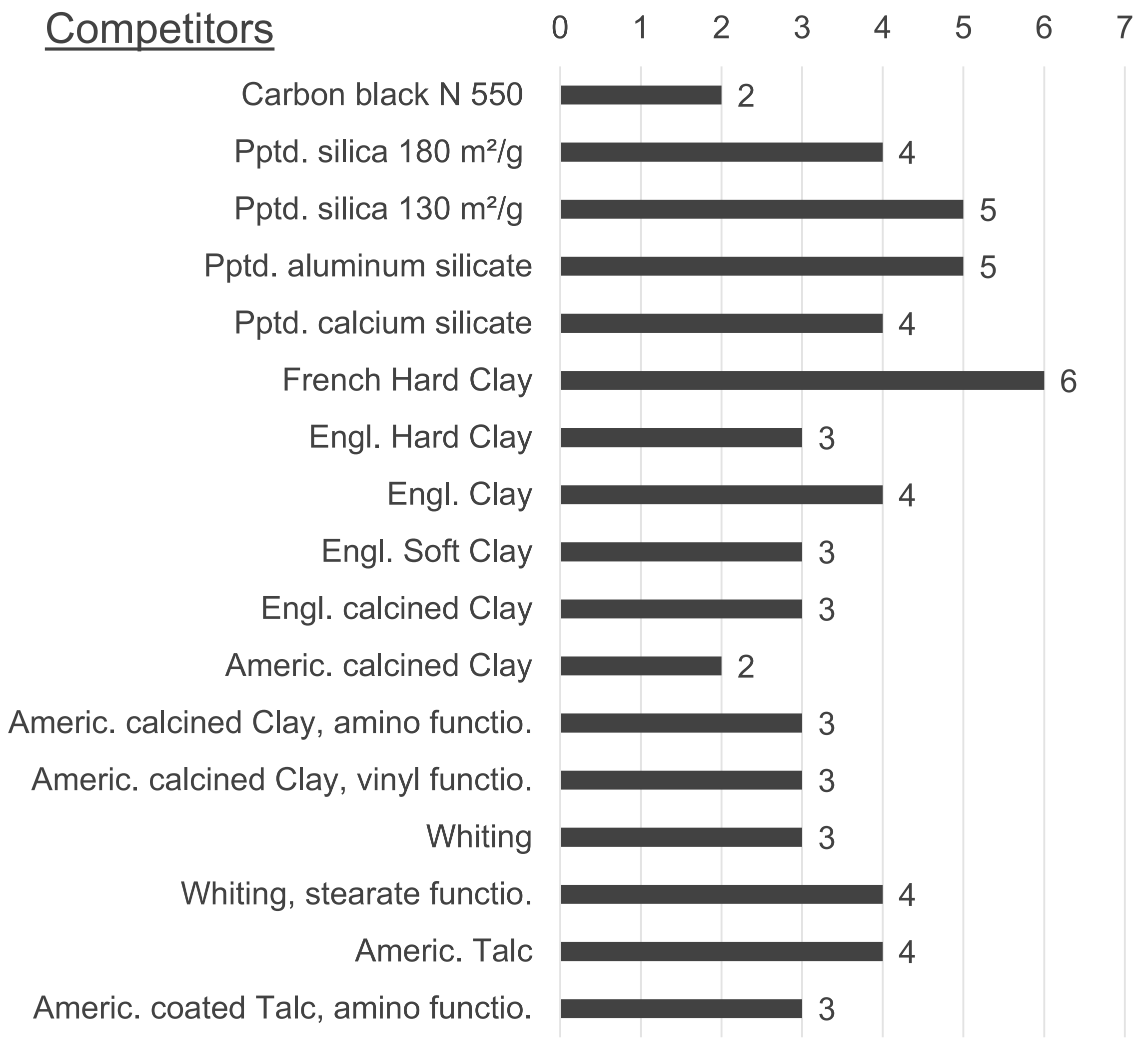
→ back to results

Hot air aging 168 h / 70 °C

ISO 188, D

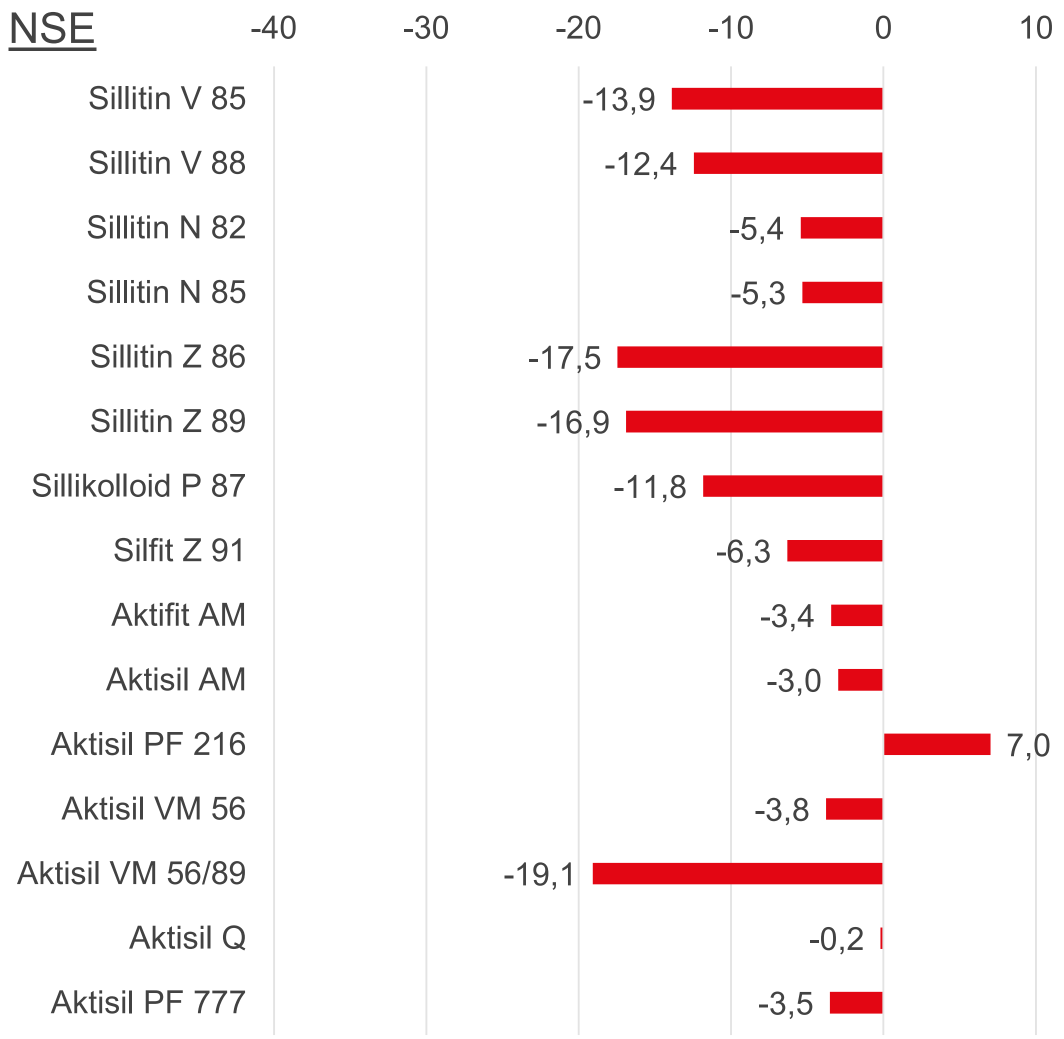
Hot air aging 168 h / 70 °C
Change of hardness in Shore A – piled up S2 dumbbells

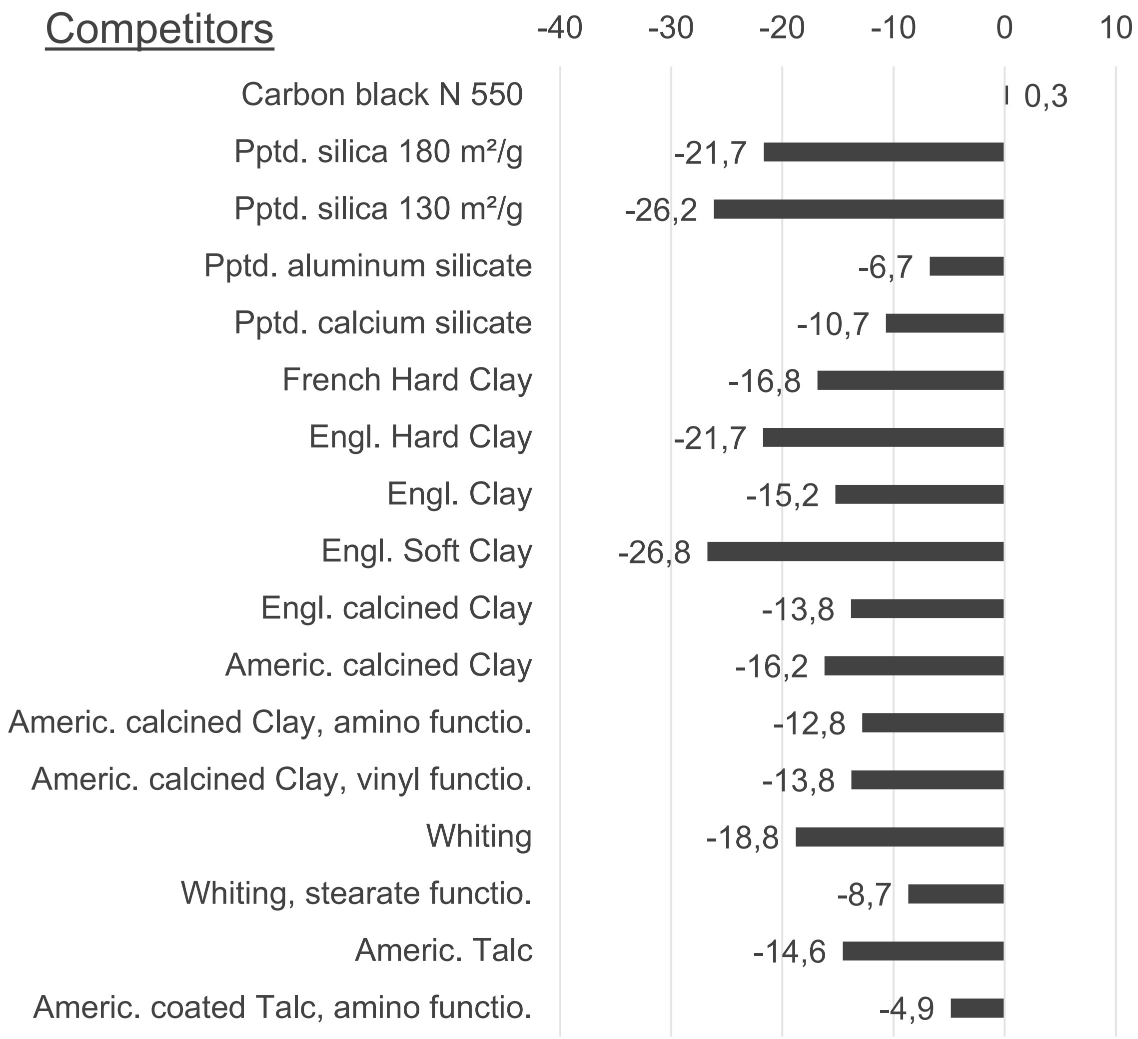




Note: Sillitin N 82 will be replaced by Sillitin N 75

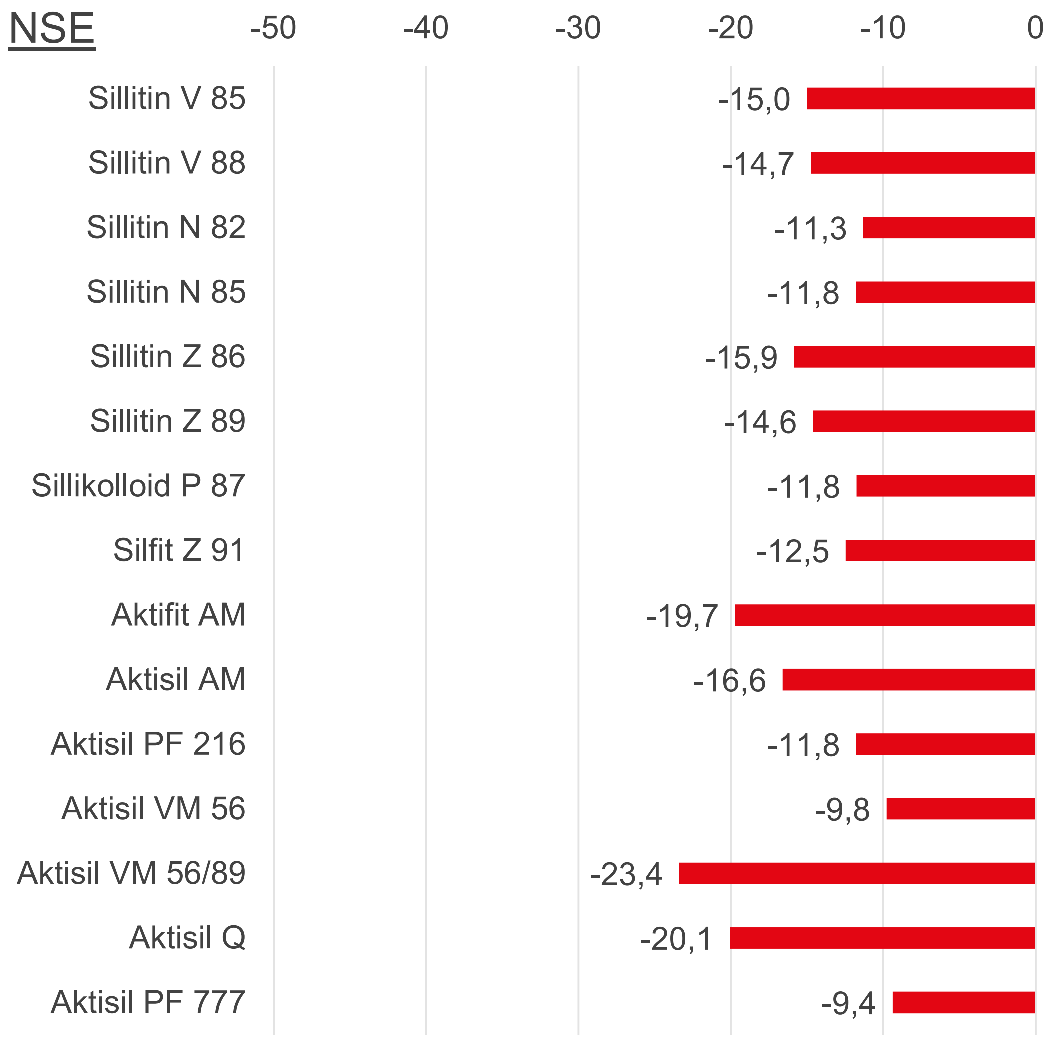
Hot air aging 168 h / 70 °C
Change of tensile strength in %

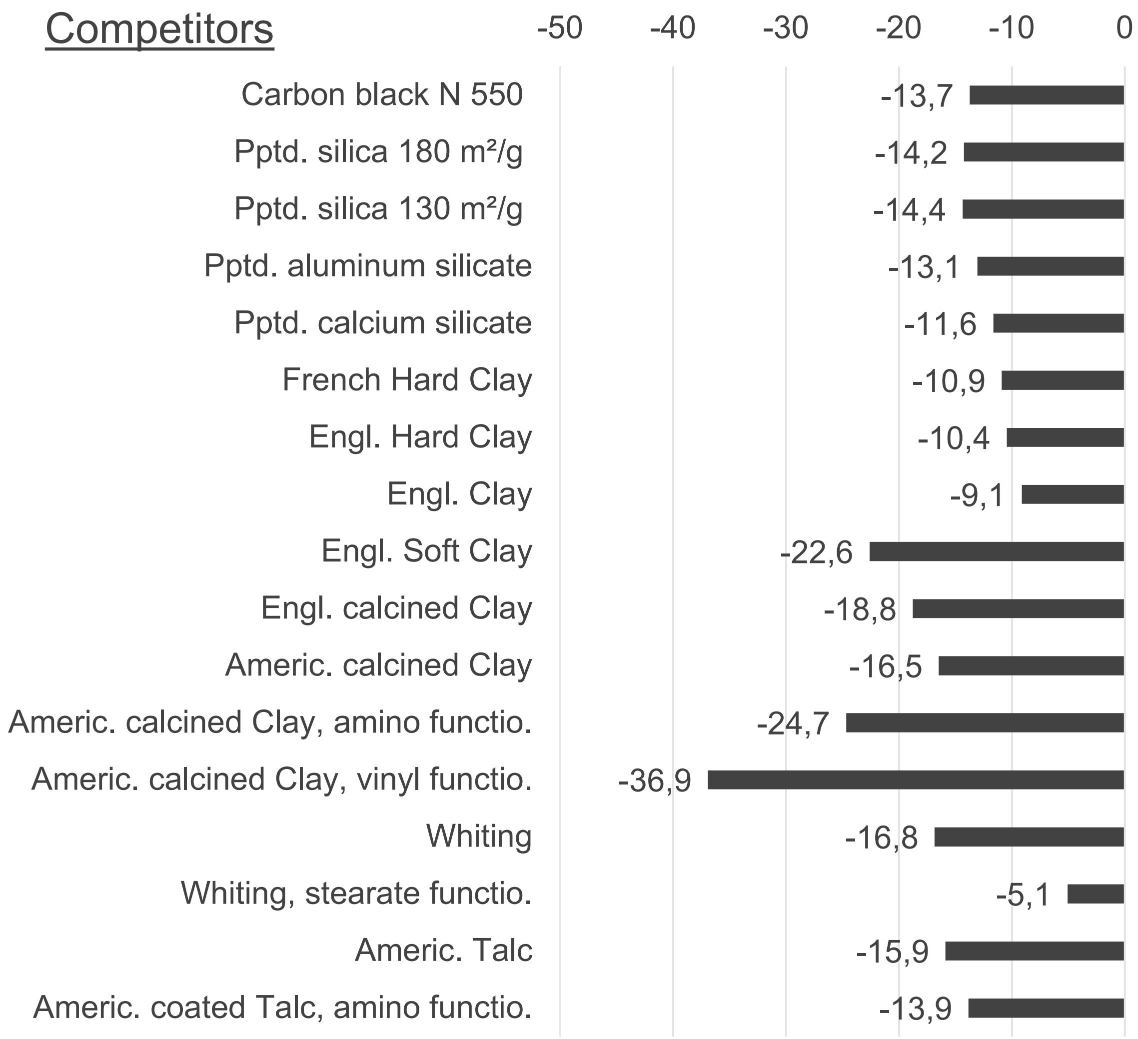




Note: Sillitin N 82 will be replaced by Sillitin N 75

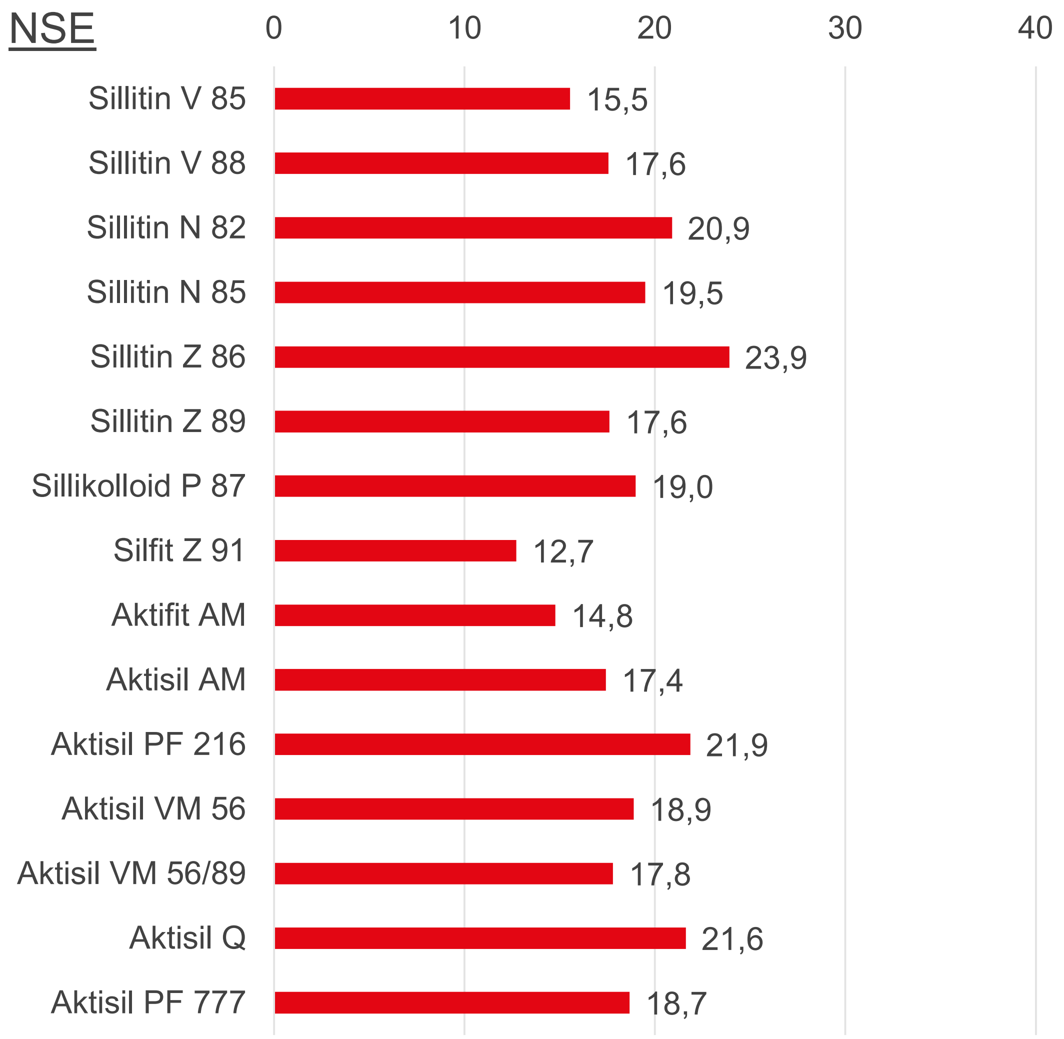
Hot air aging 168 h / 70 °C
Change of elongation at break in rel.%

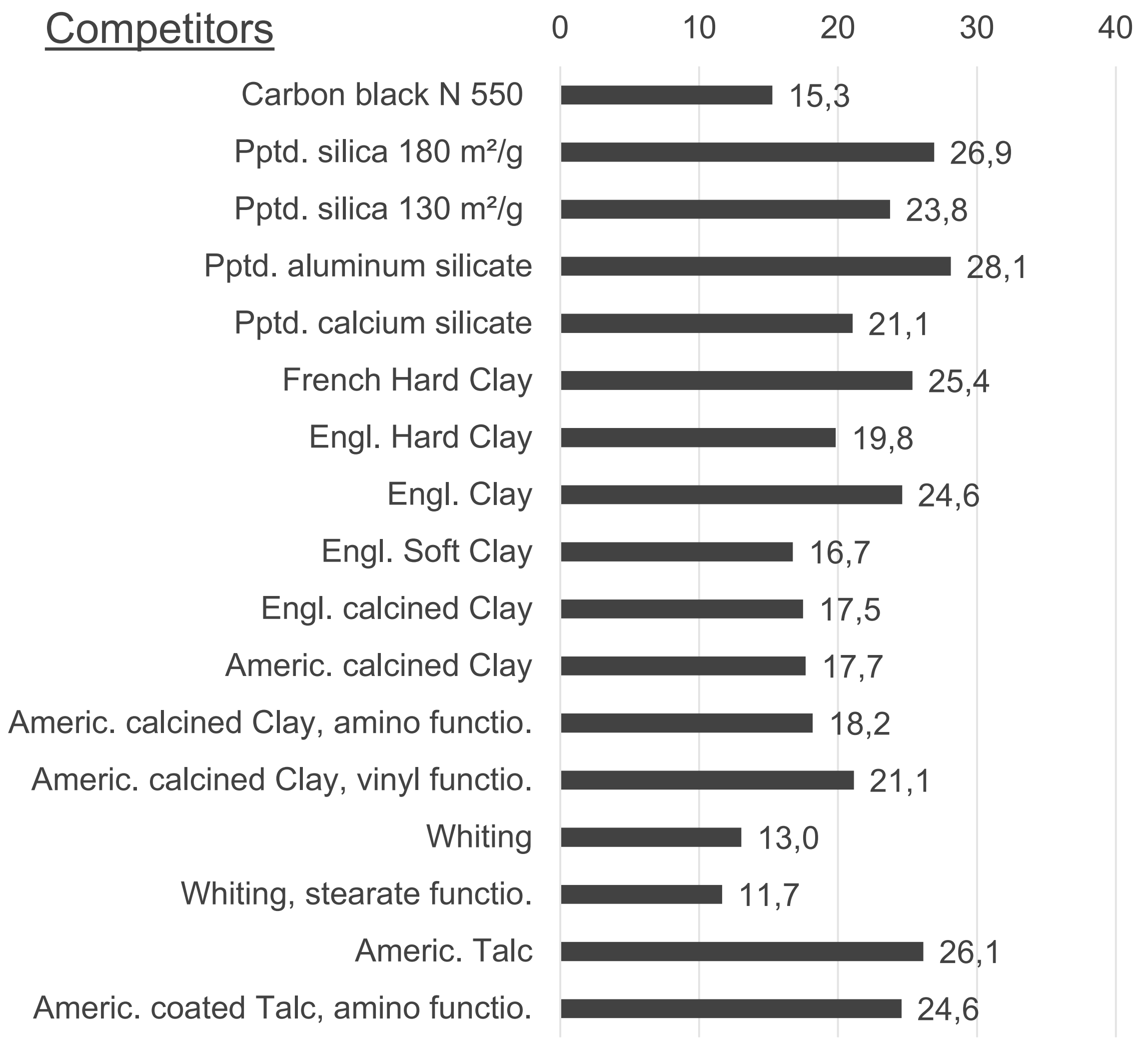




Note: Sillitin N 82 will be replaced by Sillitin N 75

Hot air aging 168 h / 70 °C
Change of modulus 100 % in %





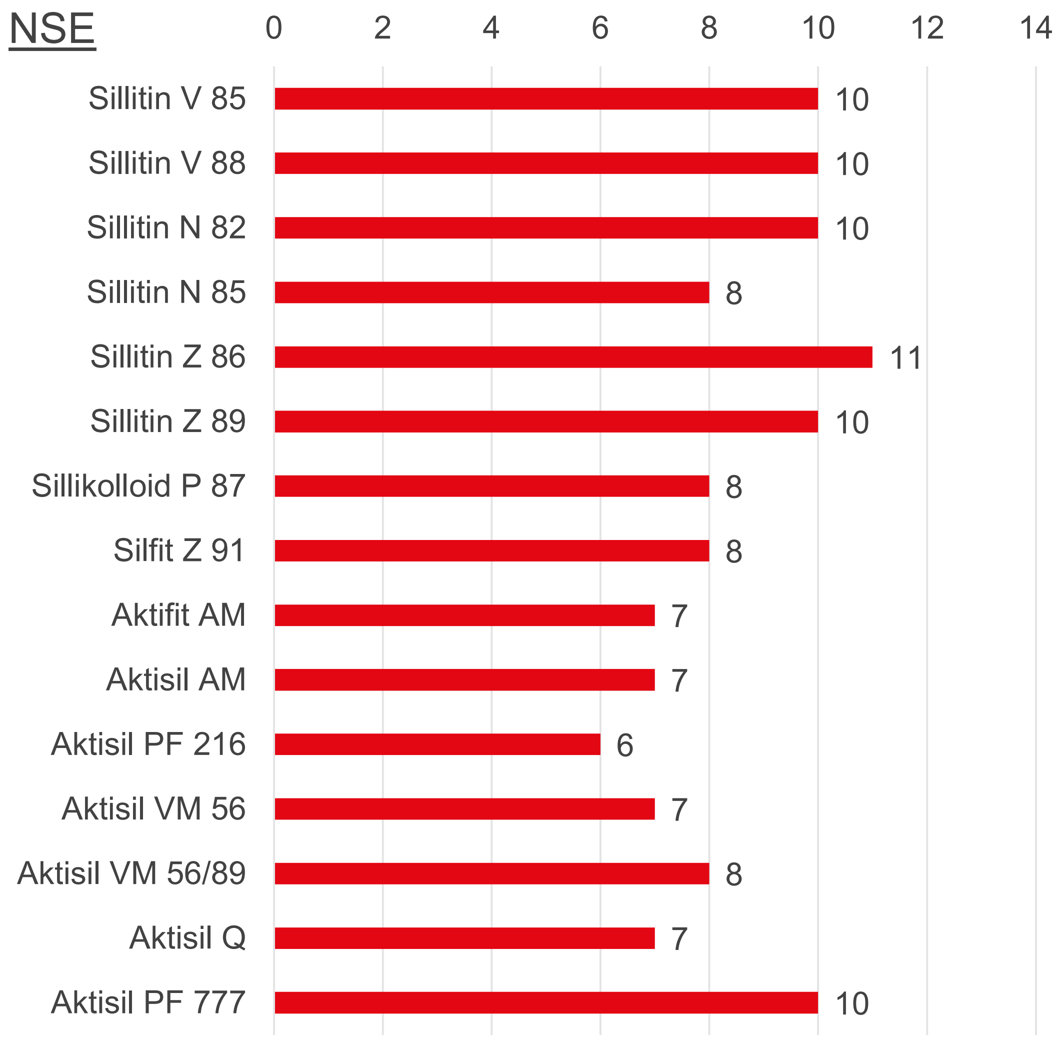
Note: Sillitin N 82 will be replaced by Sillitin N 75

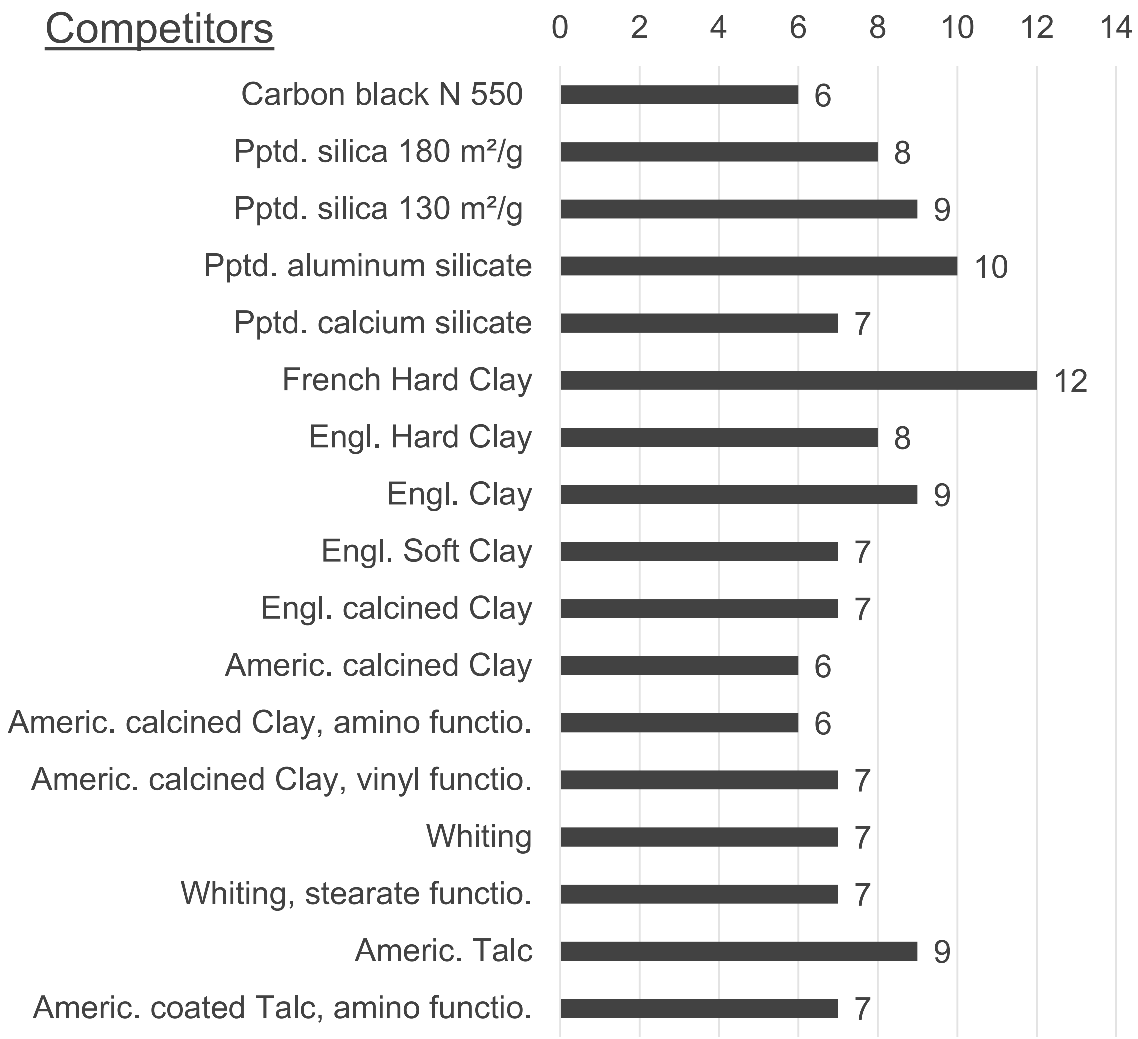
→ back to results

Hot air aging 168 h / 100 °C

ISO 188, D

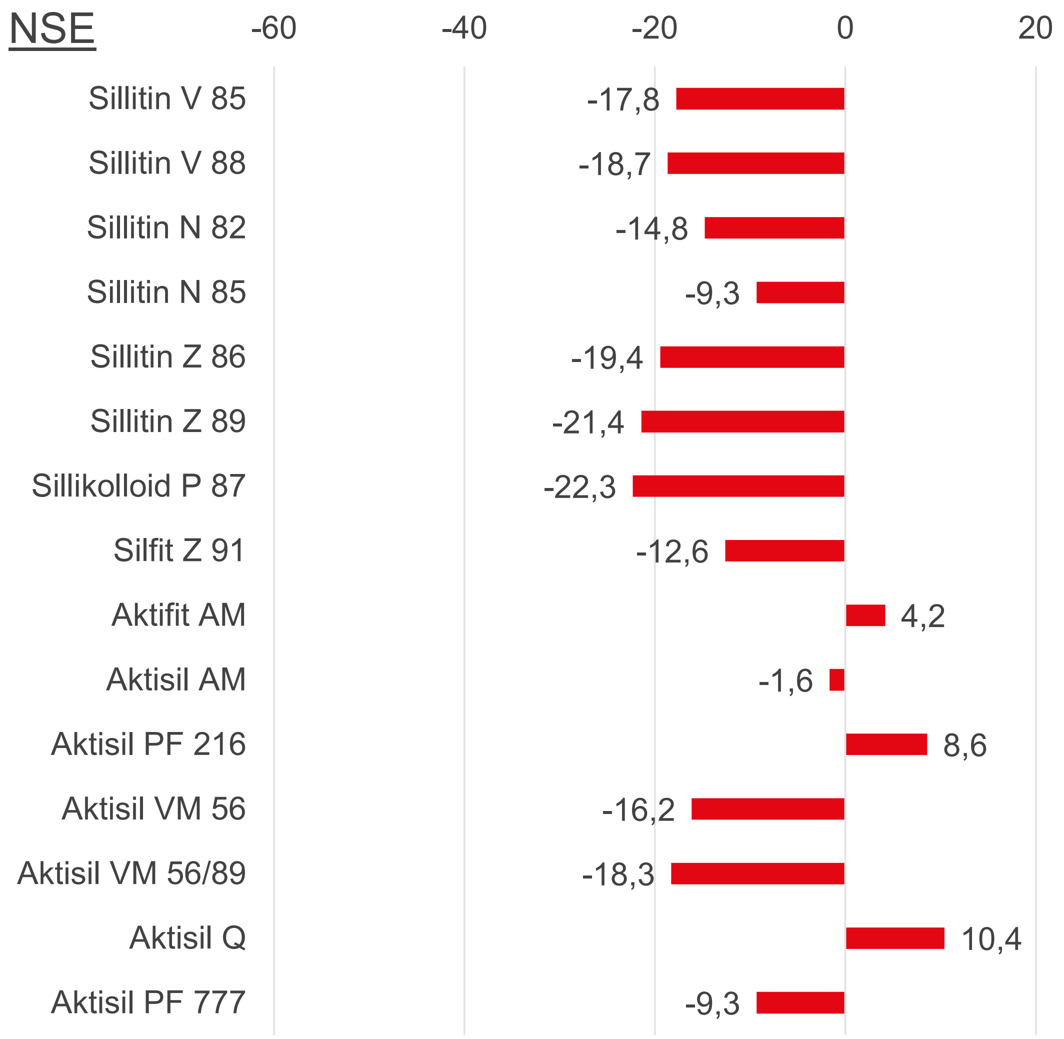
Hot air aging 168 h / 100 °C
Change of hardness in Shore A – piled up S2 dumbbells

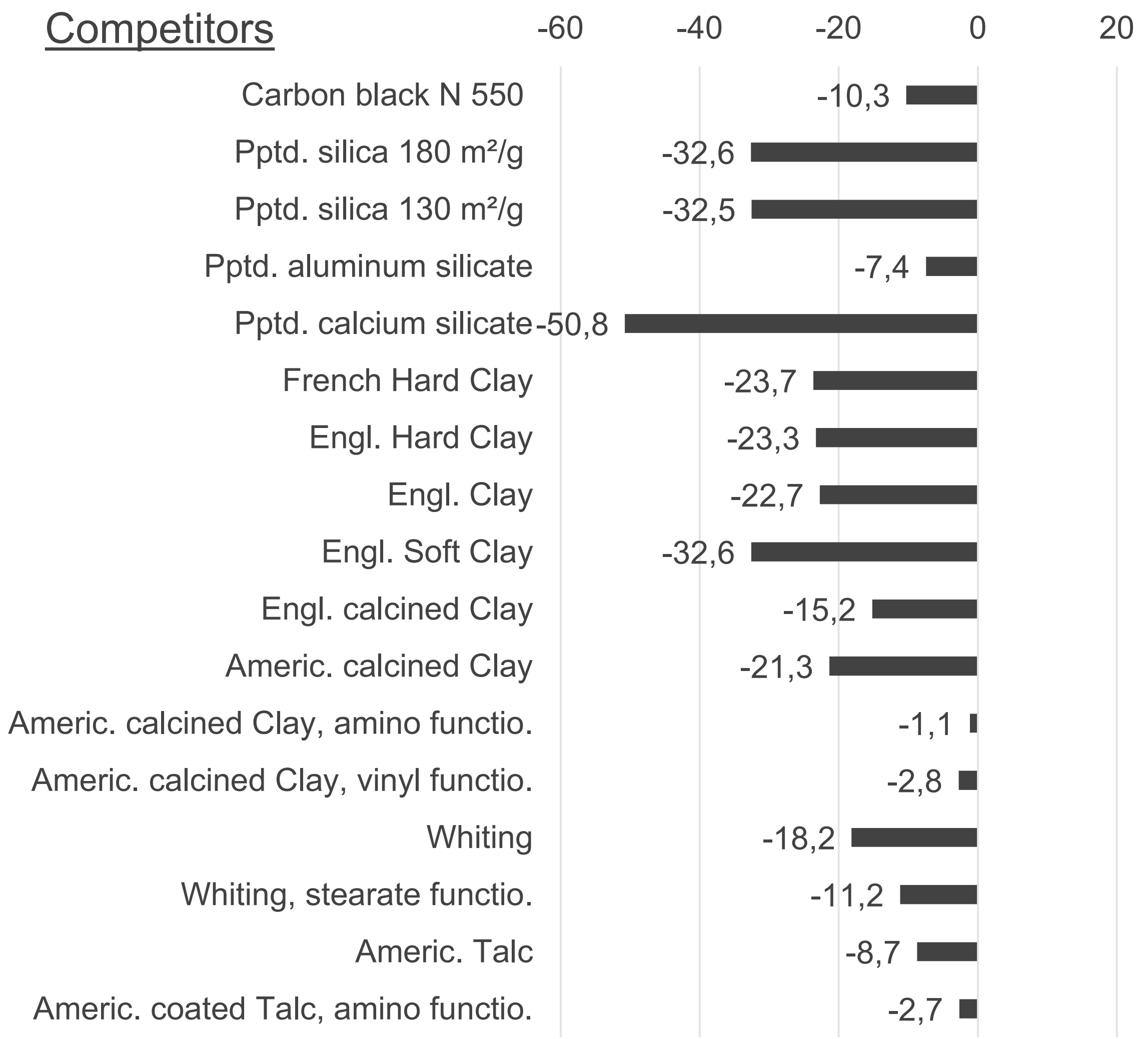




Note: Sillitin N 82 will be replaced by Sillitin N 75

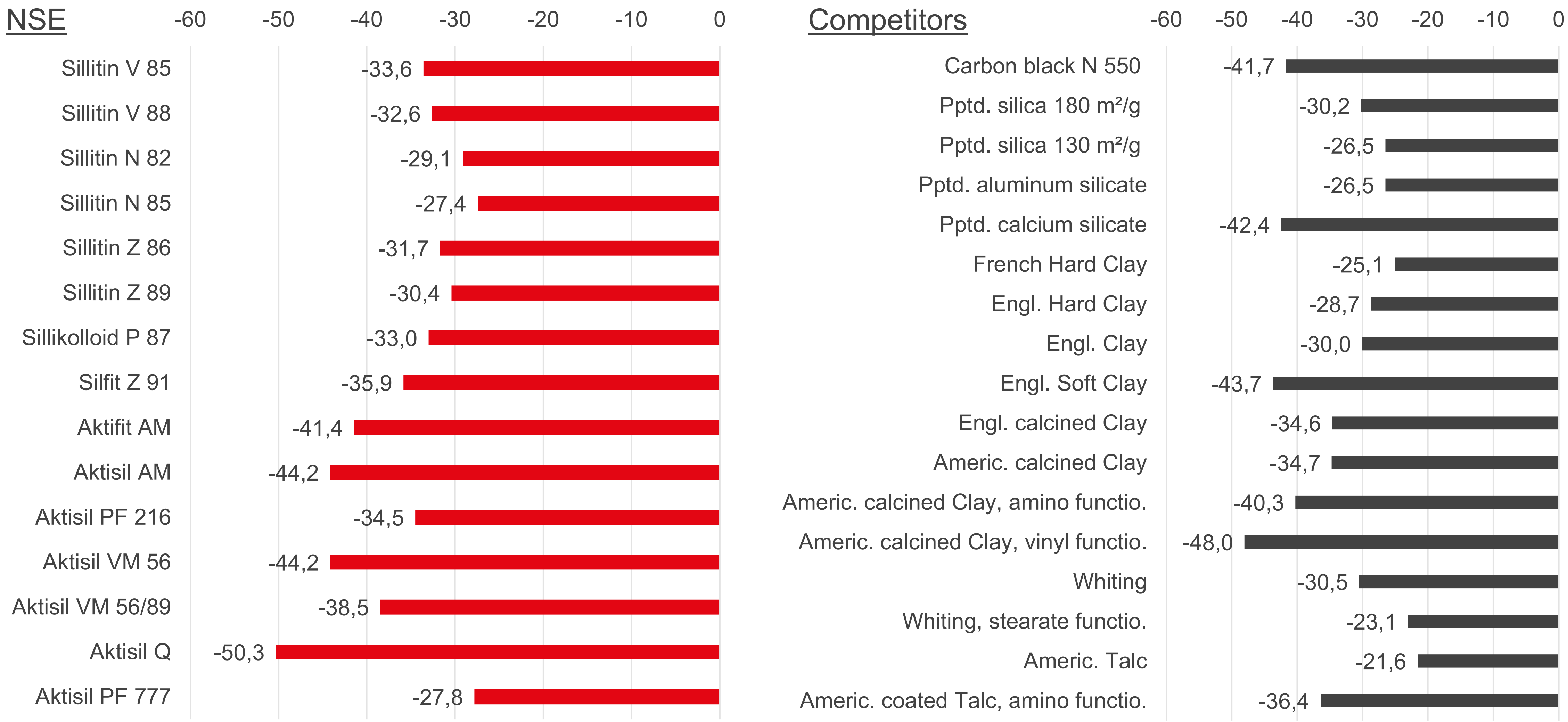
Hot air aging 168 h / 100 °C
Change of tensile strength in %





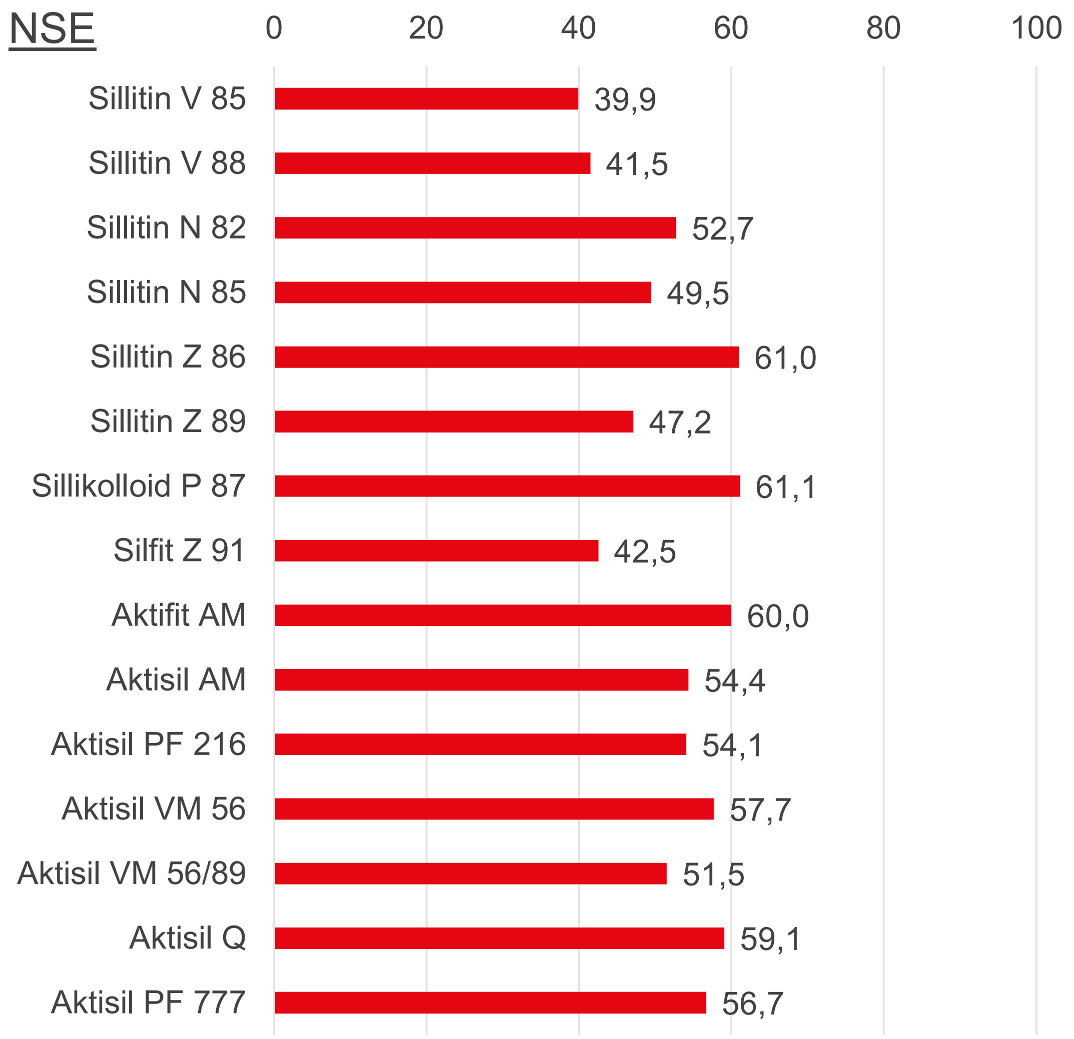
Note: Sillitin N 82 will be replaced by Sillitin N 75

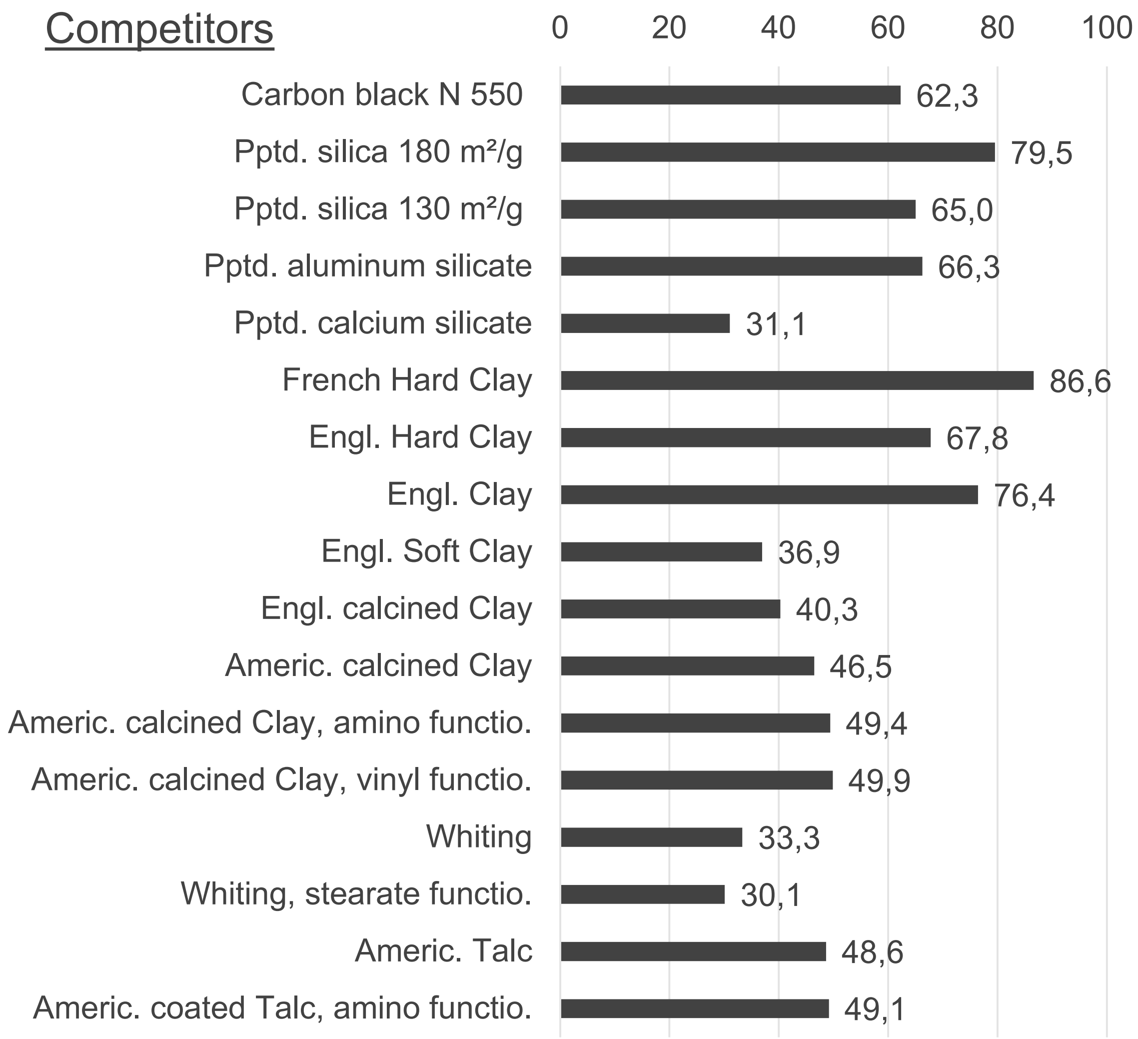
Hot air aging 168 h / 100 °C
Change of elongation at break in rel.%



Note: Sillitin N 82 will be replaced by Sillitin N 75

Hot air aging 168 h / 100 °C
Change of modulus 100 % in %





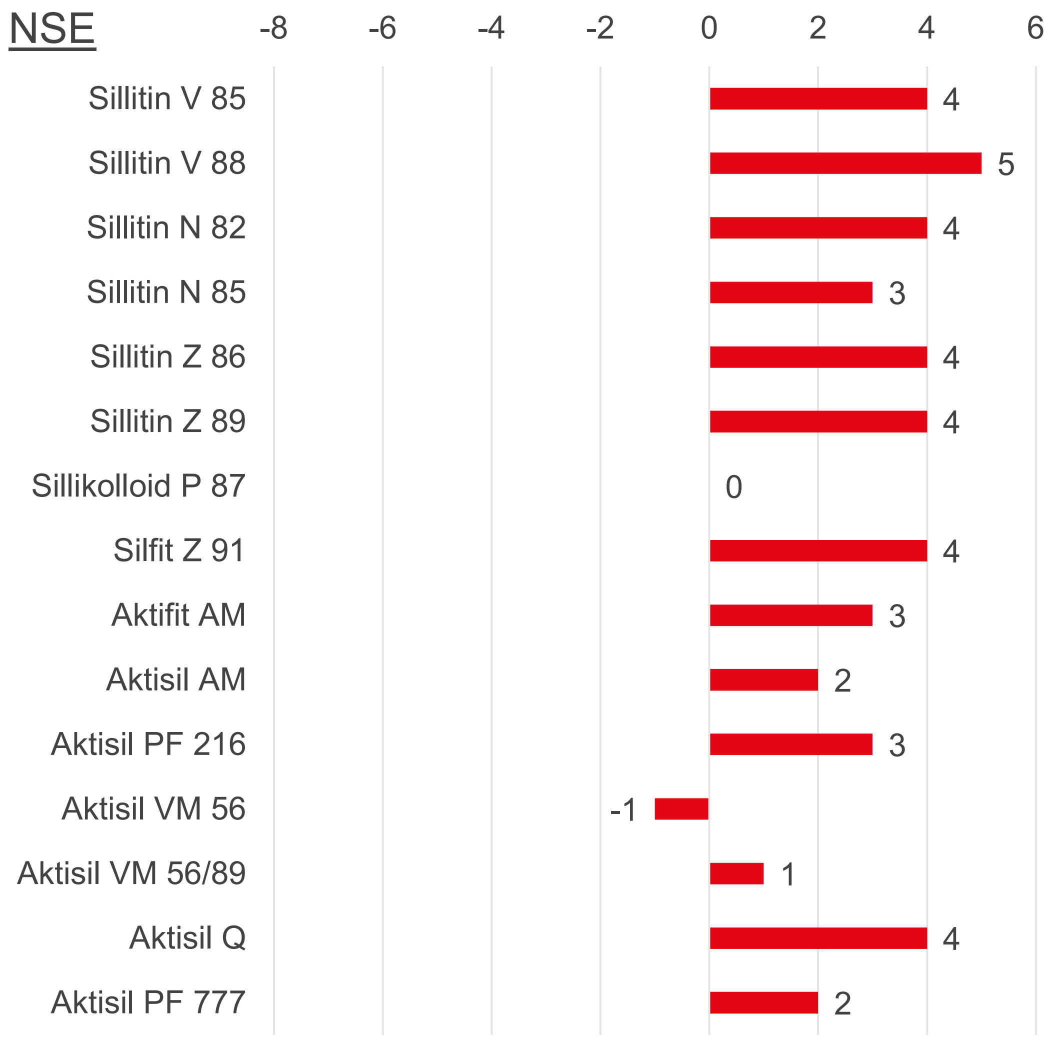
Note: Sillitin N 82 will be replaced by Sillitin N 75

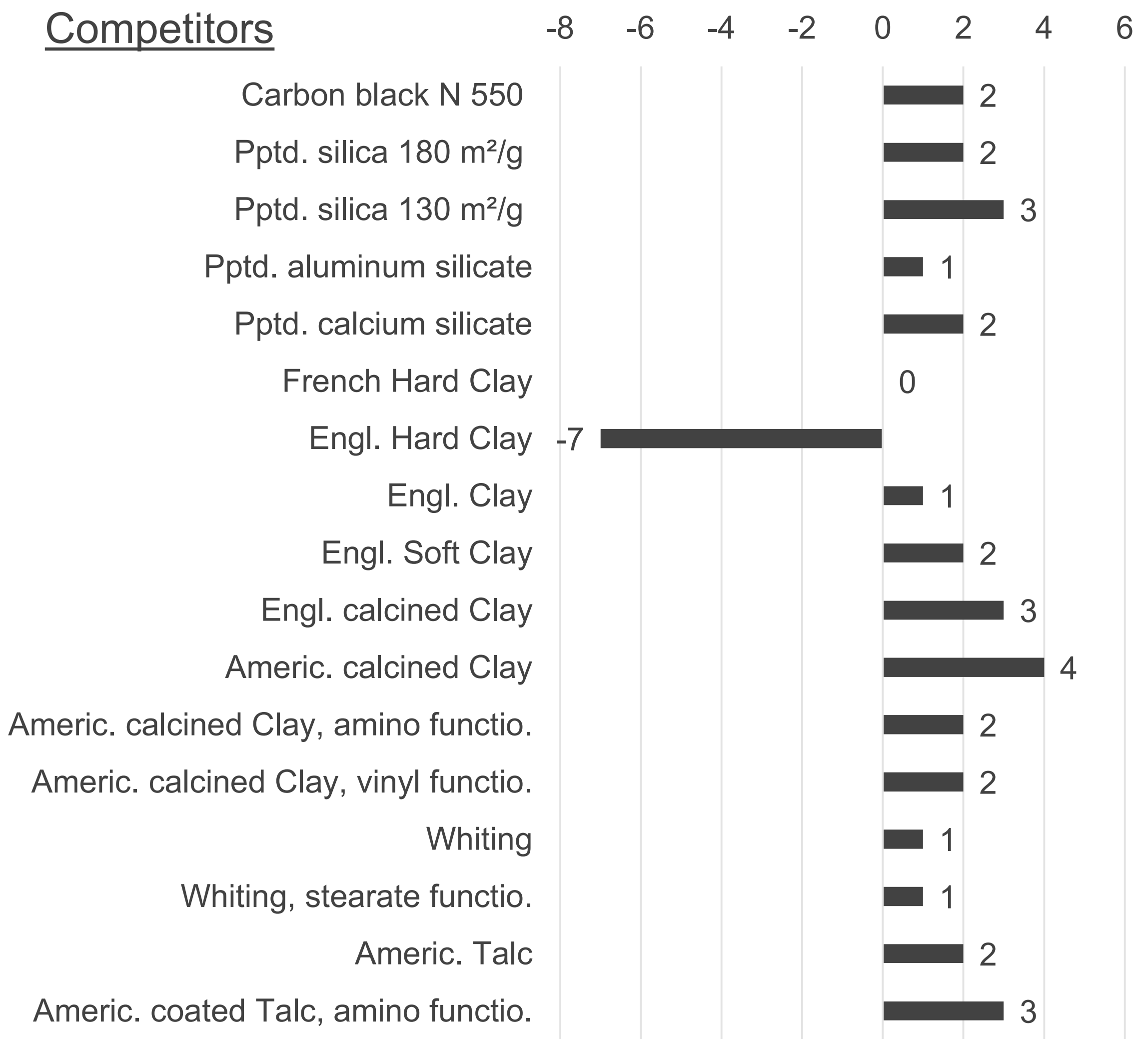
→ back to results

Immersion in deionized water 168 h / 95 °C

DIN ISO 1817

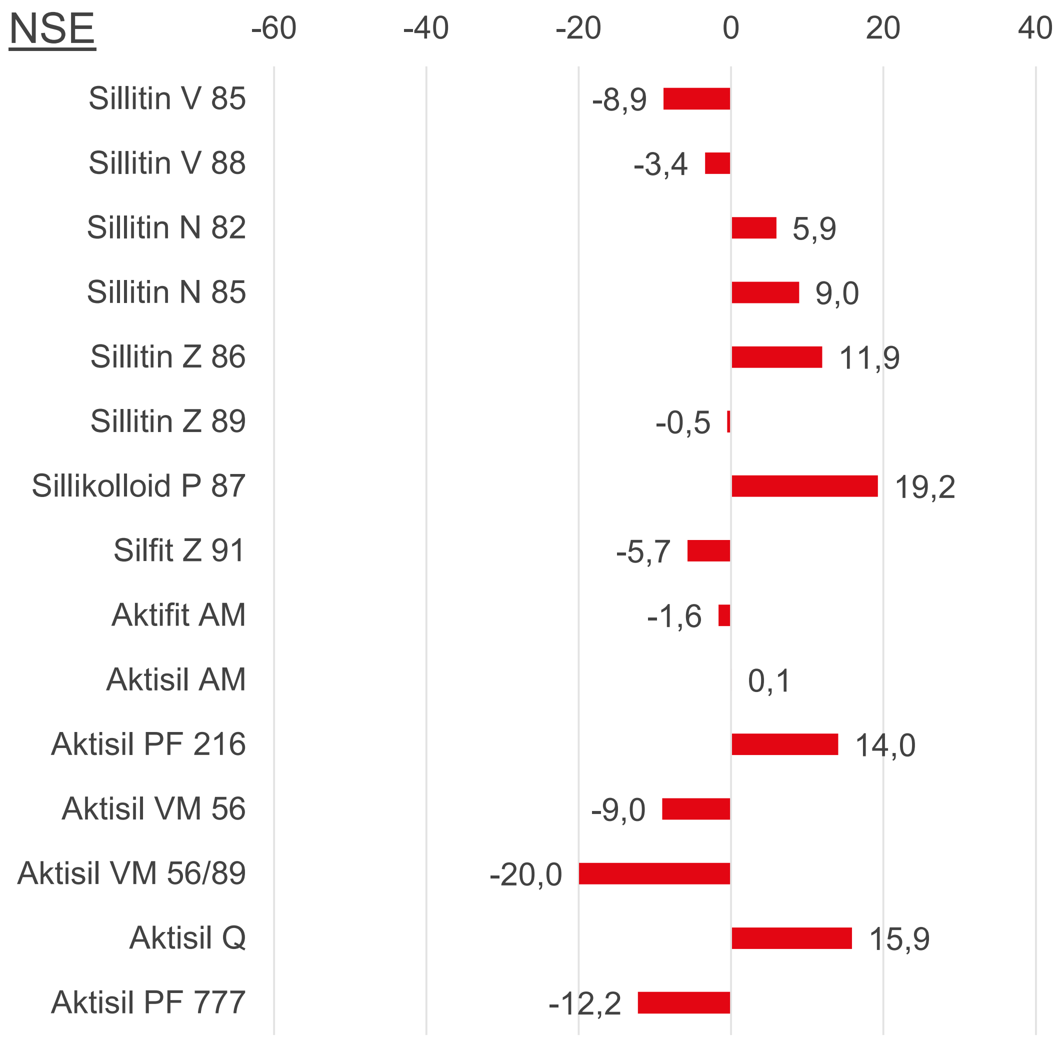
Immersion in deionized water 168 h / 95 °C
Change of hardness in Shore A – piled up S2 dumbbells

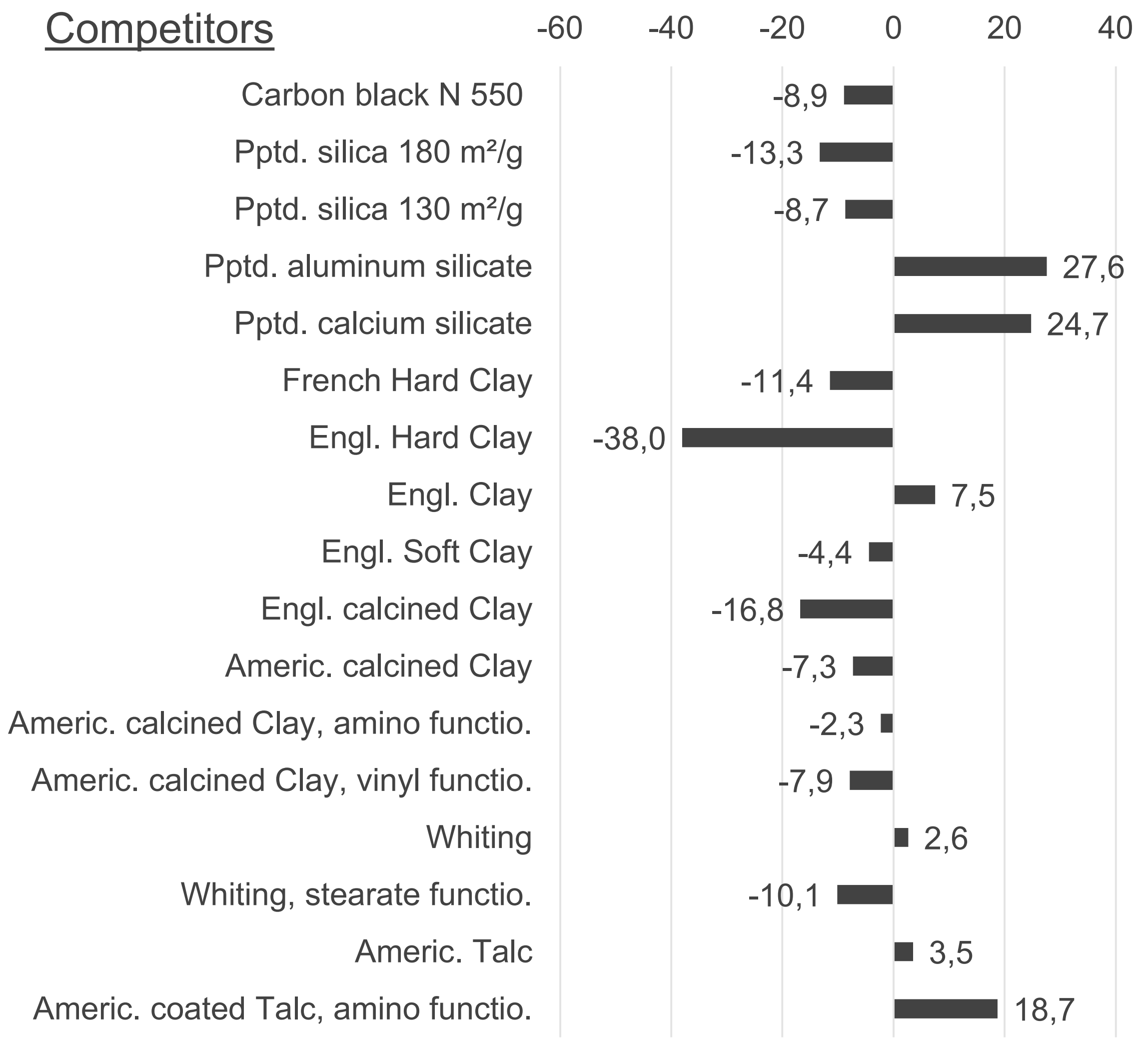




Note: Sillitin N 82 will be replaced by Sillitin N 75

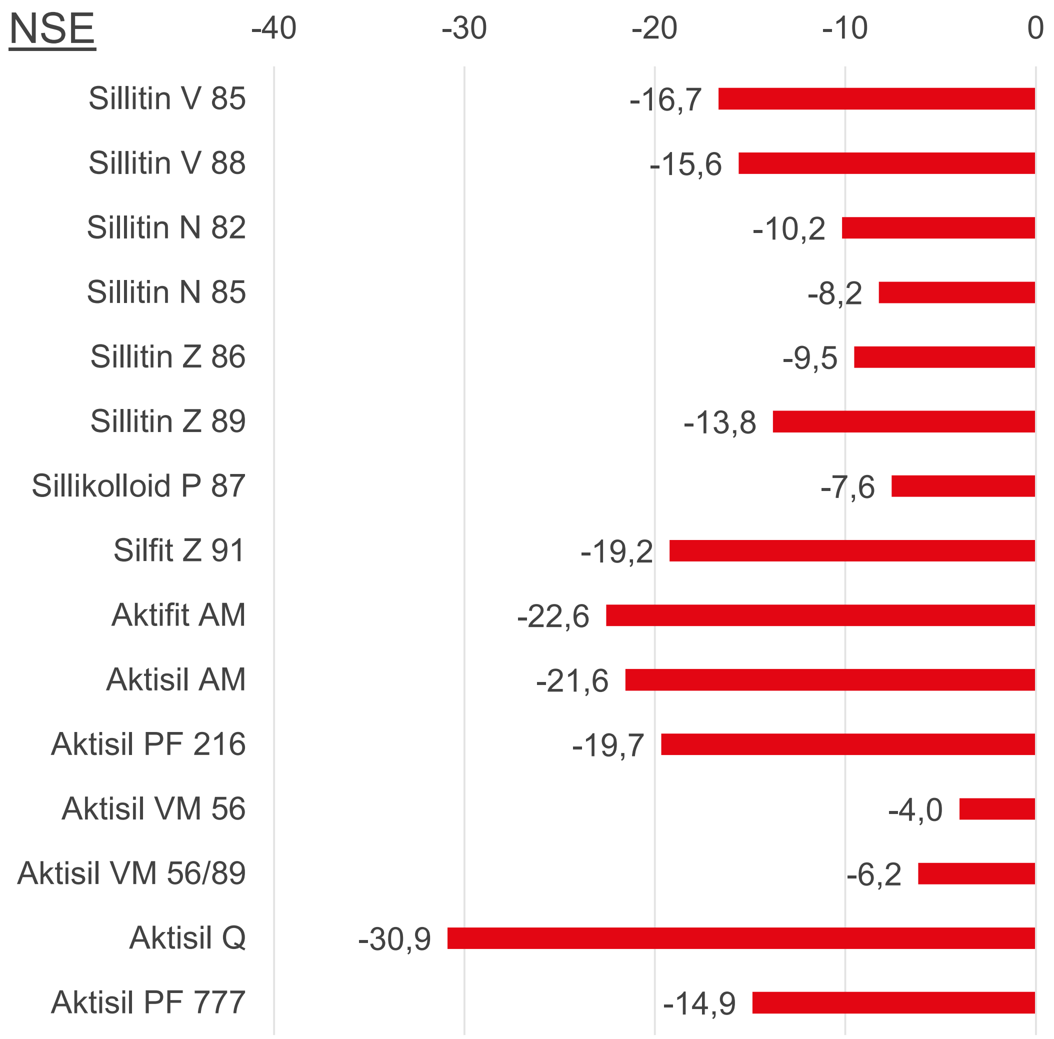
Immersion in deionized water 168 h / 95 °C
Change of tensile strength in %

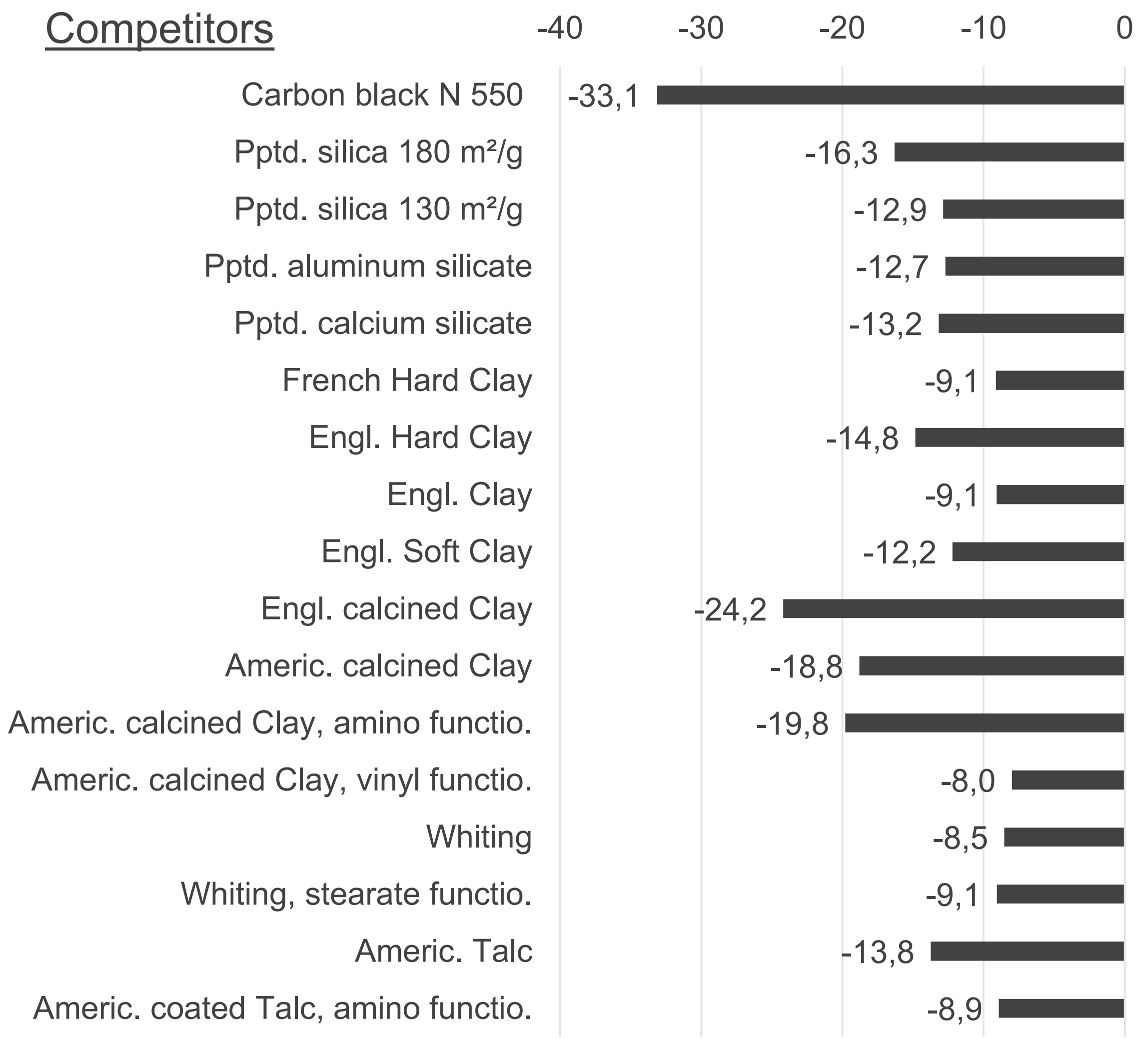




Note: Sillitin N 82 will be replaced by Sillitin N 75

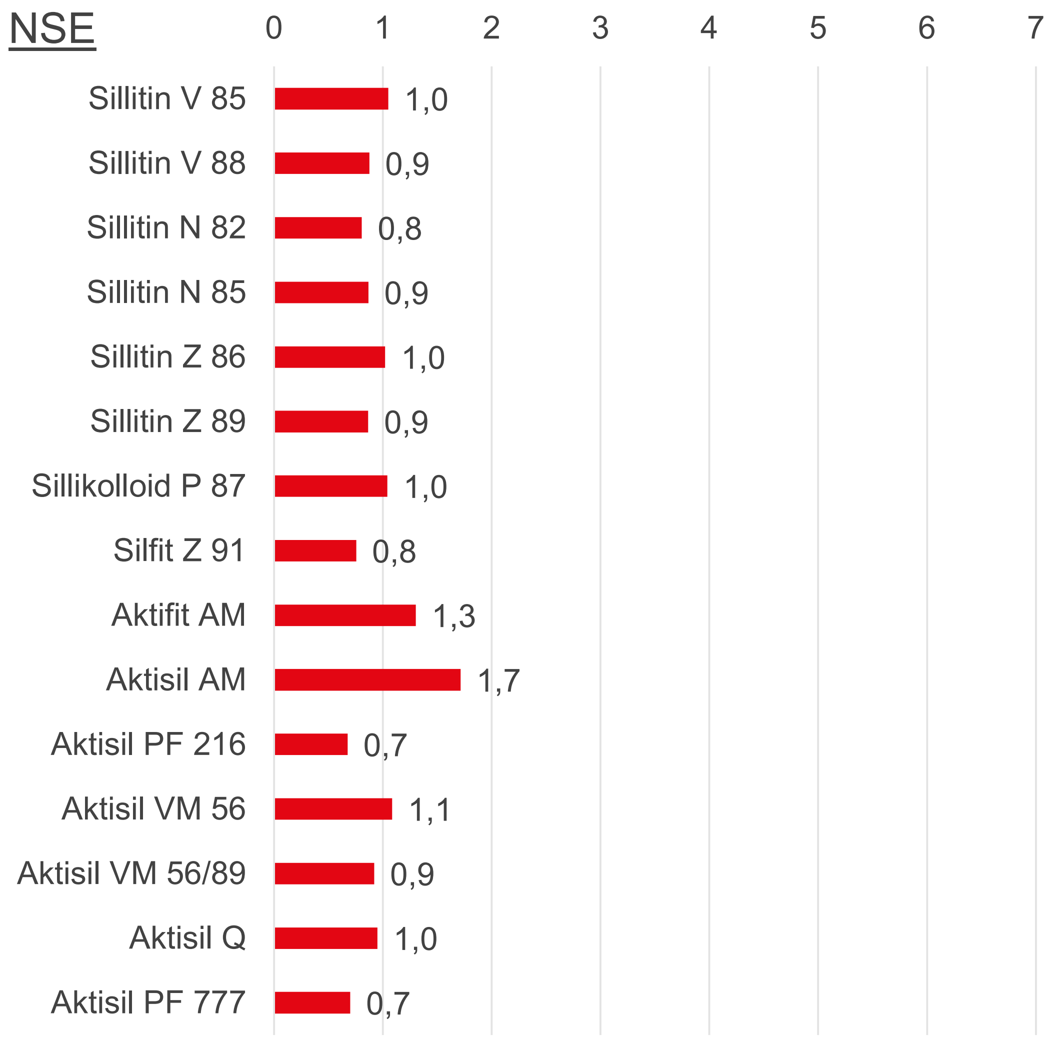
Immersion in deionized water 168 h / 95 °C
Change of elongation at break in rel.%

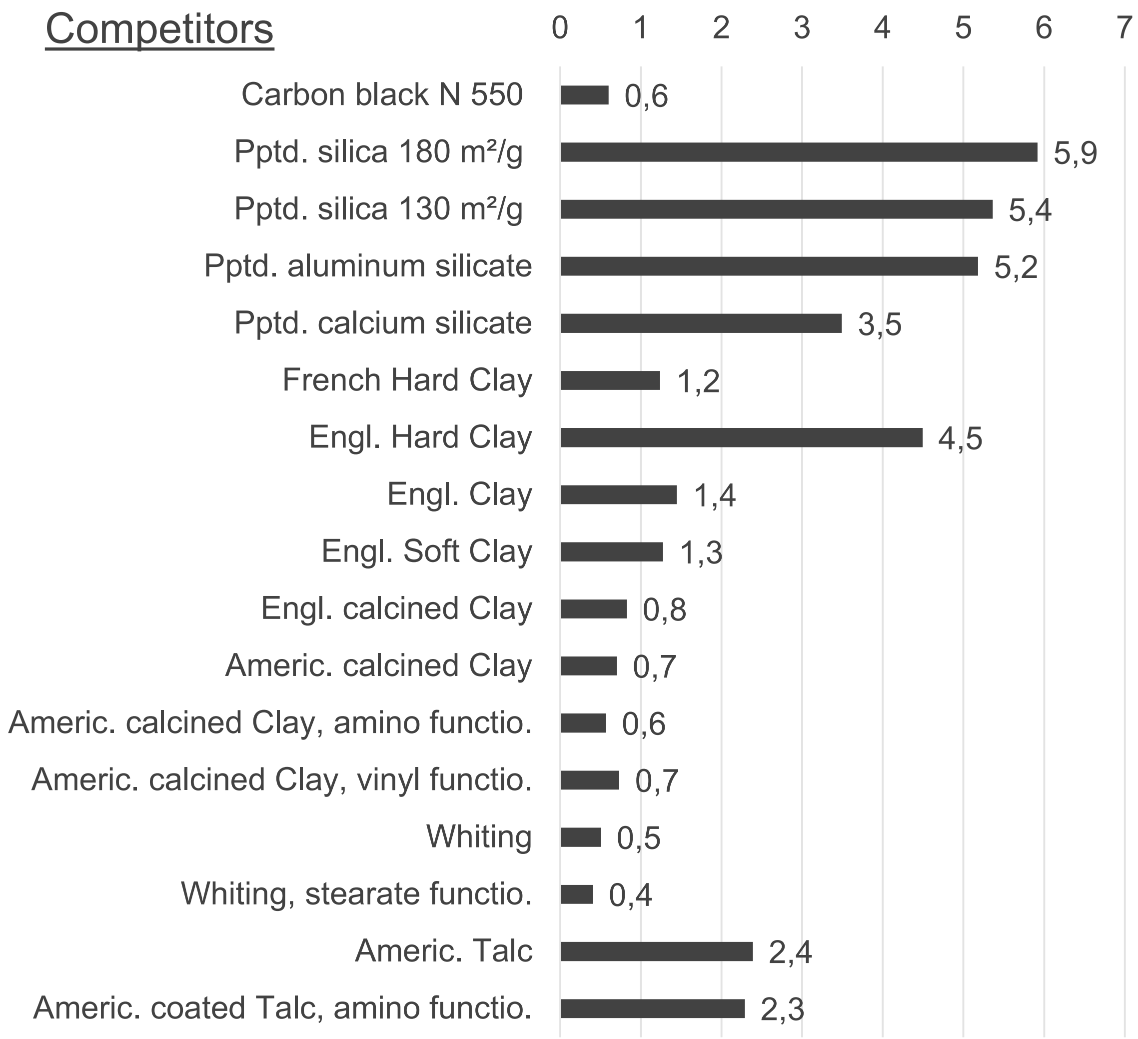




Note: Sillitin N 82 will be replaced by Sillitin N 75

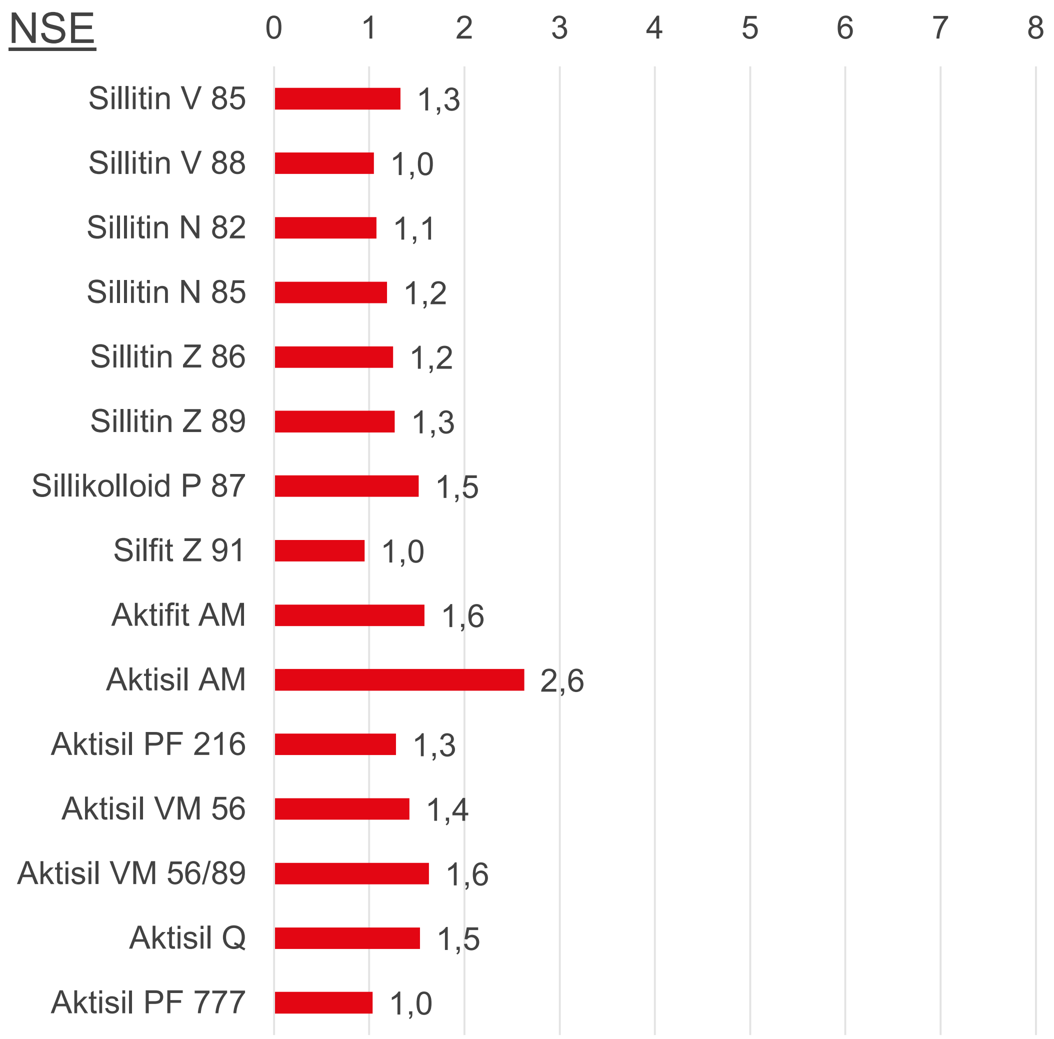
Immersion in deionized water 168 h / 95 °C
Change of weight in %

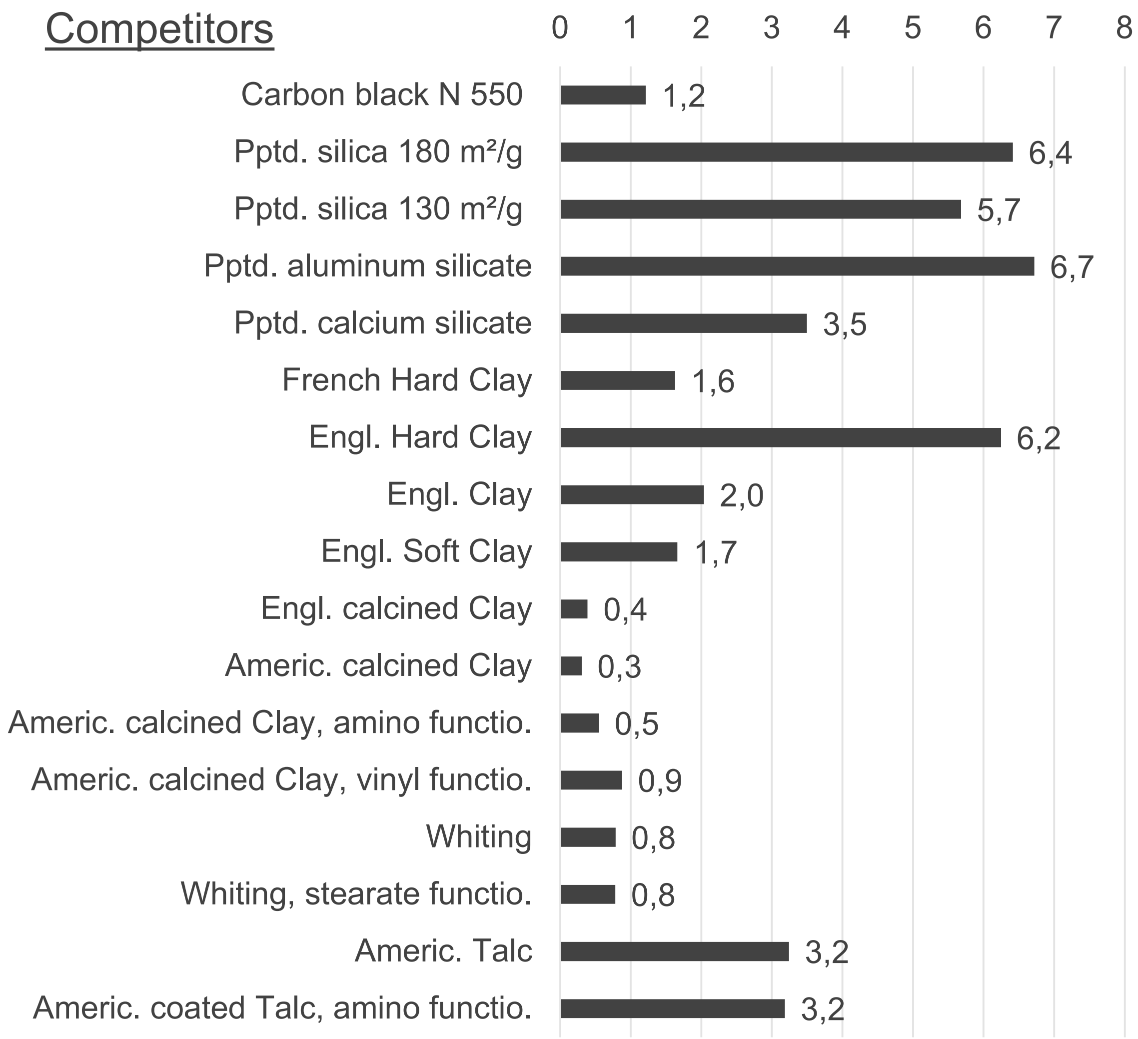




Note: Sillitin N 82 will be replaced by Sillitin N 75

Immersion in deionized water 168 h / 95 °C
Change of volume in %





Note: Sillitin N 82 will be replaced by Sillitin N 75

Summary: Special features …

… of the products based on Neuburg Siliceous Earth in sulphur-cured EPDM rubber for molding application
(Sillitin, Aktisil, Silfit, Aktifit)

Typical for NSE:

✓ good processing properties with medium viscosity ✓ fast curing time, especially with Aktisil and Aktifit

Aktisil VM 56 and Aktisil PF 216:

- overall good performance with balanced properties and good tear resistance

Aktisil AM:

- similar to Aktisil VM 56, but with higher modulus 100 % and clearly better abrasion resistance as well as slightly better compression set, the latter also observed with Aktifit AM

Aktisil PF 216:

- best performance of all fillers
- high tensile strength, highest modulus 100 %, very good compression set, best abrasion resistance, low water absorption

Compression set:

- lowest compression set with Aktisil PF 216 and Aktisil Q

Immersion in deionized water 168 h / 95 °C:

- good water resistance with almost all NSE fillers with a very small increase in weight and volume

We supply materials for good ideas!

HOFFMANN MINERAL GmbH
Muenchener Straße 75
DE-86633 Neuburg (Donau)

Phone: +49 8431 53-0
Internet: www.hoffmann-mineral.com
E-mail: info@hoffmann-mineral.com

→ back to contents

Results in tabular form

Properties of raw compound – Mooney Viscosity and Scorch

Neuburg Siliceous Earth	Mooney Viscosity ML 1+4 100 °C [MU]	Mooney Scorch ML+5 120 °C [min.]
Sillitin V 85	66	10
Sillitin V 88	65	10
Sillitin N 82	68	10
Sillitin N 85	67	10
Sillitin Z 86	68	10
Sillitin Z 89	65	10
Sillikolloid P 87	69	10
Silfit Z 91	76	9
Aktifit AM	74	7
Aktisil AM	67	8
Aktisil PF 216	66	9
Aktisil VM 56	65	9
Aktisil VM 56/89	62	9
Aktisil Q	59	10
Aktisil PF 777	51	11

Competitors	Mooney Viscosity ML 1+4 100 °C [MU]	Mooney Scorch ML +5 120 °C [min.]
Carbon black N 550	64	9
Pptd. silica 180 m^2/g	94	16
Pptd. silica 130 m^2/g	87	17
Pptd. aluminum silicate	85	8
Pptd. calcium silicate	79	9
French Hard Clay	66	12
Engl. Hard Clay	60	11
Engl. Clay	49	13
Engl. Soft Clay	45	12
Engl. calcined Clay	71	10
Americ. calcined Clay	64	10
Americ. calcined Clay, amino functio.	64	8
Americ. calcined Clay, vinyl functio.	63	9
Whiting	48	11
Whiting, stearate functio.	40	11
Americ. Talc	45	11
Americ. coated Talc, amino functio.	46	9

Properties of raw compound – Neuburg Siliceous Earth

Rotorless curemeter 180 °C	Torque minimum [Nm]	Cross-linking yield [Nm]	Conversion time t_5 [min.]	Conversion time t_{90} [min.]	Max. speed of vulcanization [Nm/min.]	Time until max. speed of vulcanization [min.]	tan δ
Sillitin V 85	0.07	0.77	0.6	2.3	0.88	1.1	0.16
Sillitin V 88	0.07	0.78	0.6	2.5	0.86	1.1	0.16
Sillitin N 82	0.09	0.84	0.6	2.8	0.92	1.0	0.18
Sillitin N 85	0.08	0.82	0.6	2.8	0.91	1.0	0.18
Sillitin Z 86	0.10	0.86	0.6	3.2	0.95	1.0	0.19
Sillitin Z 89	0.08	0.82	0.6	3.2	0.88	1.0	0.19
Sillikolloid P 87	0.10	0.78	0.4	4.2	0.98	0.6	0.22
Silfit Z 91	0.09	0.80	0.7	2.2	0.93	1.2	0.15
Aktifit AM	0.08	0.76	0.5	1.7	1.20	0.8	0.15
Aktisil AM	0.08	0.76	0.5	2.5	1.17	0.6	0.19
Aktisil PF 216	0.08	0.91	0.6	3.1	0.93	1.1	0.14
Aktisil VM 56	0.08	0.76	0.6	1.9	1.19	0.9	0.20
Aktisil VM 56/89	0.07	0.72	0.6	1.9	1.09	0.9	0.19
Aktisil Q	0.06	0.82	0.7	2.7	0.98	1.2	0.14
Aktisil PF 777	0.05	0.66	0.7	2.7	0.78	1.1	0.16

Properties of raw compound – Competitors

Rotorless curemeter 180 °C	Torque minimum [Nm]	Cross-linking yield [Nm]	Conversion time t_5 [min.]	Conversion time t_{90} [min.]	Max. speed of vulcanization [Nm/min.]	Time until max. speed of vulcanization [min.]	tan δ
Carbon black N 550	0.08	0.78	0.5	2.2	1.13	0.8	0.17
Pptd. silica 180 m^2/g	0.20	1.01	0.4	4.4	0.79	1.2	0.11
Pptd. silica 130 m^2/g	0.20	1.20	0.3	4.7	0.93	1.3	0.10
Pptd. aluminum silicate	0.16	1.06	0.4	3.1	1.35	0.8	0.14
Pptd. calcium silicate	0.12	0.96	0.5	2.4	1.38	0.9	0.11
French Hard Clay	0.13	0.82	0.6	3.3	0.93	1.0	0.24
Engl. Hard Clay	0.10	0.74	0.6	3.4	1.06	0.9	0.23
Engl. Clay	0.07	0.71	0.7	4.2	0.74	1.2	0.22
Engl. Soft Clay	0.05	0.66	0.7	2.9	0.80	1.1	0.19
Engl. calcined Clay	0.09	0.82	0.8	2.9	0.84	1.3	0.16
Americ. calcined Clay	0.08	0.76	0.8	3.0	0.76	1.4	0.15
Americ. calcined Clay, amino functio.	0.07	0.71	0.6	2.1	0.99	0.9	0.14
Americ. calcined Clay, vinyl functio.	0.06	0.67	0.7	2.1	0.98	1.1	0.16
Whiting	0.04	0.67	0.7	2.3	0.95	1.1	0.17
Whiting, stearate functio.	0.03	0.55	0.6	2.8	0.65	1.1	0.13
Americ. Talc	0.05	0.66	0.6	4.7	0.82	0.9	0.19
Americ. coated Talc, amino functio.	0.05	0.67	0.5	3.7	0.95	0.7	0.19

Properties of vulcanizate – Neuburg Siliceous Earth

	Hardness S2 specimen [Shore A]	Tensile strength [MPa]	Elongation at break [%]	Modulus 100 % [MPa]	Tear resistance Trousers specimen [N/mm]	Tear resistance Graves specimen [N/mm]	Rebound elasticity [%]	Abrasion loss 10 N [mm^3]	Compression set [24 h / 70 °C / 25 % Def.] [%]
Sillitin V 85	61	4.4	495	1.9	2.8	8.1	54	452	21
Sillitin V 88	60	4.7	509	1.9	3.1	8.6	54	423	22
Sillitin N 82	62	5.9	525	2.0	4.4	10.4	51	405	24
Sillitin N 85	63	5.3	511	2.0	3.9	10.1	51	414	23
Sillitin Z 86	62	6.5	531	2.1	4.8	11.0	49	377	25
Sillitin Z 89	61	5.7	519	1.9	4.1	9.9	49	413	25
Sillikolloid P 87	65	7.4	544	2.2	5.7	12.6	49	382	26
Silfit Z 91	64	5.1	488	2.3	3.5	9.7	51	370	20
Aktifit AM	66	7.9	433	3.3	5.0	12.4	53	299	16
Aktisil AM	66	9.7	466	3.3	6.0	15.5	50	277	17
Aktisil PF 216	70	10.3	327	4.5	4.8	13.2	52	235	14
Aktisil VM 56	66	9.5	583	2.9	7.4	16.0	50	306	19
Aktisil VM 56/89	63	9.0	568	2.6	5.9	14.0	53	325	18
Aktisil Q	64	5.1	428	2.6	3.1	9.1	56	387	13
Aktisil PF 777	58	4.8	517	1.5	4.2	9.3	45	449	22

Properties of vulcanizate – Competitors

	Hardness S2 specimen [Shore A]	Tensile strength [MPa]	Elongation at break [%]	Modulus 100 % [MPa]	Tear resistance Trousers specimen [N/mm]	Tear resistance Graves specimen [N/mm]	Rebound elasticity [%]	Abrasion loss 10 N [mm³]	Compression set [24 h / 70 °C / 25 % Def.] [%]
Carbon black N 550	66	16.2	399	3.3	6.2	17.3	52	125	13
Pptd. silica 180 m²/g	64	26.7	684	1.6	9.7	19.7	n.d.	167	30
Pptd. silica 130 m²/g	64	24.1	650	1.6	9.5	18.7	51	184	26
Pptd. aluminum silicate	63	12.8	696	1.6	9.1	16.3	54	275	35
Pptd. calcium silicate	65	8.0	601	1.9	4.5	11.1	54	336	29
French Hard Clay	63	12.8	624	2.1	11.1	18.2	44	326	32
Engl. Hard Clay	66	12.3	631	2.4	9.8	18.8	47	313	31
Engl. Clay	63	7.4	567	2.0	7.2	14.6	48	377	32
Engl. Soft Clay	63	5.0	526	2.0	3.9	10.6	54	446	30
Engl. calcined Clay	65	4.4	497	2.1	3.3	9.3	52	413	23
Americ. calcined Clay	63	5.1	516	2.0	3.5	8.8	53	373	21
Americ. calcined Clay, amino functio.	65	7.9	465	3.3	4.5	12.2	56	317	15
Americ. calcined Clay, vinyl functio.	66	8.0	518	3.7	5.8	14.9	55	300	15
Whiting	57	3.0	467	1.4	1.8	6.4	57	468	26
Whiting, stearate functio.	52	2.8	454	1.0	1.9	5.7	52	522	23
Americ. Talc	63	7.7	558	2.2	7.5	16.1	48	228	31
Americ. coated Talc, amino functio.	67	8.2	503	3.5	8.0	17.9	50	186	24

n.d.: not determinable, specimen inflated

Hot air aging 168 h / 70 °C – Neuburg Siliceous Earth

	Change of hardness S2 specimen [Shore A]	Change of tensile strength [%]	Change of elongation at break [rel.%]	Change of modulus 100 % [%]
Sillitin V 85	5	-13.9	-15.0	15.5
Sillitin V 88	6	-12.4	-14.7	17.6
Sillitin N 82	5	-5.4	-11.3	20.9
Sillitin N 85	4	-5.3	-11.8	19.5
Sillitin Z 86	6	-17.5	-15.9	23.9
Sillitin Z 89	5	-16.9	-14.6	17.6
Sillikolloid P 87	4	-11.8	-11.8	19.0
Silfit Z 91	3	-6.3	-12.5	12.7
Aktifit AM	3	-3.4	-19.7	14.8
Aktisil AM	2	-3.0	-16.6	17.4
Aktisil PF 216	3	7.0	-11.8	21.9
Aktisil VM 56	3	-3.8	-9.8	18.9
Aktisil VM 56/89	4	-19.1	-23.4	17.8
Aktisil Q	3	-0.2	-20.1	21.6
Aktisil PF 777	5	-3.5	-9.4	18.7

Hot air aging 168 h / 70 °C – Competitors

	Change of hardness S2 specimen [Shore A]	Change of tensile strength [%]	Change of elongation at break [rel.%]	Change of modulus 100 % [%]
Carbon black N 550	2	0.3	-13.7	15.3
Pptd. silica 180 m^2/g	4	-21.7	-14.2	26.9
Pptd. silica 130 m^2/g	5	-26.2	-14.4	23.8
Pptd. aluminum silicate	5	-6.7	-13.1	28.1
Pptd. calcium silicate	4	-10.7	-11.6	21.1
French Hard Clay	6	-16.8	-10.9	25.4
Engl. Hard Clay	3	-21.7	-10.4	19.8
Engl. Clay	4	-15.2	-9.1	24.6
Engl. Soft Clay	3	-26.8	-22.6	16.7
Engl. calcined Clay	3	-13.8	-18.8	17.5
Americ. calcined Clay	2	-16.2	-16.5	17.7
Americ. calcined Clay, amino functio.	3	-12.8	-24.7	18.2
Americ. calcined Clay, vinyl functio.	3	-13.8	-36.9	21.1
Whiting	3	-18.8	-16.8	13.0
Whiting, stearate functio.	4	-8.7	-5.1	11.7
Americ. Talc	4	-14.6	-15.9	26.1
Americ. coated Talc, amino functio.	3	-4.9	-13.9	24.6

Hot air aging 168 h / 100 °C – Neuburg Siliceous Earth

	Change of hardness S2 specimen [Shore A]	Change of tensile strength [%]	Change of elongation at break [rel.%]	Change of modulus 100 % [%]
Sillitin V 85	10	-17.8	-33.6	39.9
Sillitin V 88	10	-18.7	-32.6	41.5
Sillitin N 82	10	-14.8	-29.1	52.7
Sillitin N 85	8	-9.3	-27.4	49.5
Sillitin Z 86	11	-19.4	-31.7	61.0
Sillitin Z 89	10	-21.4	-30.4	47.2
Sillikolloid P 87	8	-22.3	-33.0	61.1
Silfit Z 91	8	-12.6	-35.9	42.5
Aktifit AM	7	4.2	-41.4	60.0
Aktisil AM	7	-1.6	-44.2	54.4
Aktisil PF 216	6	8.6	-34.5	54.1
Aktisil VM 56	7	-16.2	-44.2	57.7
Aktisil VM 56/89	8	-18.3	-38.5	51.5
Aktisil Q	7	10.4	-50.3	59.1
Aktisil PF 777	10	-9.3	-27.8	56.7

Hot air aging 168 h / 100 °C – Competitors

	Change of hardness S2 specimen [Shore A]	Change of tensile strength [%]	Change of elongation at break [rel.%]	Change of modulus 100 % [%]
Carbon black N 550	6	-10.3	-41.7	62.3
Pptd. silica 180 m^2/g	8	-32.6	-30.2	79.5
Pptd. silica 130 m^2/g	9	-32.5	-26.5	65.0
Pptd. aluminum silicate	10	-7.4	-26.5	66.3
Pptd. calcium silicate	7	-50.8	-42.4	31.1
French Hard Clay	12	-23.7	-25.1	86.6
Engl. Hard Clay	8	-23.3	-28.7	67.8
Engl. Clay	9	-22.7	-30.0	76.4
Engl. Soft Clay	7	-32.6	-43.7	36.9
Engl. calcined Clay	7	-15.2	-34.6	40.3
Americ. calcined Clay	6	-21.3	-34.7	46.5
Americ. calcined Clay, amino functio.	6	-1.1	-40.3	49.4
Americ. calcined Clay, vinyl functio.	7	-2.8	-48.0	49.9
Whiting	7	-18.2	-30.5	33.3
Whiting, stearate functio.	7	-11.2	-23.1	30.1
Americ. Talc	9	-8.7	-21.6	48.6
Americ. coated Talc, amino functio.	7	-2.7	-36.4	49.1

Immersion in deionized water 168 h / 95 °C – Neuburg Siliceous Earth

	Change of hardness S2 specimen [Shore A]	Change of tensile strength [%]	Change of elongation at break [rel.%]	Change of weight [%]	Change of volume [%]
Sillitin V 85	4	-8.9	-16.7	1.0	1.3
Sillitin V 88	5	-3.4	-15.6	0.9	1.0
Sillitin N 82	4	5.9	-10.2	0.8	1.1
Sillitin N 85	3	9.0	-8.2	0.9	1.2
Sillitin Z 86	4	11.9	-9.5	1.0	1.2
Sillitin Z 89	4	-0.5	-13.8	0.9	1.3
Sillikolloid P 87	0	19.2	-7.6	1.0	1.5
Silfit Z 91	4	-5.7	-19.2	0.8	1.0
Aktifit AM	3	-1.6	-22.6	1.3	1.6
Aktisil AM	2	0.1	-21.6	1.7	2.6
Aktisil PF 216	3	14.0	-19.7	0.7	1.3
Aktisil VM 56	-1	-9.0	-4.0	1.1	1.4
Aktisil VM 56/89	1	-20.0	-6.2	0.9	1.6
Aktisil Q	4	15.9	-30.9	1.0	1.5
Aktisil PF 777	2	-12.2	-14.9	0.7	1.0

Immersion in deionized water 168 h / 95 °C – Competitors

	Change of hardness S2 specimen [Shore A]	Change of tensile strength [%]	Change of elongation at break [rel.%]	Change of weight [%]	Change of volume [%]
Carbon black N 550	2	-8.9	-33.1	0.6	1.2
Pptd. silica 180 m^2/g	2	-13.3	-16.3	5.9	6.4
Pptd. silica 130 m^2/g	3	-8.7	-12.9	5.4	5.7
Pptd. aluminum silicate	1	27.6	-12.7	5.2	6.7
Pptd. calcium silicate	2	24.7	-13.2	3.5	3.5
French Hard Clay	0	-11.4	-9.1	1.2	1.6
Engl. Hard Clay	-7	-38.0	-14.8	4.5	6.2
Engl. Clay	1	7.5	-9.1	1.4	2.0
Engl. Soft Clay	2	-4.4	-12.2	1.3	1.7
Engl. calcined Clay	3	-16.8	-24.2	0.8	0.4
Americ. calcined Clay	4	-7.3	-18.8	0.7	0.3
Americ. calcined Clay, amino functio.	2	-2.3	-19.8	0.6	0.5
Americ. calcined Clay, vinyl functio.	2	-7.9	-8.0	0.7	0.9
Whiting	1	2.6	-8.5	0.5	0.8
Whiting, stearate functio.	1	-10.1	-9.1	0.4	0.8
Americ. Talc	2	3.5	-13.8	2.4	3.2
Americ. coated Talc, amino functio.	3	18.7	-8.9	2.3	3.2