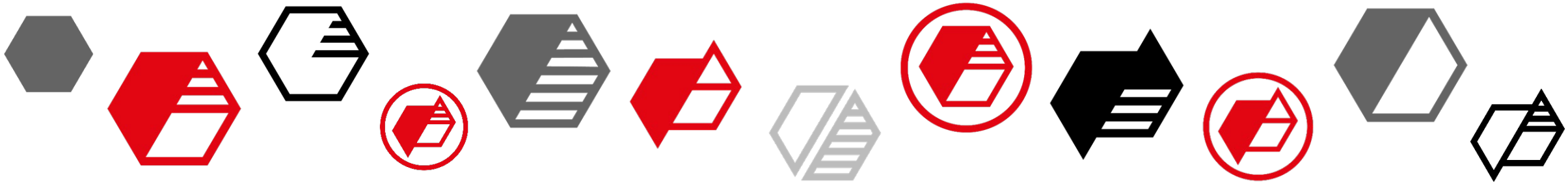
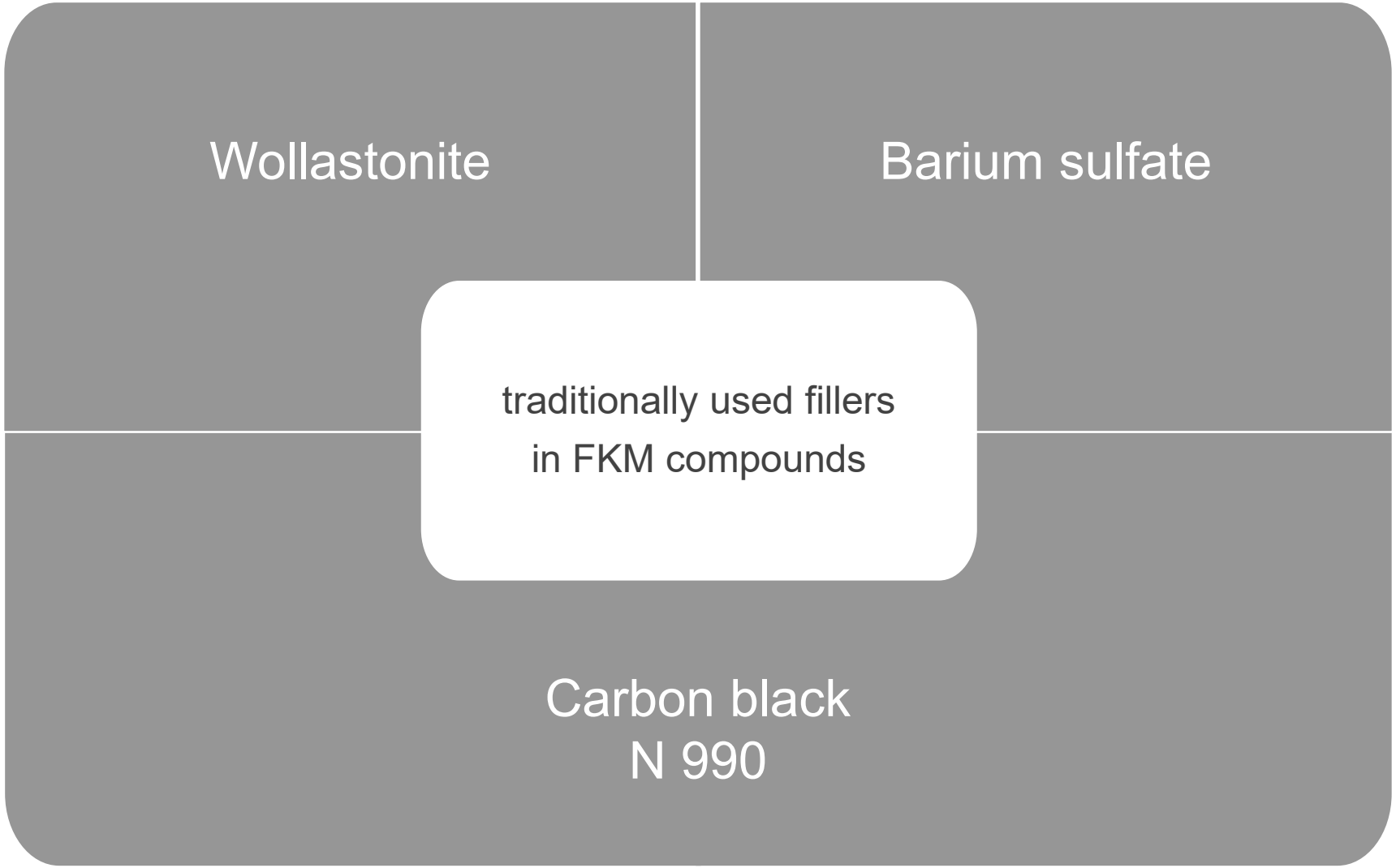


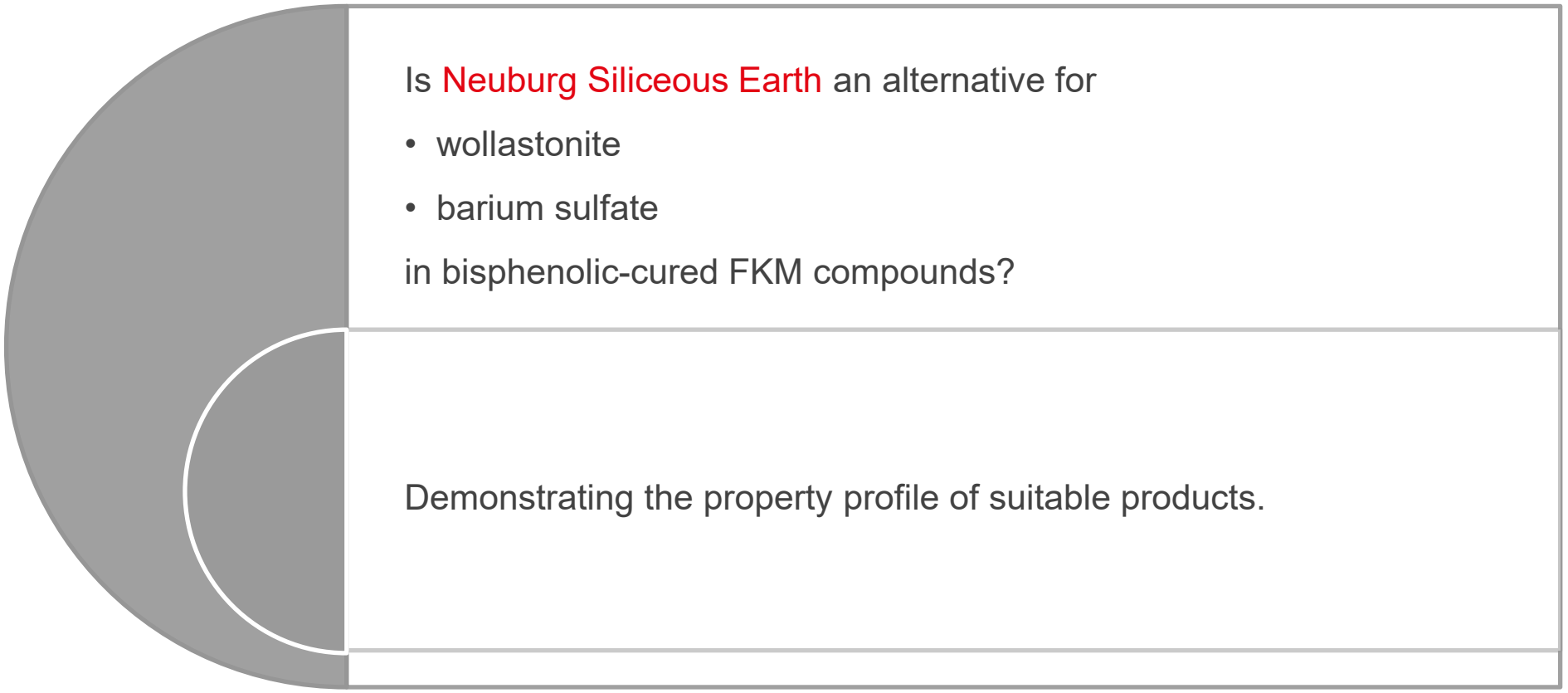
Neuburg Siliceous Earth
vs. wollastonite and barium sulfate
in bisphenolic-cured FKM

HOFFMANN MINERAL®
We supply materials for good ideas

Status quo


Wollastonite
Barium sulfate
traditionally used fillers
in FKM compounds
Carbon black
N 990

Objective


Is Neuburg Siliceous Earth an alternative for
• wollastonite
• barium sulfate
in bisphenolic-cured FKM compounds?
Demonstrating the property profile of suitable products.

Formulation

in phr		Woll. AST / EST	Barium sulfate	NSE
Viton A-201C	FKM, ML 1+10 (121 °C): 20 MU high curative level	100	100	100
Elastomag 170	MgO	3	3	3
Vulcofac F45	$Ca(OH)_2$	6	6	6
Wollastonite AST resp. EST	Calcium silicate	45	-	-
Barium sulfate	ppt. barium sulfate	-	74	-
NSE	Neuburg Siliceous Earth	-	-	45

Fillers and characteristics

Filler	Description	Functionalization
Wollastonite AST	Calcium silicate, d_{50}: 3,5 µm	Amino
Wollastonite EST	Calcium silicate, d_{50}: 3,5 µm	Epoxy
Barium sulfate	ppt. barium sulfate, d_{50}: 3 µm	-
Sillitin V 85	Neuburg Siliceous Earth, d_{50}: 5.0 µm	-
Aktisil Q	Neuburg Siliceous Earth, d_{50}: 5.0 µm	Methacryl
Aktisil AM	Neuburg Siliceous Earth, d_{50}: 2.4 µm	Amino

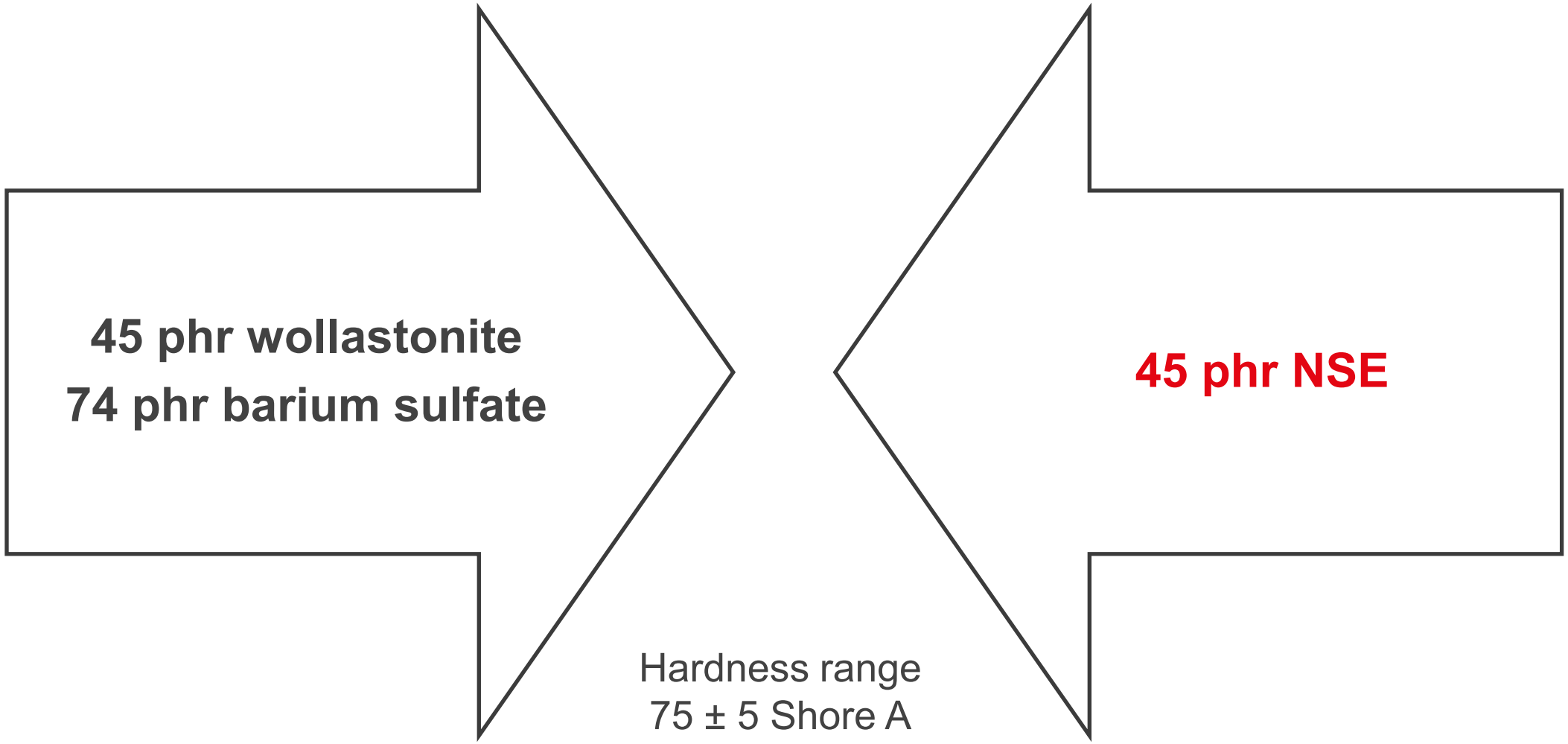
Compound preparation and curing

Mixing	
Open mill	Ø 150 x 300 mm
Batch weight	approx. 1 kg
Temperature	50 °C 30 °C for removing the sheet off the mill
Mixing time	approx. 15 min.
Curing and post-cure	
Cure	10 min. / 177 °C
Post-cure	24 h / 232 °C
All values shown refer to post-cured specimens unless otherwise noted.	

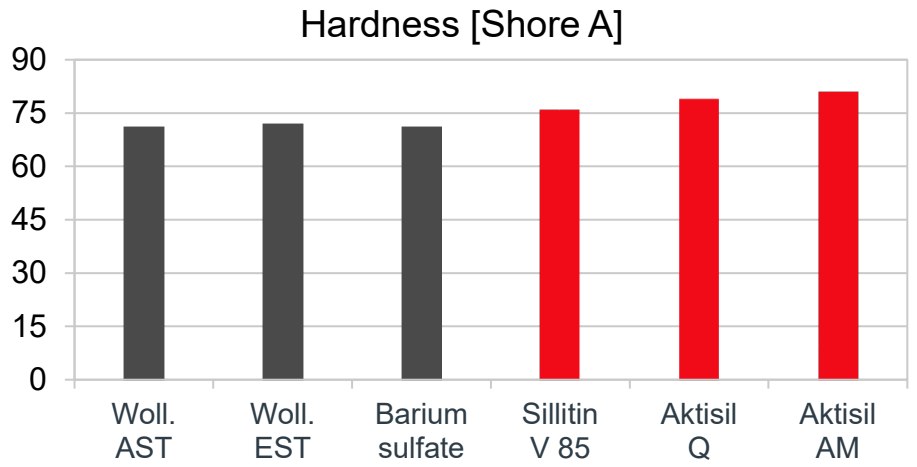
Tests

PrüfungTest	Standard	Conditions
Mooney Viscosity ML 1+4	DIN 53 523, Part 3	100 °C
Curemeter testing	DIN 53 529, Part 1 – 4	177 °C, 0.2 ° deflection
Tensile test	DIN 53 504, S2	
Compression set	DIN ISO 815-1, Type B	70 h / 232 °C / 25 % defl.
Tear resistance	DIN ISO 34-1, A	
Storage in hot air	DIN 53 508	70 h / 232 °C
Immersion in liquid media	DIN ISO 1817	Dest. water, 168 h / 60 °C Fuel FAM B, 70 / 23 °C Oil OS206304, 168 h / 150 °C

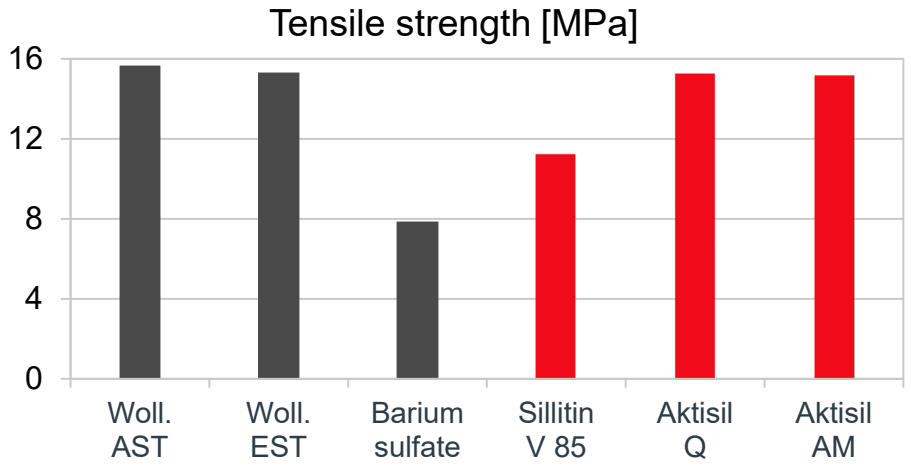
Neuburg Siliceous Earth vs. mineral filler

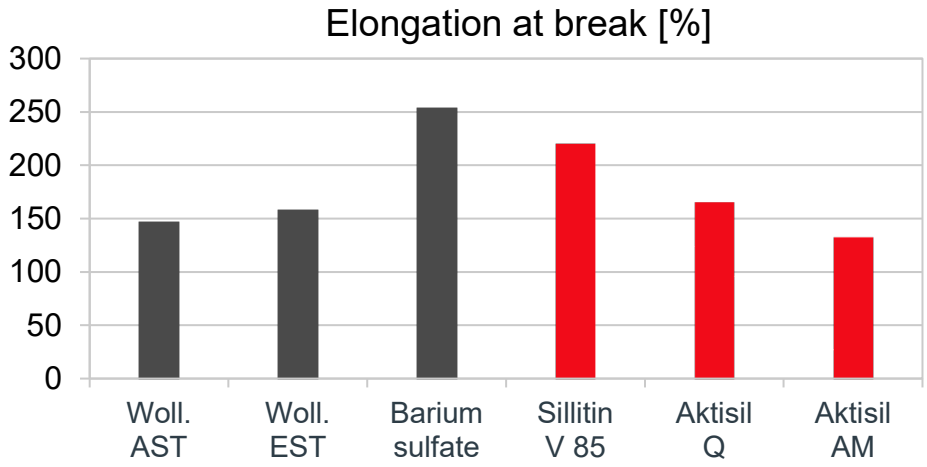


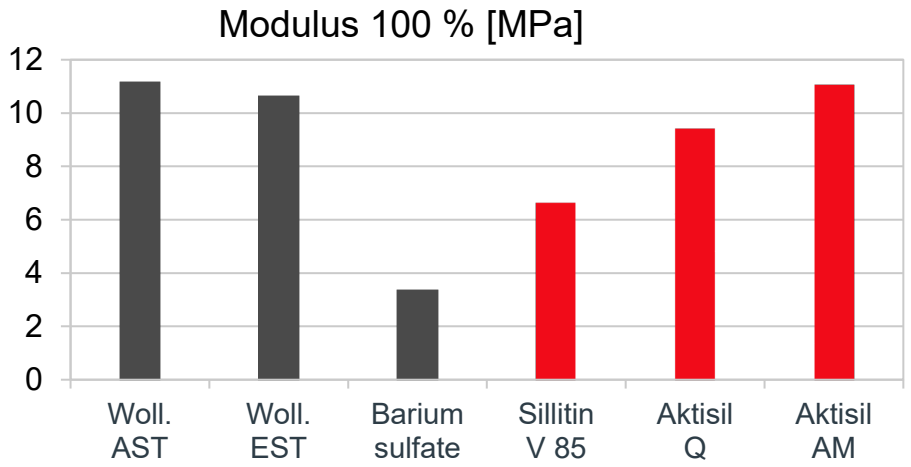
Hardness

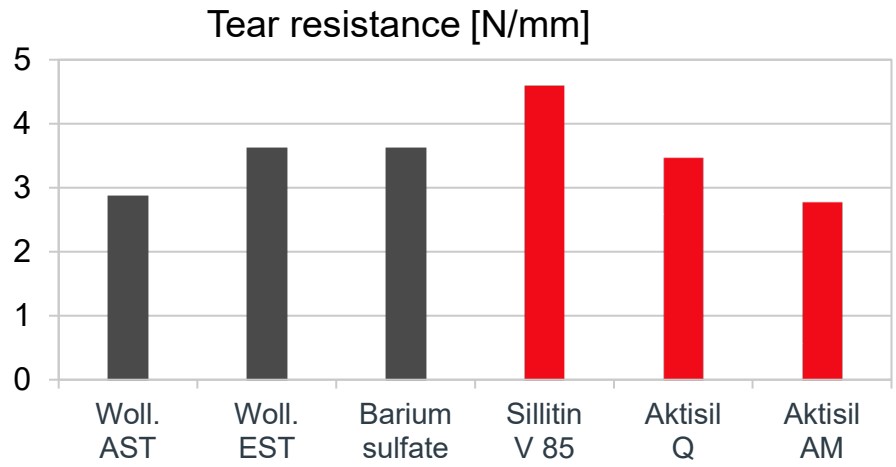

Hardness [Shore A]
90
75
60
45
30
15
0
Woll. AST
Woll. EST
Barium sulfate
Sillitin V 85
Aktisil Q
Aktisil AM

Tensile tests

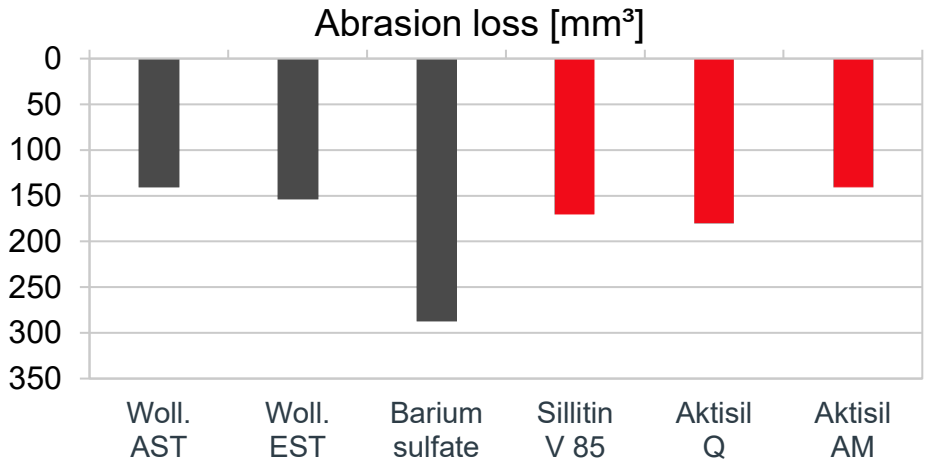


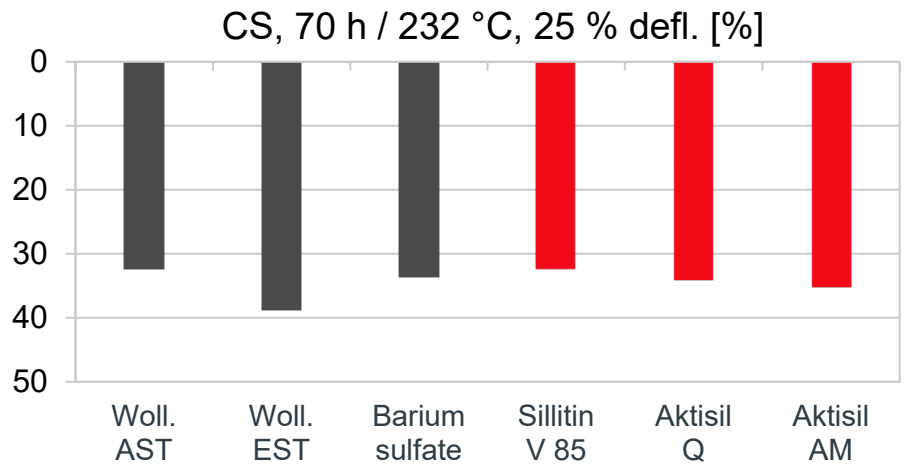




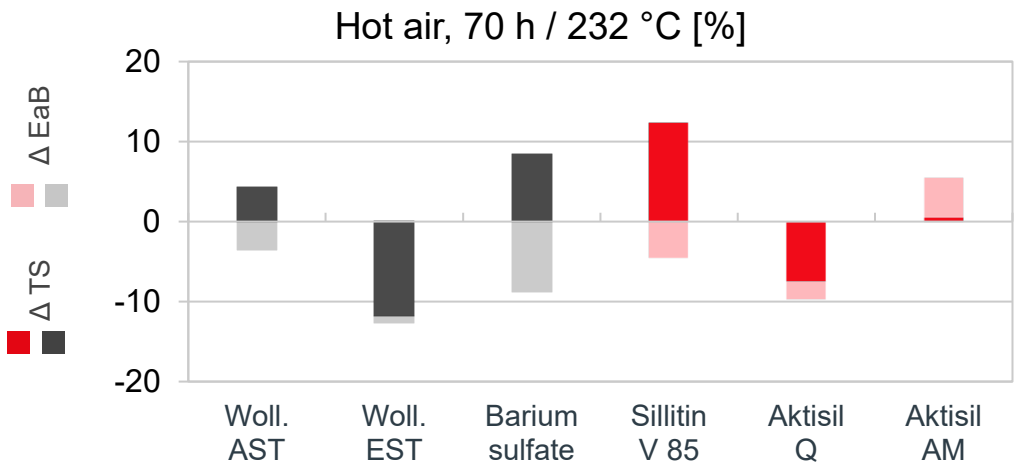


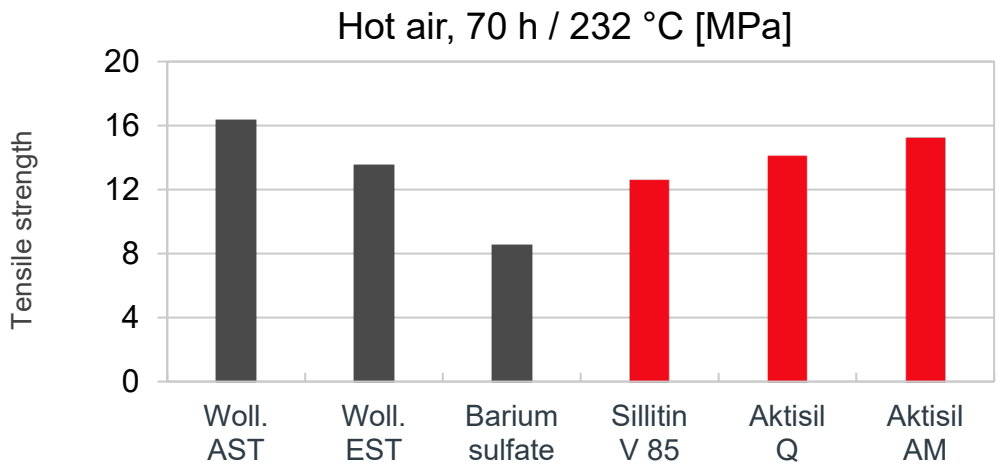
Abrasion resistance and compression set

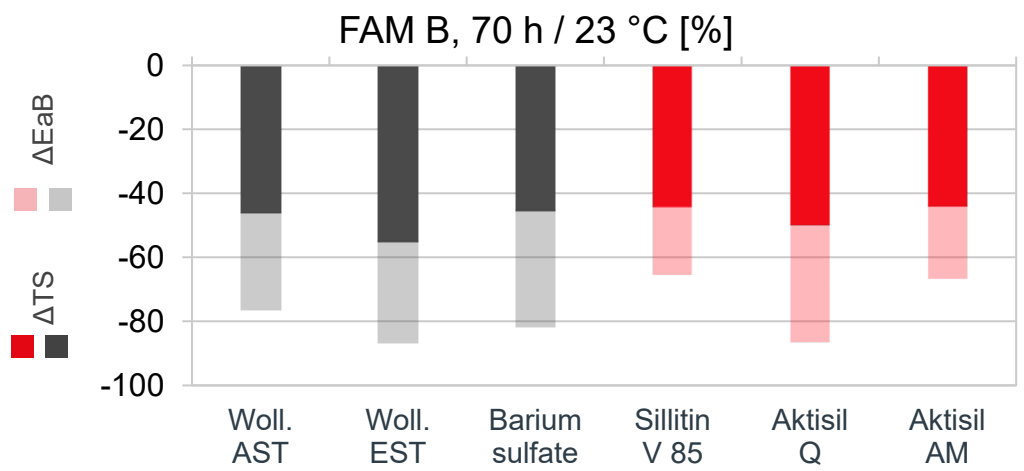


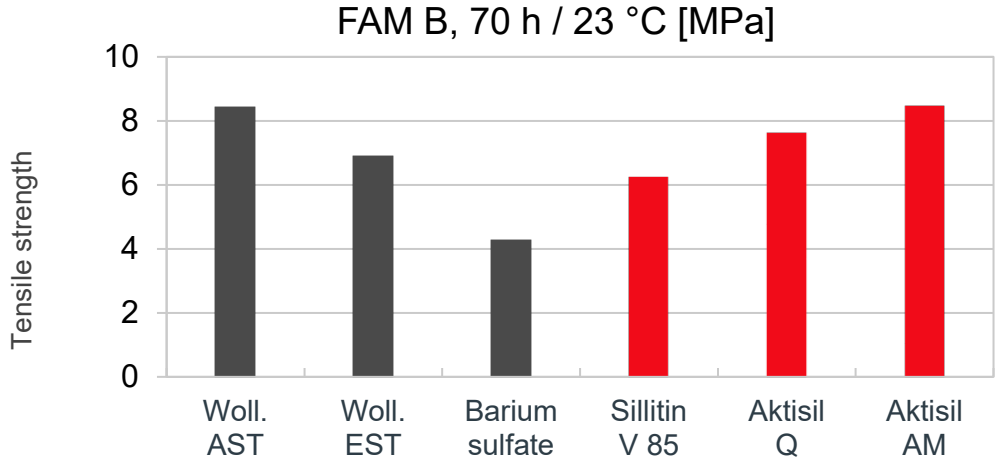


Resistance to hot air and fuel

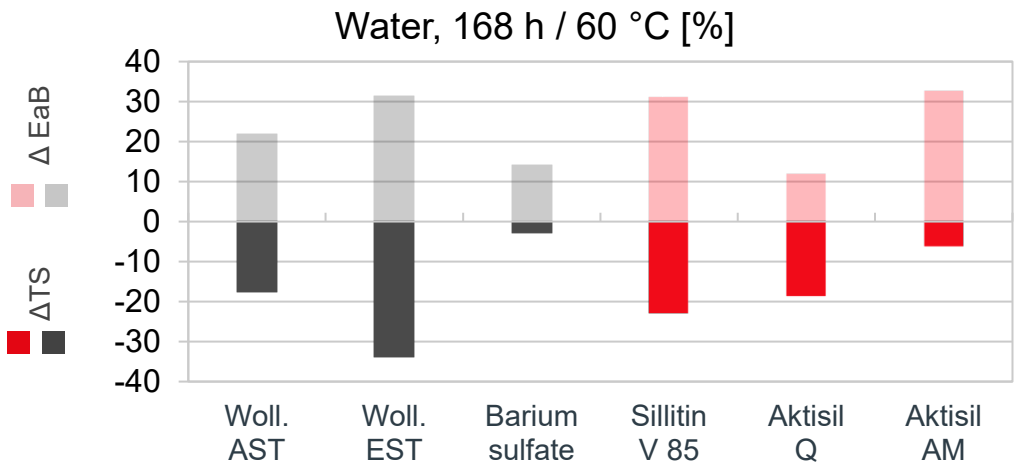


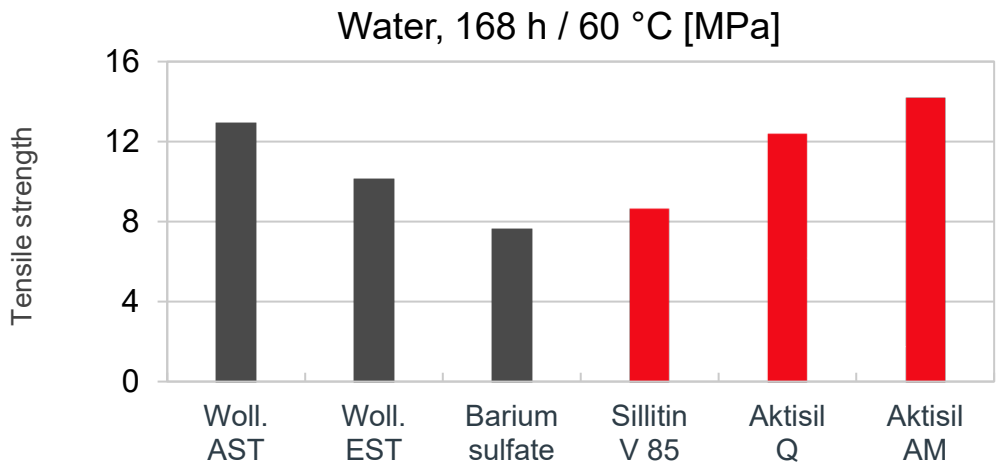


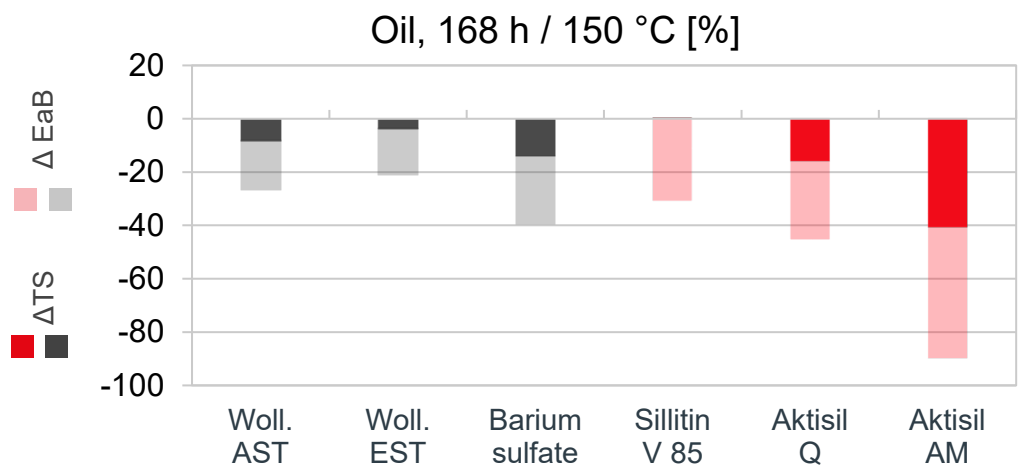


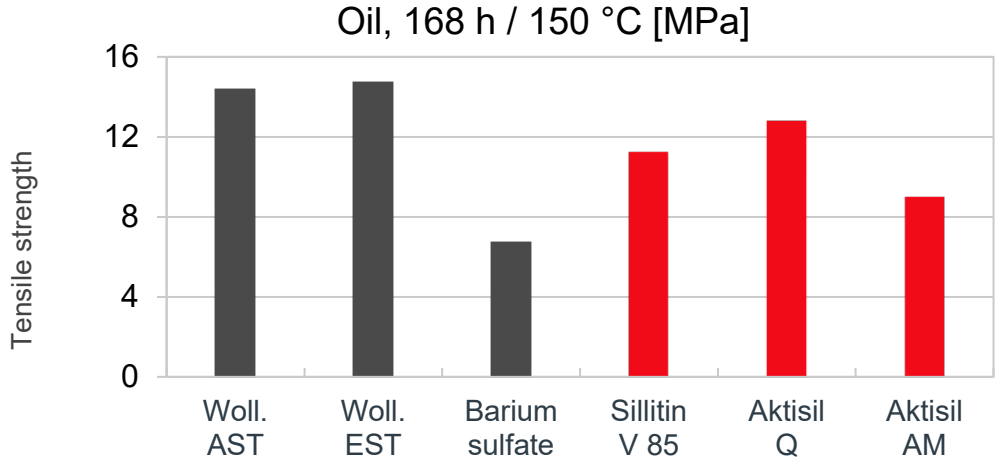


Resistance to water and oil



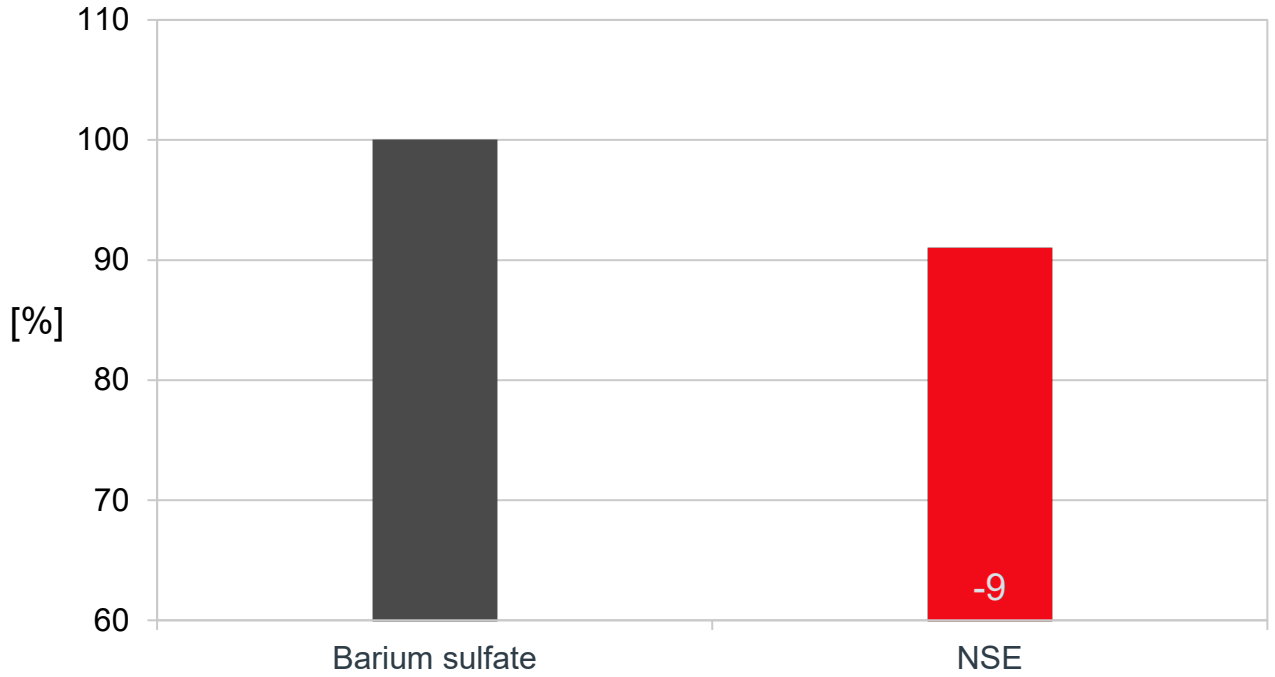






An additional benefit…

Reduction of CO_2 eq. after replacing barium sulfate with NSE, volume based



NSE vs. Wollastonite AST

70 – 80 Shore A	Sillitin V 85	Aktisil Q	Aktisil AM
Tensile strength		=	=
Elongation at break	+	=	=
Modulus 100 %			=
Tear resistance	+	=	=
Abrasion resistance	=	=	=
CS ISO 232 °C	=	=	=
Resistance to hot air	=	=	=
Resistanct to water	=	=	=
Resistance to fuel	+	=	+
Resistance to oil	=	=	

NSE vs. Wollastonite EST

70 – 80 Shore A	Sillitin V 85	Aktisil Q	Aktisil AM
Tensile strength		=	=
Elongation at break	+	=	=
Modulus 100 %			=
Tear resistance	+	=	=
Abrasion resistance	=	=	=
CS ISO 232 °C	+	=	=
Resistance to hot air	=	=	=
Resistanct to water	+	+	+
Resistance to fuel	+	=	+
Resistance to oil	=		

NSE vs. Barium sulfate

70 – 80 Shore A	Sillitin V 85	Aktisil Q	Aktisil AM
Tensile strength	+	+	+
Elongation at break	=		
Modulus 100 %	+	+	+
Tear resistance	+	=	=
Abrasion resistance	+	+	+
CS ISO 232 °C	=	=	=
Resistance to hot air	=	=	=
Resistanct to water		=	
Resistance to fuel	+	=	+
Resistance to oil	=	=	

We supply materials for good ideas!

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Results in tabular form

		Woll. AST	Woll. EST	$BaSO_4$	Sillitin V 85	Aktisil Q	Aktisil AM
Rheology							
Mooney viscosity, ML 1+4, 100 °C	MU	89	90	86	104	96	99
Rotorless Curemeter, M_{min}, 177 °C	Nm	0.03	0.03	0.03	0.05	0.04	0.06
Rotorless Curemeter, V_{max}, 177 °C	Nm/min.	2.0	1.8	1.7	0.6	1.4	0.8
Rotorless Curemeter, t_{90}, 177 °C	min.	2.0	2.1	2.2	5.0	3.1	3.7
Mechanical properties (cured 10 min. / 177 °C, no post-cure)							
Hardness	Shore A	70	70	68	74	77	78
Tensile strength	MPa	13	13	6.6	8.9	10	14
Elongation at break	%	146	172	288	303	235	151
Modulus 50 %	MPa	3.3	3.6	1.8	2.7	3.5	4.2
Modulus 100 %	MPa	9.1	8.6	2.5	4.4	6.2	9.3
Tear resistance	N/mm	3.0	3.6	3.3	4.5	3.9	2.7
CS ISO 70 h / 232 °C / 25 %	%	60	64	68	71	80	60
Abrasion loss	mm^3	165	180	379	250	230	145

Results in tabular form

		Woll. AST	Woll. EST	$BaSO_4$	Sillitin V 85	Aktisil Q	Aktisil AM
Mechanical properties (cured 10 min. / 177 °C, post-cure 24 h / 232 °C)							
Hardness	Shore A	71	72	71	76	79	81
Tensile strength	MPa	16	15	7.8	11	15	15
Elongation at break	%	147	157	254	220	165	133
Modulus 50 %	MPa	4.2	4.4	2.2	3.4	4.5	4.8
Modulus 100 %	MPa	11	11	3.4	6.6	9.4	11
Tear resistance	N/mm	2.9	3.6	3.6	4.6	3.5	2.8
CS ISO 70 h / 232 °C / 25 %	%	32	39	34	32	34	35
Abrasion loss	mm^3	140	153	286	170	180	140

Results in tabular form

		Woll. AST	Woll. EST	$BaSO_4$	Sillitin V 85	Aktisil Q	Aktisil AM
Storage in hot air, 70 h / 232 °C							
Hardness	Shore A	74	72	73	78	79	81
Tensile strength	MPa	16	13	8.5	13	14	15
Elongation at break	%	142	156	232	210	162	139
Δ Hardness	Shore A	+3	0	+2	+2	0	0
Δ Tensile strength	%	+4.3	-12	+8.5	+12	-7.4	+0.5
Δ Elongation at break	rel.%	-3.5	-1.0	-8.7	-4.5	-2.3	+4.9

Results in tabular form

		Woll. AST	Woll. EST	$BaSO_4$	Sillitin V 85	Aktisil Q	Aktisil AM
Storage in water, 168 h / 60 °C							
Hardness	Shore A	73	73	70	76	79	79
Tensile strength	MPa	13	10	7.6	8.7	12	14
Elongation at break	%	179	207	290	288	185	176
Δ Hardness	Shore A	+2	+1	-1	0	0	-2
Δ Tensile strength	%	-18	-34	-2.9	-23	-19	-6.4
Δ Elongation at break	rel.%	+22	+31	+14	+31	+12	+33
Δ Weight	%	+0.6	+0.6	+0.7	+0.9	+0.7	+0.9
Δ Volume	%	+0.1	+0.2	+0.8	+0.9	0.5	+1.1

Results in tabular form

		Woll. AST	Woll. EST	$BaSO_4$	Sillitin V 85	Aktisil Q	Aktisil AM
Storage in fuel, 70 h / 23 °C							
Hardness	Shore A	62	62	58	63	68	67
Tensile strength	MPa	8.4	6.9	4.3	6.3	7.6	8.5
Elongation at break	%	103	108	162	173	105	103
Δ Hardness	Shore A	-9	-10	-13	-13	-11	-14
Δ Tensile strength	%	-46	-55	-45	-44	-50	-44
Δ Elongation at break	rel.%	-30	-32	-36	-21	-37	-23
Δ Weight	%	+6.5	+7.6	+5.8	+7.2	+7.7	+7.9
Δ Volume	%	+17	+19	+17	+18	+19	+19

Results in tabular form

		Woll. AST	Woll. EST	$BaSO_4$	Sillitin V 85	Aktisil Q	Aktisil AM
Storage in oil, 168 h / 150 °C							
Hardness	Shore A	69	70	71	76	80	80
Tensile strength	MPa	14	15	6.7	11	13	9.0
Elongation at break	%	120	130	189	152	117	68
Δ Hardness	Shore A	-2	-2	0	0	+1	-1
Δ Tensile strength	%	-8.2	-3.6	-14	+0.2	-16	-41
Δ Elongation at break	rel.%	-18	-17	-26	-31	-29	-49
Δ Weight	%	+0.5	+0.5	+0.4	+0.6	+0.7	+0.7
Δ Volume	%	+0.7	+0.5	+0.6	+0.6	+0.6	+0.9