



GLOXIL iM16k MAM

Functionalized hollow glass microspheres in peroxide cured FKM

Partial replacement of carbon black for weight and cost reduction

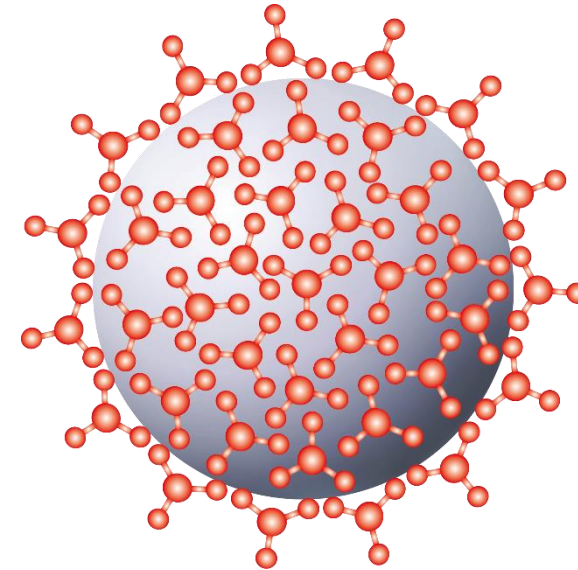
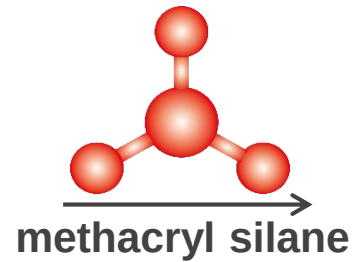


GLOXIL iM16k MAM

A special process creates the **GLOXIL iM16k MAM** based on the hollow glass microsphere 3M™ Glass Bubble iM16k.



**3M™ Glass Bubbles
iM16k**



GLOXIL iM16k MAM



Status quo

Hollow glass microspheres (HGM): used for weight-reduction and at the same time preserving the physical properties, mainly in thermoplastics

BUT: high raw material costs



For elastomers only useful in high priced polymers



Targets

- Compound density
- Compound costs
- Mechanical properties
- Resistance to various liquid media

Combination of HGM with
carbon black in peroxide cured FKM



Formulation + hollow glass microspheres

in phr	Reference	Replacement with HGM
Viton GAL-200S	100	100
Zinkoxyd aktiv	3	3
TAIC-70	4.3	4.3
Trigonox 101-50D-pd	2	2
Carbon Black N 990	30	12
HGM	-	12

HGM	Functionalization
3M™ Glass Bubbles iM16k	-
GLOXIL iM16k MAM	methacrylic



Compound preparation and curing

Mixing

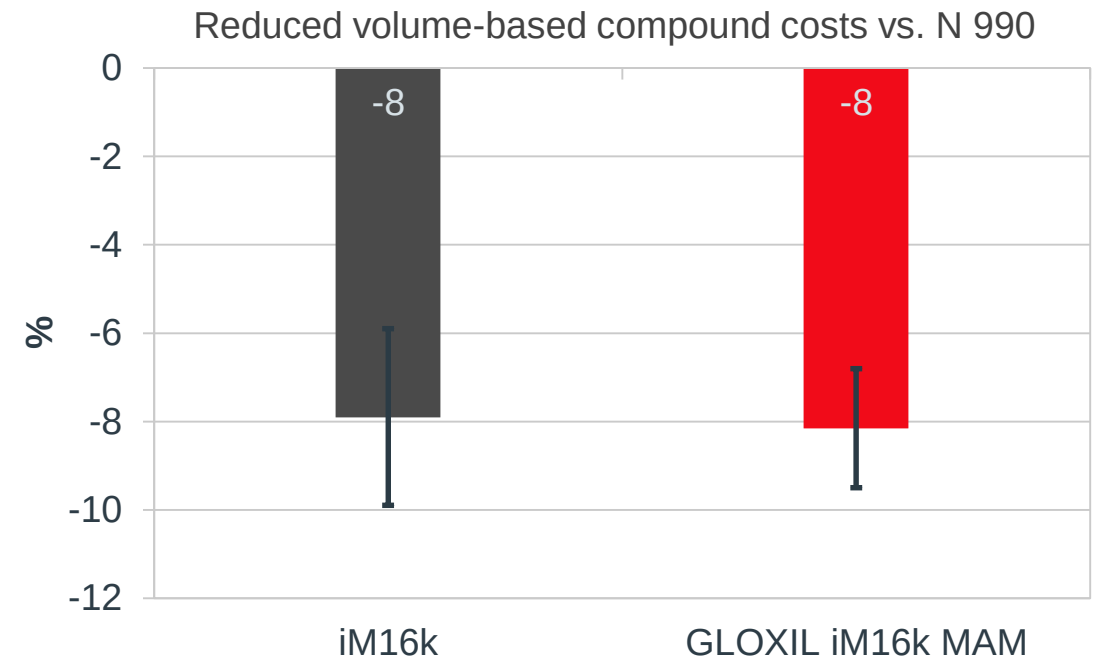
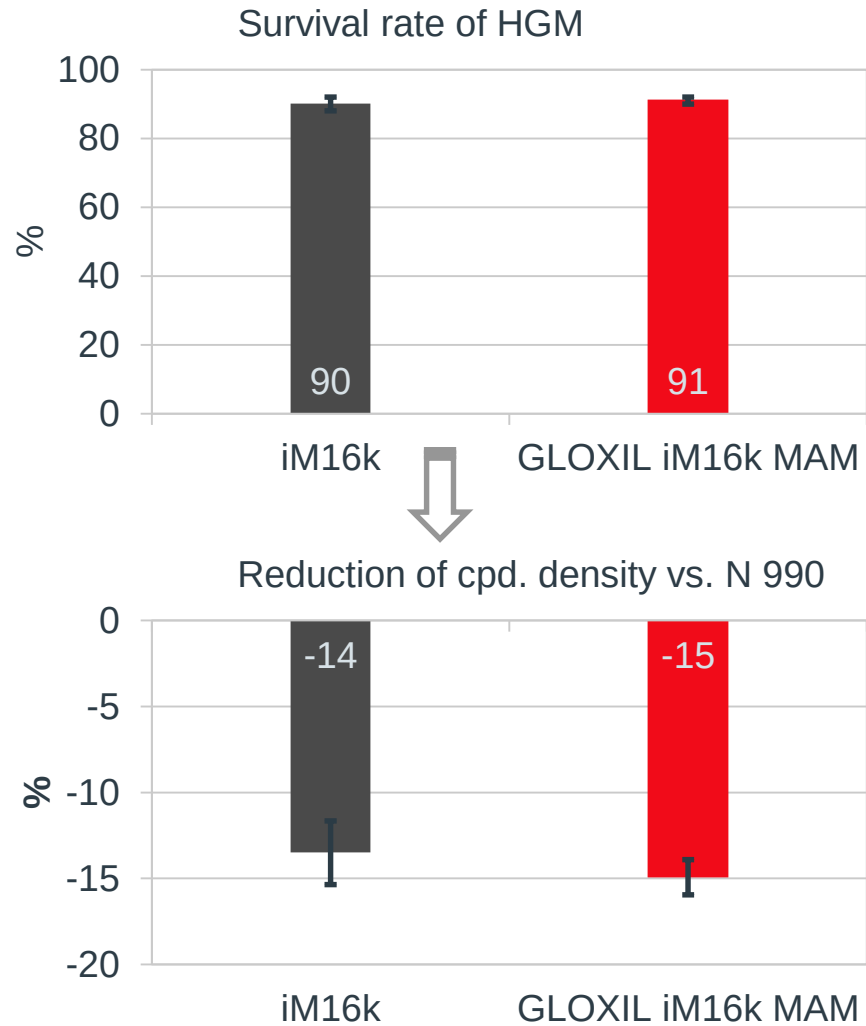
Open mill	Ø 150 x 300 mm
Batch weight	approx. 900 g
Mill temperature	50 °C for mixing, 20 °C for removal of the sheet
Mixing time	approx. 15 min.

Curing / Post-cure

Curing, lab press	7 min. / 177 °C / 200 bar
Post-cure	2 h / 230 °C



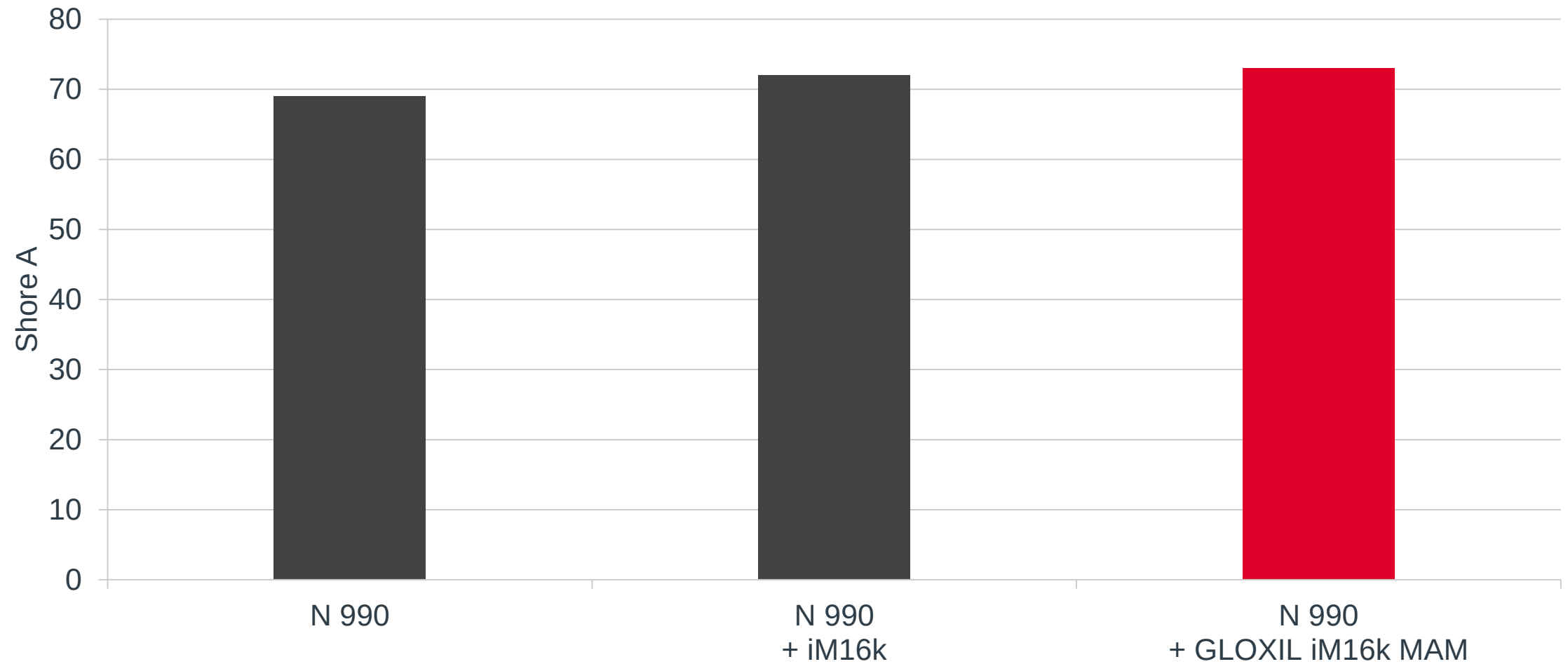
Survival rate of HGM → reduction of density vs. CB → compound costs





Hardness

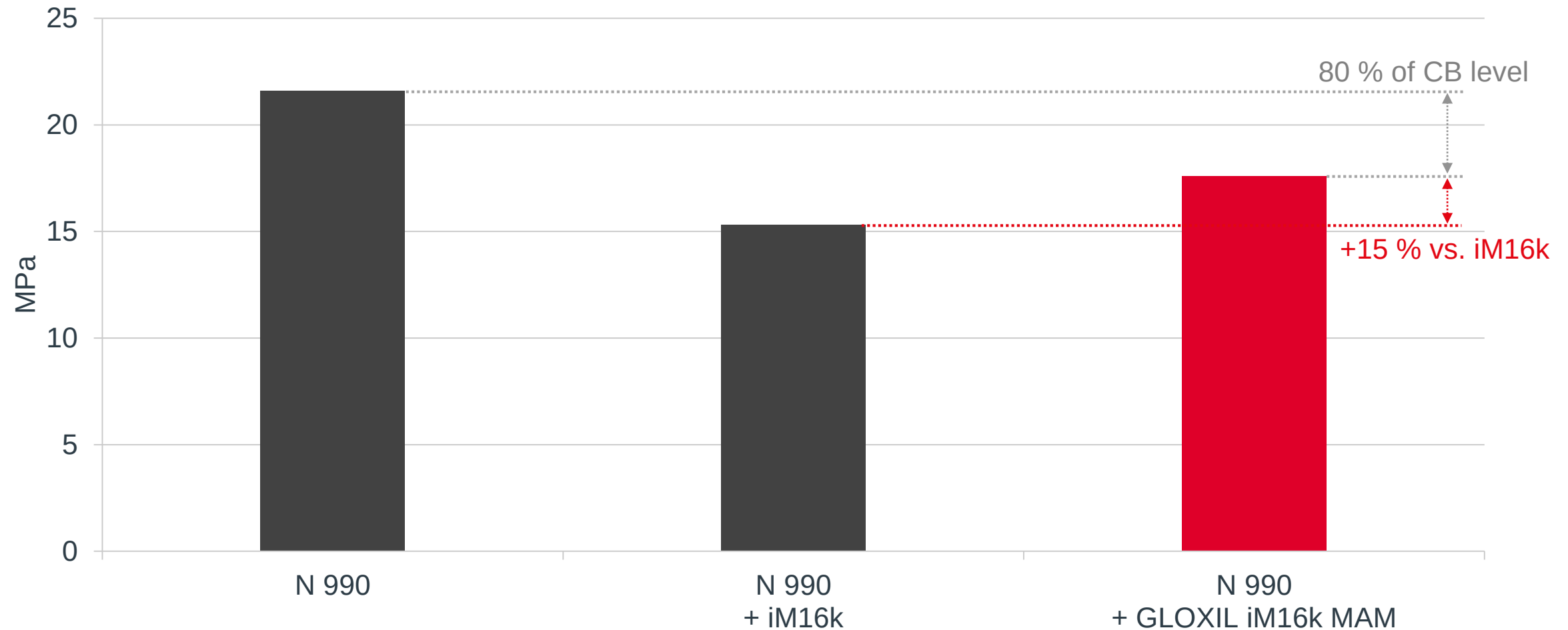
DIN ISO 7619-1





Tensile strength

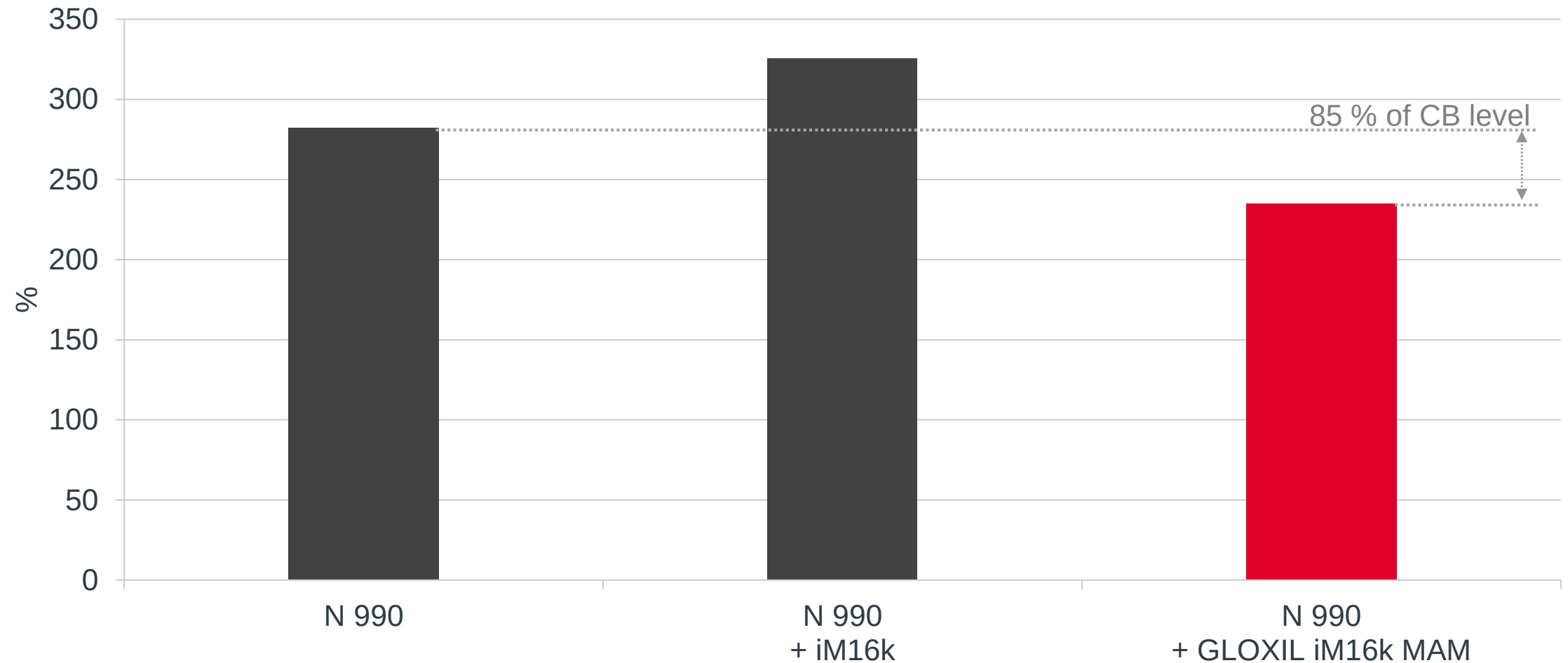
DIN 53 504, S2





Elongation at break

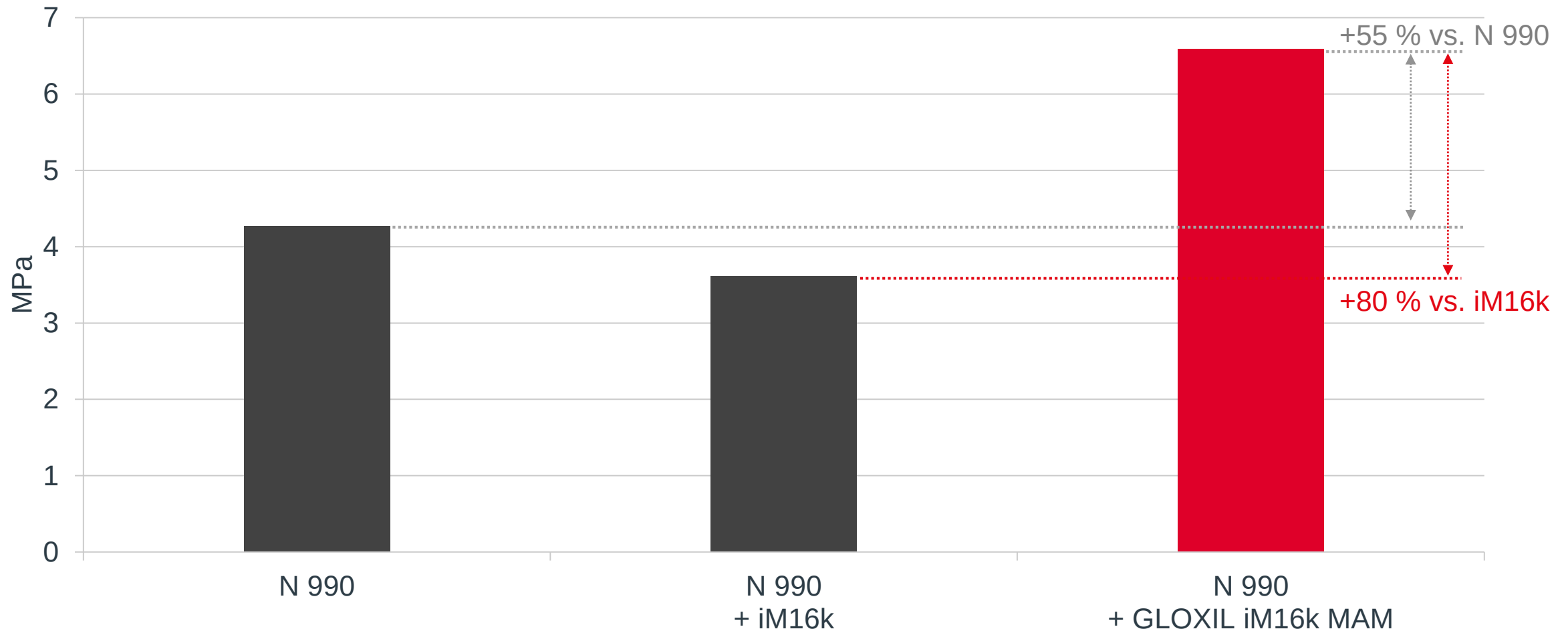
DIN 53 504, S2





Modulus 100 %

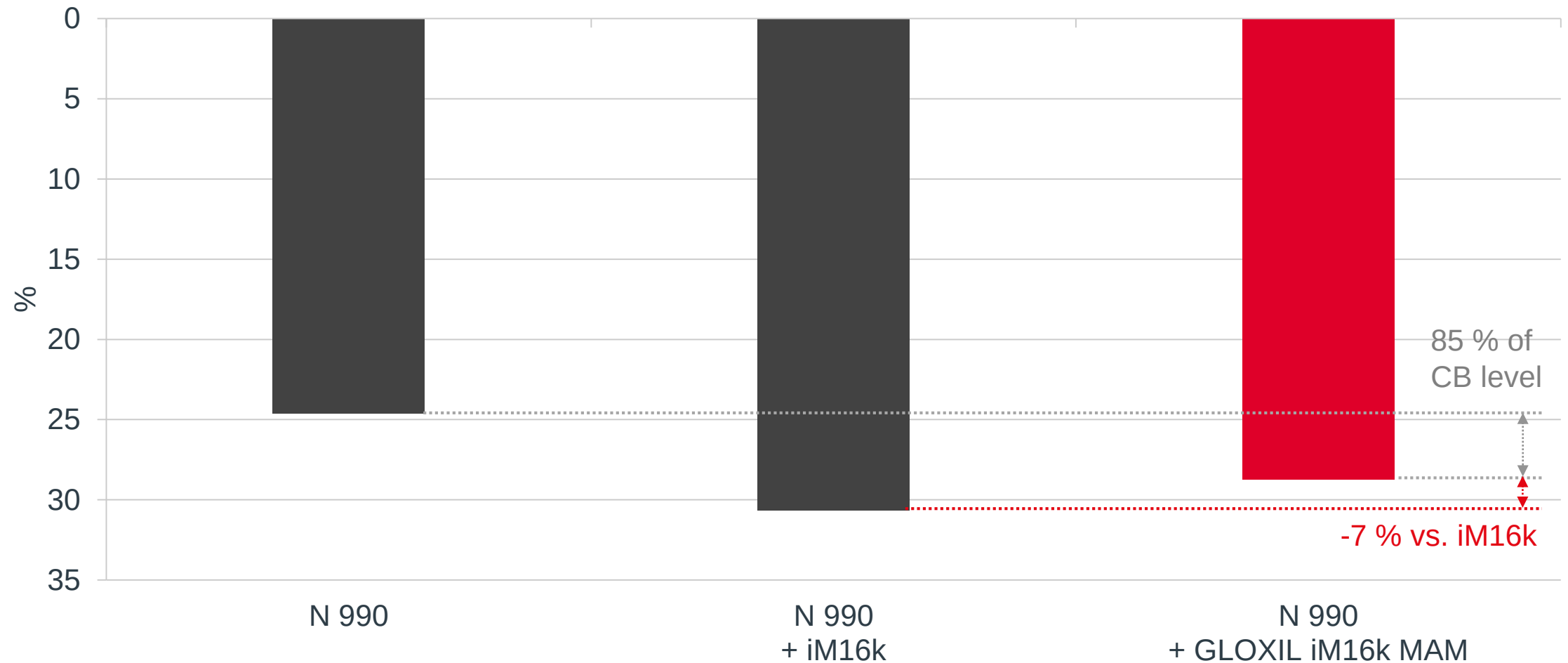
DIN 53 504, S2



Compression set 70 h / 230 °C / 25 % def.

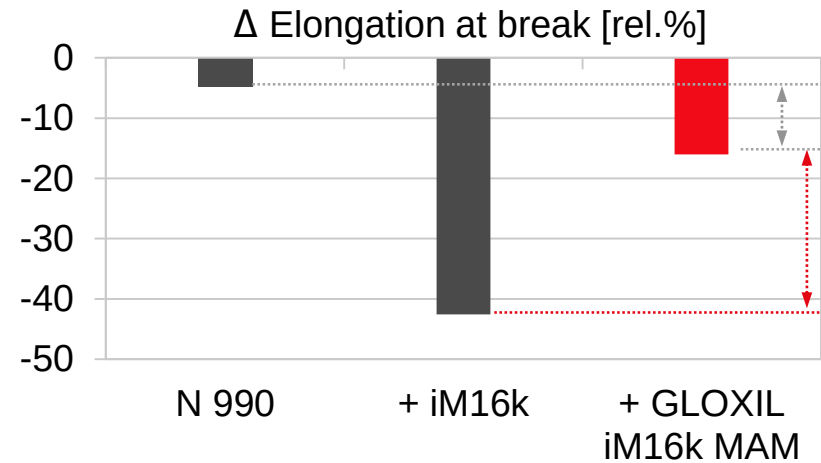
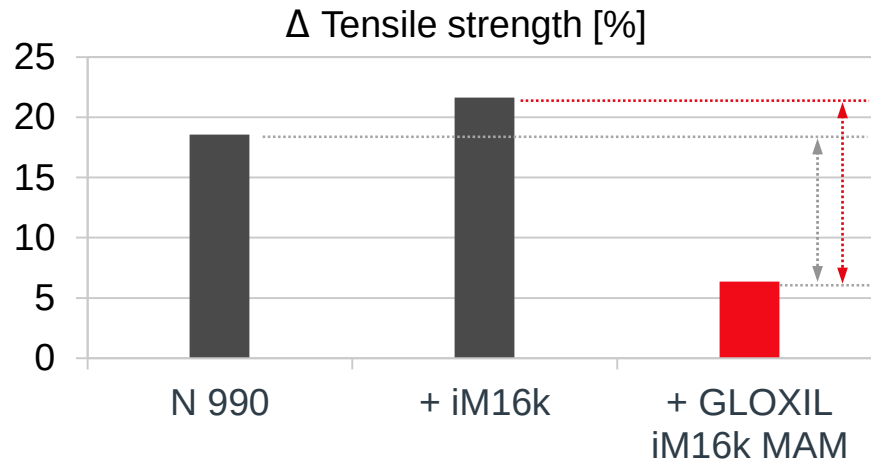


DIN ISO 815-1, B



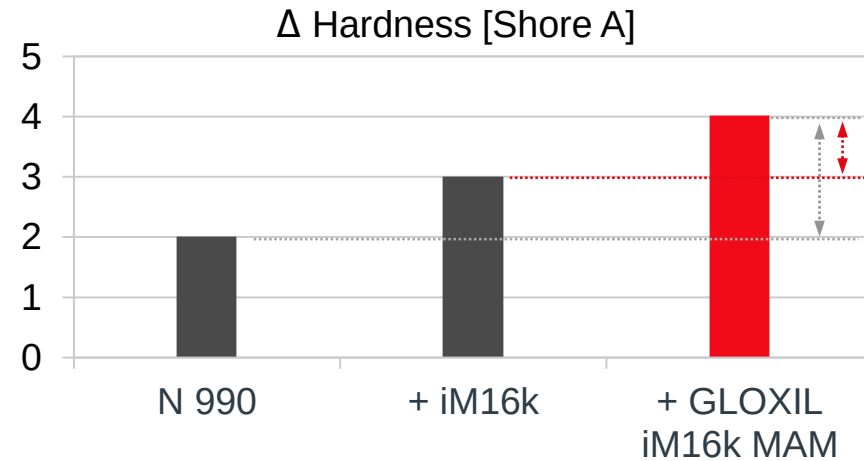
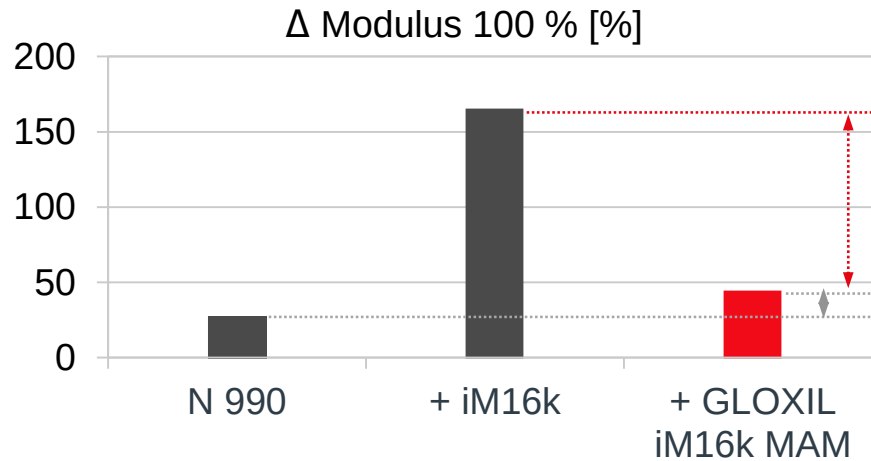


Resistance to hot air 94 h / 230 °C, 30' after removal



GLOXIL iM16k MAM vs. N 990

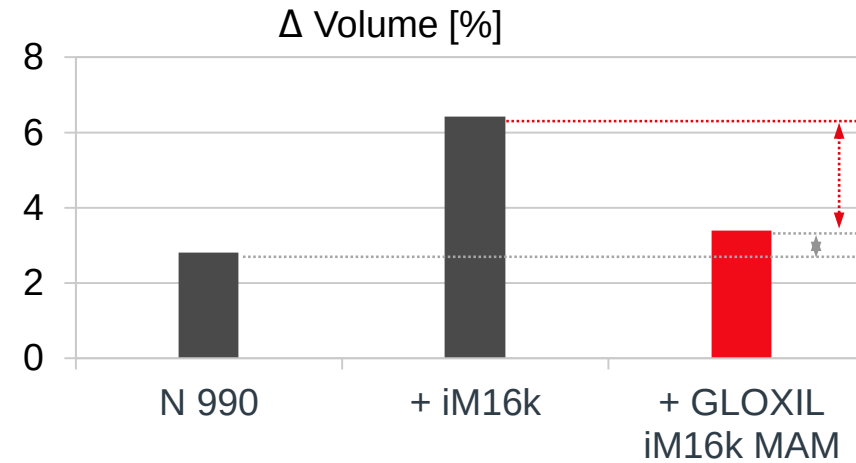
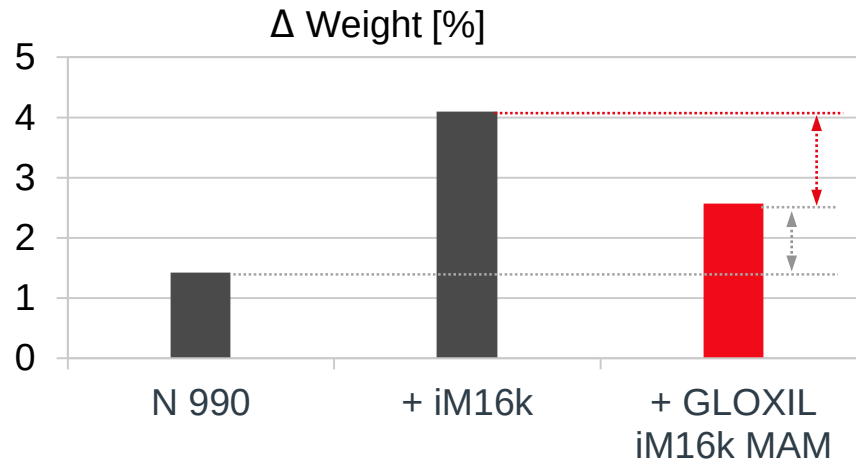
lower change of
tensile strength,
otherwise similar
properties



GLOXIL iM16k MAM vs. iM16k

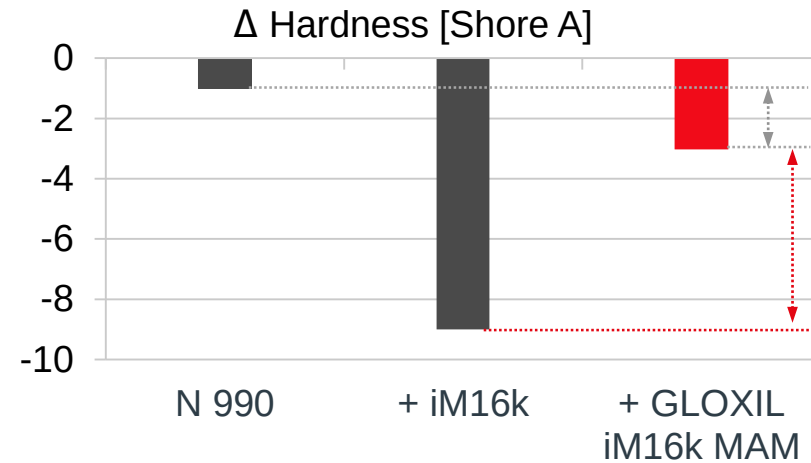
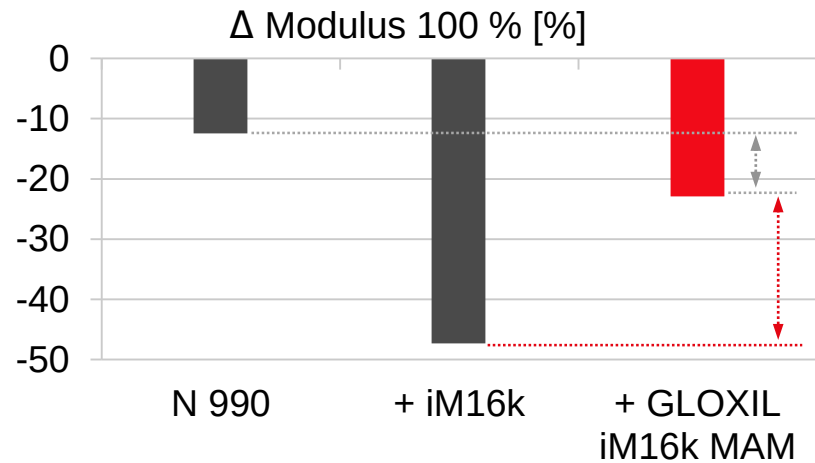
markedly lower
change of properties

Resistance to dist. water 168 h / 60 °C



GLOXIL iM16k MAM vs. N 990

comparably low
change of base
properties

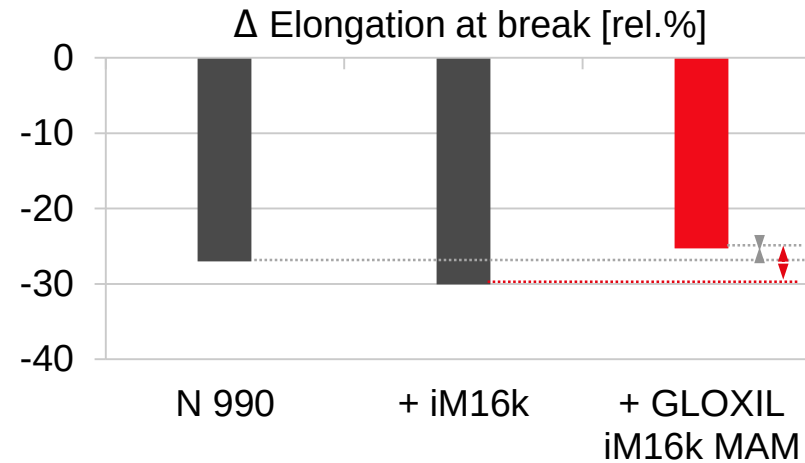
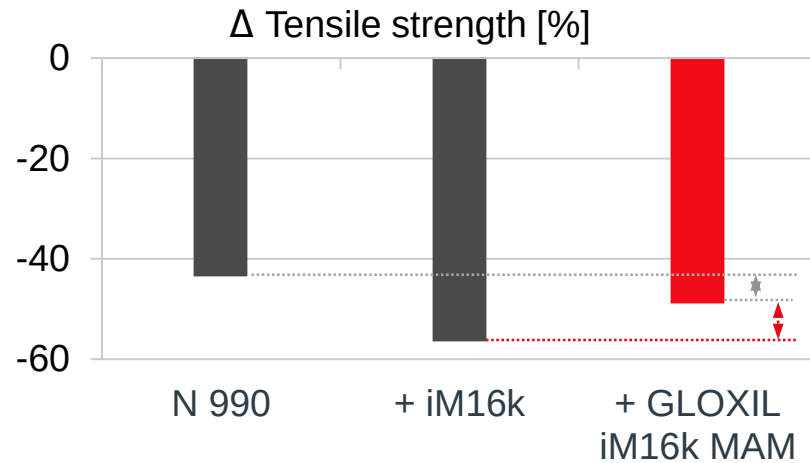


GLOXIL iM16k MAM vs. iM16k

markedly lower
change of base
properties
+ lower water
absorption

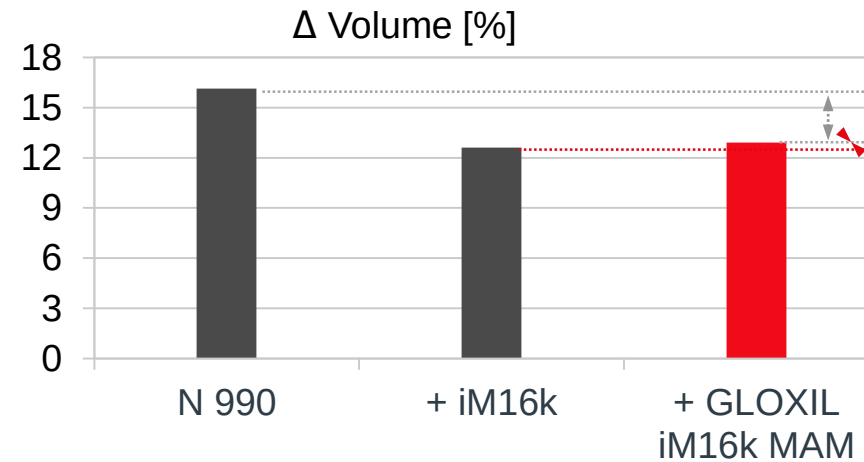
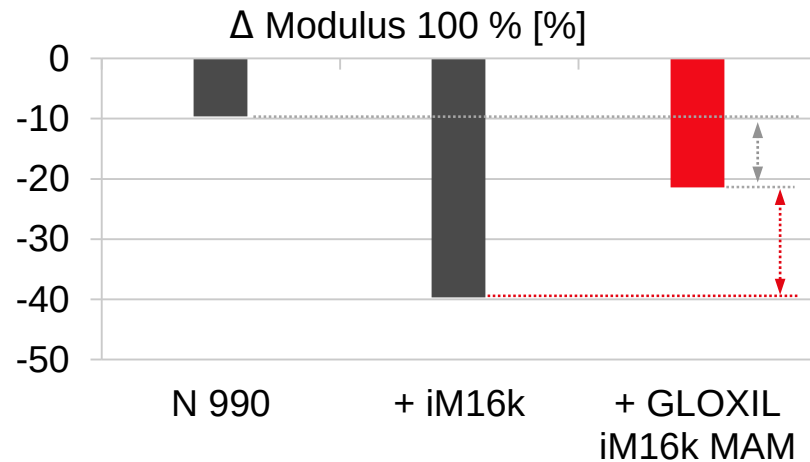
Resistance to fuel FAM B

70 h / 23 °C



GLOXIL iM16k MAM vs. N 990

comparable change of base properties
+ lower fuel absorption

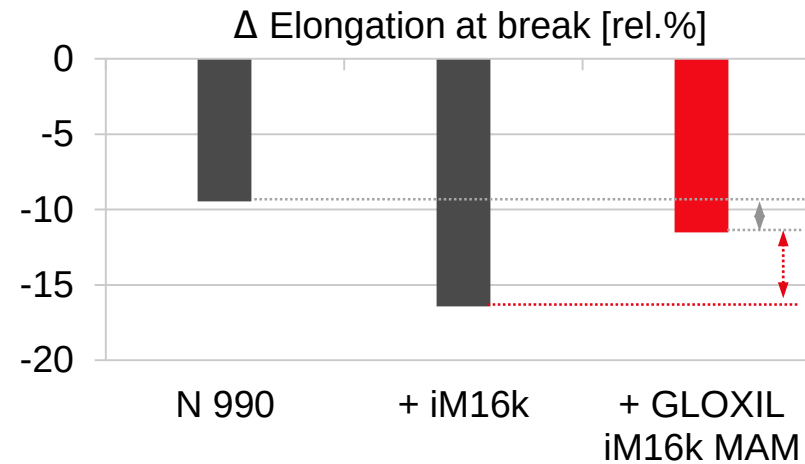
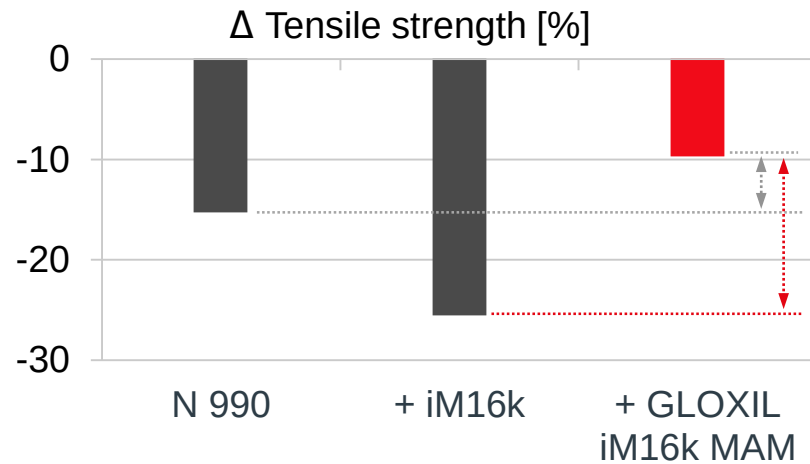


GLOXIL iM16k MAM vs. iM16k

lower change of base properties

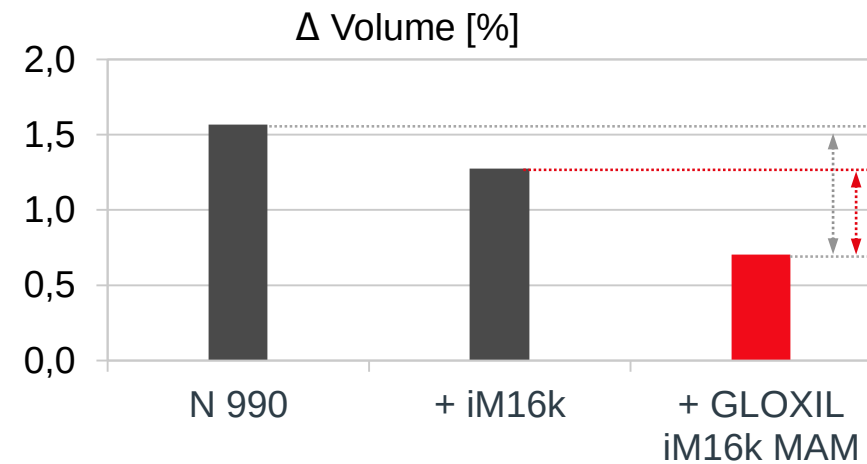
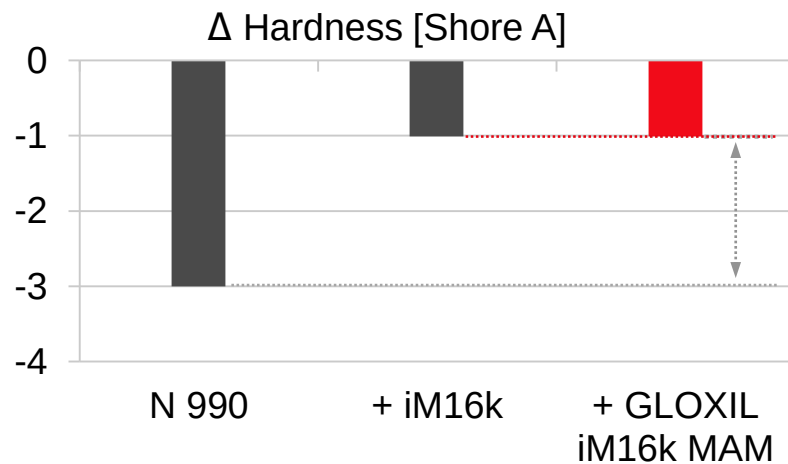
Resistance to oil OS206304

168 h / 150 °C



GLOXIL iM16k MAM vs. N 990

comparable change of base properties
+ more stable hardness
+ lower oil absorption

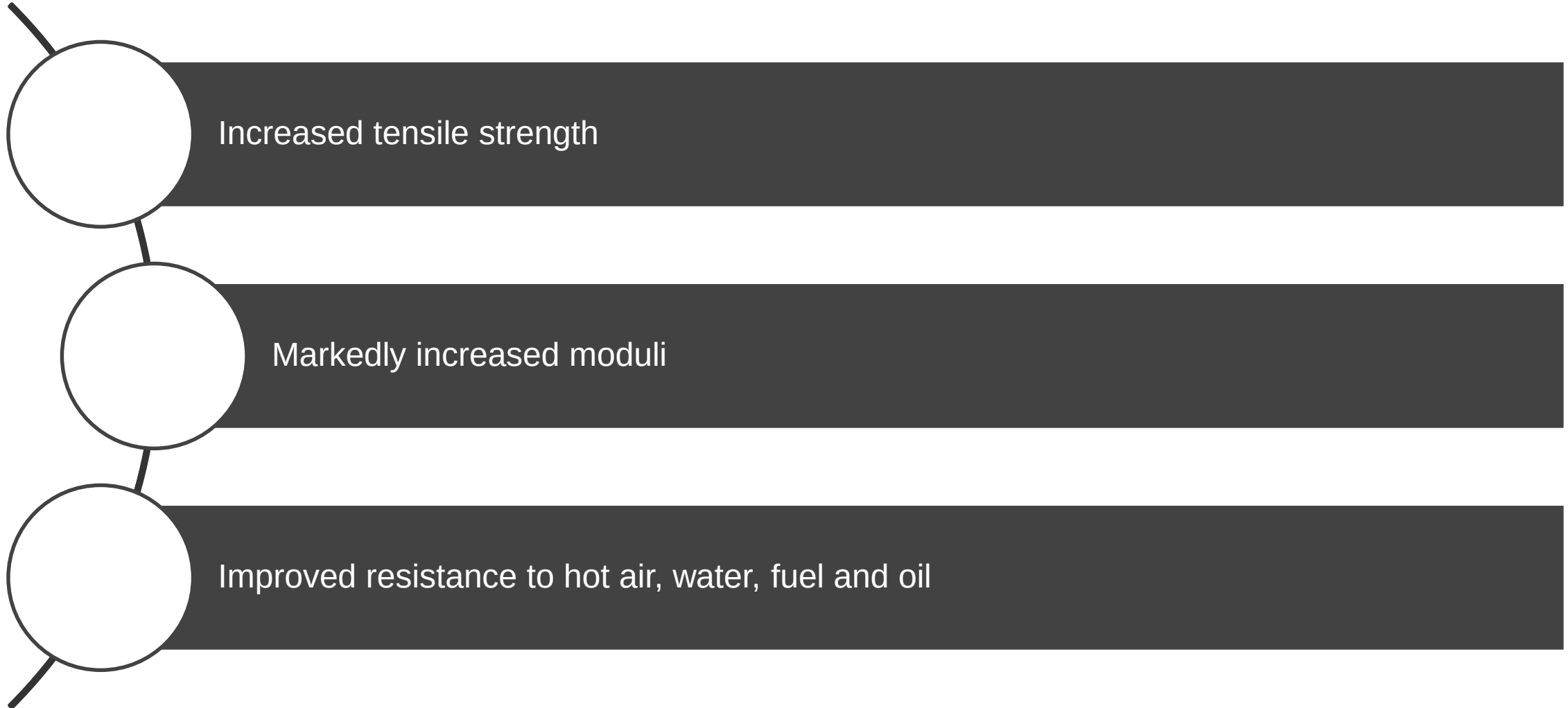


GLOXIL iM16k MAM vs. iM16k

markedly lower change of tensile properties
+ lower oil absorption



Functionalization of 3M™ Glass Bubbles iM16k with methacrylic silane





Partial replacement of carbon black N 990 with GLOXIL iM16k MAM





We supply materials for good ideas!

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Results in tabular form

		N 990	iM16k	GLOXIL iM16k MAM
Rheology				
Mooney Viscosity, ML 1+4, 120 °C	MU	41	48	49
Mooney Scorch, ML +5, 120 °C	min.	29	40	34
Rotorless Curemeter, M _{min} , 177 °C	Nm	0.04	0.05	0.05
Rotorless Curemeter, V _{max} , 177 °C	Nm/min.	2.2	2.2	2.3
Rotorless Curemeter, t ₉₀ , 177 °C	min.	1.0	1.0	1.0
Mechanical properties (cured 7 min. / 177 °C, post-cured 2 h / 230 °C)				
Hardness	Shore A	69	72	73
Tensile strength	MPa	22	15	18
Elongation at break	%	282	325	235
Modulus 100 %	MPa	4.3	3.6	6.6
Compression set 70 h / 230 °C / 25 %	%	25	31	29
Density (not post-cured)	g/cm ³	1.81	1.60	1.56



Results in tabular form

		N 990	iM16k	GLOXIL iM16k MAM
Resistance to hot air, 94 h / 230 °C, 30' after removal				
Hardness	Shore A	71	75	77
Tensile strength	MPa	26	19	19
Elongation at break	%	269	187	198
Modulus 100 %	MPa	5.5	9.6	9.5
Δ Hardness	Shore A	+2	+3	+4
Δ Tensile strength	%	+19	+22	+6
Δ Elongation at break	rel.%	-5	-43	-16
Δ Modulus 100 %	%	+28	+165	+44



Results in tabular form

		N 990	iM16k	GLOXIL iM16k MAM
Resistance to dist. water, 168 h / 60 °C				
Hardness	Shore A	68	63	70
Tensile strength	MPa	21	15	15
Elongation at break	%	336	368	260
Modulus 100 %	MPa	3.7	1.9	5.1
Δ Hardness	Shore A	-1	-9	-3
Δ Tensile strength	%	-2	+1	-16
Δ Elongation at break	rel.%	+19	+13	+10
Δ Modulus 100 %	%	-12	-47	-23
Δ Weight	%	+1.4	+4.1	+2.6
Δ Volume	%	+2.8	+6.4	+3.4



Results in tabular form

		N 990	iM16k	GLOXIL iM16k MAM
Resistance to fuel FAM B, 70 h / 23 °C				
Hardness	Shore A	61	63	65
Tensile strength	MPa	12	6,7	9,0
Elongation at break	%	206	228	176
Modulus 100 %	MPa	3.9	2.2	5.2
Δ Hardness	Shore A	-8	-9	-8
Δ Tensile strength	%	-44	-56	-49
Δ Elongation at break	rel.%	-27	-30	-25
Δ Modulus 100 %	%	-10	-40	-21
Δ Weight	%	+7.0	+6.2	+6.6
Δ Volume	%	+16	+13	+13



Results in tabular form

		N 990	iM16k	GLOXIL iM16k MAM
Resistance to oil OS206304, 168 h / 150 °C				
Hardness	Shore A	66	71	72
Tensile strength	MPa	18	11	16
Elongation at break	%	256	272	208
Modulus 100 %	MPa	4.4	3.8	6.7
Δ Hardness	Shore A	-3	-1	-1
Δ Tensile strength	%	-15	-25	-10
Δ Elongation at break	rel.%	-9	-16	-12
Δ Modulus 100 %	%	+2	+4	+2
Δ Weight	%	+0.8	+0.9	+0.8
Δ Volume	%	+1.6	+1.3	+0.7