ABOUT COMPANY

ABOUT US

Rubber Products LTD team turns rubber recycling into a commercially viable and environmentally clean process.

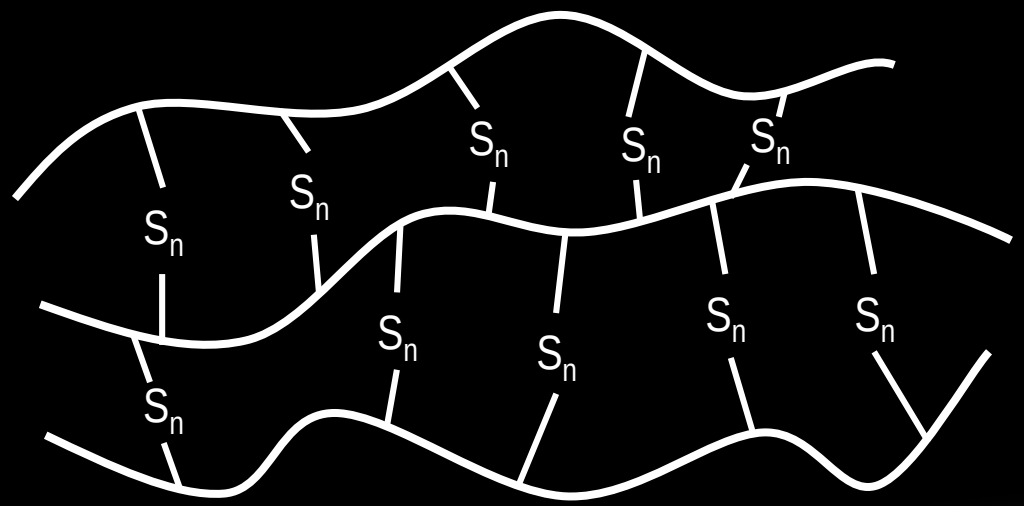
Our innovative and experienced management team ensures sustainability and viability of the project.

Rubber Products is a Company engaging in environmental technology:

- R&D of innovative natural and synthetic rubber alternatives.
- R&D of modern methods of waste rubber de-vulcanization.
- R&D of solutions for specific ecological problems in the field.
- Sales of licenses for the use of its technological solutions.
- Manufacturing of next generation ecofriendly equipment used in waste tire utilization.
- Building ready to use innovative and ecofriendly tire recycling plants.
- Financing programs elaboration, and product development services.
- Joint ventures with local organisations, for construction of recycling facilities

DEVULCANIZING

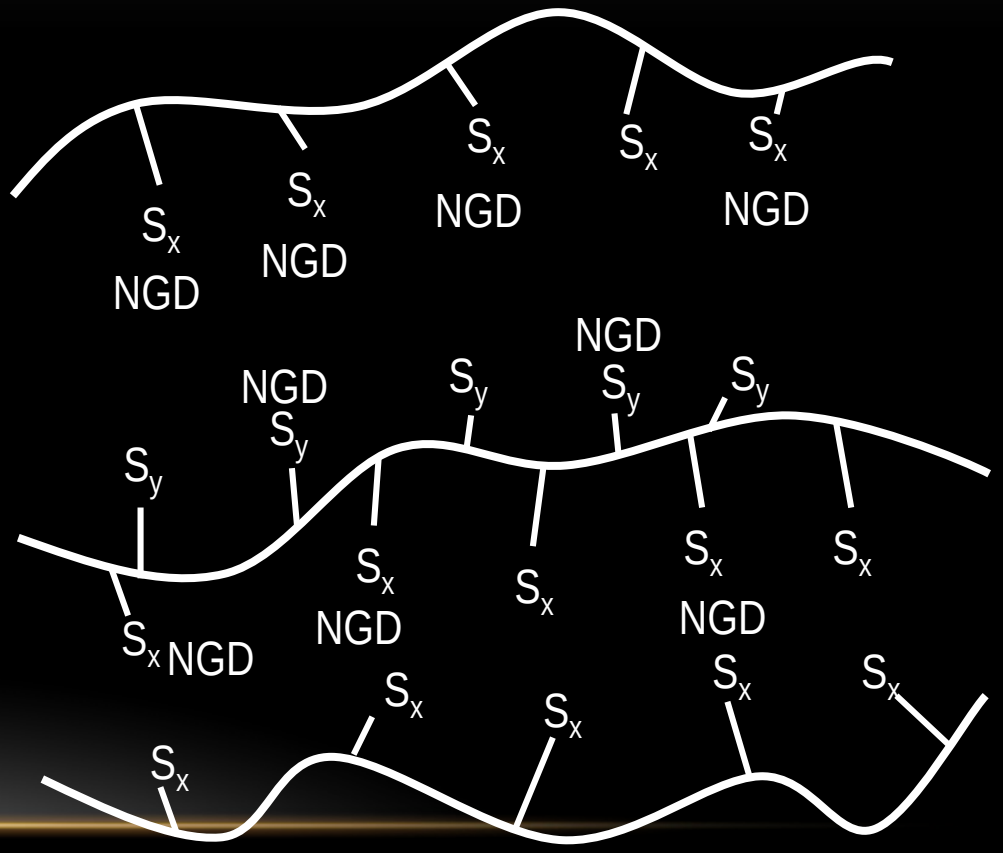
Vulcanized rubber



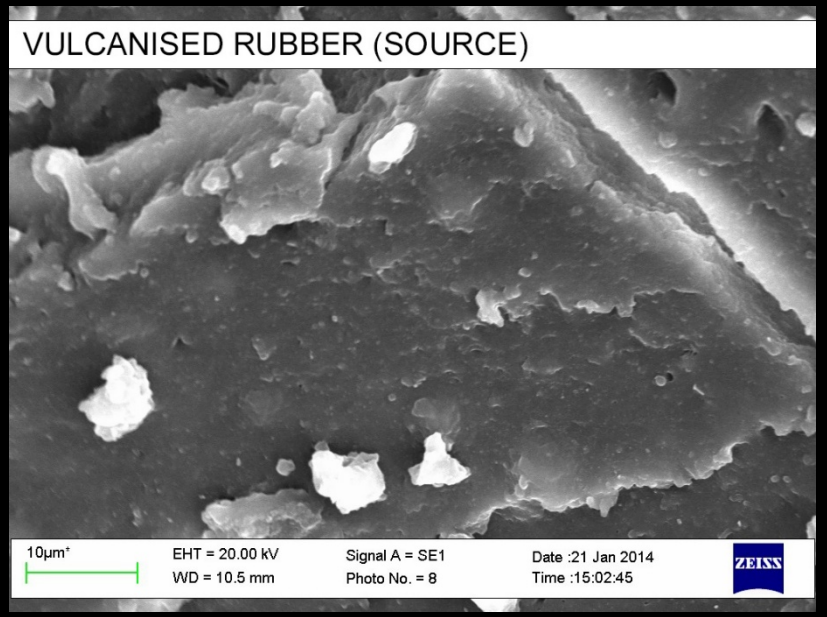
NGD

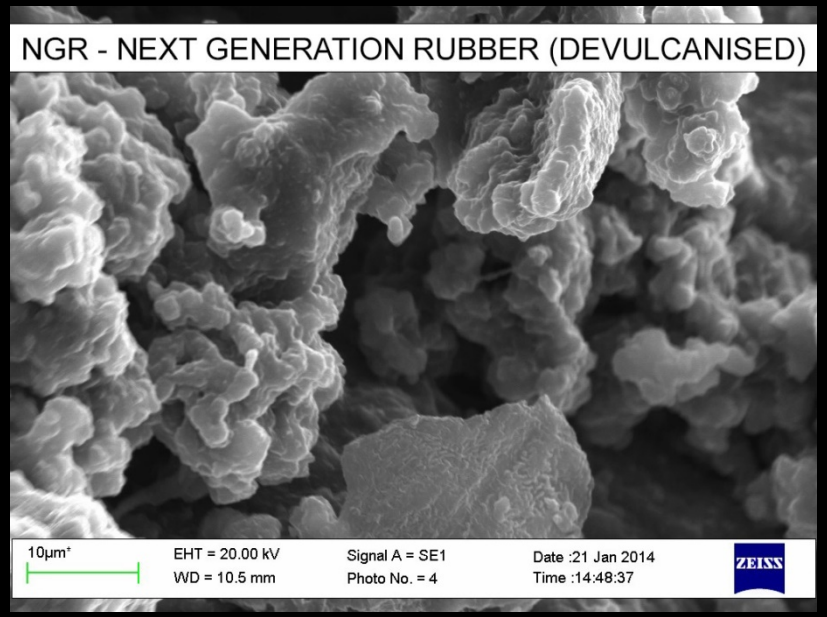
Mechanical impact

NGR



NGR – COMPOSITION AND STRUCTURE OF THE SURFACE





Composition	NGR
Rubber (mass %)	50,3
-content of Devulcanized Rubber (mass %)	13,4
Additives with low molecular weight and oil (mass %)	13,6
- General content of Sulfur (mass %)	1,8
- Carbon Black mass %)	21,5
- Noncarbon fillers (mass %)	14,6

Developed structure of the NGR surface allows to obtain high stability of interaction with raw rubber mix

TDS – OUTPUT PRODUCT CONTROL

Component	phr	%
TSR10 (pre-plastified)	100.0	26.2
ZnO	8.0	2.1
MBT	0.7	0.18
Stearic acid	3.0	0.79
S	5.0	1.31
NGR M	265.0	69.43
Total	381.7	100.00

Properties	Test method	Reference	Typical batch
Tensile strength, MPa	DIN 53504	Min 10	13.4
Elongation at break, %	DIN 53504	Min 300	450
Hardness Shore A	DIN 53505	57±5	55
Residual elongation after break %	DIN 53504	No norm	12

Recipe for track tire tread mix

ELASTOMER RESEARCH TESTING B.V.

Composition	Tread rubber	10 wt% NGR	20 wt% NGR	30 wt% NGR
SMR 10	80	80	80	80
Buna CB24	20	20	20	20
HAF N375	55	55	55	55
Nytex 840	8	8	8	8
ZnO	5	5	5	5
Stearic Acid	2	2	2	2
6PPD	2	2	2	2
TMQ	1	1	1	1
TBBS	1,5	1,5	1,5	1,5
Sulphur	1,5	1,5	1,5	1,5
NGR	-	17,3	34,6	51,9
Total	176	193,3	210,6	227,9

Properties	Tread rubber	10 wt% NGR	20 wt% NGR	30 wt% NGR
Cure optimum t90, min	6,79	5,47	5,23	5,28
Mooney viscosity	33,8	33,9	37,7	42,5
Hardness Shore A	70	73	73	74
Tensile strength, MPa	24,8	21,6	20,5	20,5
Elongation at break, %	483	418	401	395
Tear strength, kN/m	117	103	83	92
Abrasion resistance (Volume loss, mm^3)	93	97	104	107

The compounds containing powder are only slightly harder than the reference compound without addition of powder, but no significant effect on the moduli at different strain ratios can be observed. The tensile strength and elongation at break, and abrasion resistance reduces somewhat with increasing content of powder, but these values are **for all four compounds up to 30 wt% of powder still on a very acceptable level**. The powder particles do not seem to act as hard particles in the matrix causing early failure in the dumbbells.

Typical technical rubber goods compound

ELASTOMER RESEARCH TESTING B.V.

Composition	TRG	10 wt% NGR	20 wt% NGR	30 wt% NGR
TSR-10 (NR)	40	40	40	40
Europrene 1500 (SBR)	60	60	60	60
FEF-N550	75	75	75	75
Vivatec 500	5	5	5	5
ZnO	5	5	5	5
Stearic Acid	1	1	1	1
6PPD	1	1	1	1
TMQ	1	1	1	1
Sunolite 240	1	1	1	1
CBS-80%	1,8	1,8	1,8	1,8
TBzTD	0,7	0,7	0,7	0,7
Sulphur-80%	1,8	2,05	2,3	2,55
NGR	-	18,95	37,9	56,85
Total	193,8	213	232,2	251,4

Properties	TRG	10 wt% NGR	20 wt% NGR	30 wt% NGR
Cure optimum t90, min	5,35	3,27	2,86	2,79
Mooney viscosity	65,6	68,5	75,5	83,0
Hardness Shore A	72	72	74	74
Tensile strength, MPa	19,3	18,8	18,5	17,5
Elongation at break, %	234	241	241	227
Tear strength, kN/m	37	37	37	38
Abrasion resistance (Volume loss, mm^3)	79	82	92	98

There is no significant difference in hardness between the four compounds. There is only a slight effect of increasing content of NRG powder on the tensile properties: small reduction in tensile strength, elongation at break and moduli, but up to addition of 30 wt% of NRG powder, these properties stay on a very acceptable relative level.

Compound for standard SBR mix

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Composition	NGR-0	NGR-10	NGR-15	NGR-20
SBR, KER 1500	100.0	90.0	85.0	80.0
Stearic acid	2.0	2.0	2.0	2.0
ZnO	3.0	3.0	3.0	3.0
Carbon black, N-550	60.0	60.0	60.0	60.0
Oil, AN-68	10.0	10.0	10.0	10.0
TMQ	1.0	1.0	1.0	1.0
IPPD	0.7	0.7	0.7	0.7
Thiuram	0.2	0.2	0.2	0.2
CBS	1.2	1.2	1.2	1.2
Sulphur, S_8	1.8	1.8	1.8	1.8
Rubber powder, NGR	-	20.0	30.0	40.0
Σ	179.9	189.9	194.9	199.9

Parameters	NGR-0	NGR-10	NGR-15	NGR-20
Scorch time, τ_{02}	3’9”	2’19”	1’54”	1’49”
Optimum time of vulcanization, τ_{90}	7’42”	5’26”	5’3”	6’2”
M_L [dNm]	10.2	10.5	20.8	39.7
M_H [dNm]	41.3	39.5	80.9	98.2
ΔM [dNm]	31.1	29.0	60.1	58.5
Hardness [°Sh A]	60	64	66	66
TS [MPa]	15.2	13.6	12.5	14.2
E_B [%]	475	306	265	297
TES [kN/m]	42.6	43.1	39.9	42.6

The results obtained for NGR series vulcanizates prove that it is possible to replace up to 20 phr of rubber with rubber powder, **without any significant deterioration of mechanical properties and ageing resistance of standard rubber vulcanizates based on SBR**. However, one can simultaneously take care of ca. 50 % reduction of scorch time and ca. 50 % increase of the increment of vulcametric modulus for the modified mixes, being the consequence of the introduction of high amount of rubber powder. It means that processability of rubber mixes deteriorate with admixing of NGR.

Typical compound for tire tread mix

Composition	MB-0	MB-1	MB-2
SBR, KER 1500	240.0	200.0	200.0
BR, SKD II	150.0	125.0	125.0
NR, RSS-1 (plast.)	210.0	175.0	50.0
Stearic acid	12.0	10.0	10.0
ZnO	18.0	15.0	20.0
Carbon black, N-330	360.0	300.0	310.0
Oil	72.0	60.0	80.0
Kumaronic resin	18.0	15.0	15.0
KN resin	18.0	15.0	15.0
IPPD	4.2	3.5	3.5
TMQ	6.0	5.0	5.0
Rubber powder, NGR	-	190.0	190.0
CBS	7.2	6.0	6.0
Thiuram	1.2	1.0	-
Sulphur, S_8	13.2	11.0	12.0
Σ	1129.8	1131.5	1041.5

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Parameters	MB-0	MB-1	MB-2
Scorch time, τ_{02}	2'50"	2'09"	2'22"
Optimum time of vulcanization, τ_{90}	4'15"	4'10"	5'53"
Hardness [°Sh A]	65	67	73
TS [MPa]	19.8	14.2	12.5
E_B [%]	454	353	240
TES [kN/m]	42.7	41.5	32.0
Compression set [%]	25.7	28.4	29.1
Ageing resistance:			
- ΔTS [MPa]	+1	+4	+7
- ΔE_B [%]	-18	-15	-23
Friction force [N]:			
- n = 60 rpm	4.3	7.7	9.0
- n = 100 rpm	7.1	9.5	10.0
Abrasion [mm^3]	107	96	124

Even the mixes highly loaded with rubber powder exhibit acceptable by tire industry level of tensile strength and elongation at break of their vulcanizates. Together with practically the same compression set and ageing resistance as the reference tire tread material, MB-1 vulcanizates can be successfully applied for the solid wheel production.

TRACK TIRE TREAD

ELASTOMER RESEARCH TESTING B.V.

Properties	Basic rubber	30% Rubber crumb	30% NGRb
Tensile strength, Mpa	24,8	14,6	20,5
Elongation at break, %	483	280	395
Hardness Shore A	70	75	74
Abrasion resistance (Volume loss, mm^3)	93	110	107
Tear strength, N/m	117	72	92

Application of NGR in the composition of tread rubber mixes allows to obtain compositions with required complex of features and at the same time to save the valuable raw material. Particles of NGR are not the stress concentrators, which weaken the material.

Base compound – EUR 2000 .00
NGR – EUR 650.00
Gains = 2000 – (2000*0,7+650*0,3) = EUR 405.00 or 20,25%

INDUSTRIAL TIRES

Solid wheel No.1 – commercial product, manufactured from Rubber crumb (smooth rubber surface)
Solid wheel No. 2 – commercial product, manufactured from Rubber crumb, mixed with Polyurethane Rubber

Features	Solid wheel No. 1	Solid wheel No. 2	20% NGR
Hardness [°Sh A]	91	73	67
Abrasiveness [mm^3]	1393	264	96
Density [g/cm^3]	1.54	1.13	1.14
Aging resistance: - ΔH [°Sh A]	+2	+2	+6

Masterbatch – 1700 EUR/t.
NGR – 600 EUR/t.
Gains = 1700 – (1700*0,8+650*0,2) =
= 210 EUR/t or 12,3%

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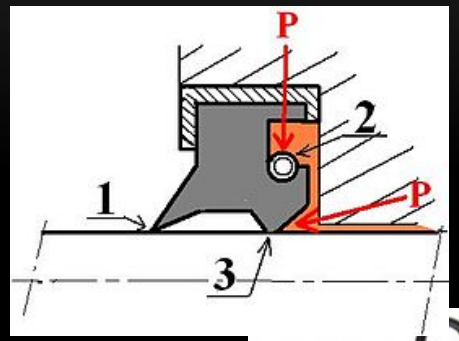
Wear resistance of the Vulcanized Rubber with 20% NGR significantly higher in compare with commercial material for Industrial solid tires No.1 and No.2

OIL- PETROL RESISTANT RUBBER



Parameter	Basic rubber	Basic rubber + 20% NGR
Tensile strength, Mpa	8,4	8,1
Elongation at break, %	220	232
Shore Hardness	67,7	65,3
Compression set	35,2	33,7
Change in properties after ageing 100°C 24 hrs		
Tensile strength	12,2	5,5
Elongation at break	-37,7	-10,3

Masterbatch – 2100 EUR/t.
NGR – 650 EUR/t.
Gains = 2100 – (2100*0,8+650*0,2) =
= 290 EUR/t. or 13,8%

Reduction of Compression set, as well as increasing the resistance to the thermal aging allows to obtain the seals with increased life-time. At that application of NGR allows to obtain the additional cost advantage due to replacement of the expensive Rubbers.

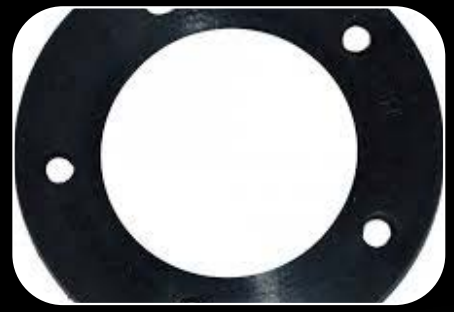
MASTERBATCH

Conveyor belts

Cushions

Carpets

Protecting covers



Seals

Fenders, bumpers

The Masterbatch with high content of NGR, which could be applied for manufacturing of different Rubber goods, was elaborated.

Dosage NGR	60% NGR
Modulus 100%, MPa	2,64
Tensile strength, MPa	10,1
Elongation at break, %	210
Shore A Hardness	64,2
Density, kg/m^3	1151

ECONOMICAL STRENGTH

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- Possibility of NGR application in the Rubber industry of Poland.
-
- Industry of Poland covers 12% of Rubber consumption in EU.
- The yearly production of Rubber goods and Tires in Poland is 800 000 tones. Among them - 56% - Tires, 8% -Conveyor belts, pipes and hoses, and 32% - Rubber goods.
- Approximate volume of Rubber compounds manufactured in Poland is about 500 000 tones.
- Potential market for NGR in Poland is estimated in 30 000 tones per year.

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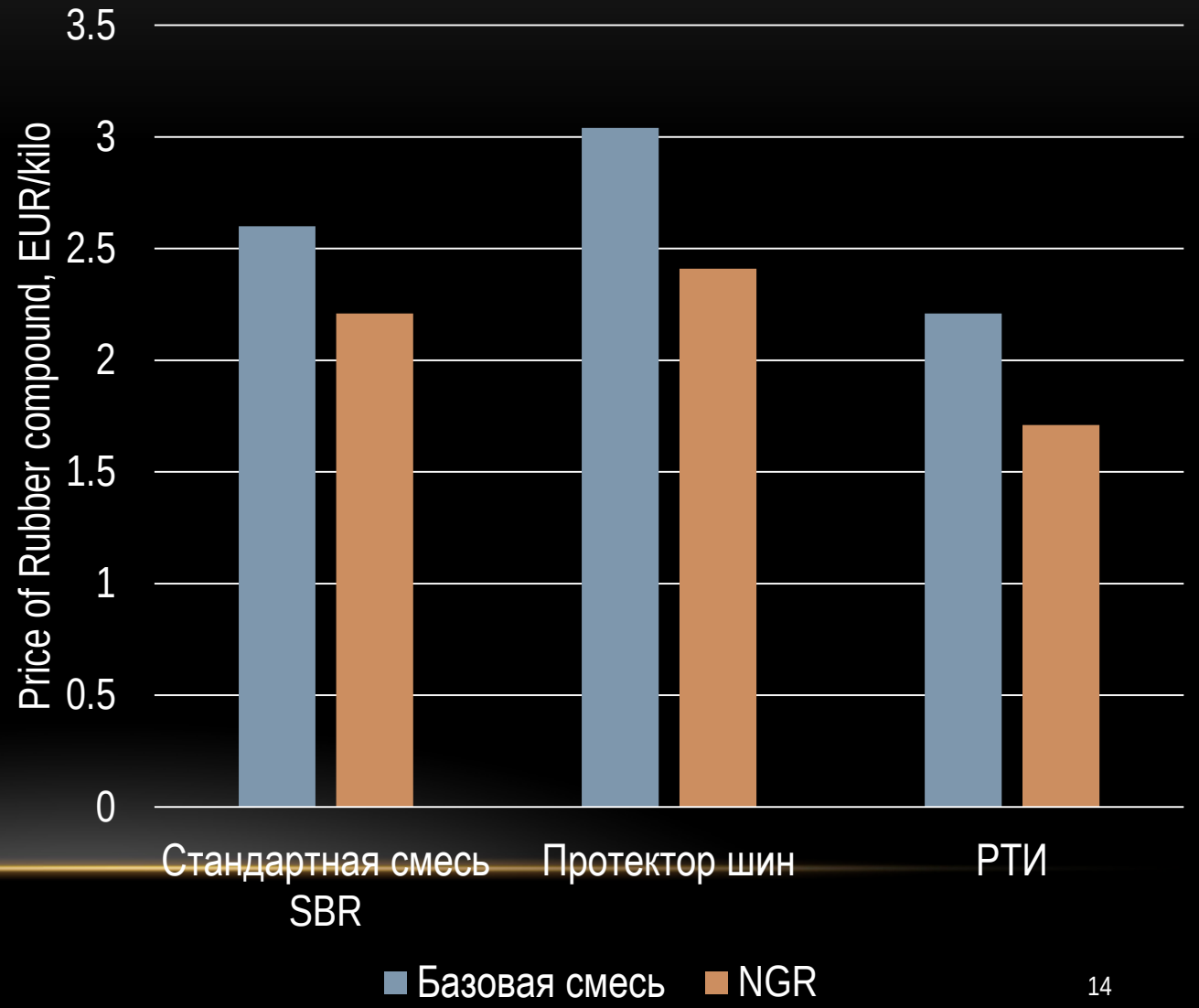
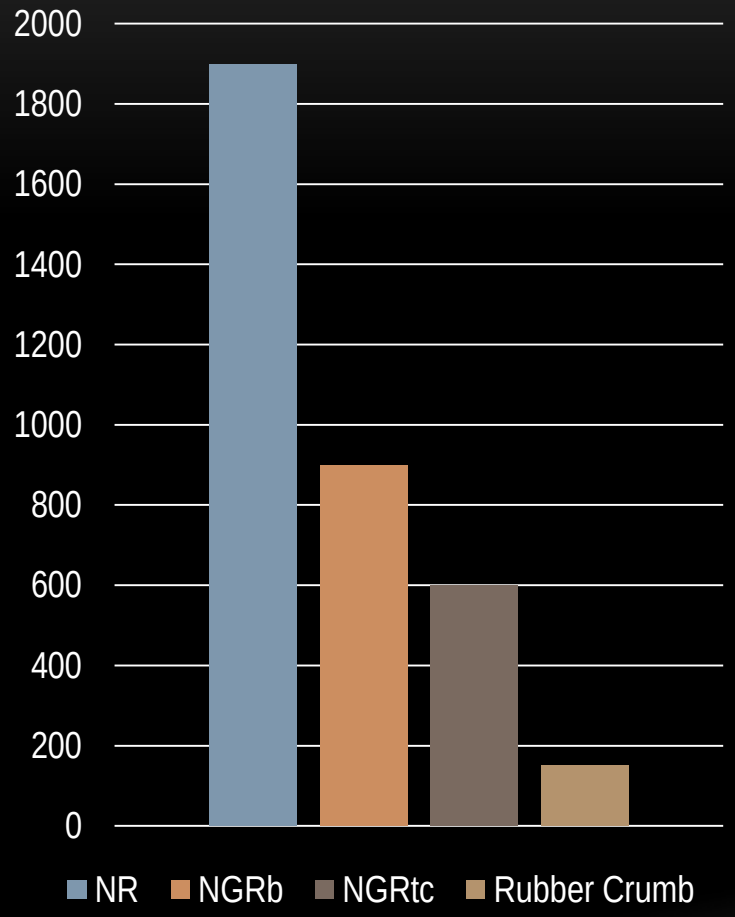
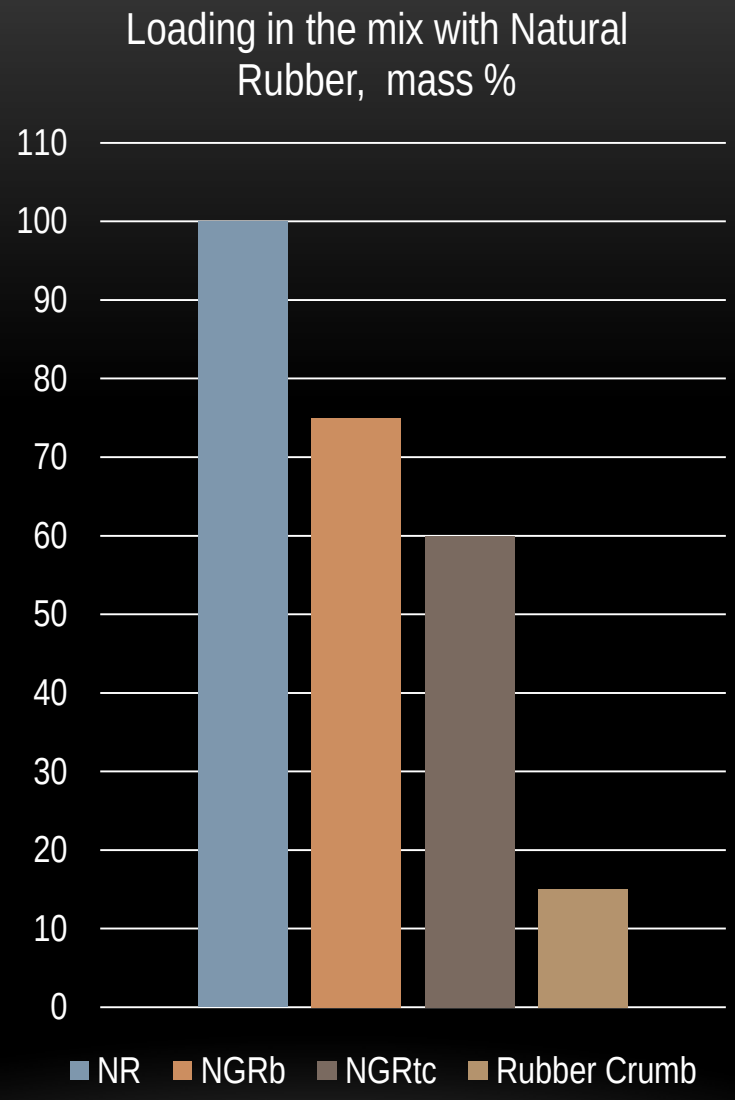
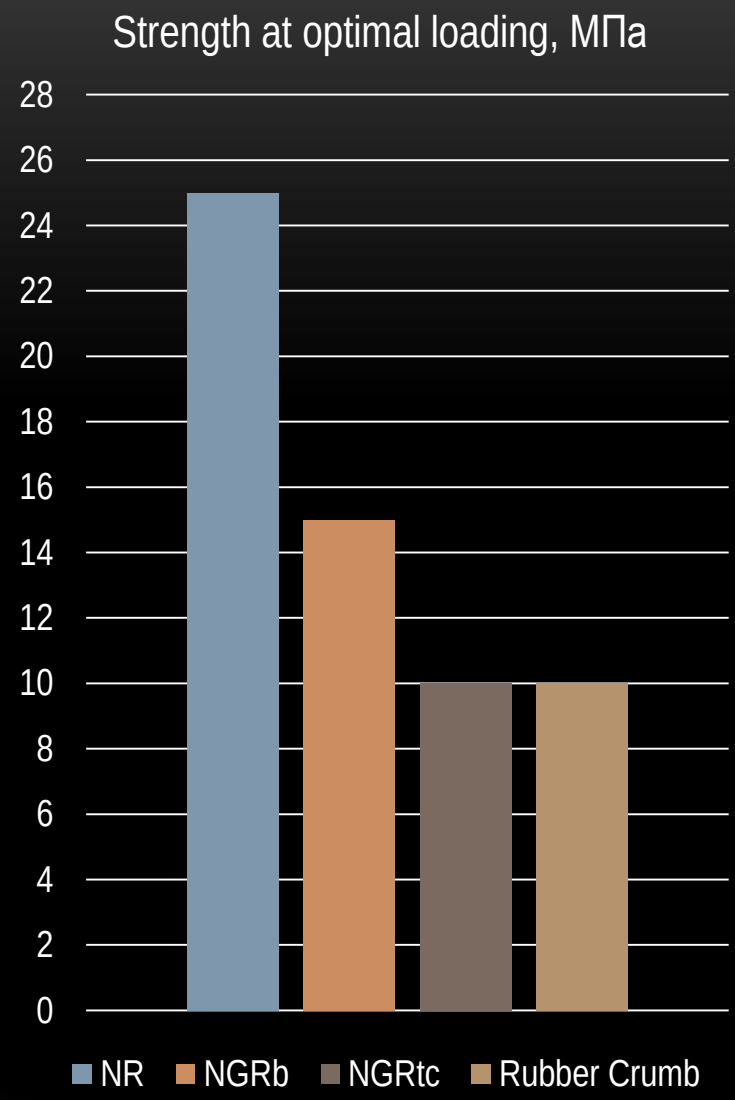
ECONOMICAL STRENGTH

- Including of the NGR to the Masterbatch on the base of SBR gives the opportunity to decrease the cost of material from 2,60 to 2,21 EUR/kilo, i.e. by 15%. In this case the reduction of time of manufacturing amounts about 10%.
- NGR application in the rubber compounds for tire treads gives the cost reduction of the material from 3,04 EUR/kilo till 2,41 EUR/kilo, i.e. by 12,5%.
- NGR application in the rubber compounds for Rubber goods gives the cost reduction of the material from 2,21 till 1,71 EUR/kilo, i.e. gives 22% gains. Additional advantage is reduction of time of manufacturing by 17%.









NGR could substitute 60-80% of Rubber in the rubber compound. NGR is much more effective than conventional Rubber crumb. Having the equal features of Rubber, the content of NGR usually 5-7 times higher than conventional Rubber crumb. NGR application allows obtaining significant economical effect due to expensive Rubbers saving.