

善贞集团

SaneZen Group

better together

轮胎行业绿色低碳发展趋势与创新应用

Green and Low-Carbon Development Trends and Innovative Applications in the Tire Industry



---- 橡胶解决方案的服务商

Rubber Solution Provider

进取Enterprising

高效Efficient

共赢Win-Win



I. Global Regulations and Policy Drivers for Green and Low-Carbon Development

II. Responsibilities and Core Aspects of the Tire Life Cycle in a Low-Carbon Context

III. Leading Tire Enterprises Under Low-Carbon Demand—Sustainable Material Applications

IV. SANEZEN Group – Low-Carbon Technology & Solutions



European Union

- **European Green Deal:** Reduce tire rolling resistance by 20% by 2030. Achieve carbon neutrality by 2050
- **Tire Labeling Regulation (EU 2020/740):** Mandatory grading: Rolling resistance, wet grip, noise levels. REACH Regulation: Restricts harmful substances (e.g., PAHs) in tires

China

- **Tire Industry Policy (2023 Revision):** Promotes green manufacturing & low-rolling-resistance tires
- **China Tire Labeling System (GB/T 29042-2021):** Aligns with EU standards (energy efficiency labels)
- **Circular Economy Promotion Law:** Waste tire recycling target: 90% by 2025
- **"Dual Carbon" Policy:** Drives production optimization (renewable carbon black, bio-based rubber)

United States

- **EPA SmartWay Certification :** Incentivizes low-rolling-resistance & low-emission tires
- **California SB 596:** Mandates carbon footprint disclosure for tire products
- **H.J.Res.61 (2025):** Repeals EPA's Total Hydrocarbon (THC) emission limits for tire plants. Avoids costly thermal oxidizer installations

Japan & South Korea

- **Japan's Energy Conservation Law:** Requires tire rolling resistance compliance (JIS D 4230)
- **Korea's Resource Circulation Act:** Mandates tire manufacturer participation in recycling programs
- **Japan Green Transformation Plan (2023):** ¥2 trillion subsidy for decarbonization tech (e.g., bio-based polymers for rubber)

Region	Policy Framework Characteristics	Core Objectives	Enforcement	Innovation Incentives	Corporate Focus Areas
EU	Full-lifecycle regulatory system	Circular economy + CBAM preparation	★★★★☆	R&D subsidies + green procurement	Digital passports, low-carbon material substitution
China	Capacity phase-out + technology upgrade catalog	Energy efficiency improvement + industry consolidation	★★★★☆	Green factory certification, tax incentives	Smart manufacturing, overseas capacity relocation
US	Production deregulation + technology incentives	Cost control + industry reshoring	★★★☆☆	IRA tax credits	Low-carbon tire development, trade policy lobbying
Japan/Korea	Industry alliance-led technological breakthroughs	Circular material commercialization	★★★☆☆	Special funding support	Bio-based/recycled materials development, technology export



Our transition to greener mobility is offering clean, accessible and affordable transport and logistics solutions to all Europeans, connecting rural and remote regions.

With the new CO2 standards, **all new cars and vans registered in Europe will be zero-emission by 2035**. As an intermediary step towards zero emissions, average emissions of new cars will have to come down by 55% by 2030, and new vans by 50% by 2030. This will put road transport on a firm path to zero-emission mobility in 2050.

55%

reduction of emissions
from cars by 2030

50%

reduction of emissions
from vans by 2030

0

emissions from new cars
by 2035

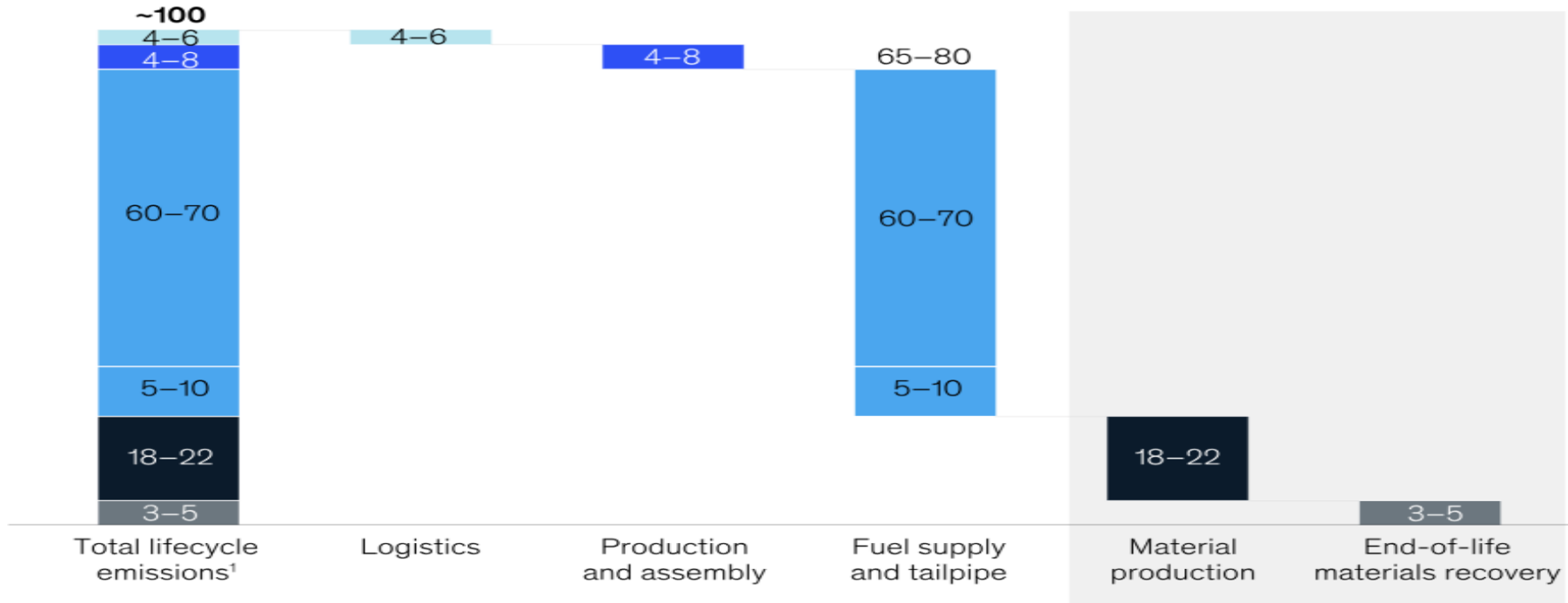
Making transport sustainable for all





The automotive industry has largely focused on the reduction of tailpipe emissions; reducing material production emissions should also be a priority.

% of total current life-cycle emissions of internal combustion engine vehicles



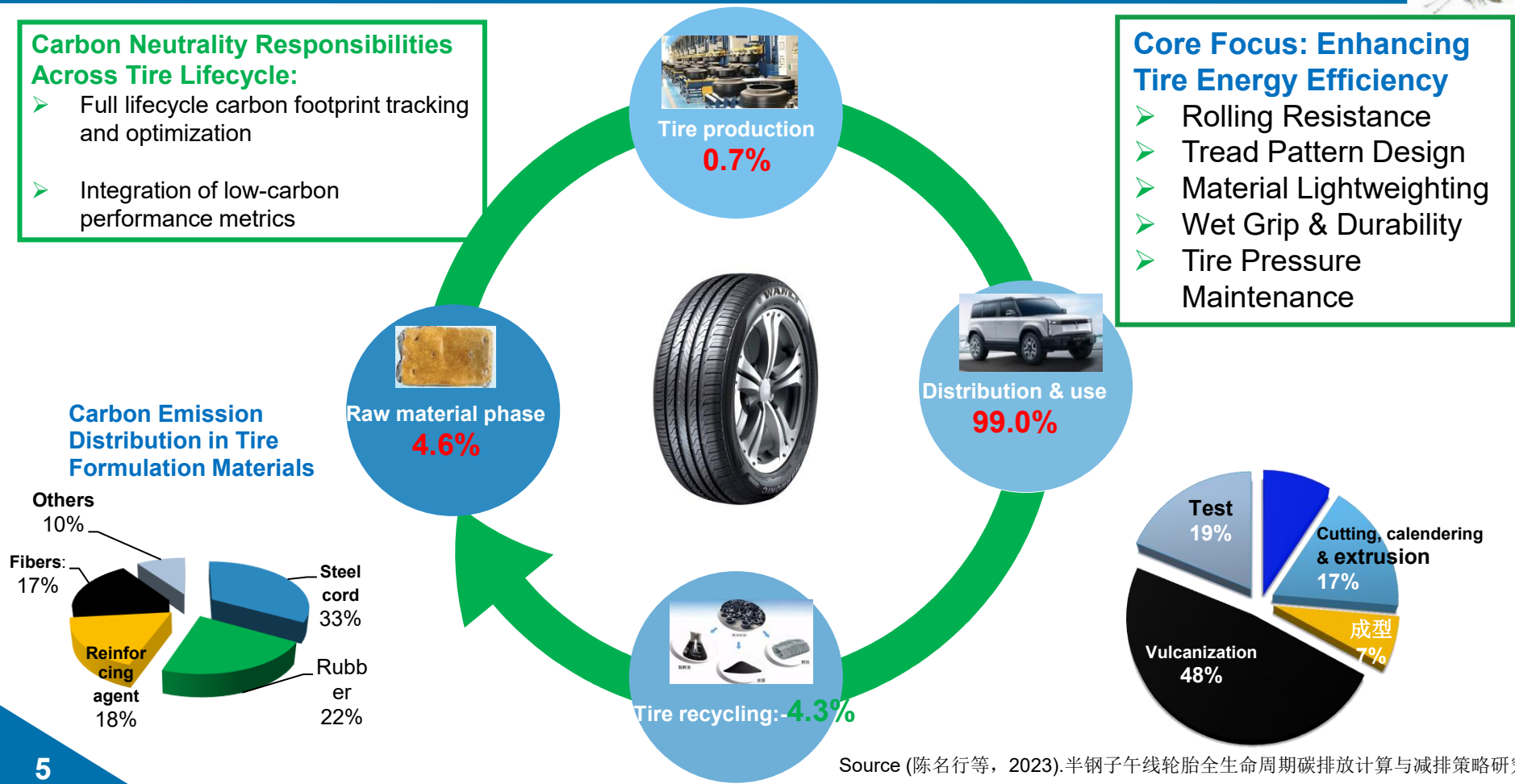


Carbon Neutrality Responsibilities Across Tire Lifecycle:

- Full lifecycle carbon footprint tracking and optimization
- Integration of low-carbon performance metrics

Core Focus: Enhancing Tire Energy Efficiency

- Rolling Resistance
- Tread Pattern Design
- Material Lightweighting
- Wet Grip & Durability
- Tire Pressure Maintenance





Rubber System	Reinforcement System	Filling System	Plasticizer System	Aging Resistance System (Others)	Vulcanization System
Natural Rubber Alternatives	Green Carbon Black Tech	Filler Innovations	Bio-based Plasticizers	Green Antioxidants	Eco-Friendly Vulcanization
Continental (Germany) & Goodyear (USA): Dandelion rubber tires	Bridgestone: Methane-cracked "Green Carbon Black"	Pirelli (Italy): Volcanic ash filler (Project Etna)	Goodyear: Soybean oil plasticizer (70% content)	Continental: Vitamin E-derived antioxidants	Zhongce Rubber (China): Amino acid-based eco-accelerators
Bridgestone (Japan) & Pirelli (Italy): Guayule plant-based natural rubber	Hankook (Korea): Pyrolyzed recycled tire carbon black	Nokian (Finland): Arctic pine cellulose filler	Zhongce: Rice bran oil plasticizer tires	Kumho (Korea): Plant tannin anti-aging agents	Doublestar (China): Nano-zinc oxide reduction tech (30% less usage)
Bio-Synthetic Rubber	Bio-Based Silica	Industrial Byproduct Utilization	Bio-Based Resins	Renewable Resins	
Michelin (France): Bio-isoprene rubber	Michelin: Rice husk ash silica (Bio-Silica)	Yokohama (Japan): Steel mill slag micro-powder filler	Bridgestone: Rosin-derived plasticizers	Goodyear: Renewable pine resin replaces petroleum-based resins	
Recycled Rubber Applications Sailun Group (China): Uses recycled rubber powder from end-of-life tires (15-30% content) Linglong Tire (China): Applies recycled rubber	Cheng Shin Rubber (Taiwan, China): Bamboo charcoal-modified silica	Triangle Tyre (China): Fly ash-based porous filler	Sentury Tire (China): Corn starch-based reinforcing agent		



Low-Carbon Technology: Pioneering a Sustainable Future

SANEZEN Group — Always on the Path of Action...



ESG Environment Social Governance

Environment, society, governance

Environment

Reduce carbon emissions:

Adopt photovoltaic clean energy and low energy consumption equipment, and optimize the mixing process to reduce energy consumption.

Save resources:

optimize the mixing process to reduce energy consumption, reuse packaging materials, optimize the supply chain network to reduce energy consumption.

Waste management:

Establish an effective waste management system, including waste reduction, recycling and safe disposal.

Social

Employee benefits:

Establish sound labor relations, protect the rights and interests of employees, and provide good working environment and welfare benefits.

Safe production:

Develop and implement safe production policies to ensure the safety of employees and the community.

Community participation:

Actively participate in local community affairs, carry out public welfare activities, and give back to society.

Governance

Independent directors and regulators:

establish an independent board of directors to strengthen the independence of decision-making and supervision of enterprises.

Compliance with regulations and ethical standards: comply with applicable laws, regulations and ethical standards to ensure that the enterprise operates in compliance with regulations.

Risk management:

Establish an effective risk management mechanism to identify, assess and manage ESG-related risks.



SANEZEN Group

As a global pioneer in tire material innovation, SANEZEN is driven by the mission of "Technology Powering a Sustainable Future." The company specializes in the research, development, and production of high-performance tire materials. With three major technology centers in Shanghai, Anhui, and Changzhou, SANEZEN has established a robust R&D network and a comprehensive innovation system across the entire industrial chain, providing tire manufacturers with eco-friendly and sustainable solutions.

In the field of new material development, SANEZEN has introduced:

Fully bio-based filler enhancers (EG Series) to improve wet grip and reduce rolling resistance.

Nano silicon-aluminum alloys (NSA Series) to enhance wet traction performance.

Carbon nanotubes (CNI Series) to boost thermal conductivity and optimize the performance of electric vehicle tires.

Fully bio-based nano lignin (LG Series) as a partial replacement for carbon black, reducing CO₂ emissions while increasing tear strength.

Leveraging its core technologies, SANEZEN reduces carbon emissions and mixing energy consumption. The company's "Dynamic Reinforcement Model" optimizes the filler network, minimizing heat generation during production.

SANEZEN Group

Committed to ESG principles, SANEZEN Group ensures its products comply with EU REACH/ROHS standards, achieving a higher proportion of low-carbon emissions.

The company is shifting its focus toward bio-based materials in R&D, offering a product line that includes tire functional additives, bio-based materials, and green solutions.

Through the dual drivers of "material innovation + refined processes," SANEZEN is propelling the tire industry toward a future of high performance and sustainability.



Tires

High-performance Eco-friendly Materials





EG22 is a filler enhancer specifically designed for high-filler rubber compounds to promote silanization reactions, particularly suitable for systems containing high-surface-area fillers (e.g., silica). It improves the degree of silanization and features a unique chemical structure that ensures better compatibility and dispersion in rubber compounds, forming a more efficient network in the rubber matrix to enhance overall performance.

➤ Key Features

- 1. Filler Dispersion & Mixing Performance:** Promotes rapid filler incorporation and dispersion, significantly reducing mixing cycles. Lowers Mooney viscosity, improving compound flowability and subsequent processing.
- 2. Filler (Silica, etc.) Treatment Effect:** Reduces filler (e.g., silica) particle aggregation, effectively minimizing the Payne effect and stabilizing Mooney viscosity.
- 3. Enhanced Physical Properties :** Improves tear resistance without negatively affecting other properties or abrasion resistance. Minimizes compression heat buildup, extending tire service life.
- 4. Dynamic Performance Optimization :** Enhances filler dispersion, contributing to improved rolling resistance and wet grip performance.

Application Guidelines

- Addition Method: EG22 is typically added in the first mixing stage.
- Recommended Dosage: 2-5 PHR (adjustable based on process requirements and performance targets).



GreenThinking

产品名称 (Material Name): GreenThinking® EG22

包装描述(Packing Description): 25Kg/Bag

发货数量 (Delivery Quantity):

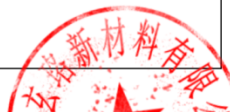
交货日期 (Delivery Date):

生产批号 (Batch No.): PFEG240716B01

检验日期 (Test Date): 2024-7-17



检测项目 Item	单位 Unit	下线 Limit Lower	上线 Limit Upper	检测结果 Test Result
外观 Appearance			白色	
950℃ 灰分 Ash content	%		0.5	0.08
105℃ 加热减量 Heating loss	%		1.5	0.97
熔点 Melting point	℃	56	66	61.1
判定状态 Conclusion			合格 PASS	



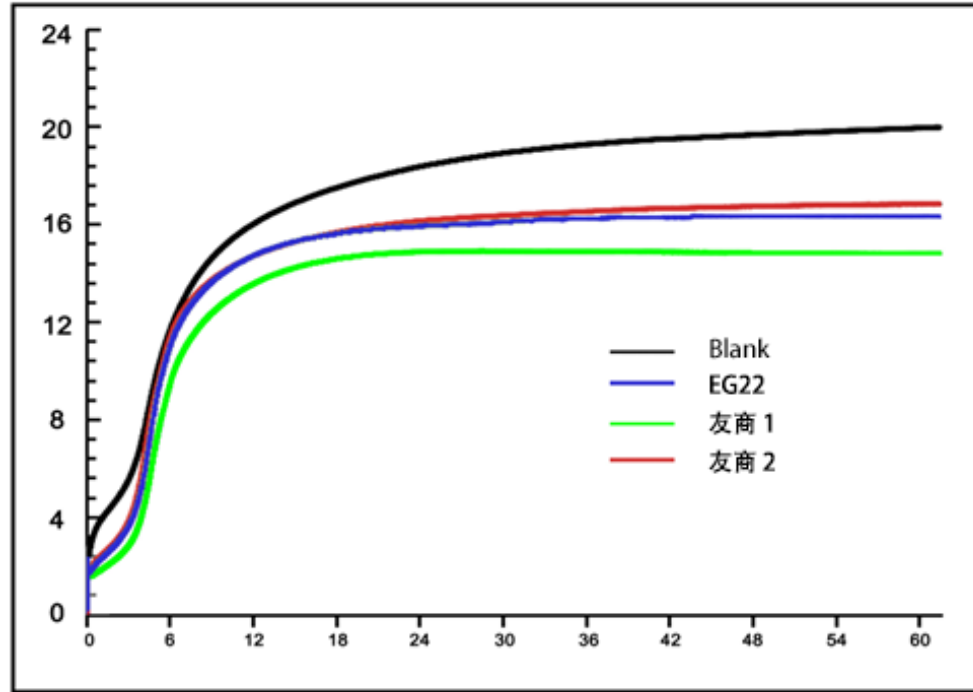


No.	Material Name	Blank	EG22	Competitor 1	Competitor 2
1	SSBR (Oil-extended, 37.5%)	96	96	96	96
2	BR	30	30	30	30
3	PT702	80	80	80	80
4	N330	6.4	6.4	6.4	6.4
5	SI-69	6.4	6.4	6.4	6.4
6	ZnO	3	3	3	3
7	SA	2	2	2	2
8	RAE Eco-Friendly Oil	10	10	10	10
9	Microcrystalline Wax	1	1	1	1
10	4020	1.5	1.5	1.5	1.5
11	S	1.5	1.5	1.5	1.5
12	DPG	2	2	2	2
13	CZ	1.5	1.5	1.5	1.5
14	EG22 (Bio-based)		4		
14	Competitor 1			4	
14	Competitor 2				4
Total		241.3	245.3	245.3	245.3



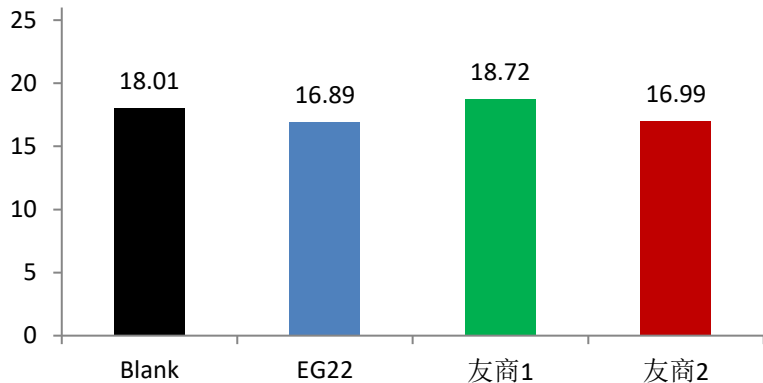
EG22 Vulcanization Characteristics : 160°C ×60min

Test project	Blank	EG22	Competitor 1	Competitor 2
ML(dN.m)	2.46	1.92	1.61	1.86
MH(dN.m)	20.01	17.63	14.95	16.94
T10 (min)	1.45	2.55	3.19	2.62
T50 (min)	5.67	5.03	5.4	5.11
T90 (min)	22.39	12.41	11.91	15.08
TS1 (min)	0.62	1.85	2.75	1.74
TS2 (min)	1.81	3.11	3.77	3.01

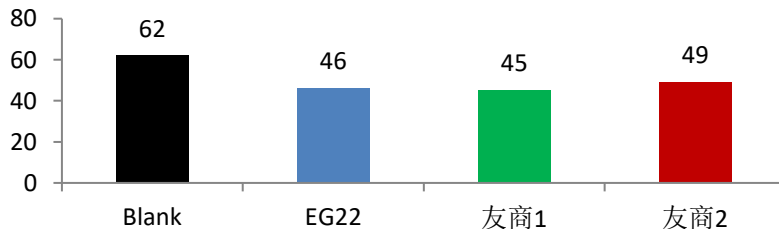




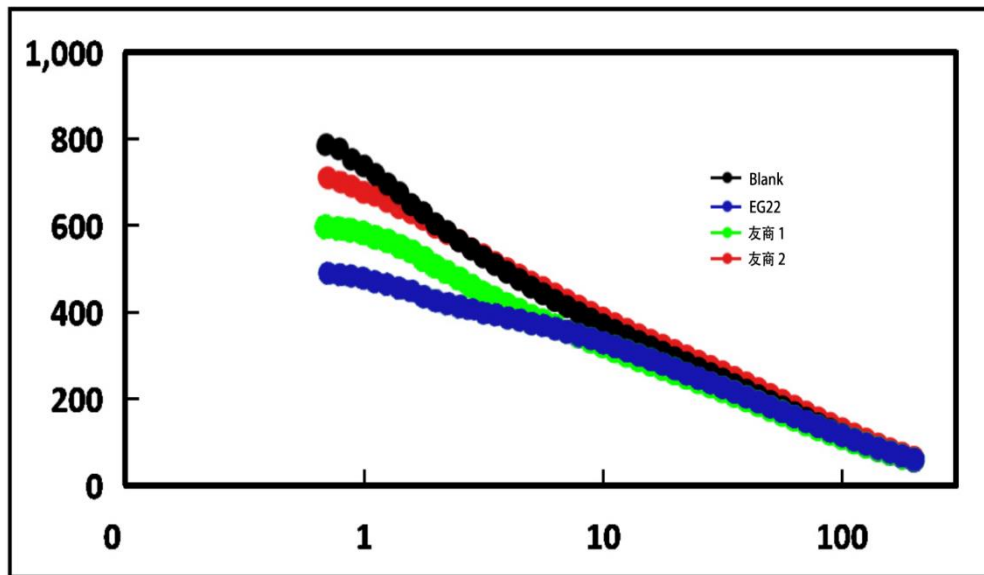
Ts5 (min)



Mooney Viscosity ML1+4



RPA Strain Sweep @60° C , G'



EG22:

1. Effectively reduces the Payne effect and enhances rubber performance.
2. Lowers Mooney viscosity, improves silica dispersion and mixing efficiency.

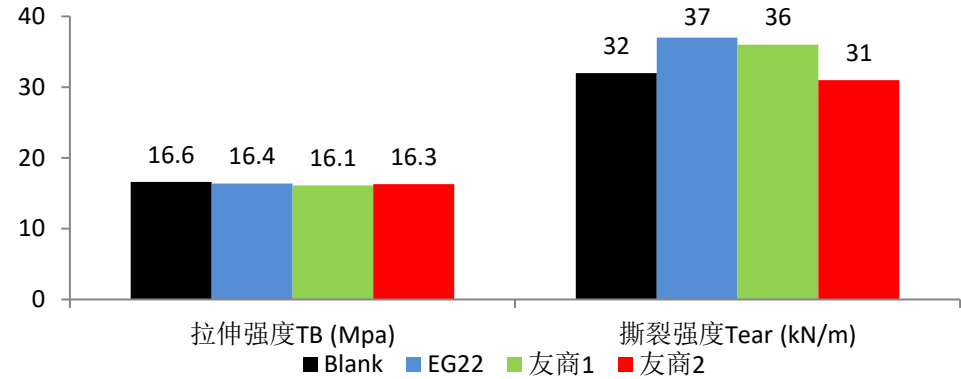
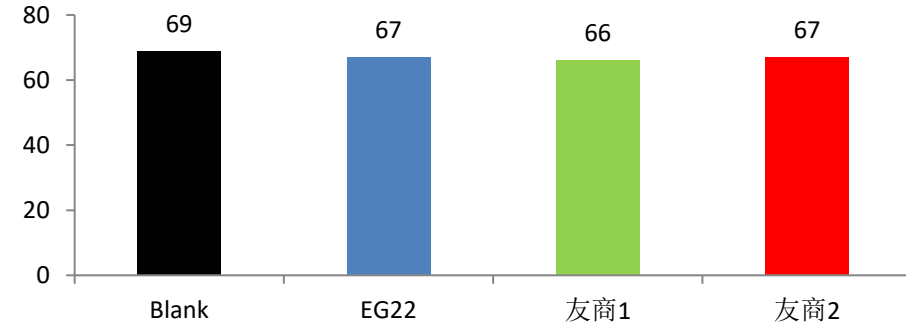


➤ 试片硫化条件 **Curing Condition:** 160°C × 30min

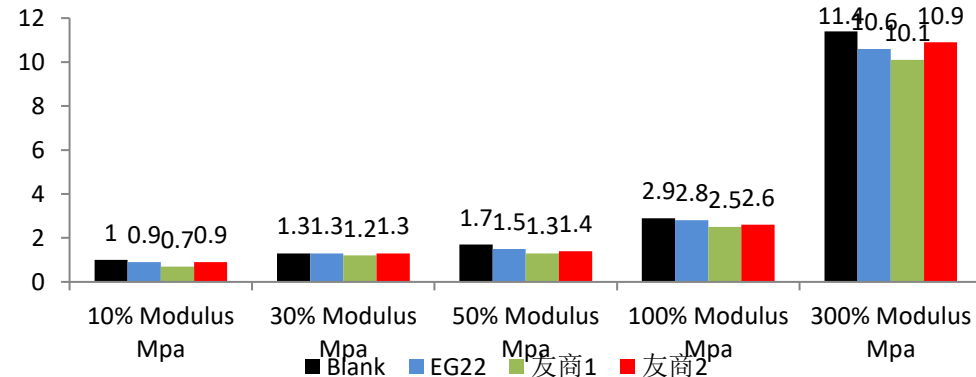
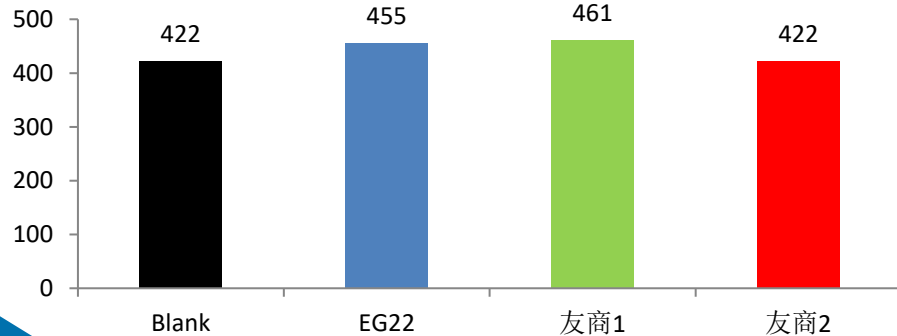
Item	Blank	EG22	Competitor 1	Competitor 2
Hardness (Shore A)	69	67	66	67
Tensile Strength (MPa)	16.6	16.4	16.1	16.3
Elongation at Break (%)	422	455	461	422
Tear Strength (kN/m)	32	37	36	31
10% Modulus Mpa	1	0.9	0.7	0.9
30% Modulus Mpa	1.3	1.3	1.2	1.3
50% Modulus Mpa	1.7	1.5	1.3	1.4
100% Modulus Mpa	2.9	2.8	2.5	2.6
300% Modulus Mpa	11.4	10.6	10.1	10.9



Hardness (Shore A)



Elongation at Break EB (%)





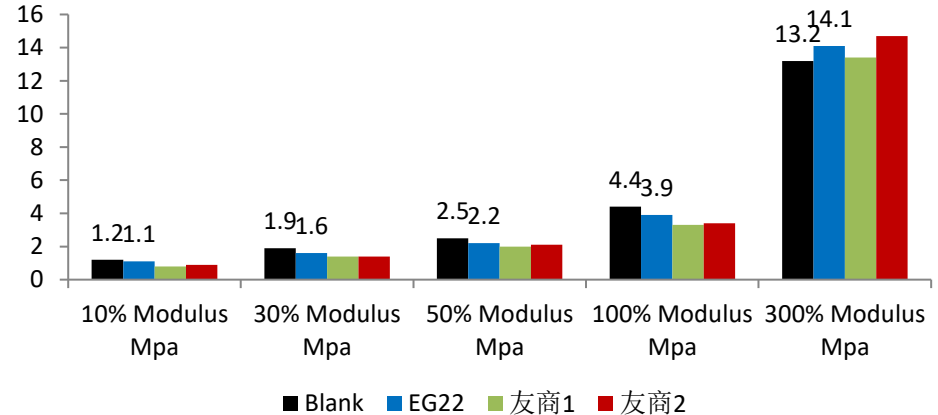
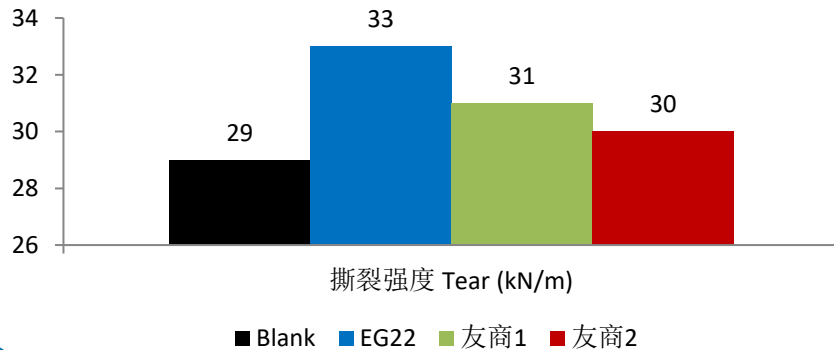
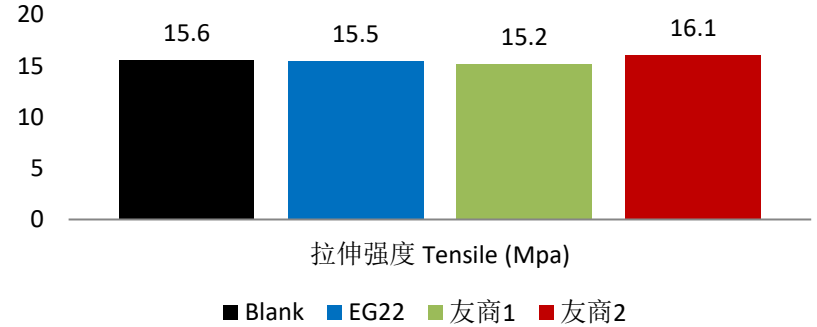
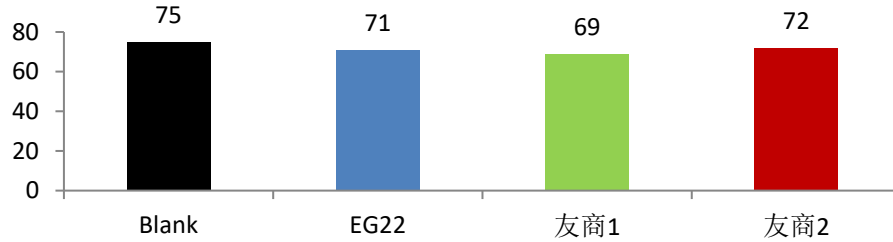
- 试片硫化条件 **Curing Condition:** $160^{\circ}\text{C} \times 30\text{min}$
- Aging Condition Aged: $100^{\circ}\text{C} \times 48\text{h}$

Test Item	Blank	EG22	Competitor 1	Competitor 2
Hardness (Shore A)	75	71	69	72
Tensile Strength (MPa)	15.6	15.5	15.2	16.1
Elongation at Break (%)	307	339	327	314
Tear Strength (kN/m)	29	33	31	30
10% Modulus Mpa	1.2	1.1	0.8	0.9
30% Modulus Mpa	1.9	1.6	1.4	1.4
50% Modulus Mpa	2.5	2.2	2	2.1
100% Modulus Mpa	4.4	3.9	3.3	3.4
300% Modulus Mpa	13.2	14.1	13.4	14.7



- **EG22 demonstrates positive improvements in aging resistance of physical properties, while maintaining the highest tear strength performance.**

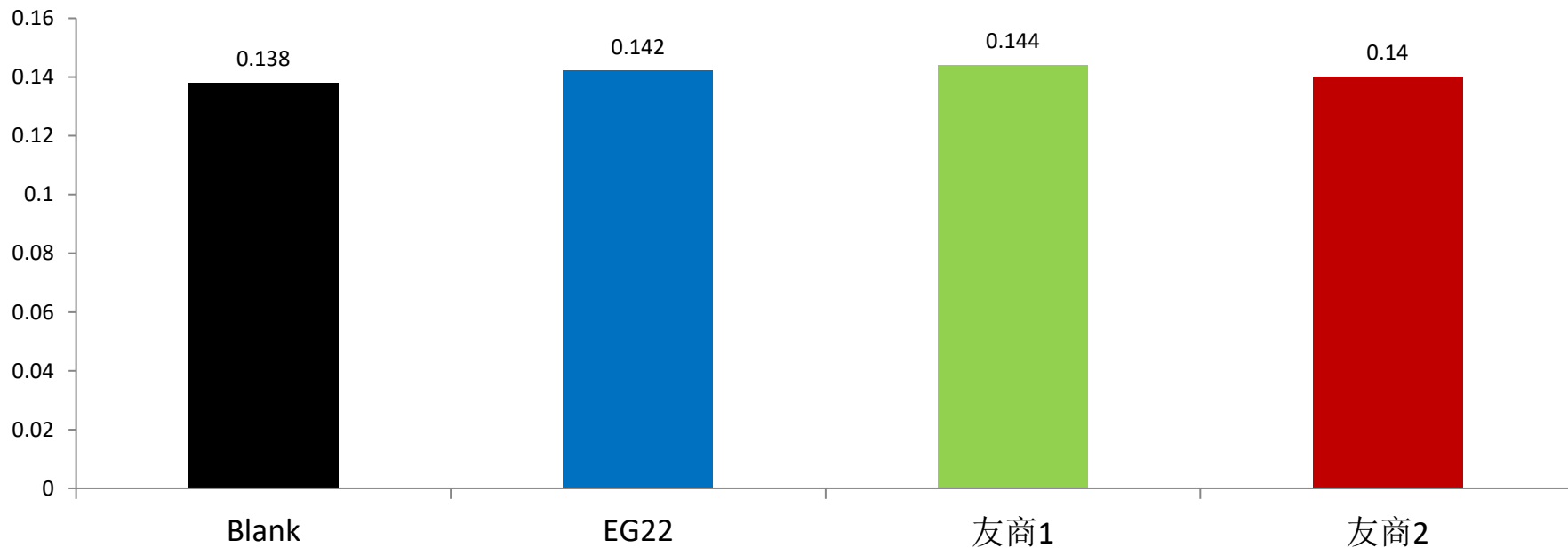
Hardness (Shore A)





- EG22 exhibits negligible impact on abrasion resistance.

兰伯恩磨耗
Lamborn abrasion, Vol./cm³





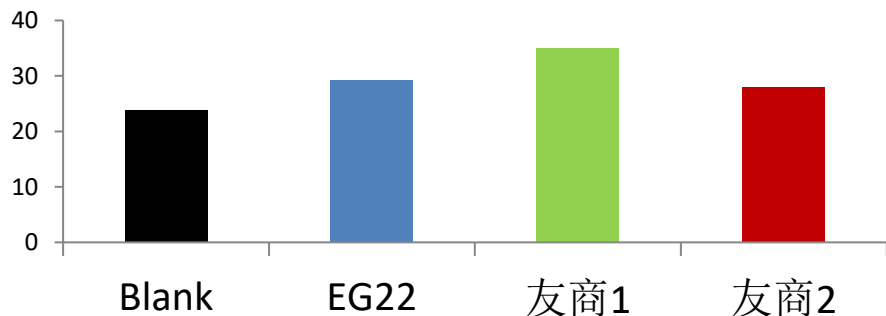
Constant Stress: The addition of 4phr results in decreased hardness (Hs), greater deformation, and higher heat buildup compared to the blank sample; reducing plasticizer oil content appropriately can mitigate heat generation.

Constant Strain: EG22 demonstrates effective reduction in compression heat build-up under constant strain conditions.

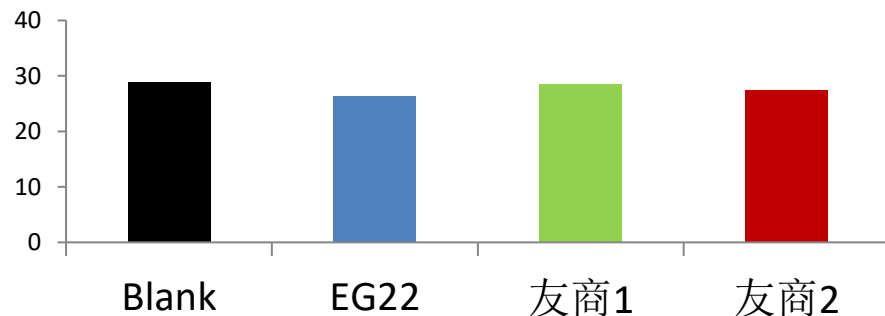
定应力 Constant Stress : 700N

定应变 Constant Strain : 3.0mm

Central Temperature Rise /°C



Central Temperature Rise /°C



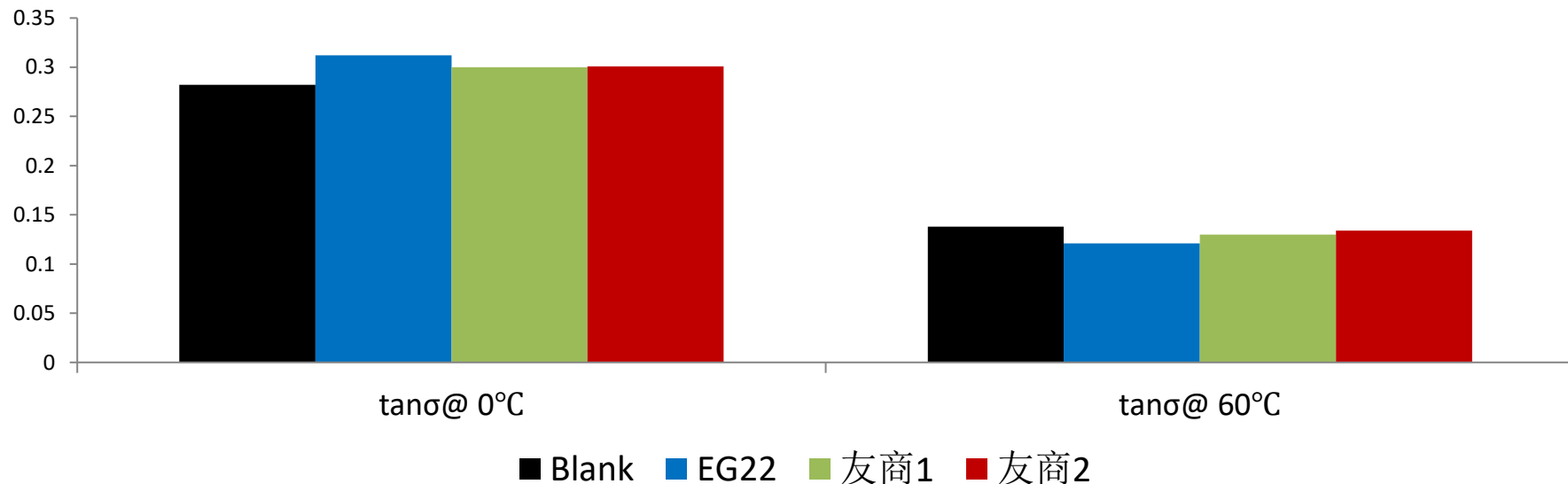
Heat Build Up

vulcanization conditions :150°C×30min, with an initial temperature of 55°C, 30-minute preheating, 25-minute testing, 100N static load, and 10Hz frequency.

EG22 Filler Enhancer – DMA Dynamic Performance



➤ **EG22:** Optimal Dynamic Performance: Highest Wet Grip (11% ↑) Lowest Rolling Resistance (14% ↓)



Item	Temp.	Blank	EG22	友商1	友商2
E'	0°C	32.38	25.3	29.91	33.92
	60°C	12.41	11.39	11.56	11.48
tanδ	0°C	0.282	0.312	0.3	0.301
	60°C	0.138	0.121	0.13	0.134

10Hz, Preload 5%, Dynamic strain 0.25%, -80°C ~ 100°C, 3°C/min

动态性能 DMA Conditions:



LC25, LC25T, and other LC series bio-based functional modifiers are 100% plant-derived additives. Their primary components include modified nano-lignin and nano-cellulose, which employ a multi-level structural design (nano-sizing, functionalization, supramolecular assembly) to deliver synergistic effects in rubber compounds. These materials enhance rubber-filler interactions, optimize dynamic performance, reduce heat buildup, and improve wear and aging resistance. They significantly boost tire wet grip, rolling efficiency, and durability. Their natural porous structure and active functional groups can partially replace silica/carbon black while maintaining mechanical strength and reducing compound density, supporting low-carbon, energy-efficient green tire design.

Key Performance Benefits:

- **Reduced Rolling Resistance:**

The low density and softness of LC modifiers decrease tire rolling resistance, improving fuel efficiency. This contributes to lower vehicle energy consumption and reduced emissions.

- **Enhanced Wet Grip:**

The rigid aromatic ring structure restricts polymer chain mobility, while nano-scale surface protrusions increase contact points with wet roads, effectively improving wet grip.

- **Lower Heat Buildup:**

Under dynamic strain, LC modifiers facilitate molecular slippage and reorganization, reducing internal friction heat generation and extending tire service life.



- **Improved Heat Resistance:**
The phenolic hydroxyl groups effectively scavenge free radicals generated during thermal, oxidative, and dynamic fatigue processes, interrupting oxidation chain reactions. They also decompose hydroperoxides, delaying tire compound hardening, cracking, and performance degradation.
- **Increased Wear Resistance:**
LC modifiers enhance tear and cut resistance, reducing tread wear and prolonging tire lifespan.
- **Sustainability & Lightweighting:**
Sourced from renewable materials with excellent biodegradability. Their high strength-to-weight ratio enables lighter tires, reducing energy consumption and carbon emissions.

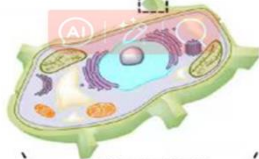
➤ Application Guidelines

- **Incorporation Method:** LC bio-based modifiers are typically added during the first mixing stage alongside silica/carbon black.
- **Recommended Dosage:** 5–30 phr (adjust based on processing requirements and performance targets).

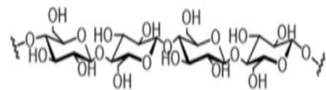


天然植物资源

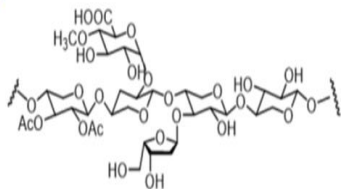
The diagram illustrates the structure of a plant cell wall. It shows a network of fibers. Brown wavy lines represent cellulose, which are the primary structural components. Green wavy lines represent hemicellulose, which are interspersed among the cellulose fibers. Yellowish-brown irregular shapes represent lignin, which acts as a glue, binding the cellulose and hemicellulose fibers together. Labels at the top point to these components: 'Hemicellulose' (green line), 'Lignin' (yellowish-brown shape), and 'Cellulose' (brown line). A dashed line at the bottom indicates the boundary of the 'Plants Cell Wall'.



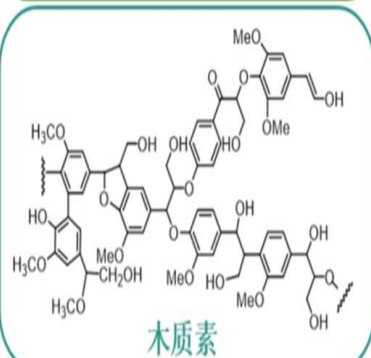
Plants Cell



纤维素



半纤维素



木质素



LC25

Bio-Based Functional Modifiers

LC Series – Experimental Formulation



Material	Blank	LC25	LC25T	LC25	LC25T
BR	20	20	20	20	20
SBR1723	34.4	34.4	34.4	34.4	34.4
SSBR	55	55	55	55	55
Silica	120	110	110	100	100
LC25		10		20	
LC25T			10		20
SI69	9.6	9.6	9.6	9.6	9.6
N234	5	5	5	5	5
Plasticize	5	5	5	5	5
PR383	16	16	16	16	16
StearicAcid	2	2	2	2	2
4020	2.5	2.5	2.5	2.5	2.5
TMQ	1.5	1.5	1.5	1.5	1.5
Wax	2	2	2	2	2
DP20W	2	2	2	2	2
ZINC OXIDE	3	3	3	3	3
DPG(D)	0.5	0.5	0.5	0.5	0.5
SULFUR	1.3	1.3	1.3	1.3	1.3
TBzTD-70	0.3	0.3	0.3	0.3	0.3
TBBS	1.15	1.15	1.15	1.15	1.15



- LC25/25T show minimal impact on vulcanization rate. The increased T35-T5 interval indicates improved processing safety, with higher Mooney viscosity observed.

Material		Blank	Blank	LC25-10	LC25T-10	LC25-20
160*15min	ML	5.0	5.9	4.3	4.6	4.3
	MH	17.1	19.1	15.5	12.6	14.8
	MH-ML	12.2	13.2	11.2	7.9	10.5
	T10	0.59	0.92	0.99	2.36	2.23
	T50	4.38	4.81	5.49	5.46	5.77
	T90	10.29	10.74	11.17	11.32	11.45
	T90-T10	9.70	9.82	10.18	8.96	9.22
	TS1	0.47	0.62	0.83	2.62	2.13
	TS2	1.63	1.72	2.53	3.66	3.27
Mooney/10 0°C	ML1+4	119.90	136.70	117.30	127.20	125.50
Scorch/125 °C	T5	13.23	12.78	19.46	13.57	17.61
	T35	20.99	23.20	31.15	24.89	26.80
	T35-T5	7.76	10.42	11.69	11.32	9.19

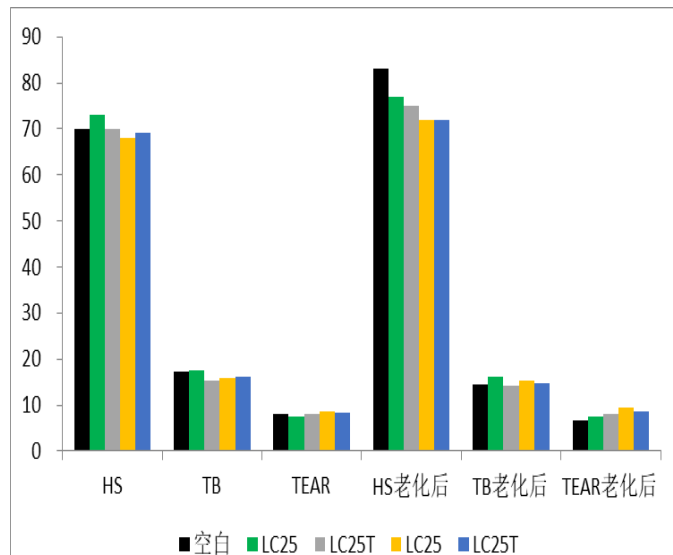


Material		Blank	LC25-10	LC25T-10	LC25-20	LC25T-20
Pre-Aging Properties	HS	70	73	70	68.00	69
	TB	17.4	17.6	15.3	15.8	16.3
	EB	310	330	310	320	320
	M10	1.2	0.9	0.8	0.7	0.8
	M25	1.8	1.5	1.3	1.2	1.3
	M50	2.5	2.2	1.9	2.0	2.1
	M100	4.1	3.9	3.3	3.8	3.9
	M300	16.4	15.3	13.9	14.5	14.7
	TEAR	7.99	7.63	8.01	8.71	8.31

Material		Blank	LC25-10	LC25T-10	LC25-20	LC25T-20
Post-Aging Properties 100*48h	HS	83	77	75	72.00	72
	TB	14.5	16.3	14.3	15.3	14.9
	EB	190	230	230	230	230
	M10	1.73	1.20	1.00	0.70	0.80
	M25	2.70	2.00	1.70	1.40	1.50
	M50	3.80	3.00	2.70	2.60	2.60
	M100	6.70	5.50	4.80	5.30	5.10
	TEAR	6.75	7.54	7.94	9.44	8.55

Post-Aging Property Change Rates 100*48h	HS	13	4	5	4	3
	TB	-16.7%	-7.4%	-6.5%	-3.2%	-8.6%
	EB	-38.7%	-30.3%	-25.8%	-28.1%	-28.1%
	M10	44.2%	33.3%	25.0%	0.0%	0.0%
	M25	50.0%	33.3%	30.8%	16.7%	15.4%
	M50	52.0%	36.4%	42.1%	30.0%	23.8%
	M100	63.4%	41.0%	45.5%	39.5%	30.8%

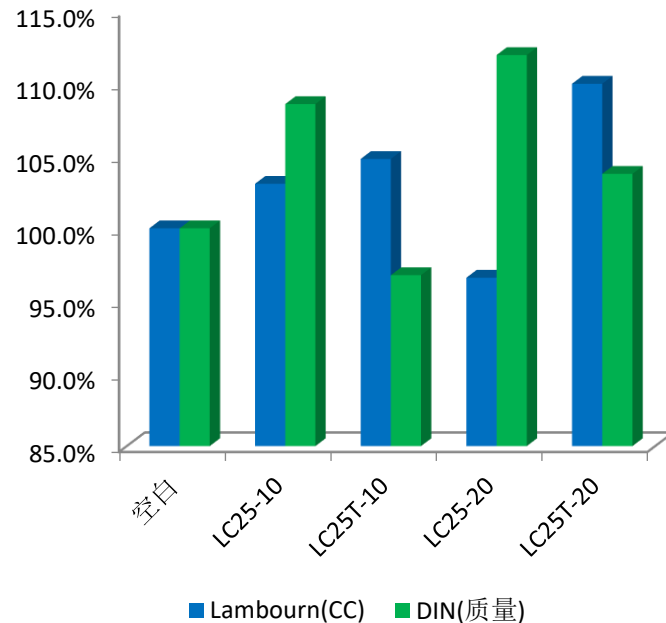
➤ After adding LC series bio-based functional modifiers, initial properties remain comparable, while tear and aging resistance improve significantly by 10–40%. ↑





- **Lambourn Test: LG25/25T improves wear resistance by 3–11.9% ↑**
(lower Specific Gravity → cost/weight savings).

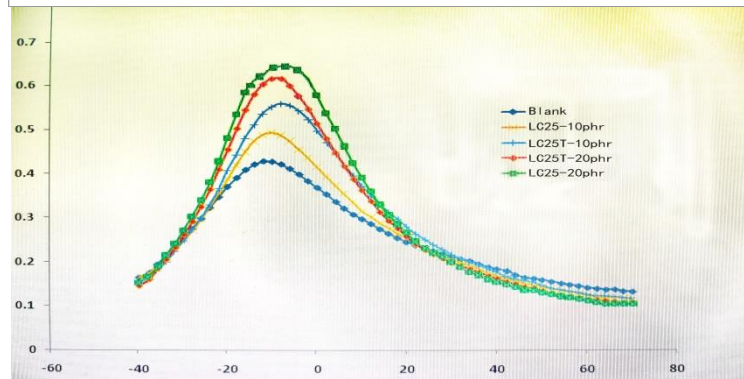
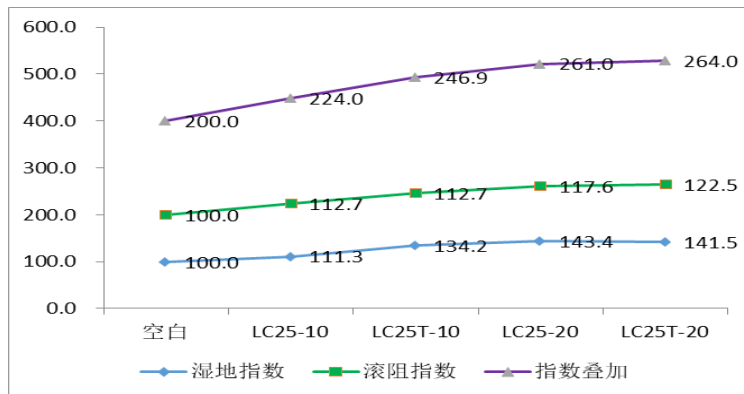
Item	空白	LC25-10	LC25T-10	LC25-20	LC25T-20
Specific Gravity	1.28	1.27	1.27	1.26	1.26
Lambourn (CC)	0.3093	0.3001	0.2952	0.3202	0.2813
DIN (质量)	0.1079	0.0994	0.1115	0.0964	0.1040
Lambourn (CC)	100.0%	103.1%	104.8%	96.6%	110.0%
DIN (质量)	100.0%	108.6%	96.8%	111.9%	103.8%





➤ **LG25/25T:** Optimal Results: **Highest Wet grip** 11.3~41.5%↑、**Lowest Rolling resistance** 12.7~22.5%↓

Item	空白	LC25-10	LC25T-10	LC25-20	LC25T-20
Tanδ-30℃	0.253	0.253	0.248	0.265	0.261
Tanδ0℃	0.371	0.413	0.498	0.532	0.525
Tanδ30℃	0.211	0.204	0.213	0.192	0.190
Tanδ60℃	0.142	0.124	0.124	0.117	0.110
Rolling resistance index	100.0	112.7	112.7	117.6	122.5
E' -30℃	819.7	824.1	872.2	826.4	815.3
E' 0℃	80.6	66.0	55.5	36.6	39.6
E' 30℃	26.4	21.2	15.4	10.3	12.8
E' 60℃	16.0	13.7	10.0	7.2	9.0



➤ **动态性能 DMA 测试条件:**

10Hz, Preload 1%, Dynamic strain 0.2%, -24℃ ~105℃, 4℃/min

GreenThinking® NSA04: A nano silica-alumina alloy (nano silica-alumina, $\text{Al}_2\text{SiO}_5 \cdot n\text{H}_2\text{O}$) functional material specifically designed to enhance tire wet grip performance, wear resistance, and rolling resistance performance. With an average particle size of approximately 500 nanometers, the mechanism of action of the nano silica-alumina alloy primarily lies in its unique physical and chemical properties, including the formation of Al-O-Si bonds that puncture the water film between the tire and the road surface. This significantly improves tire grip on wet roads. Furthermore, it enables excellent interfacial bonding with the rubber matrix, enhancing rubber's abrasion resistance, reducing heat generation, and improving fatigue resistance. The nano silica-alumina alloy has broad applicability and is suitable for various tire types, including passenger car tires, commercial vehicle tires, and high-performance racing tires. In high-performance tires, its use can markedly improve overall performance, delivering superior grip on wet surfaces and enhanced wear resistance, while simultaneously lowering rolling resistance and improving fuel economy.

➤ Key Performance

1.Wet Grip Performance: Combined with the silane coupling agent Si75, the nano silica-alumina alloy effectively disrupts the water film between the tire and the road surface, increasing friction on wet roads. This performance enhancement stems primarily from the material's high specific surface area and excellent dispersibility, allowing it to form effective reinforcing phases within the rubber matrix and thereby improve wet grip.

2.Wear Resistance: The high specific surface area and fine particle characteristics of the nano silica-alumina alloy enable the formation of micro-reinforcing particles within the rubber matrix. These particles effectively distribute stress, enhancing the rubber's abrasion resistance. This is crucial for extending tire service life and reducing replacement frequency.

3.Reduced Rolling Resistance: The incorporation of the nano silica-alumina alloy modifies the rubber's molecular structure and interfacial bonding, leading to lower tire rolling resistance. This improvement contributes to enhanced vehicle fuel economy, reducing energy consumption and emissions.

➤ **Applications:**

The application scenarios of GreenThinking® NSA04 Nano Silica-Alumina Alloy in tires primarily include the following aspects:

1.Enhanced Wet Grip Performance:

The nano silica-alumina alloy, combined with a silane coupling agent, can puncture the water film between the tire and the road surface, thereby improving the tire's grip on wet roads. This characteristic is particularly crucial for driving safety in rainy conditions, effectively reducing the risk of skidding and hydroplaning.

2.Improved Wear Resistance:

Due to its high specific surface area and excellent dispersibility, the nano silica-alumina alloy forms micro-reinforcing particles within the rubber matrix, enhancing the rubber's abrasion resistance. This is especially important for tires subject to long driving hours and high wear, such as commercial vehicle tires and high-performance racing tires.

3.Reduced Rolling Resistance:

The incorporation of the nano silica-alumina alloy modifies the rubber's molecular structure and interfacial bonding, leading to lower tire rolling resistance. This performance improvement helps enhance vehicle fuel economy, reducing energy consumption and emissions.



4.Enhanced Mechanical Properties:

Adding the nano silica-alumina alloy improves the rubber's tear resistance and fatigue resistance, providing greater stability during high-speed driving and frequent braking. This is significant for extending tire service life and improving safety.

➤ Dosage Recommendations:

- Addition Method:** NSA04 is typically added **during the primary mixing stage** and is usually used in conjunction with additives like silane coupling agents.
- Recommended Dosage:** **10-30 Phr (parts per hundred parts of rubber)**. The specific amount can be adjusted based on actual processing conditions and performance requirements.

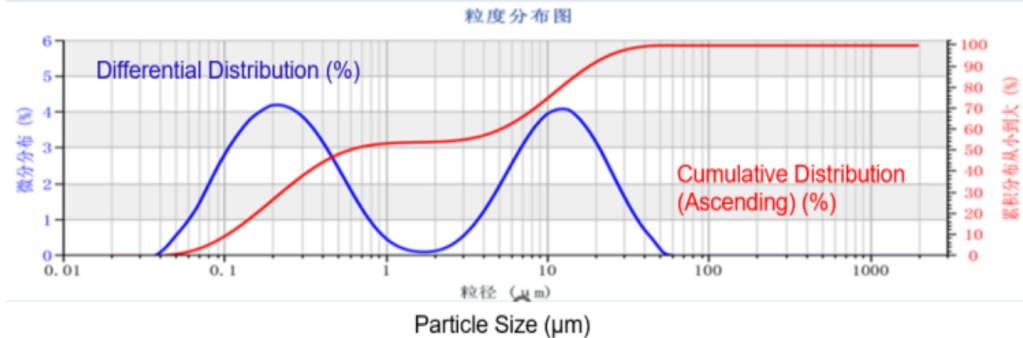


Particle Size Test Report

Sample Name:	SOP Name:	Measurement Time:	Sample Code:
PF87	Nano Silica-Alumina Alloy	2025/5/20 14:50	0001
Tester:	Background Sampling Time:	Single Sampling Time:	Result Type:
Tianhong Laboratory	9 seconds	9 seconds	Volume (V)
Sample Material:	Refractive Index of Sample Material:	Absorption of Sample Material:	Dispersion Medium:
Nano Reinforcing Agent	1.5	0.01	Water
Refractive Index of Dispersion Medium:	Analysis Mode:	Extinction (%):	Analysis Range (um):
1.33	General Mode	6.69	0.02 ~ 2000
D10(um):	D25 (um):	D50 (um):	D75 (um):
0.104	0.188	0.583	10.108
D90 (um):	D97 (um):	D(3, 2) (um):	D(4, 3) (um):
18.137	27.769	0.288	6.114
Span:	Specific Surface Area by Volume (sq. m/c.c.):	Specific Surface Area by Weight (m²/kg):	Residue on Sieve (%):
30.94	20.834	20833.66	0.377
Dmin Setting Value:	Concentration(%Vol):	C. V (%):	
0.005	0.0043	138.24	



Particle Size Distribution Graph





Material Name	Formula 1	Formula 2	Formula 3
SSBR	70	70	70
BR	30	30	30
N234	5	5	5
Precipitated silica	80	80	80
Zinc oxide	2	2	2
Stearic acid	2	2	2
Si 75	6.8	6.8	6.8
6PPD	2	2	2
AKPP	4	4	4
Microcrystalline wax	1.3	1.3	1.3
TMQ	0.5	0.5	0.5
Environmentally friendly oil	1	1	1
Styrene resin	8.8	8.8	8.8
S	1.8	1.8	1.8
CBS	2	2	2
DPG	2	2	2
NSA04(Nano Silica-Alumina Alloy)		15	12.5
Total	219.2	234.2	231.7



160°C*60min	ML	MH	ts1	ts2	t10	t50	t90	门尼
Formulation 1: Blank	1.92	14.05	2.44	2.83	2.55	3.54	6.66	59.8
Formulation 2: 15phr	1.76	14.59	2.27	2.60	2.40	3.22	6.27	55.9
Formulation 3: 12.5phr	1.70	15.06	2.22	2.55	2.37	3.16	6.04	55.50

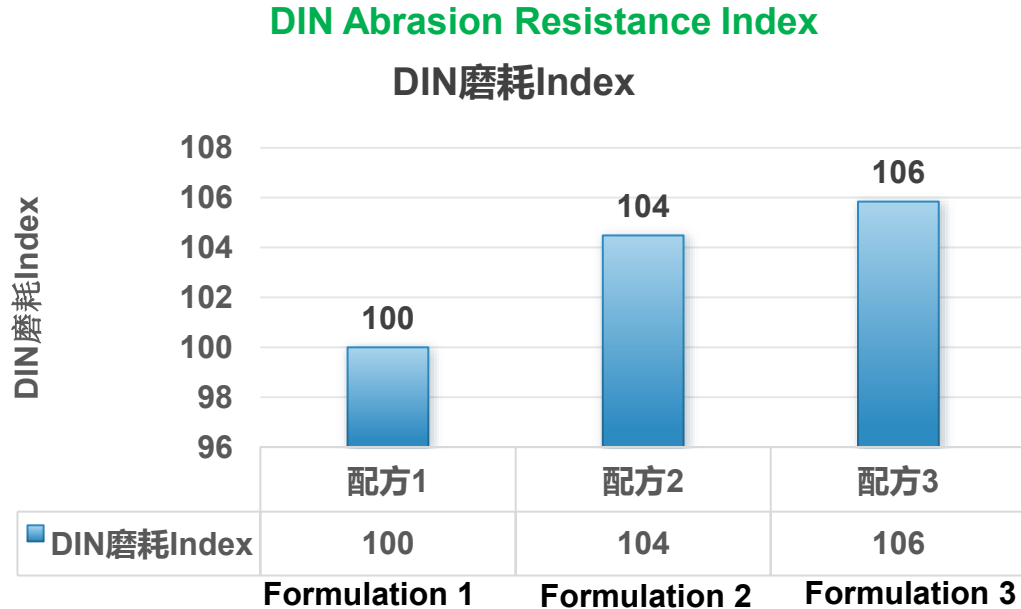
Conclusions:

- NSA04 (Nano Silica-Alumina Alloy) accelerates the cure rate, thus improving production efficiency.
- NSA04 (Nano Silica-Alumina Alloy) reduces Mooney viscosity, enhancing compound flowability.



- **NSA04** : The wear resistance performance has improved by approximately 6% ↑

DIN Abrasion Resistance	Loss-Vol (cm ³)
Formulation 1: Blank	0.163
Formulation 2: 15phr	0.156
Formulation 3: 12.5phr	0.154



➤ Conclusions:

NSA04 (Nano Silica-Alumina Alloy) reduces abrasion loss, demonstrating approximately 6% improvement in abrasion resistance.



160*30min	Hardness	Specific Gravity	Tensile Strength (Mpa)	Elongation at Break (%)	Tensile Stress at 50% Strain (MPa)	Modulus at 100% (M100) (MPa)	Modulus at 300% (M300) (MPa)
Formulation 1: Blank	64.2	1.208	24.8	420.6	2.1	3.5	15.5
Formulation 2: 15phr	64.8	1.202	27.9	433.4	2.4	3.9	17.4
Formulation 3: 12.5phr	64.7	1.205	25.3	436.0	2.5	4.2	17.8

➤ Conclusions:

NSA04 (Nano Silica-Alumina Alloy) enhances both tensile strength and elongation at break, contributing to improved modulus properties (e.g., M300).



Aging	Tensile Strength (Mpa)	Elongation at Break (%)	Tensile stress at 50% strain (MPa)	Modulus at 100% (M100) (MPa)
Formulation 1: Blank	22.8	291.0	3.0	5.5
Formulation 2: 15phr	24.4	303.0	3.1	5.7
Formulation 3: 12.5phr	22.3	298.0	3.3	5.9

➤ Conclusions:

NSA04 (Nano Silica-Alumina Alloy) increases tear strength both before and after aging compared to the control formulation.



Curing: 160°C × 30 min (ASTM D3182) Aging: 100°C × 48 h (ASTM D573)	Tear strength (kN/m) - Before aging	Tear strength (kN/m) - After aging
Formulation 1: Blank	18.1	9.1
Formulation 2: 15phr	18	9.8
Formulation 3: 12.5phr	21.9	10.3

➤ Conclusions:

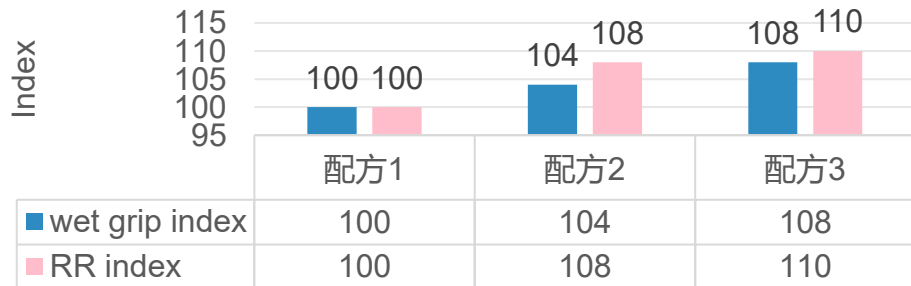
NSA04 (Nano Silica-Alumina Alloy) increases tear strength both before and after aging compared to the control formulation.



- **NSA04** : Optimal Dynamic Performance Enhancement — Peak Wet Grip Improvement (8.3%) ↑ with Maximum Rolling Resistance Reduction (10.4%). ↓

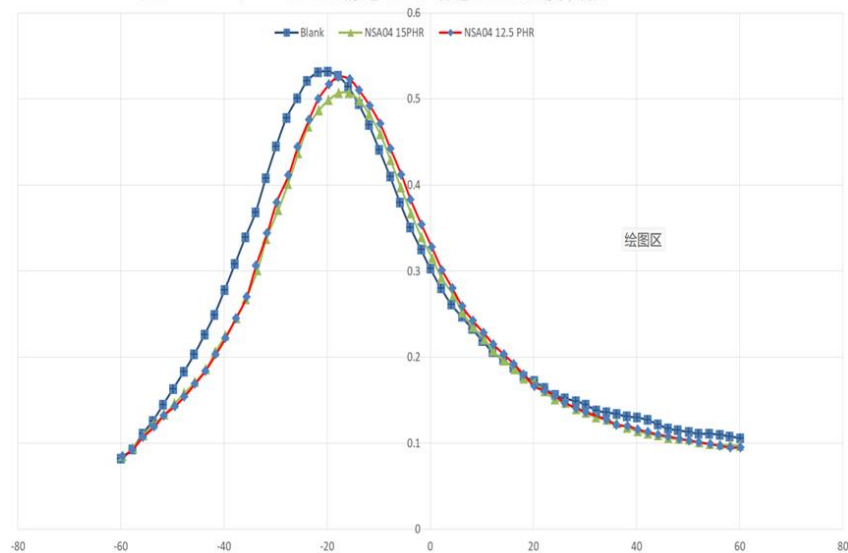
DMA data	tan 0℃	tan 20℃	tan 60℃
Formulation 1: Blank	0.303	0.172	0.106
Formulation 2: 15phr	0.315	0.170	0.097
Formulation 3: 12.5phr	0.328	0.166	0.095

Wet Grip & Rolling Resistance Index Diagram



Conclusion: NSA04(nano-silicon-aluminum alloy) can effectively improve wet grip and reduce rolling resistance, forming hard particles of Al-O-Si bond compounds.

10HZ static 0.5% dynamic 0.2% temperature scan
10 HZ 静态0.5% 动态0.2% 温度扫描

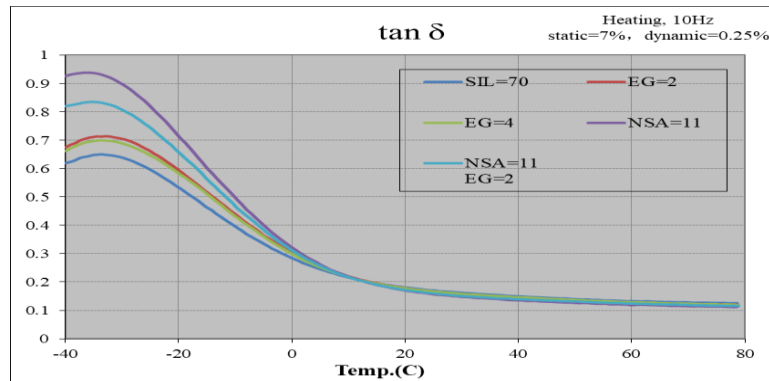


NSA04 Nano Silica-Alumina Alloy : DMA Test Data

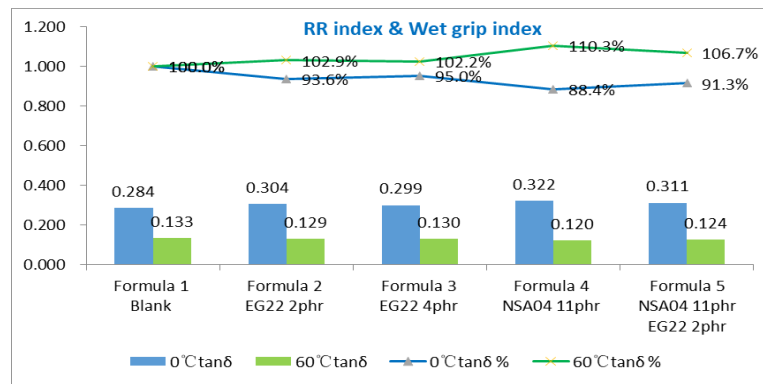


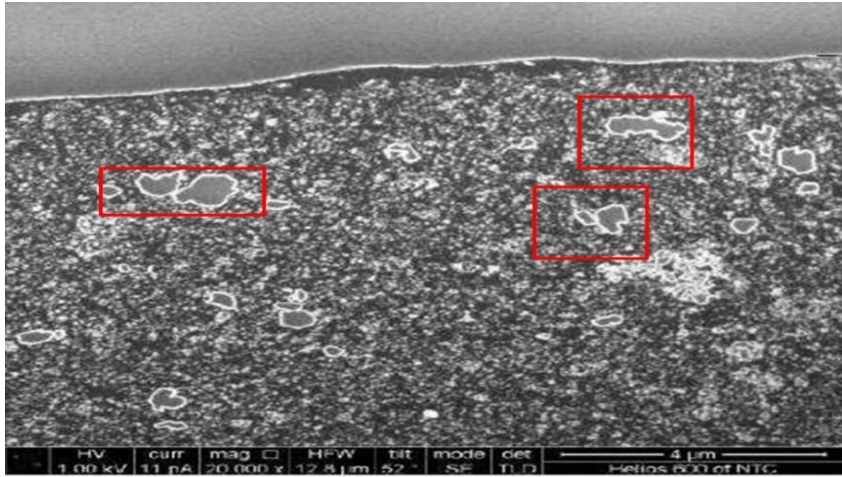
	Formulation 1: EG22 2phr Blank	Formulation 2: EG22 4phr	Formulation 3: NSA04 11phr	Formulation 4: NSA04 11phr	Formulation 5: EG22 2phr
NR 20号标胶	25	25	25	25	25
NS612	75	75	75	75	75
N330	4	4	4	4	4
HD165MP	70	70	70	59	59
Si75	5.6	5.6	5.6	5.6	5.6
Oil	10	10	10	10	10
6PPD	2	2	2	2	2
TMQ	1	1	1	1	1
ZnO	2	2	2	2	2
Stearic acid	2	2	2	2	2
DPG	1	1	1	1	1
EG22		2	4		2
NSA04			11	11	
Resin	15	15	15	15	15
CBS	2.3	2.3	2.3	2.3	2.3
S	1.4	1.4	1.4	1.4	1.4
Total	216.3	216.3	220.3	205.3	205.3

➤ **NSA04 : Optimal Dynamic Performance Enhancement — Peak Wet Grip Improvement (10.3%) with Maximum Rolling Resistance Reduction (11.6%).**



ML(1+4)100°C	74.18	68.35	63.1	65.26	62.31
Scorch Time (130°C) min	37.4	43.7	40.0	47.6	40.3
T10 (min)	6.1	10.8	10.8	10.3	10.3
T90 (min)	24.6	27.6	29.1	26.6	28.5
ML(dNm)	3.10	2.29	1.89	2.11	1.85
MH(dNm)	22.98	20.69	20.83	19.76	20.93
Shore A	63.4	61.4	62.7	58.44	60.5
M100% MPa	2.38	2.32	2.55	2.26	2.41
M200% MPa	4.91	4.83	5.33	4.83	5.09
M300% MPa	8.68	8.57	9.15	8.52	8.83
Tensile strength (MPa)	21.6	23.2	21.5	23.8	21.5
Elongation at break (%)	600	646	606	653	608
Resilience	49	50	46	55	51
Tg	-33.6	-32.9	-33.6	-35.9	-35.2
0°C tanδ	0.284	0.304	0.299	0.322	0.311



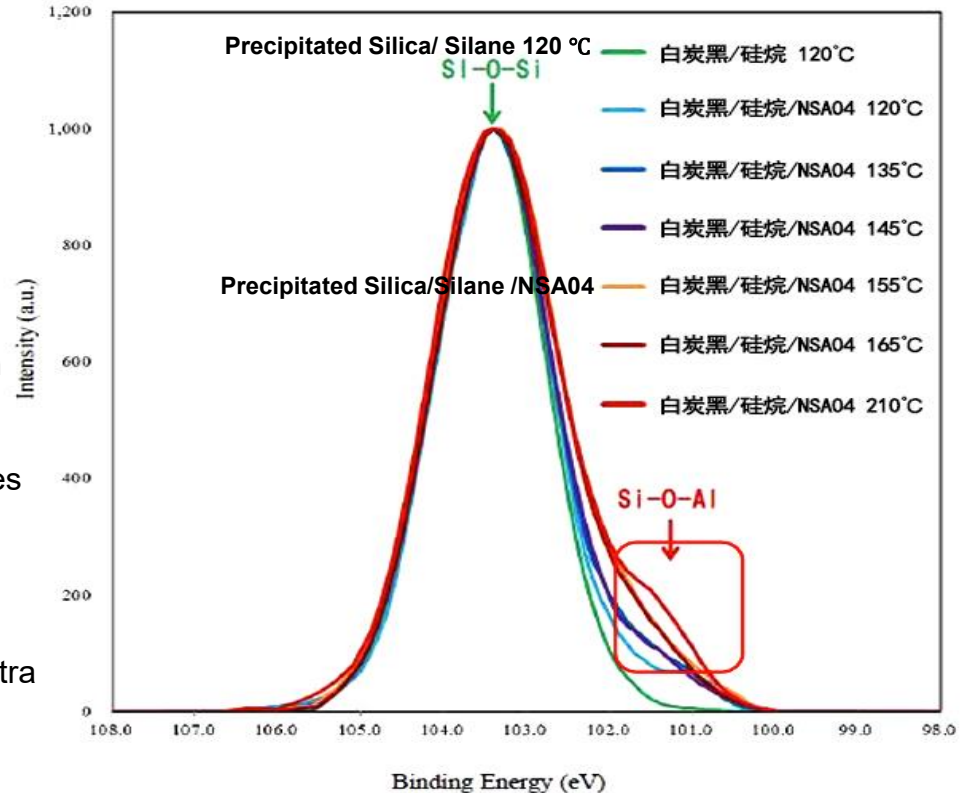


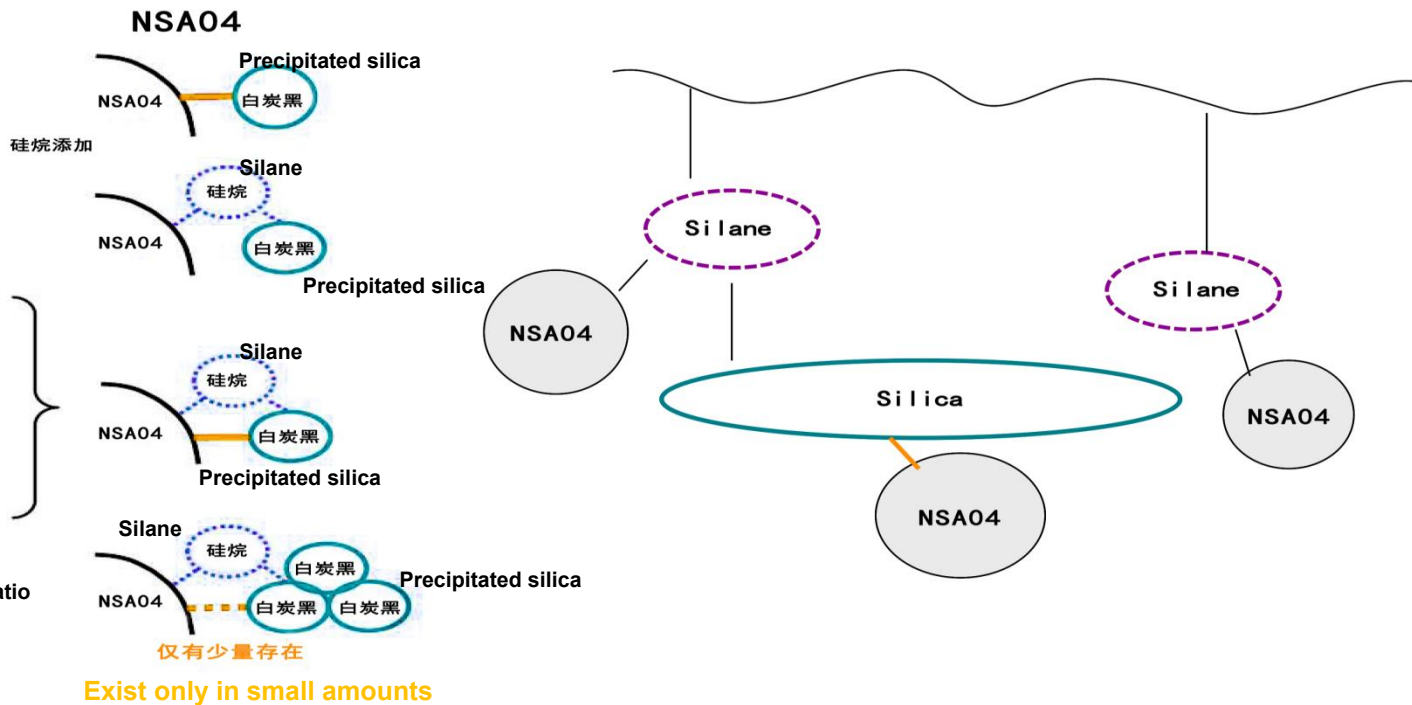
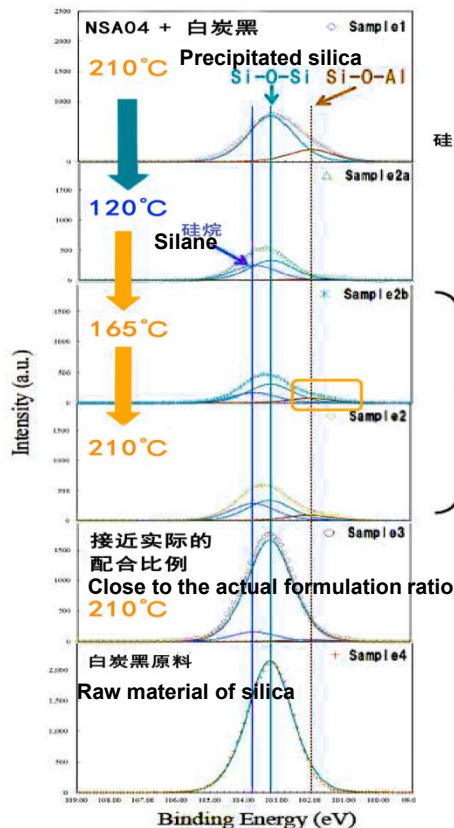
SEM cross-sectional image (20K) of the reaction between NSA04 and silica. The position of NSA04 is highlighted with white outlines in the image, indicating that during the material mixing stage, as the temperature increases, NSA04 undergoes changes. Its outline has transformed into alumina or aluminosilicate bonds.

XPS spectra showing the relationship between binding energy and intensity under different conditions. The spectra reveal that when the temperature exceeds 165° C, aluminosilicate bonds form, explaining the superior wear resistance of NSA04.

X-ray Photoelectron Spectroscopy

XPS 即 X 射线光电子能谱



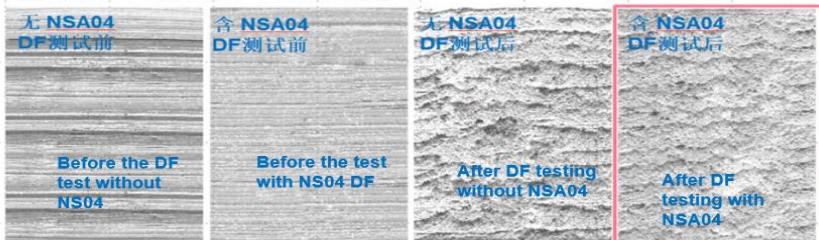


When the temperature exceeds 165 ° C, the formation of aluminosilicate bonds between NSA04 and silica reaches its highest efficiency, fully activating the performance of NSA04 to enhance wet grip, reduce rolling resistance, and improve abrasion resistance.

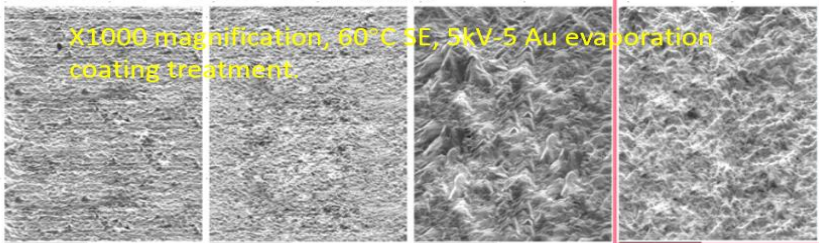


X50 magnification, 60°C SE, 5kV-5 Au evaporation coating treatment

X50倍 60° SE 5kV-5 Au 蒸镀处理



X1000倍 60° SE 5kV-5 Au 蒸镀处理



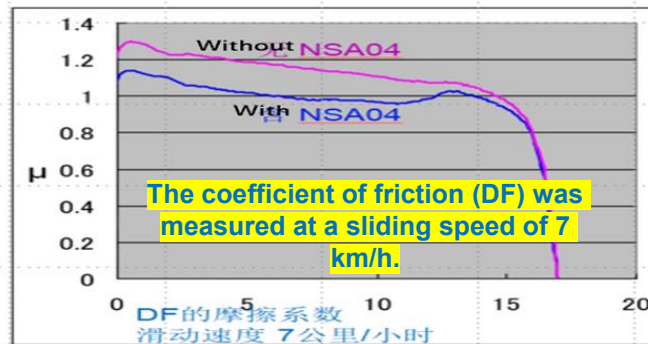
DF tester: Coefficient of friction on concrete surface = 0.9.

DF测试仪

混凝土表面的摩擦系数0.9

Without 无 NSA04: 0.98 (100)

With 含 NSA04: 1.15 (118)



➤ Conclusion:

Incorporating NSA04 (nano silicon-aluminum alloy) resulted in a 17.3% improvement in the coefficient of friction. ↑

1.Surface Roughness:

The surface of NSA04 (nano silico-aluminum alloy) exhibits finer (smoother) roughness after the DF test, compared to surfaces without aluminum compounds.

2.Coefficient of Friction:

The surface of NSA04 shows a higher coefficient of friction, but with less variation across different sliding speeds, indicating better frictional stability.

3.Conclusion:

This study demonstrates that the addition of NSA04 (nano silico-aluminum alloy) significantly improves the tribological properties of the surface, resulting in smoother texture and enhanced frictional stability. This is particularly important for applications that demand low friction coefficients and high wear resistance.



01

Company Profile

02

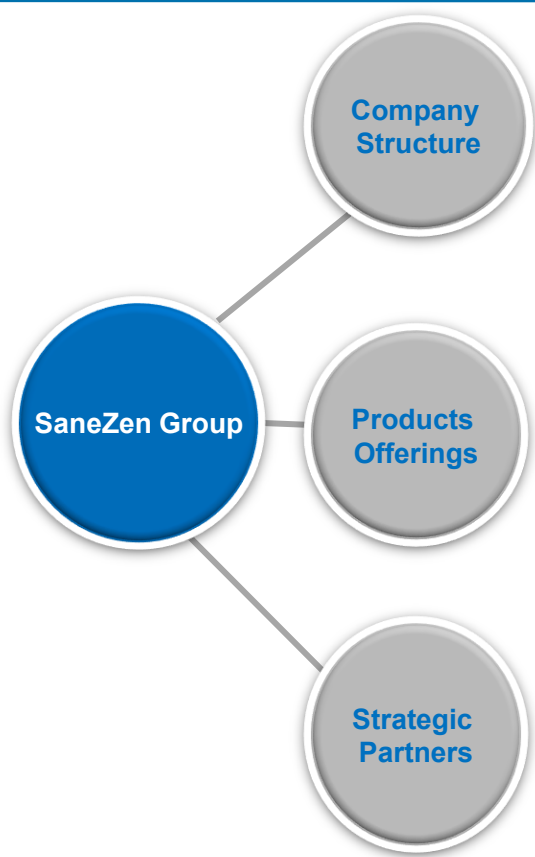
Main Products

03

SaneZen Platform

04

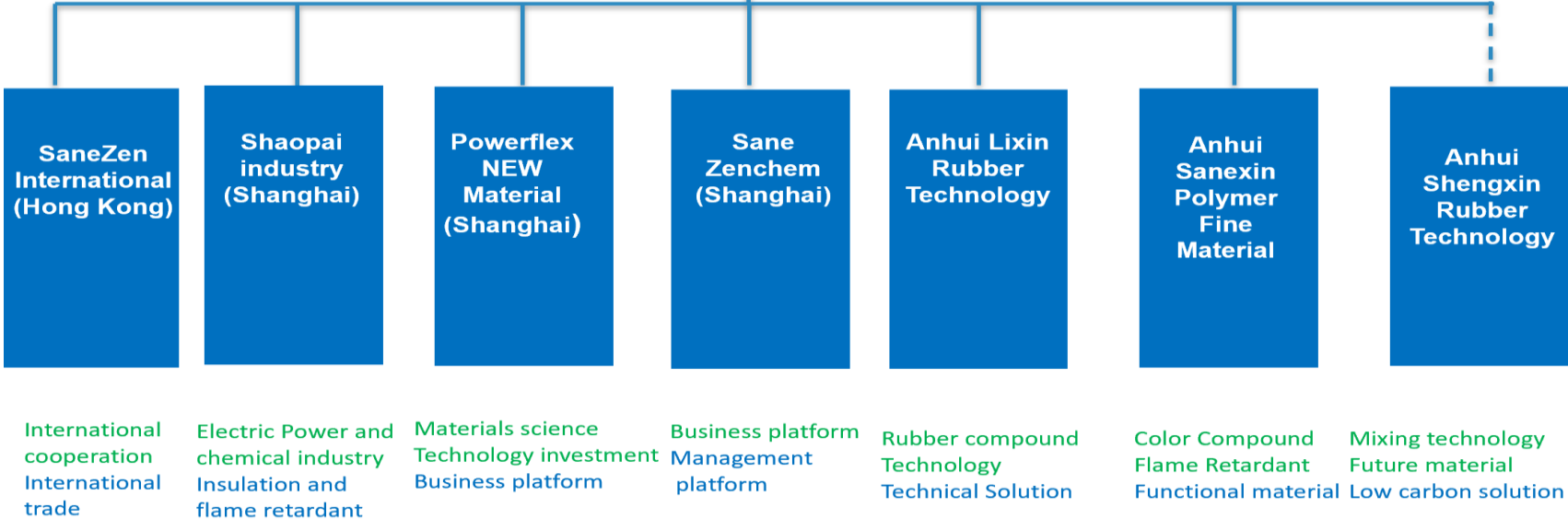
Partners

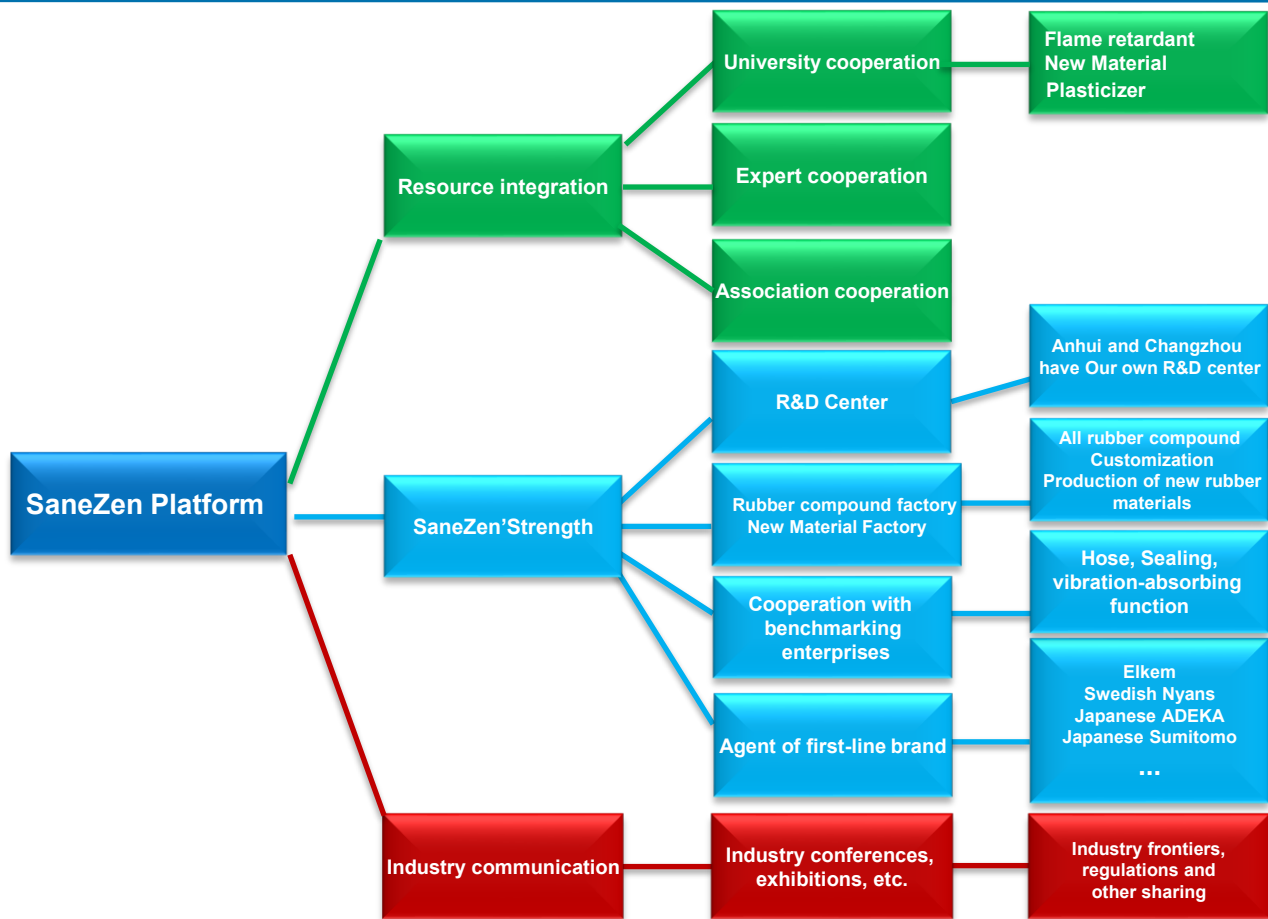


- Headquartered in Shanghai, China, the company has its own branches in Guangzhou, Xiamen, Tianjin and Chengdu, Hong Kong, Thailand. At the same time, it has established local warehousing and perfect market network to serve our customers conveniently;
- Subsidiary : Shanghai Powerflex & Anhui Shengxin specializes in the R & D and sales of new materials in the rubber and plastics industry. It has Lixin and Shanxin rubber mixing factories in Anhui (Xuancheng) to provide customized overall solutions for customers;
- Subsidiary: Sane Zen International (Hong Kong) Co., Ltd. actively expands international business and builds a bridge for cooperation between China and foreign rubber raw materials for customers.
- Specialty Tire Functional Additives (Low Rolling Resistance, High Wet Grip, excellent wear resistance, Bio-based, etc.), Environmentally Friendly Rubber Oils, Plasticizers, Flame Retardants, Functional Fillers, Functional Resins, Carbon Black, and Release Agents.
- VQM Silicone Rubber, Fluorosilicone Rubber (FVMQ), Ethylene Propylene Diene Monomer (EPDM) Rubber, Nitrile Rubber (NBR), Hydrogenated Nitrile Rubber (HNBR), Polyacrylate Rubber (ACM), etc.
- All series of rubber compound (VQM, FS, FKM, EPDM, NBR, HNBR, ACM, AEM, ECO, etc).
- Good strategic cooperation with leading companies in various industries: Nynas, Elkem, ADK, Sumitomo, Sibelco, Eni, Franklyn, TIMAB, Zannan, Anlun Dowell and other world-renowned chemical companies have established close strategic partnerships
- To provide customers with advanced, high-quality, characteristic and stable products, as well as customized overall solutions and other services.



SaneZen Group







SaneZen's Service

Technology-Driven Enterprise in Rubber and Plastics Industry

Functional Filler BU	Functional Additive BU	Plasticizer BU	Silicone Fluorine BU	Rubber Polymer BU	Rubber Compound BU
Functional Reinforcement Materials PF Series Reinforcing Agent FR Series Flame Retardant PT Series Precipitated Silica WL Series Calcium Silicate RS Series Wear-Resistant Silicon SF Series Conduct SA Series Conductive Spherical Aluminummive Silicon ASA Series Nano Silicon Aluminum Alloy LG Series Lignin LC Series Bio-Based Functional Modifier	Functional Rubber Additives Anti-Fatigue Agent & Heat Resistant Agent Filler Reinforcing Agent Acid and Alkali Resistant & Wear-Resistant Agent Adhesive & Dispersing Agent Active Crosslinking Agent Eco-friendly accelerator Anti-Blooming&Defoaming Agent Bloom cleaning agent Environmentally friendly release agent	Special Environmental Paraffin Oil Sanepar9X6 Ester Environmental Plasticizer Sanepar7XX	High Performance Silicone Rubber High-Temperature Silicone Rubber Liquid Silicone Rubber Room Temperature Silicone Rubber Fluorosilicone Rubber Phenyl Silicone Rubber Silicone Customization Services	High-end Silicone Rubber Sanexin Acrylate Rubber Sanexin NBR+PVC Shengxin	Full Range of Rubber Compounds Lixin Rubber Sanexin Polymer (Professional Colored Rubber Factory) Shengxin Rubber

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善贞实业（上海）有限公司 SANE ZENCHEM(SHANGHAI) CO.,LTD

Sane:

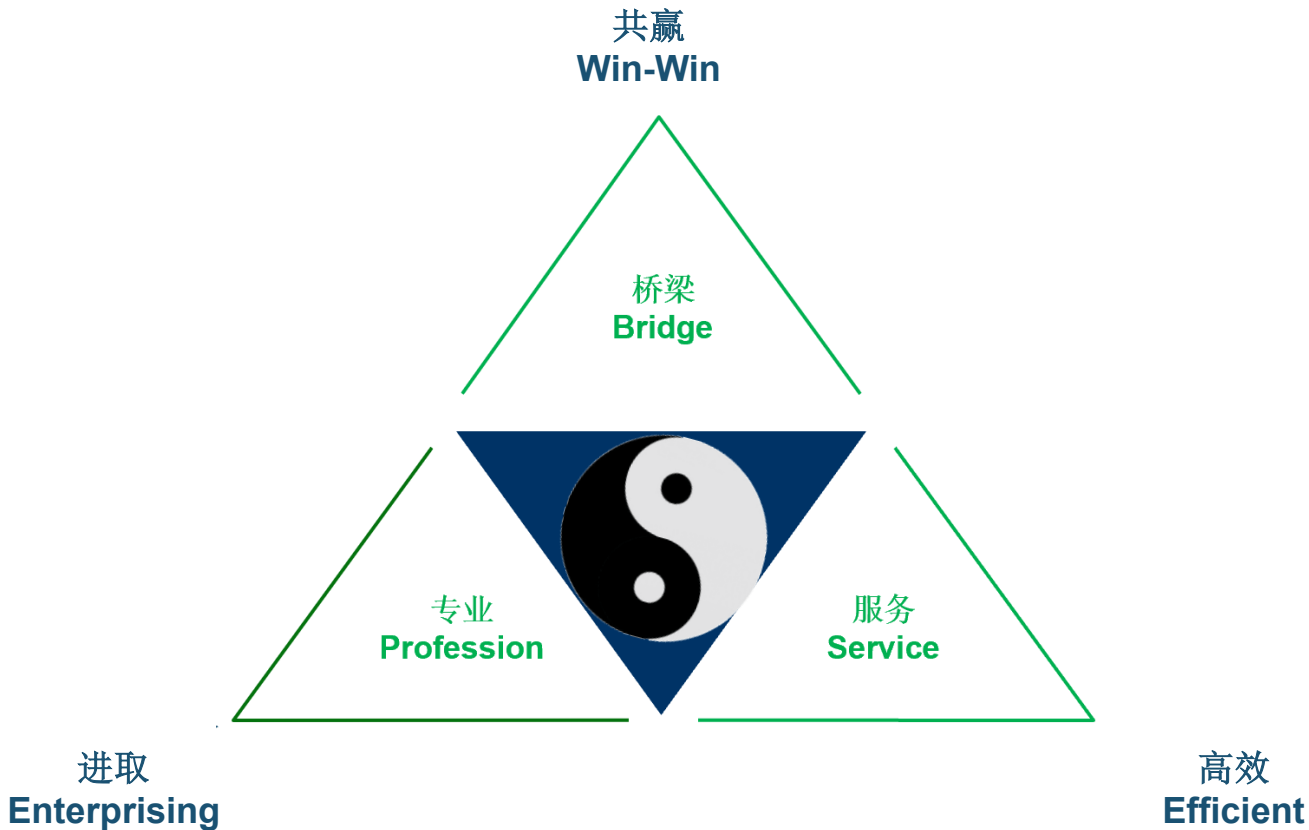
- 1. Benevolence:** The supreme good is like water. Water is beneficial to everything, and contend with none .—*Lao Tzu Chapter8*
- 2. Excellence:** Emperor Qin cherished a man's expertise in beating "Zhu Chi" - an ancient stringed instrument.
— *Records of the Historian of Biographies of assassins*
- 3. Prize and Recognition :** If the ministers and the people think it is right, then the king thinks it is good.

Zen:

- 1.Firmness :** Consistent words and deeds are firmness —*Jia Zi Taoism*
- 2.Loyalty:** Honor the loyalty of the ancients—*Sixuan FU*
- 3. Foresight:** Zen tortoise (divination, the ancients burned tortoise shells for divination)



The Cornerstone of Sane ZenChem Success





PS. Establish effective and efficient sales network



Automotive industry



Locomotive industry



Consumer goods industry



Medical industry



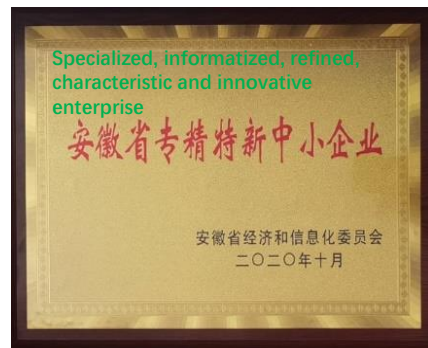
Home appliance industry



Wire and cable industry

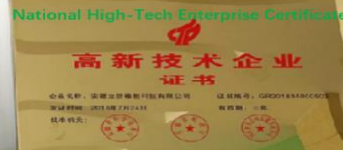
Our products are mainly used in tires, shock absorption, seals, sealing strips, hoses, compounds, wires and cables, belts and other industries.







Certificates of Patent





共赢精进！ Better Together

天行健，君子以自强不息

Nature's course is unswerving; the noble person strives for relentless self-improvement.

地势坤，君子以厚德载物

Earth's foundation is receptive; the noble person carries the weight of virtue and nurtures all.

天地的运行周而复始，刚健不息；

君子处世，就应效法天地的刚健，自强不息；
地势宽厚，君子应效法地地的宽厚，以厚德载物。

