Material Sector Business Briefing

Performance Polymers SBU

September 8, 2016
Asahi Kasei Corp.

Contents

Overview of
Performance Polymers SBU

Outline of medium-term strategy

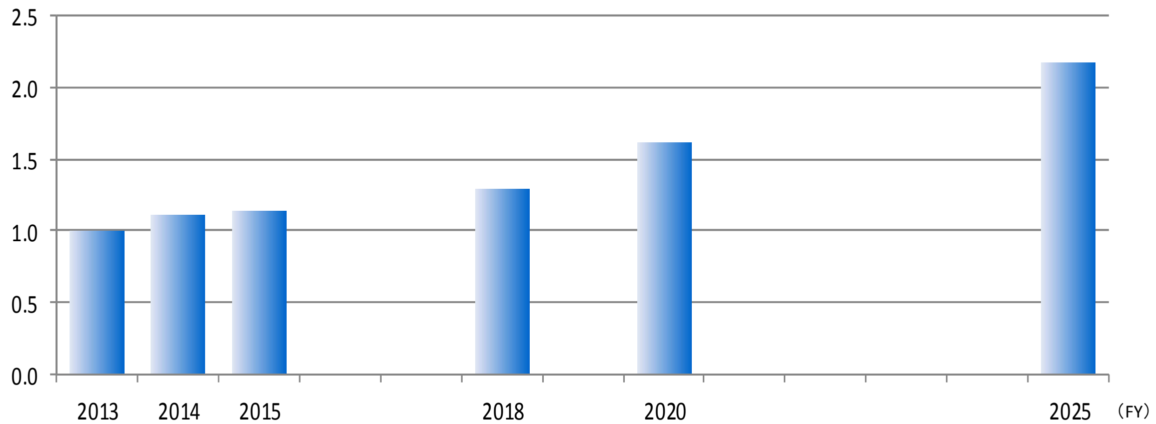
1. Expansion of profitable businesses on a global scale

- Europe: Strengthening business relations with European automotive manufacturers
- North America/Mexico: Expanding compounding business
- China: Driving growth through competitive materials
- ASEAN: Expanding market share in Japanese automotive sector

2. Expansion focused on S-SBR for high-performance and fuel-efficient tires

3. Expansion focused on engineering plastics for automotive applications

Sales growth plan
(FY2013 = 1.0)

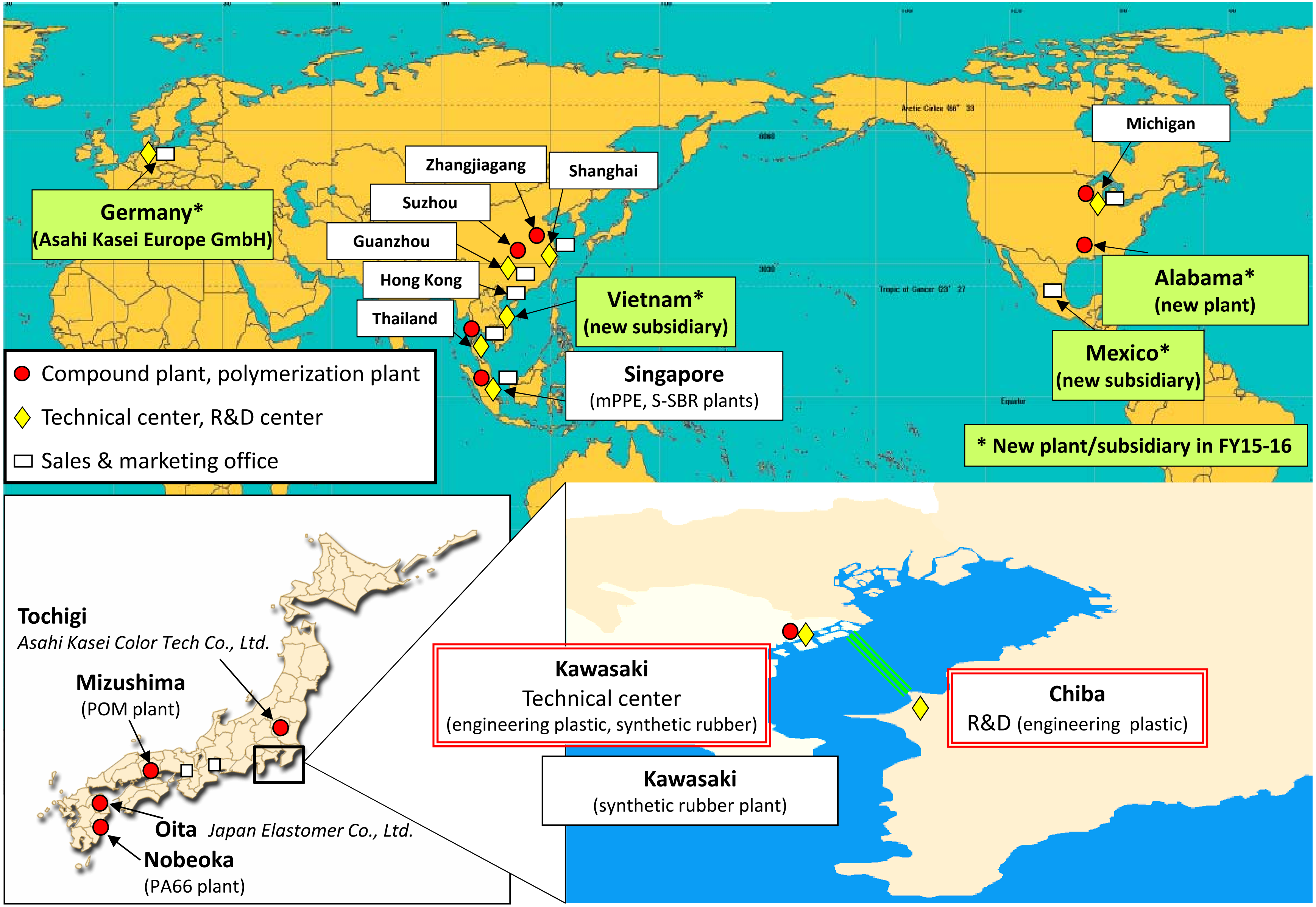


AsahiKASEI

Main products

Business	Main products	Main applications
Synthetic Rubber	S-SBR (solution-polymerized styrene-butadiene rubber)	High-performance and fuel-efficient tires
	Hydrogenated styrene-butadiene thermoplastic elastomer (SEBS and SBBS)	Medical fluid bags, sanitary products
Engineering Plastics	Leona polyamide 66 (PA66)	Automotive parts, electrical/electronic parts
	Tenac polyacetal (POM)	Automotive parts, office equipment
	Xyron modified polyphenylene ether (mPPE)	Automotive parts, solar panels, office equipment
	Thermylene reinforced polypropylene (PP) compound	Automotive parts, furniture

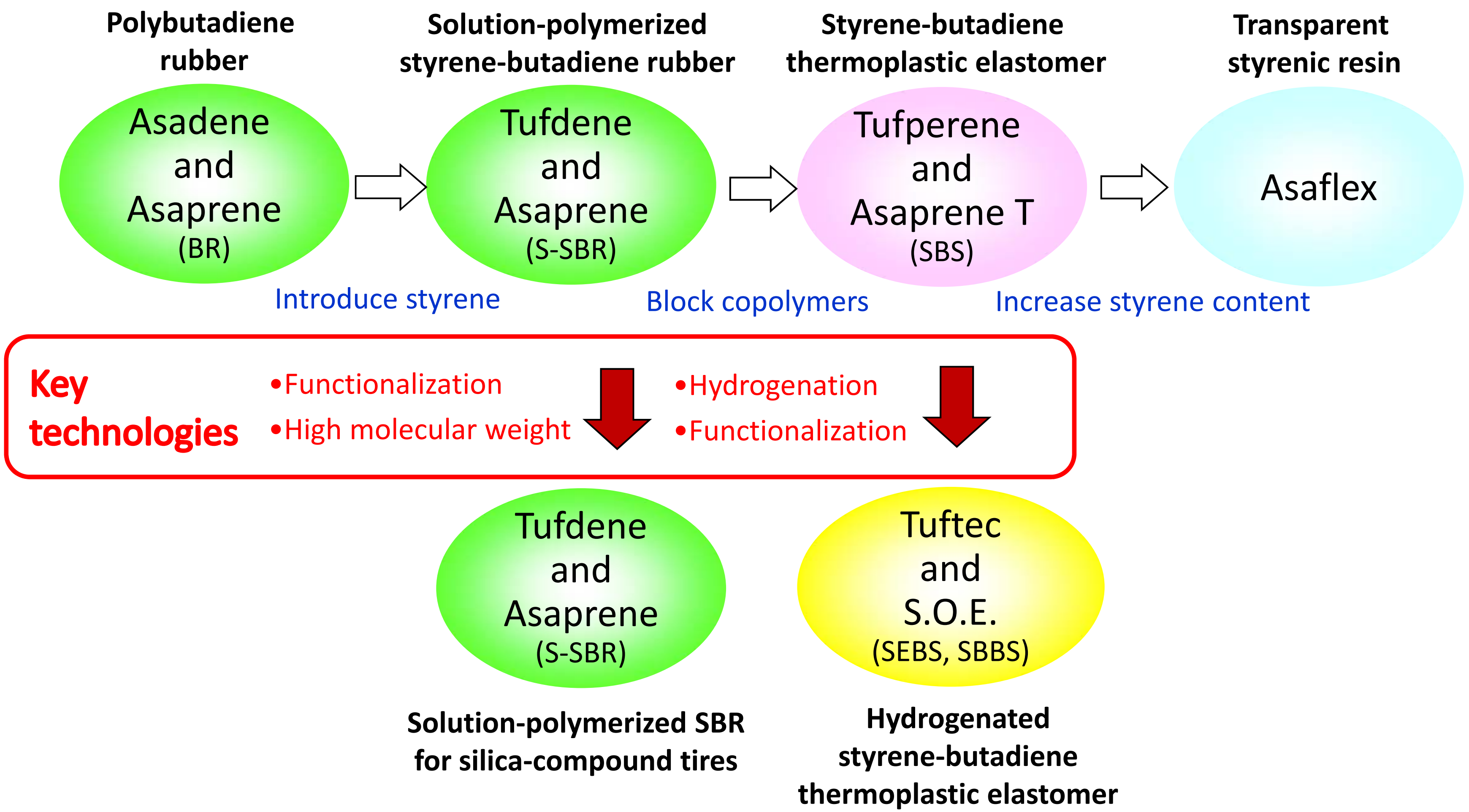
Global bases (production, sales, and R&D sites)



Synthetic rubber business

Synthetic rubber & elastomer products

Contributing to life and living around the world with our broad lineup of products based on butadiene and styrene



AsahiKASEI

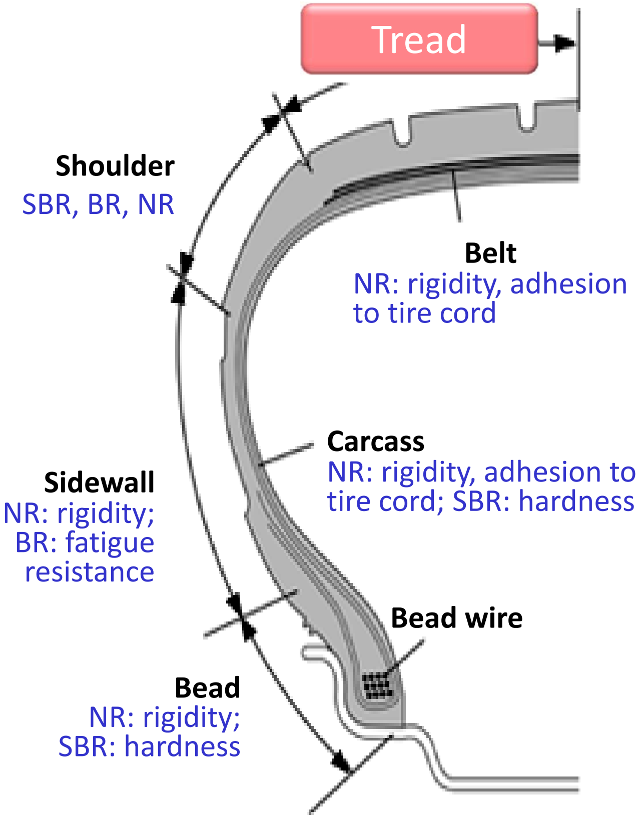
S-SBR

Solution-polymerized styrene-butadiene rubber

- There are two types of SBR, E-SBR and S-SBR. Both are used for vehicle tire tread.
- Featuring high design flexibility, S-SBR enables various performance criteria for tires to be met. S-SBR is especially suited to high-performance and fuel-efficient tires.

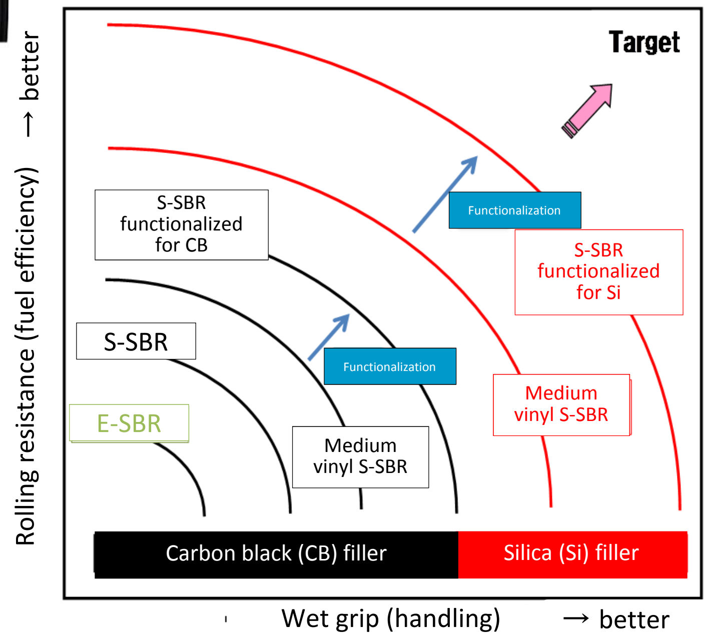
	S-SBR (solution polymerized)	E-SBR (emulsion polymerized)
Polymer design flexibility	High	Low
Manufacturers	Few	Many
Applications	High-performance and fuel-efficient tires	General-purpose tires

Tire structure



Tread compound technology revolution: from carbon black to silica filler

Tread	
Performance criteria	Polymers used
⌖ Fuel efficiency ⌖ Wet grip ⌖ Wear resistance ⌖ Handling stability	SBR (main polymer) Natural rubber (NR) High-cis BR



Dramatic increase in both fuel efficiency and wet grip performance

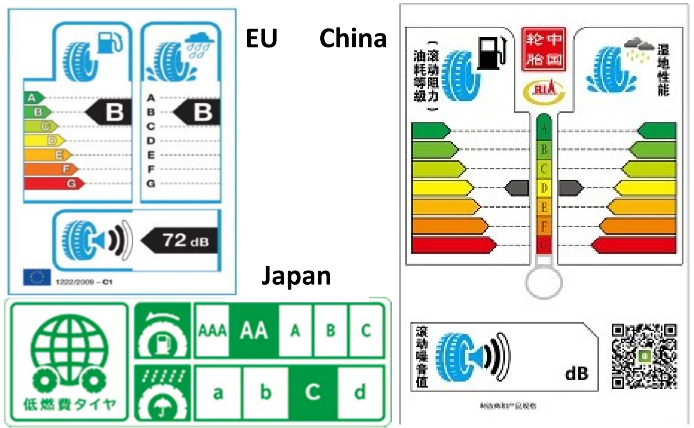
Dramatic improvement in fuel efficiency by compounding tread with silica. Achieving all performance criteria is highly dependent on the properties of SBR.

↓

Key technology is SBR structural design

Trends impacting S-SBR demand

Demand for higher tire performance
(both fuel efficiency and wet grip)



NEW

Tire labeling regulations

Region	Evaluation criteria	Launch
Japan	1. Rolling resistance 2. Wet grip	January 2010 (voluntary)
Korea	1. Rolling resistance 2. Wet grip	Voluntary from November 2011, mandatory from December 2012
EU	1. Rolling resistance 2. Wet grip 3. Noise	Mandatory from November 2012, sale of F and G rated tires prohibited from November 2016, stricter rolling resistance standard applied from 2018
China	**1. Rolling resistance** **2. Wet grip** **3. Noise**	**Voluntary from September 2016, mandatory from 2019 (planned)**
Brazil	1. Rolling resistance 2. Wet grip 3. Noise	Under study
USA	1. Rolling resistance 2. Wet grip 3. Wear resistance	Under study

Needs for lighter vehicles

Improving fuel efficiency of conventional fuel cars

Extending driving range of hybrid/electric cars

↓

Lighter weight tire

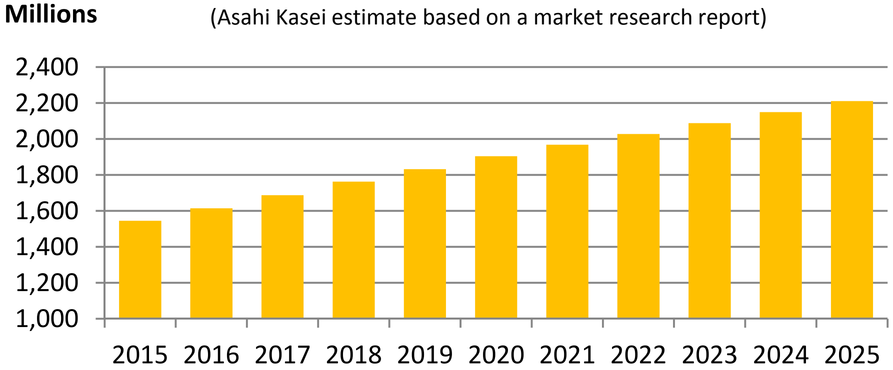
↓

Thinner and longer-life tread

↓

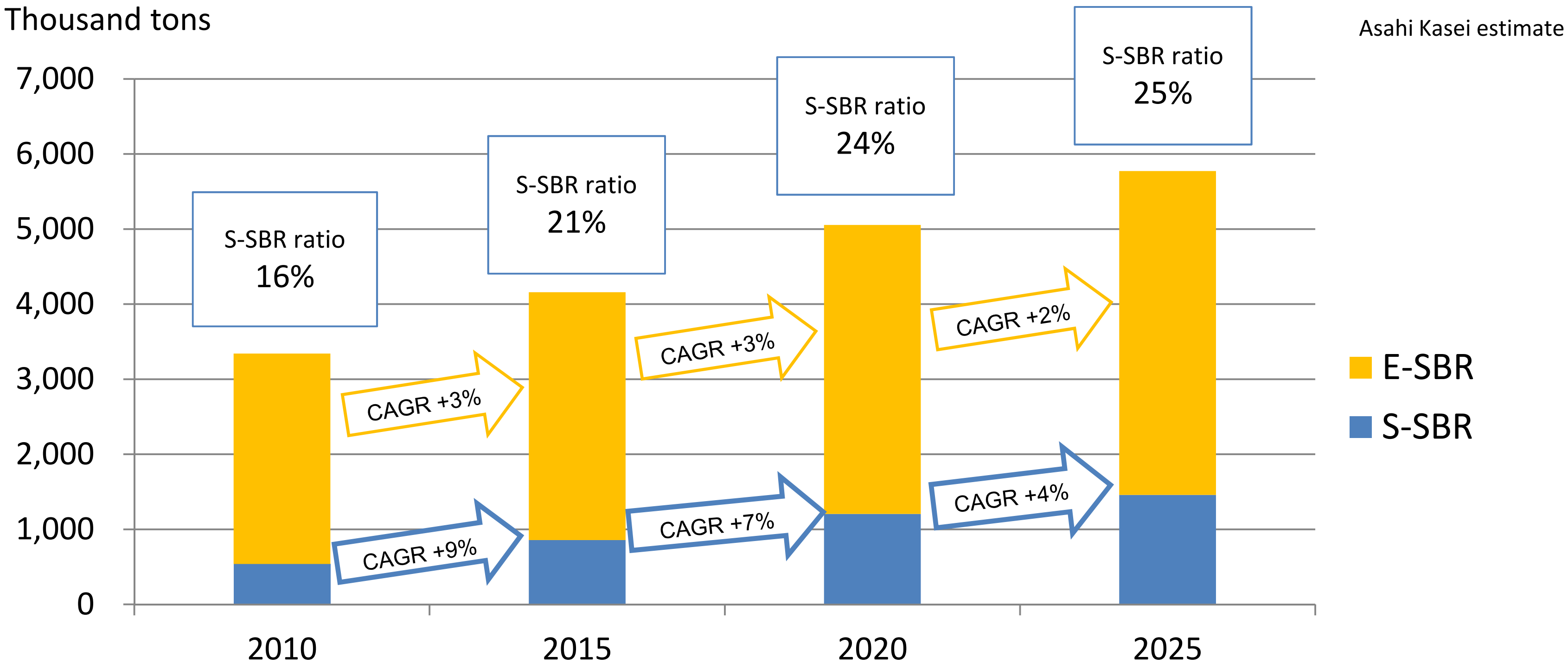
Needs for better wear resistance

Global sales forecast of tires
for passenger cars and light trucks
(Asahi Kasei estimate based on a market research report)



Growth of S-SBR market for tire

Global demand forecast for SBR for tires (excluding in-house production by tire manufacturers)



- **S-SBR demand growth exceeding that of E-SBR**
- **Asahi Kasei's global S-SBR sales growth far above overall market growth**

AsahiKASEI

S-SBR business growth strategy

1. Technological development

Continuous R&D to further heighten our original technology to create products that meet customers' needs and support their development of higher-performance tires

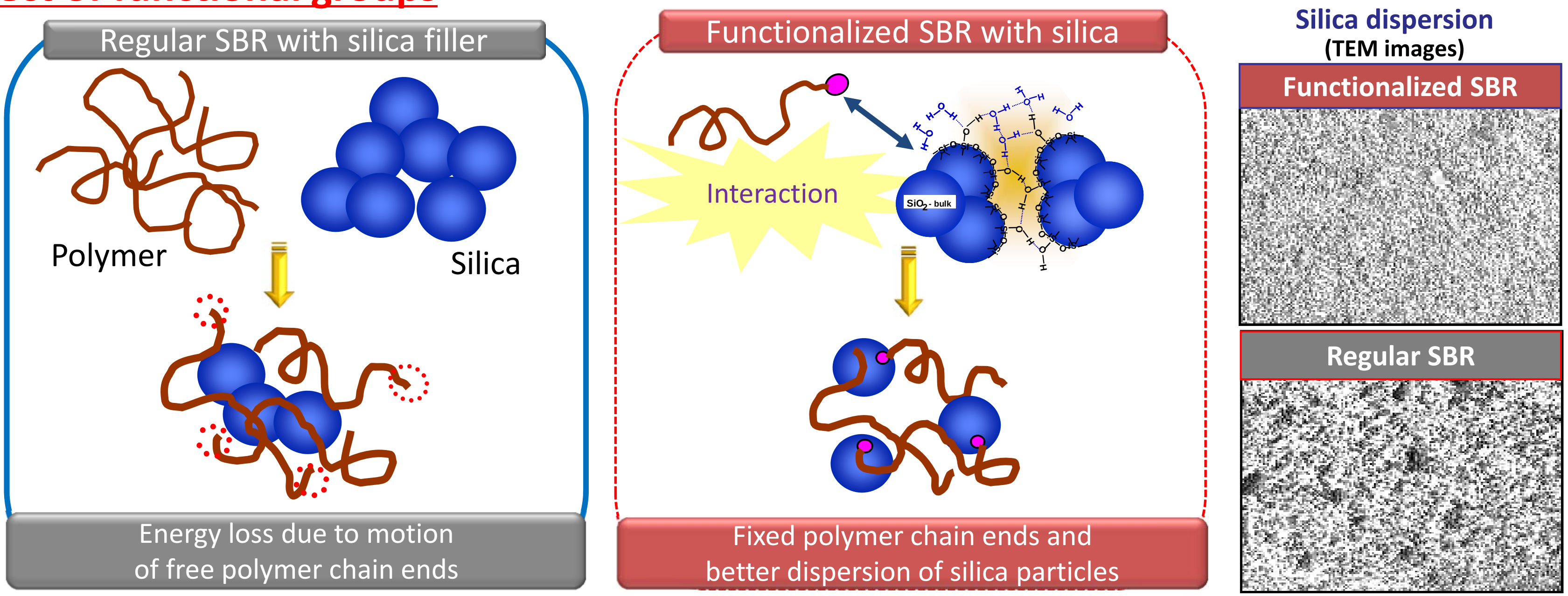
2. Proactive supply capacity expansion

Proactive expansion of our production capacity to ensure a stable supply to our customers as demand continues to grow

Technology for fuel-efficient tires

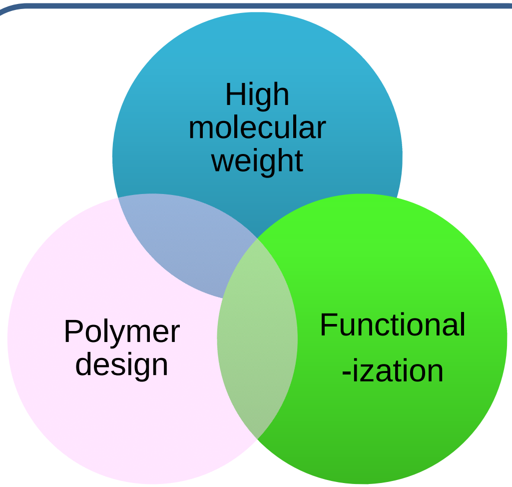
Cause of energy loss	Approach to reducing energy loss	Polymer design features
Filler-to-filler interaction (friction between filler particles)	Finer dispersion of filler	- Higher molecular weight (higher shear force) - Functionalization (functional group introduced)
	Reduced filler content	- Higher molecular weight (loss of strength suppressed) - Branched structure (processability improved)
Motion of polymer chain ends (energy lost as heat)	Reduced number of free polymer chain ends	- Higher molecular weight - Narrow molecular-weight distribution
	Fix free polymer chain ends	- Functionalization (functional group introduced)
Filler-to-polymer interaction (friction between filler and polymer)	Chemical bond between filler and polymer	- Functionalization (functional group introduced)

Effect of functional groups

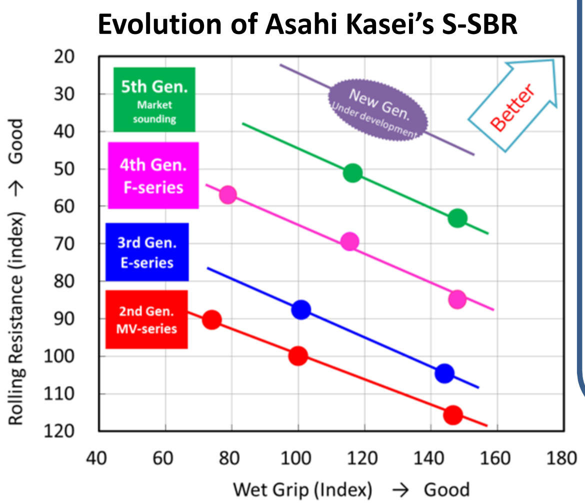


Technical advantages of Asahi Kasei's S-SBR

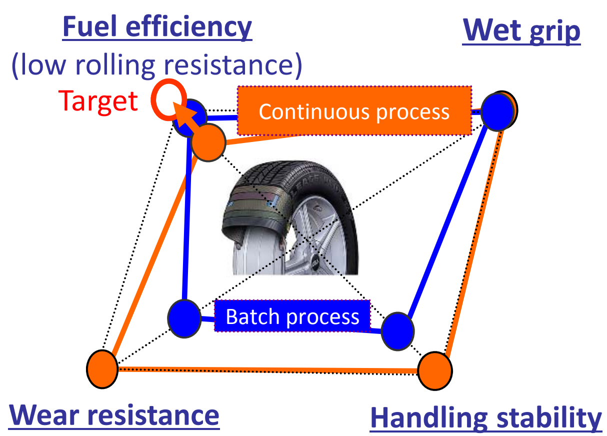
- S-SBR production technologies are continuous process and batch process. Asahi Kasei focuses on continuous process, which is employed by fewer manufacturers.
- Our continuous-process S-SBR, with high molecular weight, contributes to enhanced wet grip, wear resistance, and handling stability. Together with functionalization technology and polymer design technology, we offer high-value specialty products that contribute to overall tire performance.



Asahi Kasei's continuous process technology for S-SBR



・4th Gen. launched in 2012
・3rd Gen. launched in 2015



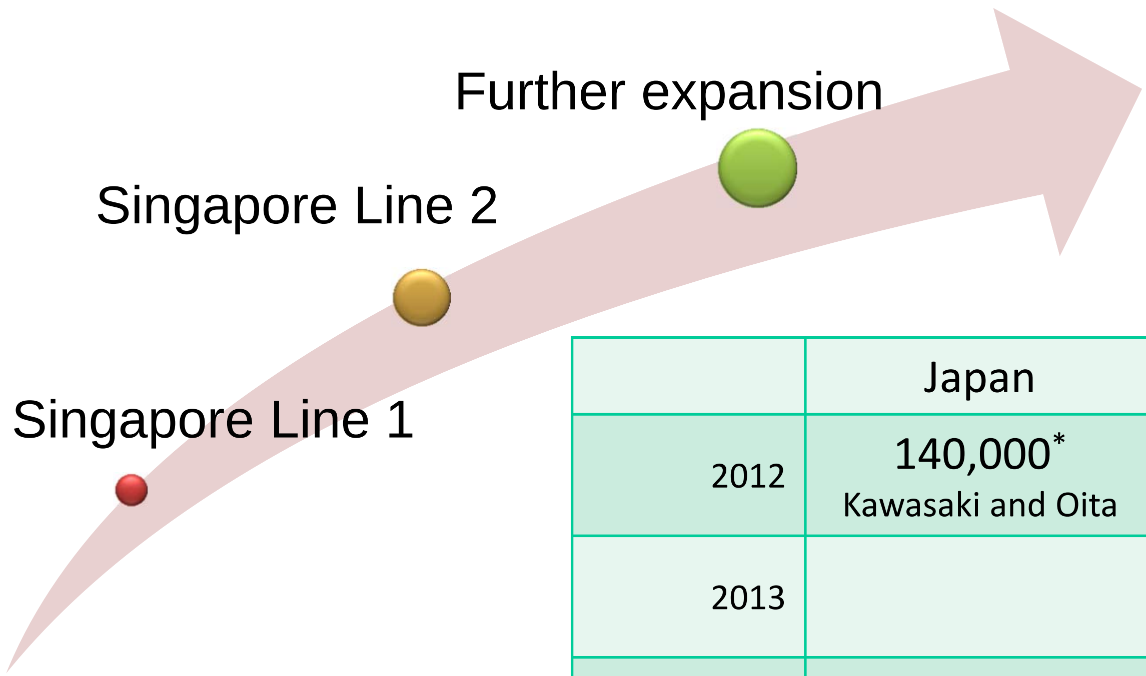
Utilizing polymer design, high molecular weight, and functionalization technologies to improve the four major performance criteria of tires.

Comparison between continuous process and batch process in four major performance criteria

AsahiKASEI

Proactive expansion of supply capacity

- Proactively expanding capacity to meet rapid market growth
- Studying expansion of existing facilities and construction of new facilities overseas



World's No. 1 S-SBR supplier

Unit: tons / year

	Japan	Overseas	Total
2012	140,000* Kawasaki and Oita		
2013		+50,000 Singapore Line 1	190,000
2015		+50,000 Singapore Line 2	240,000
by 2020		Expansion New line or facility	

* Flexible capacity including BR

Engineering plastics business

AsahiKASEI

About our engineering plastics business

Value added to products by Asahi Kasei technology

Customers' value increased

Monomer process

Polymer-ization process

Compounding process

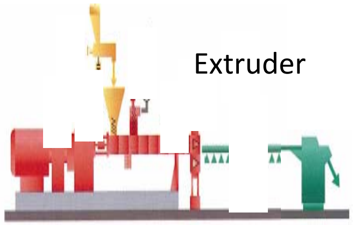
Superior grade lineup

Matching customer needs

Needs in automotive applications

- Lighter weight and reduced number of parts
- Greater safety and comfort
- Longer-term reliability

Polymer technology	Alloy technology	Compound technology	Grade development technology	Application development technology	CAE technology



What is compounding?

- A process in which a polymer material is given various additional performance properties.
- A polymer is melted and mixed in an extruder with other polymer, glass fiber, flame retardant, and other additives to produce a compound.

AsahiKASEI

Engineering plastics business growth strategy

Basic principle

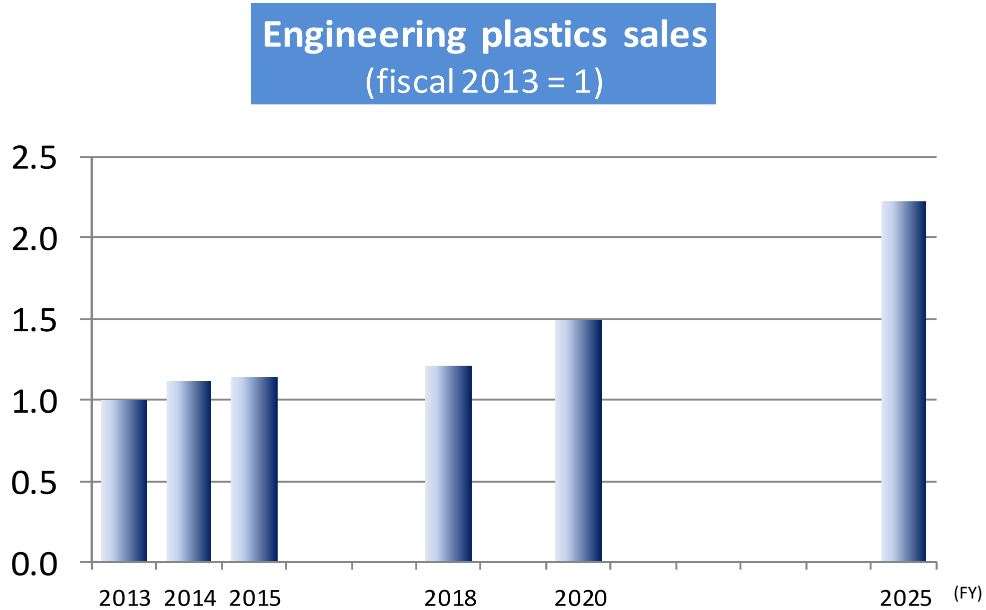
Expanding business by leveraging our superior grade lineup and application development technology with our global compounding infrastructure

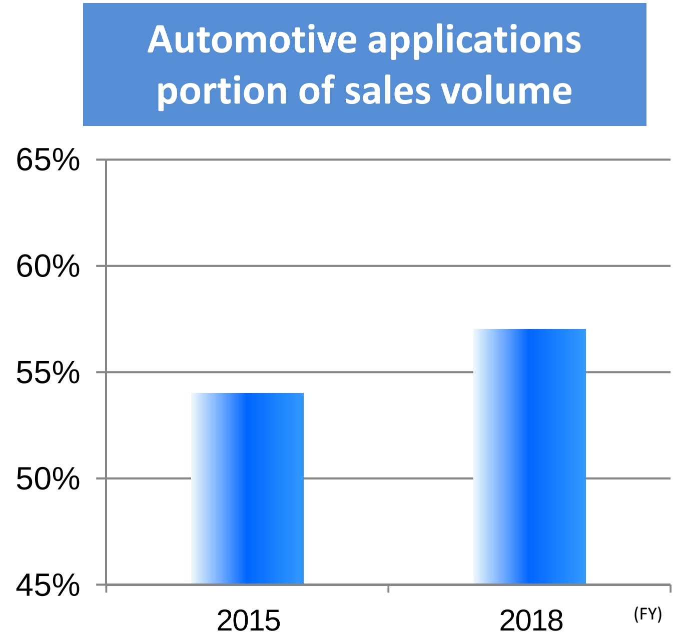
Strategic focus on automotive applications

- **Demand for engineering plastics** expanding with needs for greater fuel efficiency (vehicle weight reduction) prompting greater **substitution of metal**
- Establishment of **Asahi Kasei Europe GmbH** for further expansion of business in Europe
- Meeting customers' needs through our capability of **developing superior grades** by polymerization, alloy, and compound technologies, and capability of **developing new applications**
- Employing **CAE** (computer-aided engineering) for product proposals in the design of automotive parts
- Utilizing our **global network** to swiftly met customers' needs

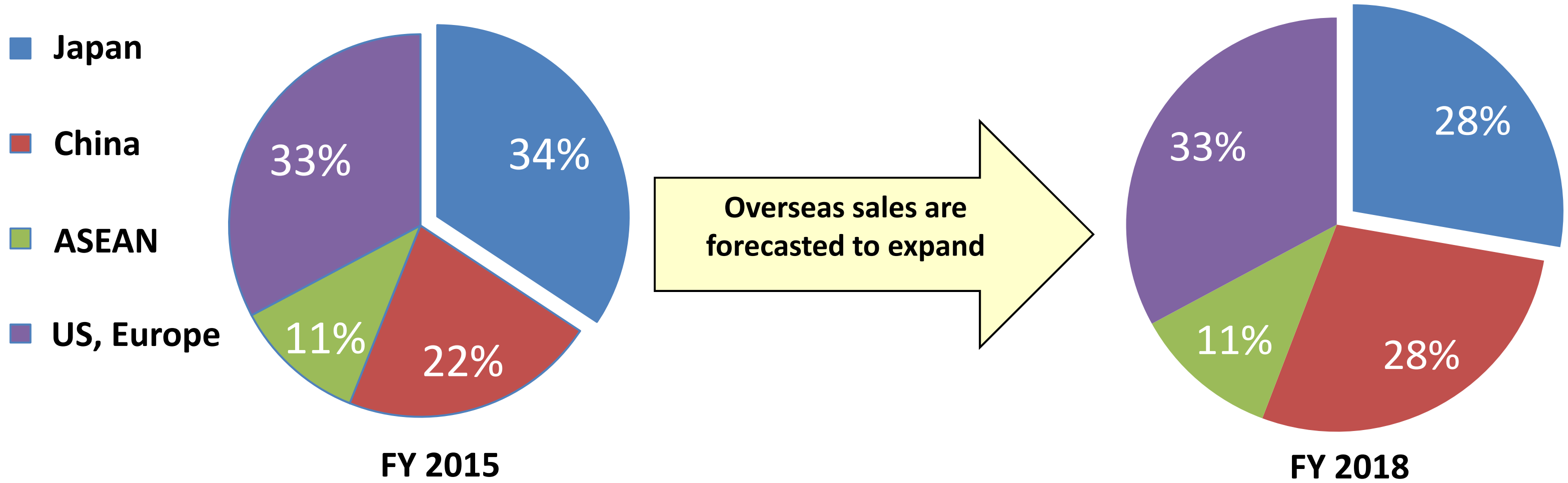
Main products	Main applications
Leona polyamide 66 (PA66)	Automotive parts, electrical/electronic parts
Tenac polyacetal (POM)	Automotive parts, office equipment
Xyron modified polyphenylene ether (mPPE)	Automotive parts, solar panels, office equipment
Thermylene reinforced polypropylene (PP) compound	Automotive parts, furniture

Engineering plastics sales growth plan





Sales by region

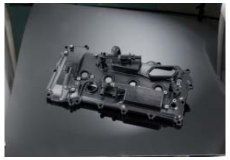


Strengths by material (1)

AsahiKASEI

Our engineering plastics improve performance, quality, and reliability of automotive parts
- Leona: Maintains good heat resistance and strength even in harsh conditions of engine compartment
- Tenac: Contributes to comfortable and pleasant car interiors with low VOC emission

Leona polyamide (PA) 66
- ❖ Broad lineup of grades with good balance of heat resistance, strength, and rigidity
- ❖ Rich track record in substitution of metal


Head cover


Engine mount


Door mirror bracket

Know-how for applications development and substitution of metal

Alloy and compound technology to develop superior grades

Grades with heat resistance, strength, and rigidity

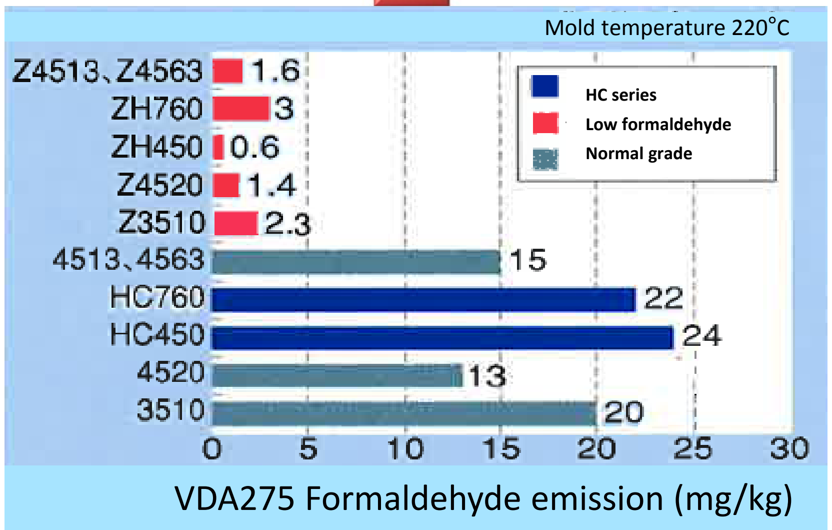
Polymer technology

PA66 | PA610 | PA612 | 66/I

Tenac polyacetal (POM)
- ❖ Superior grades with low VOC (volatile organic compound) emission
- ❖ Formaldehyde emission reduced by 90%


Inside handle


Seatbelt buckle



AsahiKASEI

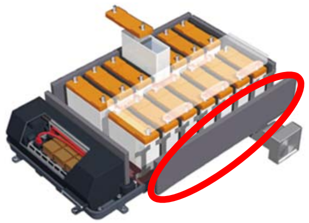
Strengths by material (2)

Our engineering plastics improve performance, quality, and reliability of automotive parts
- Xyron: Good balance of heat resistance, chemical resistance, and dimensional stability
- Thermylene: Light weight, easy to mold, good strength and durability

Xyron modified polyphenylene ether (mPPE)
- ❖ Improved heat resistance, chemical resistance, and dimensional stability by alloying with PA and PP in addition to polystyrene (PS)
- ❖ Differentiation with original alloy technology

Thermylene polypropylene (PP) compound
- ❖ Improved strength added by compounding with glass fiber (GF) and minerals, while leveraging PP's low cost and easy moldability
- ❖ Growing as a substitute of high performance plastics

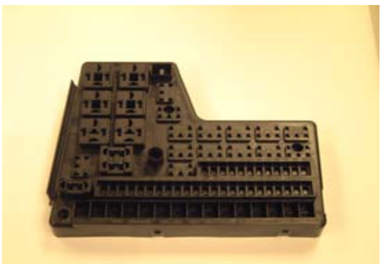

Truck fender
PA/PPE


Lithium-ion battery holder
PPE/PS


Fan shroud
PA + GF ➔ PP + GF


Interior console
PP + long GF ➔ PP + short GF


Car battery case
PP/PPE

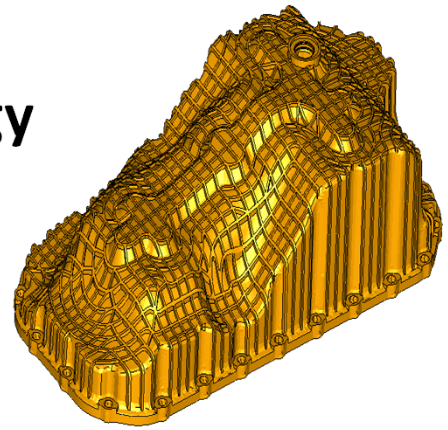

Relay block
PA/PPE


Door module
PP + long GF ➔ PP + short GF


Mirror bracket
PA + GF ➔ PP + GF

Strengths in computer-aided engineering (CAE)

CAE technology



Oil pan for car engine

Succeeded in 60% weight reduction compared to metal with outstanding stiffness, impact resistance, and vibration resistance

Using CAE technology to make design proposals that meet customers' needs to reduce vehicle weight for better fuel consumption

Customers' needs

- **Substitute metal parts with plastic**
- **Integrate two or more parts into one**
- **Predict how new parts can be molded**
- **Reduce costs**

Hundreds of successful cases including cylinder head covers and brake brackets

Predicting stress and deformation

Predicting failure under conditions of use

CAE for proposal-based applications development

Analysis to propose optimum designs

Supporting mold design by flow and warp analysis

Meet customers' requirements with our engineering plastics

Asahi Kasei Plastics Vietnam Co., Ltd. (CAE center) began operation in June 2016

Roadmap for expanding business bases

Expanding our global network of bases for swift response to customers' needs

■ Complete ☐ Under study

	2013–2015	2016–2018	2019–
US/ Mexico	■ Asahi Kasei Plastics Mexico S.A. de C.V. (sales office, Sep. 2015)	■ New plant in Athens (second compounding plant in US, Feb. 2016)	☐ Local compounding in Mexico
Europe		■ Asahi Kasei Europe GmbH (European headquarters, Apr. 2016) ☐ Technical center in Europe	☐ Local compounding in Europe
China	■ Shanghai technical center (2013) ■ Sales offices in Wuhan and Ningbo (2013)	☐ Technical center in Guangzhou	☐ Expand sales offices in China ☐ Increase compounding capacity in Suzhou
ASEAN/ India		■ Asahi Kasei Plastics Vietnam Co., Ltd. (CAE center, Jun. 2016) ☐ Technical center in Thailand ☐ Local compounding in India	☐ Increase compounding capacity in Thailand

Sales office in Mexico

Name:	Asahi Kasei Plastics Mexico S.A. de C.V.
Address:	Querétaro, Mexico
Established:	June 2015
President:	Iichiro Kitsuda
Ownership:	100% owned by Asahi Kasei Corp. through North American subsidiaries
Operation:	Sales and technical support of performance plastic compounds, mainly polyamide and polypropylene
Start-up:	September 2015

AsahiKASEI

Second compounding plant in the US

Company:	Asahi Kasei Plastics North America, Inc.
Location:	Athens, Alabama
Capacity:	30,000 tons/year
Products:	Performance plastic compounds, mainly polyamide and polypropylene
Start-up:	February 2016

About Asahi Kasei Plastic North America (APNA)

Headquarters:	Fowlerville, Michigan
Establishment:	July 2000
President:	John Moyer
Operation:	Manufacture and sale of performance plastic compounds, mainly polyamide and polypropylene
Capacity:	105,000 tons/year (Fowlerville, MI)
	30,000 tons/year (Athens, AL)