

# MAJOR INNOVATIONS

## Synthetic Rubbers



### Developed F-LiBR for tires

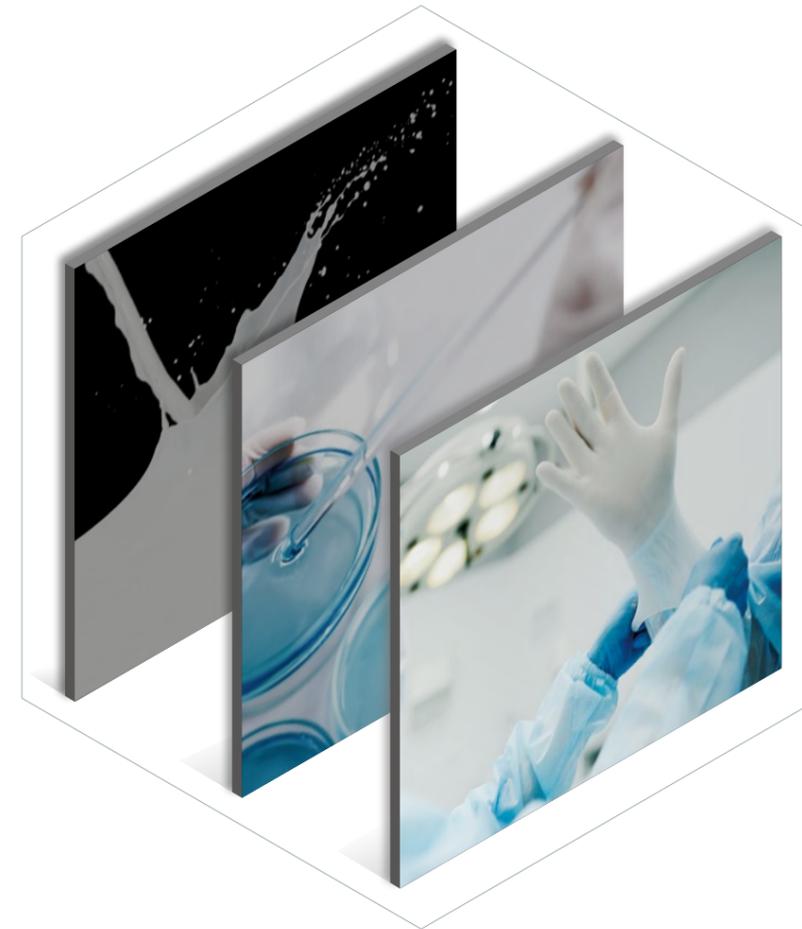
Lithium butadiene rubber (LiBR) is a synthetic rubber made by using a lithium catalyst and butadiene. It is used mainly in manufacturing HIPS and ABS resins. KKPC has developed functional-lithium butadiene rubber (F-LiBR) by converging LiBR with our synthetic rubber manufacturing and eco-friendly functionalization technologies. F-LiBR offers the best fuel efficiency in the world, with 20-40% improvements in efficiency compared to existing BR tire materials. Thanks to its low heat build-up and excellent resistance to blow-outs, F-LiBR can be used in truck and bus radial (TBR) materials, as well as in materials for all other tires. In addition, because its modification is unrestricted and its glass transition temperature can be adjusted, it can be applied to the new concepts of tires. As such, we leveraged new technology to upgrade a commodity rubber to a specialized rubber for tires, thereby creating new value.

#### Features

Best fuel efficiency in the world



Low heat build-up and excellent blow-out resistance



### Commercialized NB latex with outstanding chemical resistance

The purpose of wearing gloves is to protect the skin from the external environment, such as the physical environment and chemical environment. The role of gloves in providing protection from the chemical environment is vital especially when chemicals are being handled. KKPC has successfully developed and commercialized 'KNL 870', an NB latex for chemically-resistant gloves which offers a high level of safety for a wide range of chemicals. This has expanded our range of materials for industrial gloves which includes 'KNL 860', used for coating gloves and other applications, and now we have NB latex products for all types of rubber gloves, from medical, experimental and industrial use to kitchen gloves. As a result, we further solidified our leading position in the global rubber gloves market. Going forward, we continue to focus on attracting new customers and increasing sales of our NB latex, while also developing market-leading products.

#### Features

KNL 870: High level of safety for a wide range of chemicals



NB latex product line-up for all types of rubber gloves



## WORLD-CLASS PRODUCTS

- **SBR**  
Styrene butadiene rubber
- **HBR**  
High-cis polybutadiene rubber
- **NBR**  
Acrylonitrile butadiene rubber
- **LBR**  
Low-cis polybutadiene rubber
- **NB Latex**  
Acrylonitrile butadiene latex
- **KSL-341 foam latex**
- **EPDM**  
Ethylene propylene diene monomer
- **KUMANOX 13 antioxidant**
- **KUMANOX 5010L antioxidant**
- **PA**  
Phenolic additives
- **MIBK**  
Methyl isobutyl ketone
- **BPA**  
Bisphenol-A
- **Phenol**
- **Aceton**
- **Polymethylene polyphenylisocyanate**
- **Diphenylmethane-4,4, diisocyanate**
- **SBS**  
Styrene butadiene styrene

## Synthetic Resins



### Developed eco-friendly SAN resin

Atyrene acrylonitrile (SAN) resin is used in various products, ranging from food and cosmetics containers to parts for home appliances and disposable lighters. Although demand for SAN resin has been rising, Food Contact Material (FCM) regulations stipulated in EU Regulations and GB 4806.7, which is the national standard criteria in China, have recently become stricter, making it more difficult to export to these markets. KKPC has sought to minimize remaining acrylonitrile (AN) by optimizing devolatilization process and applying a re-extrusion method, but it has proved difficult to satisfy all relevant regulations. We have therefore obtained a technology that can completely remove all remaining AN through a reactive extrusion method which uses a special additive that functions as a scavenger for leftover AN. Now we are making additional improvements to this technology in relation to manufacturing costs, and we expect to complete the development of AN control process with price competitiveness in the near future, which will enable us to lead the eco-friendly SAN market.

#### Features

Technology that can completely remove all remaining AN



Remaining AN control process under development



## Specialty Chemicals



### Developed multi-functional epoxy paint diluent

KKPC offers an eco-friendly epoxy paint diluent additive that has the chemical features of nonylphenol (NP) but without the risks associated with existing NP. In 2018, we released Kumanox-3113, a multi-functional epoxy paint diluent, thus strengthening our product line-up. It is a non-reactive diluent which can be used in paints for construction, heavy duty paints for ships, adhesives and composite materials. As a hydrocarbon group, Kumanox-3113 offers extremely good usability with epoxy resins and amine hardeners. In addition, it offers excellent adhesive power and improved mechanical properties since it comes from a high hydroxy functional group. It can be used to both main agent and hardener, and because there is no discoloration after mixing, it can also be applied to transparent materials.

#### Features

Outstanding usability as a hydrocarbon group



Excellent adhesive power and mechanical properties improvement



## WORLD-CLASS PRODUCTS

- **SBR**  
Styrene butadiene rubber
- **HBR**  
High-cis polybutadiene rubber
- **NBR**  
Acrylonitrile butadiene rubber
- **LBR**  
Low-cis polybutadiene rubber
- **NB Latex**  
Acrylonitrile butadiene latex
- **KSL-341 foam latex**
- **EPDM**  
Ethylene propylene diene monomer
- **KUMANOX 13 antioxidant**
- **KUMANOX 5010L antioxidant**
- **PA**  
Phenolic additives
- **MIBK**  
Methyl isobutyl ketone
- **BPA**  
Bisphenol-A
- **Phenol**
- **Aceton**
- **Polymethylene polyphenylisocyanate**
- **Diphenylmethane-4,4,diisocyanate**
- **SBS**  
Styrene butadiene styrene

## Electronic Materials



### Developed a new ArF immersion BARC product

Bottom anti-reflection coating (BARC) is a polymer coating that is used on the lower layer of PR to control light reflectivity, which enables higher resolution. KKPC succeeded in the mass production of an ArF immersion BARC product in 2015 and sells it. Based on this technology, we have developed a new ArF immersion BARC product that has a higher refractive index and better etching performance than the existing product, and we are awaiting customer evaluation. Moreover, we have been targeting the growing semiconductor market in China by selecting BARC products which are suited for the local market, and we are now moving forward with customer evaluations.

#### Features

High refractive index



High etching performance



## 17 World-class Products

### Styrene butadiene rubber (SBR)

This synthetic rubber product is manufactured by the emulsion polymerization of styrene and butadiene at low temperature. SBR delivers more consistent quality, as well as excellent heat and wear resistance, when compared with natural rubber, and is widely used as a feedstock for tires, shoes and industrial goods.

### High-cis polybutadiene rubber (HBR)

HBR is manufactured through the solution polymerization of 1,3-butadiene. With more than 96% cis content, it has outstanding wear resistance, rebound resilience, aging resistance and water resistance. Its glass transition temperature (Tg) is very low, at around -100°C, which means it is a widely used synthetic rubber product.

### Acrylonitrile butadiene rubber (NBR)

This copolymer is manufactured by emulsion-polymerizing acrylonitrile and butadiene at low temperatures. NBR is a synthetic rubber product with excellent oil and chemical resistance, and is easy to process due to its good usability, including roll-winding, mixing dispersibility and extrudability, and its proper vulcanization characteristics.

### Low-cis polybutadiene rubber (LBR)

LBR is manufactured by using lithium catalysts. It features a cis content of 34.5%, good elasticity, and a vinyl bonding structure of around 14.5%, all of which combine to offer good reactivity. It is mainly used as a base polymer in manufacturing HIPS.

### Acrylonitrile butadiene latex (NB Latex)

This carboxy-modified acrylonitrile butadiene latex is used for making latex gloves, including for medical purposes, and abrasive paper. It is replacing natural latex, and the market is growing sharply thanks to its durability, wear resistance, high tensile strength and outstanding color hold.

### KSL-341 foam latex

This styrene-butadiene latex is used for foam rubber. Compared with other latex, it has high density, low flow and outstanding stability, which is why it can be used on its own to manufacture foam rubber. It is used for mattresses, shoes, cosmetic powder puffs and impact resistance reinforcing agents for various plastics.

### Ethylene propylene diene monomer (EPDM)

This amorphous polymer material is manufactured through the copolymerization of ethylene and propylene. It delivers outstanding heat resistance, ozone resistance, insulation characteristics and a low specific gravity, making it perfect for lightweight materials. Because of its stable chemical characteristics, it is used for a wide variety of purposes, including in automobiles, electricity and electronics, as well as general industrial goods.

### KUMANOX 13 antioxidant

This commodity antioxidant enables basic attributes of a product to be maintained, such as ozone resistance, flexibility resistance, oxidation resistance and cracking prevention. Because of its coloration and staining characteristics, it is widely used in rubber, tires and belts.

### KUMANOX 5010L antioxidant

This high-performance phenolic antioxidant delivers outstanding discoloration and coloration-prevention. It is a non-staining antioxidant with low volatility, and offers both high quality and excellent price competitiveness. It is used for a wide range of purposes, including tires, belts and medical gloves.

### Phenolic additives (PA)

This fine chemical product is added to polymers such as rubber, resin and paint, in order to maintain their performance for a longer period of use or a wider temperature range, and thus improve their unique properties. It prevents oxidation of the double bonds of rubber and improves the viscosity of resin and paints, which improves processing quality and reduces processing time.

### Methyl isobutyl ketone (MIBK)

MIBK is made through an acetone and hydrogen reaction using a catalyst. This colorless, transparent liquid is flammable and has an unusual odor. It is used as a feedstock for vinyl, acryl, alkyd, polyester, epoxy resin solvents and various chemical reactions.

### Bisphenol-A (BPA)

This white crystalline solid is created through a condensation reaction between phenol and acetone, in the presence of a catalyst. It is used as a feedstock for polycarbonate, phenolic, polyester and other resins, and is used in automobiles, electricity and electronics, as well as IT industries.

### Phenol

Cumene is used as the feedstock to manufacture this colorless raphide or white crystalline aggregate with a unique odor. It is used as a feedstock for phenolic resin, BPA, caprolactam, alkylphenol, adipic acid and plasticizer, and is used in automobiles, electricity and electronics, as well as IT industries.

### Acetone

Acetone is manufactured using cumene as its feedstock, and is co-produced with phenol. This colorless liquid has a unique odor, and is flammable with a low boiling point. It is used as a feedstock for MIBK, BPA and methyl acrylate, and in the manufacture of a wide range of coatings and plastics.

### Polymethylene polyphenylisocyanate

This material is obtained by the phosgene treatment of diphenylmethane diamine, created through the condensation of aniline and formaldehyde. It is in liquid form at room temperature, and is used in a range of products, including hard foam, semi-hard foam and CASE.

### Diphenylmethane-4,4,diisocyanate

This pure monomeric MDI is the result of high-purity refinement. It is in white solid form at room temperature, and has water-like transparency in liquid form. It features outstanding discoloration resistance against high temperatures and UV rays, and is used in spandex fibers and TPU.

### Styrene butadiene styrene (SBS)\*

SBS is a thermoplastic elastomer with excellent deformation recovery and high elasticity, even without vulcanization, thanks to its unique chemical structure. It has multiple applications, including asphalt modification, compounding and plastic modification, and the manufacturing of shoes and adhesives.

## WORLD-CLASS PRODUCTS

- **SBR**  
Styrene butadiene rubber
- **HBR**  
High-cis polybutadiene rubber
- **NBR**  
Acrylonitrile butadiene rubber
- **LBR**  
Low-cis polybutadiene rubber
- **NB Latex**  
Acrylonitrile butadiene latex
- **KSL-341 foam latex**
- **EPDM**  
Ethylene propylene diene monomer
- **KUMANOX 13 antioxidant**
- **KUMANOX 5010L antioxidant**
- **PA**  
Phenolic additives
- **MIBK**  
Methyl isobutyl ketone
- **BPA**  
Bisphenol-A
- **Phenol**
- **Acetone**
- **Polymethylene polyphenylisocyanate**
- **Diphenylmethane-4,4,diisocyanate**
- **SBS**  
Styrene butadiene styrene

\* Newly selected in 2018