

## Reducing Environmental Impact in the Product Design and Raw Material Acquisition Phases

We preemptively identify the environmental impact generated in the product lifecycle and mitigate such impacts even from the product development phase.

We ensure that the ratio of eco-friendly products is constantly on the rise through multi-faceted endeavors to discover eco-friendly materials and develop their application technology.

### Improving the chemical management process and establishing its system

The expanding and tightening chemical regulations in Korea and abroad (K-REACH, Chemicals Control Act, Occupational Health and Safety Act, EU-REACH, etc.) have highlighted the growing importance for information management on the properties, harmfulness and hazards of chemical substances. Building on the compiled list of chemicals used in Korea in 2018, we developed the Global Chemical Information System (G.CIS) in 2019 to upload the data of chemicals, including what the chemicals are composed of applicable regulations, and information on their applications. We also set up a system to perform preliminary reviews on any and all new chemicals regarding their hazards and risks prior to them being brought on to our worksites. In 2020, we plan to continue this monitoring to stabilize the newly-established processes and systems while developing their dissemination plans in consideration of the chemical management status at overseas worksites and relevant regulations.

### Conducting LCA

Our product Life Cycle Assessments (LCA) were first made at the Geumsan Plant in 2012 and have since been conducted on two products each year to identify major factors that lead to environmental impact along the product lifecycle. We took note of the fact that environmental impacts that occur in the product use phase accounts for the majority of the total, and this has prompted us to focus on improving rolling resistance performance and optimal product weight in the development phase. In 2019, LCA was performed on the products manufactured at the Daejeon

Plant the previous year. This came in tandem with the quantitative analyses made on the mitigation of environmental impact as a result of replacing petroleum-based oil with natural oil and adopting renewable materials, and the outcomes were shared with our R&D centers.

### Identifying eco-friendly raw materials and developing their application technology

To ensure the sustainability of tire compounds, we identify eco-friendly and recycled materials while developing technology to use such materials for compound production. In 2019, we expanded the application of eco-friendly silica and green carbon<sup>1)</sup> to further focus on the creation of environmental value. While we previously used mineral-based silica, this was replaced with silica made from plant-based waste and these substitutes were adopted for the mass-production of tires. The supply of reclaimed rubber and green carbon was also stabilized to allow for the use of recycled butyl rubber across all our plants in Korea and abroad. Going forward, we will develop compounds made from green carbon and recycled rubber to consistently raise the percentage of recycled materials while conducting continuous performance verifications and assessments to adopt these newly-discovered materials for products.

1) Green carbon: recycled carbon black generated from the pyrolysis of end-of-life tires

### Defining eco-friendly products and resetting goals

As the tire labeling program extends from Europe, Japan, and Korea into other regions of the world, we added a rating criteria for these regions to our definition of eco-friendly products established back in 2015. Taking into account the feedback that safety grades as essential criteria were set too loosely, we tightened these grades from five grades to one~three grades. In addition, we eliminated the criterion of 'use of eco-friendly raw materials' and instead will separately monitor 'ratio of using sustainable materials' to include assessment indicators on improving eco-friendliness from the product use and disposal phases. According to our conventional definition of eco-friendly products, the ratio of such products amounted to 65% as of quantities and 71% as of sales. This was recalculated, however, to 45% and 49% respectively in accordance with the new criteria with upgraded safety grades. Our goal is to raise the percentage of eco-friendly products to 80% by 2030 (in accordance with the revised definition of eco-friendly products), and this will further spur our endeavors to improve on energy efficiency and wear and noise performance.

## Reducing environmental impact in the manufacturing phase

We take a multi-layered approach to fundamentally reducing environmental pollutants and waste from the manufacturing process.

### Reducing the generation of waste and increasing its recycling

Task force teams are up and running within our plants to reduce the generation of waste. As a result of our endeavors to mitigate scraps from semi-finished/finished products, the waste intensity at the Daejeon and Geumsan Plants declined to 34.64kg/ton in 2019. In addition, our full-fledged efforts to recycle waste resources allowed us to identify companies known for recycling technology in 2019 and to successfully recycle calcium hydroxide and carbon dust that had been processed through landfilling.

### Minimizing the discharge of pollutants

As the government and the general public are increasingly interested in particular matter (PM) issues, we were urged to make equipment investments to reduce the emission of nitrogen oxides (NOx), one of the main causes of PM, as a way to fundamentally reduce environmental pollutants. We replaced boiler burners with ultra-low NOx burners, and strive to mitigate environmental pollutants with the goal of maintaining our NOx emissions at 42% or lower than the tightened emission threshold. Proactive environmental investments were also made by replacing outdated dust collectors to improve the efficiency of pollutant removal, and diffractive scrubbers were installed to minimize the discharge of pollutants and improve the work environment as well. For processes with limited local ventilation, the proportional relationship between duct sizes and static pressures was analyzed to provide the appropriate air flow and improve dust collection efficiency in so doing.

In recognition of the importance of protecting the aquatic ecosystem, we apply internal management standards that are even more stringent than the applicable legal standards. In 2019, two sand filters were replaced at the Daejeon Plant to maintain the discharge concentration of suspended solids to 20% and below the legally allowable threshold to contribute to the preservation of the aquatic ecosystem.

### Developing energy-saving curing technology

Curing is the process of applying high temperatures and pressures to the green tire in a mold to form its pattern. Our goal of curing technology research is to efficiently use thermal energy in the curing process and improve product quality. Optimal timeframes, temperatures and pressures were set to ensure energy efficiency through extensive testing and research, and these variables were standardized to optimize curing conditions and to enable respective plants to increase their productivity output to the highest possible levels. A recent focus of research is inert gas, one of the numerous factor that affect curing conditions, and research was conducted on PCR<sup>2)</sup> and LTR<sup>3)</sup> tires for the optimization of inert gas use conditions in 2018, followed by TBR<sup>4)</sup> tires in 2019. Technology was identified to reduce gas consumption to appropriate levels to ensure both productivity and quality in the TBR tire manufacturing process, and this technology was adopted for production to eventually reduce gas consumption by 8% from conventional technology.

2) PCR: Passenger Car Radial  
3) LTR: Light Truck Radial  
4) TBR: Truck Bus Radial

### Promoting shared growth with local communities

Our Daejeon Plant has operated the Donggrami consultation group since 2016 to improve the environment in nearby areas and effectively undertake social-giving programs. The group consists of resident representatives, city/district council members, and professors from environmental academic departments, and assumes multiple roles as a communication channel for stakeholders. Group meetings are held quarterly to brief on the Company's activities to improve the environment and arrange factory tours, share CSR outcomes with the local community, and gather feedback from resident representatives and cater to their requirements in order to achieve shared growth with local communities.

#### Joining the Biz N Biodiversity Platform

Hankook Tire & Technology supports a biodiversity policy that promotes the creation of various values using biological resources. Our company makes efforts to minimize the environmental impact of business activities and improve the environment around our business sites. As biodiversity issues, such as the protection of endangered species, are structural problems that are difficult to solve through our company's efforts alone, we feel the need to network with government and other companies for problem-solving through policymaking. For this reason, we joined the Biz N Biodiversity Platform (BNBP), a biodiversity platform under the Korea Business Council for Sustainable Development (KBCSD), and have taken part in related activities.



## Reducing Environmental Impact in the Product Use and Disposal Phases

The environmental impact generated in the product use phase is determined by tire weight and rolling resistance. This is why our researchers are dedicated to optimizing tire weight and reducing rolling resistance - as it has an impact on the fuel consumption of automobiles.

### Optimizing tire weight

We have been conducting research on lightweight tires that contribute to reducing the use of raw materials as well as vehicle weight, bringing a positive impact to fuel efficiency improvement. In particular, we focus on the research of structural improvement on respective tire components and the development of tire compounds that are conducive to higher fuel efficiency. In 2019, we developed compounds for ultra-lightweight tires in an effort to optimize the volume of rubber used for respective tire sections while studying 3D Kerf<sup>5)</sup> technology applicable to the development of new tire profiles and patterns that minimize losses affecting handling and braking performance. Presently, these technologies were disseminated to our plants in Korea and abroad, and are being adopted for regular production.

5) 3D Kerf: Three-dimensional kerfs (fine grooves found on the tread surface) are formed in their optimal zigzag shape, rather than in a linear shape, to aid in the deformation of tire tread blocks in order to prevent grip losses and to increase rigidity.



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### Reducing Tire Rolling Resistance

Our basic research continues on structures, raw materials, compounds and manufacturing to reduce tire rolling resistance and improve automobile fuel efficiency in so doing. Such endeavors enabled us to increase the rolling resistance labeling grade of our PCR OE tires mounted on the BMW X5/X6 from grade C to grade A in 2019<sup>6)</sup>. Research outcomes were also applied to TBR tires and their rolling resistance performance improved by 25% from conventional ones<sup>7)</sup>. If fuel efficiency increases simply as a result of reduced rolling resistance, this may hamper a tire's braking, handling and wear performance. As such, we are studying optimal compounds that strike the right balance between contact pressure against the road surface and tire performance, in addition to eco-friendliness.

6) Comparison between K127A against K117A equipped on the BMW X5/X6 (255/55R18 109W)

7) Comparison between DL20W against DL10+ (315/70R22.5)

### End-of-Life Tire Management

Hankook Tire & Technology supports the position of the Tire Industry Project (TIP), which has established principles of waste tire management and aims to establish global standards (rules). With an estimated 50 million tons or more of waste tires discarded around the world, Hankook Tire & Technology thinks that the improvement of waste tire management worldwide needs to be promoted by expanding and applying the waste tire management manual.