Clear Definition of Environmentally Sound Products

Progress in FY2006 Toward Combating Global Warming

One of a manufacturer’s important duties is to help fight global warming through its products. Thanks to continued action led by the Environmentally Sound Product Committee established in June 2006, Yokohama Rubber has made two major steps toward fulfilling this duty: (1) clarification and application of the definition of environmentally sound products, and (2) calculation of the proportion of environmentally sound products in our lineup and the adoption of management by objective using the resulting figures.

Definition of Environmentally Sound Products According to Four Environmental Functions

Yokohama Rubber defines environmentally sound products based on their scoring along four dimensions of environmental performance. These are: prevention of global warming, resource recycling, resource conservation, and safety and comfort. A product’s environmental performance along these dimensions is assessed based on detailed metrics calculated for each dimension. Only new products that outperform conventional products along all four dimensions and that exceed our own internal general environmental assessment standards are recognized as being environmentally sound.

Use of Environmentally Conscious Design Applying LCA

Yokohama Rubber presently examines how environmentally friendly the designs of new products are employing a check sheet called the “Product Environmental Assessment Check Sheet,” one of the key items of which is lifecycle assessment (LCA). LCA is a method of analysis using numerical data of the load on the environment at each stage of a product’s life, from production to disposal. Although we have conventionally used LCA in tire design, we established the LCA measure and began using LCA for some MB products as well in 2006.
Proportion of environmentally sound products among new products

What might be described as Yokohama Rubber’s first environmentally sound product, a pneumatic fender, appeared on the market around half a century ago in 1958. In 1998, we led the rest of the industry by launching the DNA series of eco-tires for passenger cars, which were the first line of tires designed specifically to save fuel. “Rolling resistance,” which is what we used at the time as an indicator of fuel-saving performance, came to be used by the Japanese Ministry of the Environment as an indicator of tires’ fuel efficiency. In July 2007, we also launched a new product in the DNA series made from 80% non-petroleum resources. Regarding tires for trucks and buses, we unveiled in March 2007 the ZEN series, featuring drastically improved fuel efficiency performance and tire life. Looking ahead, we intend to contribute to the prevention of global warming by developing products that offer outstanding environmental performance.

MBO Based on the Percentage of Environmentally Sound Products

Clearly defining environmentally sound products has made it possible to calculate the proportion of environmentally sound products in our lineup. We presently calculate two percentages: one indicates the proportion of environmentally sound products among our entire lineup, and the other indicates the proportion among new products only. By adopting management by objective (MBO) based on the proportion of environmentally sound products, we plan to achieve our goal of “making all products environmentally sound by fiscal 2017” adopted as a goal in GD100.

Environmental Labeling Based on Voluntary Standards

In order to convey to the customer in an easy-to-understand manner that a product has been designated “environmentally sound products” by Yokohama Rubber, we plan to develop an environmental labeling system for certifying products that clear our own voluntary standards.
Development of Tire Products

DNA Series of Eco-tires for Passenger Cars

Leading the rest of the industry, Yokohama Rubber launched in 1998 the DNA series of eco-tires, which offer reduced roll resistance and contribute to improved fuel efficiency of vehicles. Since then, we have continued to pursue development of new products and improvements in quality, and now the DNA series has an excellent reputation as an environmentally sound product. Presently, the lineup consists of eight types of tires.

Gattai-gomu™ Underpins the Improved Performance of the DNA Series

Gattai-gomu™ is a compound that offers outstanding fuel-saving performance and excellent grip, which is achieved by infusing the rubber with a stable mix of the natural mineral silica. It underwent three major evolutions—first-generation Gattai-gomu™ in 1998, second-generation Gattai-gomu II™ in 2002, and third-generation Nano-Power Rubber in 2005—before being reborn in July 2007 as Super Nano-Power Rubber, which further boosts fuel-saving performance and is derived from non-petroleum resources.
DNA dB super E-spec Made from 80% Non-petroleum Resources

The DNA dB super E-spec tire for passenger cars announced in December 2006 is Yokohama Rubber’s flagship environmentally sound product, and was developed with the aim of producing the ultimate eco-tire that contributes to the global environment in every possible way. It is made from a variety of new materials and technologies that raise environmental performance, including a new compound made using orange oil called Super Nano-Power Rubber, and offers the largest reduction in rolling resistance of any tire in the DNA series (20% less than the DNA dB ES501). The proportion of materials used to make the tire that are derived from non-petroleum resources has also been raised to 80%, contributing to conservation of limited petroleum resources. The tire went on sale in three sizes in July 2007.

Core Design Technologies

Yokohama Rubber employs “multi-scale simulation,” a third-generation basic design technology, in tire development. This is a means of simulating tire performance across a wide range of scales—all the way from the nano-scale to the global environmental scale—to develop tires that offer better performance while at the same being more environmentally friendly. In fiscal 2006, two new techniques were added to our design arsenal: the element-free Galerkin method, which leads to more precise material design simulation, and robust design, which increases products’ market stability.
The New ZEN Eco-brand of Tire for Trucks and Buses

March 2007 saw the unveiling of three products under the new ZEN* eco-brand of tires for trucks and buses. This brand was developed with three goals in mind: to allow tires to be retreaded for reuse by extending the life of the casing, to reduce tire consumption by extending tread life, and to improve fuel efficiency by reducing rolling resistance. To achieve these three goals for environmental performance, a variety of new technologies were deployed, including “skew control profiling” and “C’ roll compounding,” to greatly improve durability, wear resistance, and fuel-saving performance. Progressive roll-out of eco-brand tires commenced in April 2007.

*“ZEN” is short for “Z-environment.”

Launch of Eco-tires for Trucks and Buses in 2002

The PRO FORCE eco-tire brand, the first such range for trucks and buses, was launched in 2002, and we have so far brought five products to market. Furthermore, we unveiled the new ZEN eco-tire brand in 2007, completing our line-up to meet a wide range of user needs.

<table>
<thead>
<tr>
<th>Year</th>
<th>Product</th>
<th>Description</th>
<th>Launch Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>TV687</td>
<td>An all-season tire whose extended tread life increases tire life and saves resources due to tire consumption. 12% better wear resistance than conventional products (PRO FORCE tough TY787).</td>
<td>October 2002</td>
</tr>
<tr>
<td>2005</td>
<td>TV787</td>
<td>An all-season tire whose dramatically reduced rolling resistance improves vehicle fuel efficiency, thus helping to save resources and lower exhaust emissions while at the same time reducing maintenance needs. 22% lower rolling resistance than conventional products (PRO FORCE eco RY237).</td>
<td>October 2005</td>
</tr>
<tr>
<td>2007</td>
<td>ZEN 701ZE</td>
<td>An all-season tire offering improved fuel-saving performance thanks to reduced rolling resistance, and also lower maintenance due to uniform wearing. 18% lower rolling resistance than conventional products (PRO FORCE eco TY687).</td>
<td>March 2007</td>
</tr>
<tr>
<td>2007</td>
<td>ZEN 102ZE</td>
<td>A ribbed tire whose dramatically reduced rolling resistance improves vehicle fuel efficiency, thus helping to save resources and lower exhaust emissions while at the same time reducing maintenance needs. 22% lower rolling resistance than conventional products (PRO FORCE eco RY237).</td>
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Development of MB Products

Yokohama Rubber’s MB product range covers a diversity of fields, including industrial products, sealant and adhesives, hoses and coupling, aircraft products, and golf products. We have developed and sold a multitude of products whose excellent environmental performance contributes to the fight against environmental pollution, resource conservation, and recycling.

Completion of Definition of Environmentally Sound Products and Commencement of LCA

Whether tires or MB products, goods brought to market by Yokohama Rubber as “environmentally sound products” are subject to the same assessment of environmental performance. As MB products span an extremely wide range, development of environmental metrics has taken some time. By fiscal 2006, however, we had finished work on developing methods for assessing environmental functions in each product group. Methods of LCA (lifecycle assessment) of belts and hoses were also introduced in fiscal 2006, and the intention is to develop LCA methods for assessing all our MB products as soon as possible.

LCA of belt and hose products

Example of assessment of environmental functions (sealant)
As They Pound Our Roads Everyday, the Environmental Performance of Truck and Bus Tires is Especially Important

Environmental awareness is rising in the transport and bus industries, whose fuel-hungry vehicles are constantly on our roads, so in March 2007 we unveiled our new ZEN brand of eco-tire.

- **Achievement of World-class Fuel-saving Performance**
  In the six years since development of the ZEN brand began in 2001, we have achieved major improvements in durability, along with our goal of improved fuel-saving performance, resulting in improved fuel efficiency and lower exhaust emissions. Three products have been announced, one of which, the ZEN 702ZE, offers world-beating fuel-saving performance in its class.

- **Focus on Increasing Retreadability**
  Considerable resources go into making truck and bus tires, and so I have been feeling for long that increasing the number of times that they can be retreaded makes it possible to reduce tire consumption, contributing to the fight against global warming. Increasing retreadability was therefore made an explicit design goal of the ZEN brand, and in order to achieve such high retreadability, significant improvements were made to durability. To combat global warming, we aim to play our part in contributing to the spread of retreaded tires as well as increasing the useful life of new products.

- **Reducing Noise by 90%**
  "The porous elastic road-surfacing material" is made by hardening ground scrap tires with urethane resin. In trials on a section of public road last year, it was found to reduce noise by around 90% compared with ordinary asphalt, and users who actually drove on the surface reported that it sounded completely different. Since then, we have received over 150 inquiries.

- **Laying at Ordinary Temperatures and Need for Fewer Road Repairs Contributes to Prevention of Global Warming**
  Unlike ordinary asphalt, our "porous elastic road-surfacing material" can be laid at ordinary temperatures. It is also expected to be more durable than conventional materials, as no flow rutting occurs under vehicle loads. Emissions of heat when the material is laid should therefore be lower, and repair work should be required less frequently, which means that exhaust emissions due to traffic congestion during surfacing and repair work will be reduced.

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**Reinventing Waste Tires to Make Quieter Roads**

We invest a lot of effort in “material recycling,” a prime outcome of which is the development of “a porous elastic road-surfacing material” produced from rubber chips made out of scrap tires.

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Yokohama Rubber develops a multitude of products designed to make life safer and more comfortable. One such example is the air-cell cushion for wheelchair users unveiled in July 2007, which is designed to prevent pressure sores, and we have also begun development of other disability and care-related products.

**Development of Disability and Care-related Products Now Also Underway**

**1980s**
- Entered the electronics field following development of a pressure-sensitive conductive rubber
- Development of monitoring system for construction vehicle tires
- Recipient of the Good Design Award
- Recipient of the Nissan Jidosha Shinbun’s 2006 Grand Award of Products

**2000**
- "HiTES" air-pressure monitoring system for truck and bus tires
- "AIR watch" air-pressure monitoring system for passenger car tires
- "FENDER watch" air-pressure checking system for pneumatic marine fenders
- "G" sensor vehicle behavior sensor system
- "MIX-GT" high-performance tank for dispensing gas into tires (developed jointly with Iwatani Gas Co.)
- "DNA dB EURO ZPS E550R" run-flat tires
- "Medi-Air" air-cell cushion to prevent wheelchair pressure sores

**Number of published patent applications**
- (No. of applications)
  - 2002: 462
  - 2003: 414
  - 2004: 640
  - 2005: 817
  - 2006: 1,003

**Number of IP rights held**
- (as of March 31, 2007)
  - Patents: 1,099
  - Trademarks: 1,300
  - Design rights: 287
  - Utility models: 41
  - Other countries: 2,617

**Intellectual Property Situation**

Led by the Intellectual Property Department, individual divisions work with research and analysis specialist Yokohama Techno Research to protect Yokohama Rubber’s intellectual property. In 2006, the number of published applications for patents was 1,003 (513 by the Tire Group and 490 by the MB Group), and the number of patent registrations was 261. The total number of intellectual property rights held is 2,727 in Japan, and 2,617 overseas.