



## TECHNOLOGY HANDBOOK

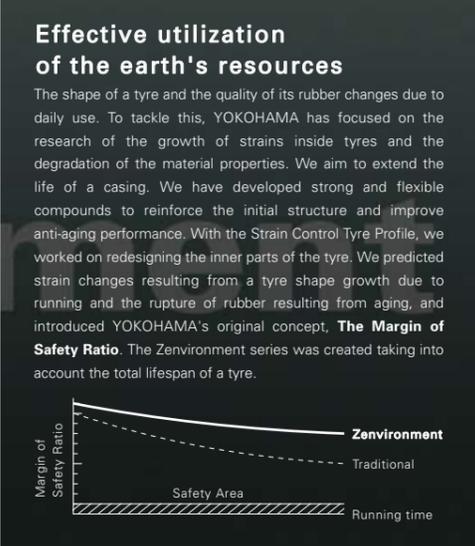
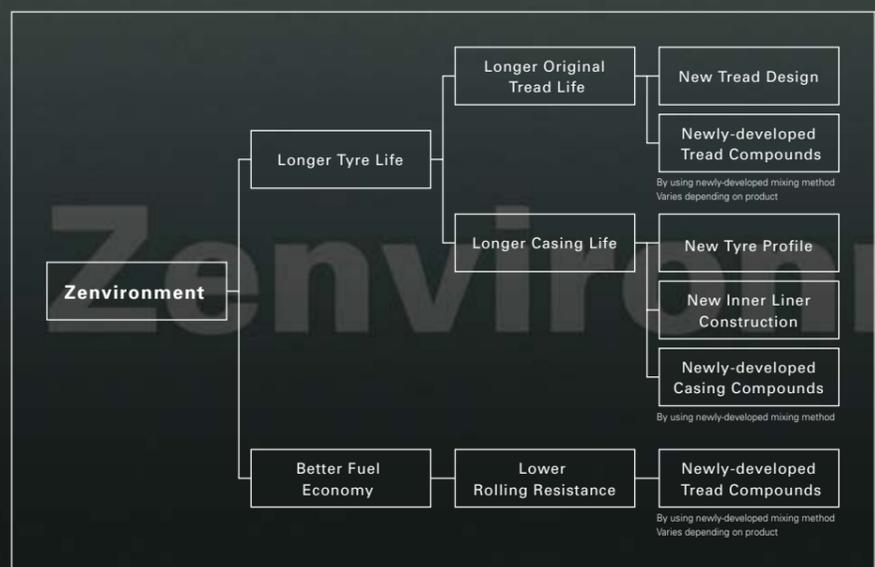
The Zenvironment series has been developed by YOKOHAMA to contribute to the global emissions reduction programme. YOKOHAMA has created new technologies in factory processes, as well as new tyre designs, compounds and constructions.

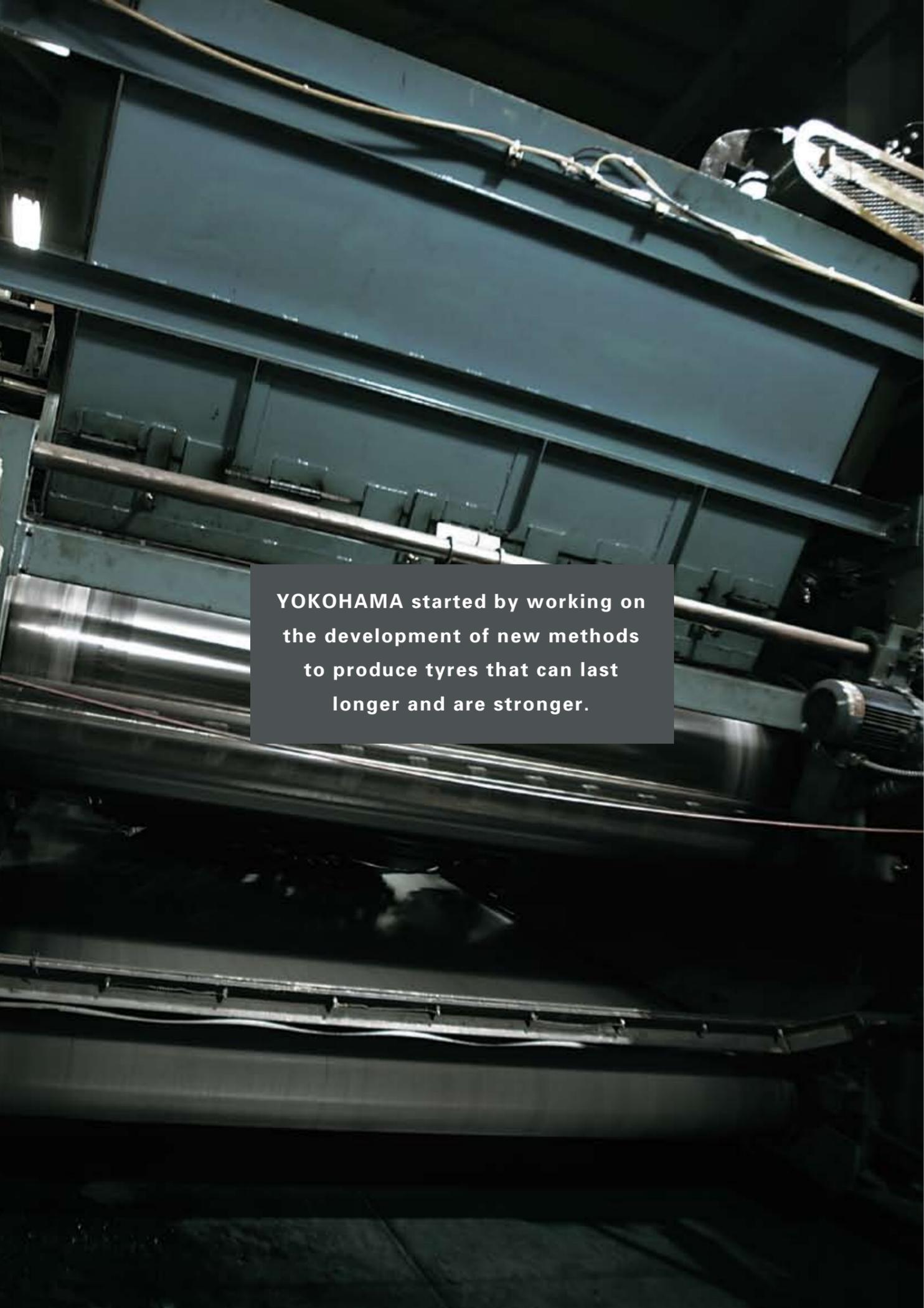


Through our activities, we want to contribute to the environment and we always endeavor to use only environmentally-friendly materials.

## The all-new Zenvironment line of tyres for trucks and buses improves fuel economy and provides long-life service.

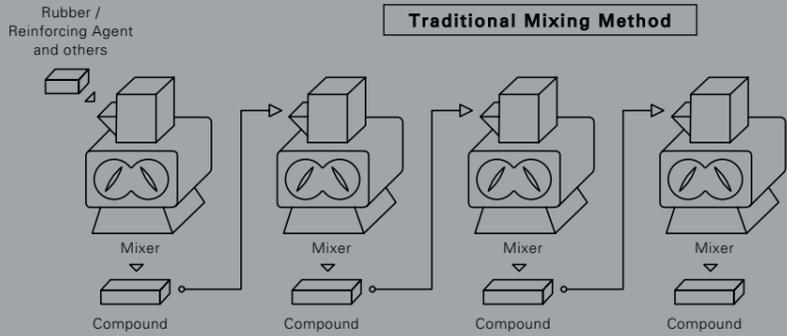
Technological advancements in tyres can reduce the environmental impact in several ways. YOKOHAMA has led advances in tyre technologies for improving fuel economy, which reduce emissions and curtail the output of the greenhouse gas carbon dioxide. Our all-new Zenvironment line of truck and bus tyres incorporates further progress in the improvement of fuel economy.



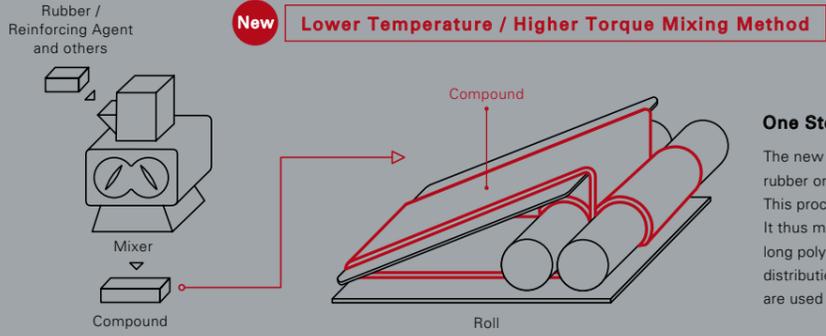


**YOKOHAMA started by working on the development of new methods to produce tyres that can last longer and are stronger.**

**Improvements in the compound mixing process have increased durability greatly in the Zenvironment tyres.**



**Multi-Step Mixing**  
The traditional multi-step mixing process mixes and kneads the rubber simultaneously. The long periods of mixing result in high temperatures, which tend to cause deterioration in the quality of rubber.



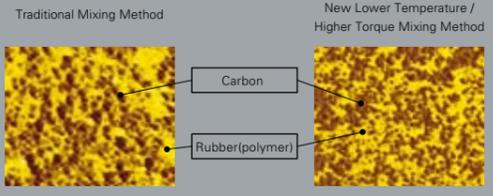
**One Step Mixing & Roll Mixing**  
The new method performs the kneading of the rubber on rollers after the rubber has been mixed. This process results in lower temperatures. It thus minimizes the splitting of the rubber's long polymer chains and promotes a more even distribution of the carbon black particles, which are used as a reinforcing agent.

**YOKOHAMA's aim is to produce ideal compounds that are tough and flexible.**

The theme "Reduce & Reuse" should not be ignored when considering the environmental performance of future tyres. Previously, the mixing and kneading of rubber and carbon, which act as a stiffener, were carried out simultaneously in the mixer. This method heats the mixture to a high temperature, which results in breaking the molecules of the rubber and produces insufficient torque; therefore, the efficiency of dispersion is lowered. YOKOHAMA has worked on increasing the durability of

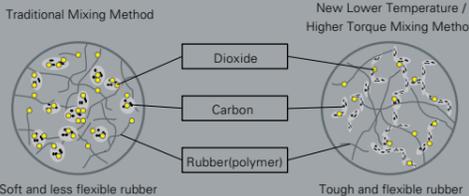
casings to increase the life of a tyre. The result is a new method, the Lower Temperature / Higher Torque Mixing Method. This method kneads the rubber at a low temperature using rolls. Rubber and carbon can be mixed more uniformly because the functions of the mixer and the rolls are divided. Kneading rubber with rolls at a low temperature can provide sufficient torque. This can prevent molecules of rubber from being broken and improve their dispersion. Totally new compounds that are tough and flexible can be produced. YOKOHAMA succeeded in extending the life in original tread durability and casing life for better retreadability.

**Microscopic Imagery reveals the improvement in rubber composition that results from the new Lower Temperature / Higher Torque Mixing Method**



The distribution of carbon particles is more even in rubber produced with the New Lower Temperature / Higher Torque Mixing Method process than in traditionally processed rubber.

**Rubber Structure Model**

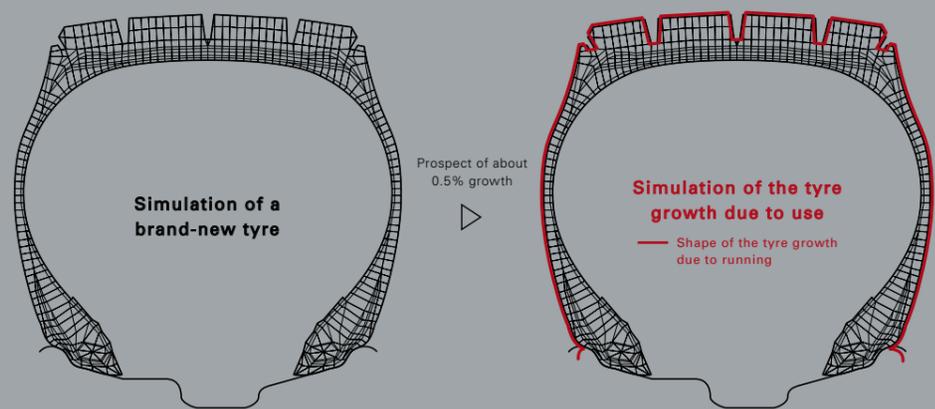


The new Lower Temperature / Higher Torque Mixing Method significantly reduces dioxide obstacles and disperses carbon in rubber evenly.



Over the course of their life, tyres change, they wear out, they become harder. Predicting these changes can enhance durability.

Our Tyre designs are based on a prediction of their growth.



**Double Inflation Pressure Simulation Method**

This method is YOKOHAMA's own computer simulation for predicting tyre growth due to running. By using this method, the ultimate tyre / casing profile with uniform tyre growth can be determined for each product.

Even small changes in the tyres due to use can make a difference.

The Strain Control Tyre Profile is completed on the basis of an in-depth prediction of strains.

The period of using radial tyres for trucks and buses is longer in the "grown" state than in a "brand-new" state. YOKOHAMA studied the anti-aging performance. Heat generated during running increases the internal temperature of tyres, causing their outside diameter to grow slightly. Tyres generally halt growing after 40,000 to 50,000 km.

Until then, their outside diameter grows. The traditional performance evaluation could not always give strict results because it evaluated new tyre state only. YOKOHAMA developed its own simulation method, the **Double Inflation Pressure Simulation Method**, to solve the problem.

This method can precisely analyze potential strains inside tyres in a entire tyre life through a computer simulation. The Zenvironment series conducts the Total Strain Tyre Control. A tyre profile with high durability is achieved, which makes the tread growth due to running more uniform.

**Strain Control Tyre Profile**

The Strain Control Tyre Profile reduces strain energy.

**Development of New Profiles**

**New Concept**

The Double Inflation Pressure Simulation Method enhances uniform profiles at brand-new state and after growth.



Reducing the waste of resources reduces environmental impacts.

YOKOHAMA has created a new construction.

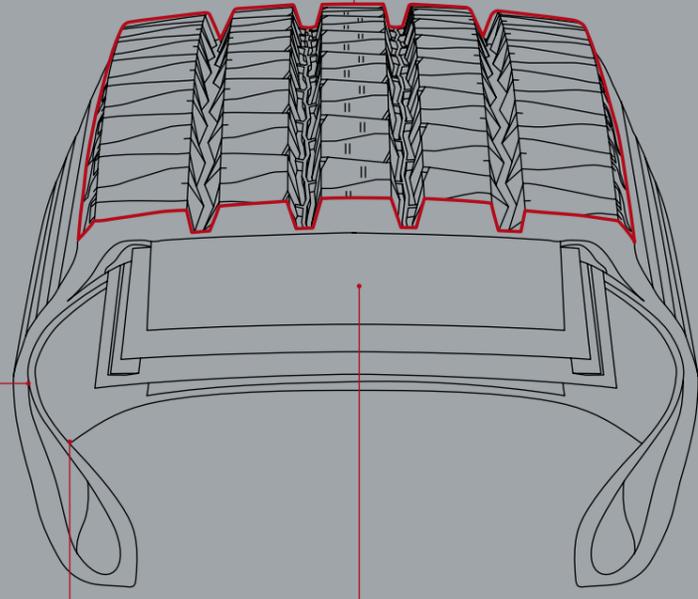
**Newly-developed Carcass Profile**

For improved casing life

**Newly-developed Tread Compounds**

The newly-developed tread compounds extend the mileage and improve the rolling resistance without sacrificing important factors such as wet performance, cutting / chipping resistance.

\*Varies depending on product



**New Inner Liner Construction**

For improved casing life

**Newly-developed Casing Compounds**

The newly-developed casing compounds increase the casing life for multi-retreads.

**Newly-designed tyre inner liner construction improves Anti-Aging Performance.**

Heat generated by oxygen contained in the air inflation pressure chambers of tyres causes oxidation and degradation of the rubber inside a tyre. With the Zenvironment series, YOKOHAMA redesigned the tyre inner liner construction, so that oxidation and therefore degradation could be prolonged. A new carcass shape with the Strain Control Tyre Profile and new compounds that are strong and flexible were used, resulting in tougher-than-ever casings.

**New Tread Compounds are Wear-resistant and have less Rolling Resistance.**

The **Lower Temperature / Higher Torque Mixing Method** was also used to produce tread compounds. Specially designed tread compounds have significantly increased wear-resistance due to the optimum composition balance of rubber. The long life performance and the fuel-efficient series were made by combining new tread patterns with tread compounds optimized for wear-resistance and fuel-efficiency.

YOKOHAMA wants to reduce emissions even further.  
YOKOHAMA also wants to reduce nitrogen oxides (NOx)  
and particulate matter (PM) to protect the environment.  
We will never stop pursuing our quest to make tyres  
run more efficiently.  
With the evolution of tyres, vehicles will evolve.  
At YOKOHAMA, we will never stop trying to solve  
problems on a global scale.

