New Progress in Reducing Environmental Impact

The dB super E-spec addition to the DNA family reduces reliance on petrochemical materials, improves fuel economy, and reduces noise

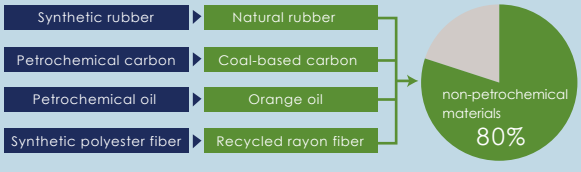
We have reduced the petrochemical portion of overall tire weight to only 20% in the DNA dB super E-spec. That compares with a weighting of about 60% for rubber, carbon black, and other petrochemical materials in typical synthetic-rubber tires. The DNA dB super E-spec, which will go on sale in July 2007, is our showcase tire for minimizing environmental impact in passenger-car tires. It offers superior fuel economy and a quiet ride.

The biggest challenge in reducing reliance on petrochemical materials was in replacing synthetic rubber with natural rubber. We have always used a lot of natural rubber, of course, in our tire products, but synthetic rubber is the first choice for maximizing grip in tire tread. Natural rubber is more resistant to wear than synthetic rubber, and it has less rolling resistance. Heat dissipation is poor in natural rubber, however, which affects grip adversely.

We offset the drawbacks of natural rubber by compounding it with orange oil, a natural solvent that blends well with natural rubber. The orange oil imparts suppleness to our new compound, Super Nano Power Rubber, and enables it to grasp the texture of the road. The oil improves grip in braking, meanwhile, by promoting heat dissipation. Our DNA dB super E-spec tires thus offer the traditional advantage of natural rubber in minimizing rolling resistance while providing grip comparable to that of synthetic rubber.

Another innovation in the DNA dB super E-spec tires is the gas-barrier film we have adopted for the inner liner. Tire manufacturers typically fix a sheet of rubber to the inner surface of passenger-car tires to help prevent air seepage. Our new material combines the elasticity of rubber with the lightness and superior gas-barrier characteristics of plastic. Only one-fifth as thick as conventional tire liners, our new liner material contributes to weight reductions in tires. And by reducing air seepage, it prevents the worsening of fuel economy that can result from pressure loss.

Reducing the petrochemical portion to 20%



The all-new ZEN line of tires for trucks and buses improves fuel economy and provides long-life service

Advances in tires can reduce environmental impact in several ways. Yokohama has led advances in tire technologies for improving fuel economy, which reduces noxious emissions and curtails the output of the greenhouse gas carbon dioxide. Our all-new ZEN line of truck and bus tires incorporates further progress in improving fuel economy.

Improvements in the mixing process have increased durability greatly in the ZEN tires. That has extended their usable life, which diminishes the generation of tire scrap. The superior durability of the ZEN tires promotes reusability, meanwhile, through retreading.

C'ROLL is our name for the improved mixing process behind the ZEN breakthrough. We use high shearing in the C'ROLL process and conduct the mixing at an unprecedentedly low temperature. Traditional mixing processes mix and knead the rubber simultaneously. Their extended mixing results in high temperatures, which tend to cause deterioration in the quality of the rubber. In the C'ROLL process, we perform the kneading on rollers after mixing the rubber in the mixer. That sequence results in lower temperatures. It thus minimizes the splitting of the rubber's long polymer chains and promotes a more-even distribution of the particles of carbon black used as a reinforcing agent. The result is a rubber compound that is tougher and suppler than ever.

Another advance in the ZEN line of truck and bus tires is a configuration profile that minimizes distortion. The external diameter of truck and bus radial tires typically expands about 0.5% during the first 40,000 kilometers to 50,000 kilometers traveled and then stabilizes. In our ZEN tires, the improved profile distributes the distortion evenly throughout the expanded tires and thereby helps maximize durability. Our development work included creating simulation technology for securing a previously impossible grasp of the pattern of distortion.

The first three ZEN tire models went on the market in April 2007: the 701ZE, 702ZE, and

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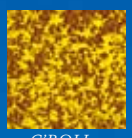
102ZE. We emphasize excellent wear resistance and long-life, all-season performance in the ZEN 701ZE. That tire is an apt choice for the stop-and-go driving of urban logistics. The ZEN 702ZE, also an all-season tire, features minimized rolling resistance to maximize fuel economy in long-haul driving on freeways. It is highly resistant to wavy wear. That reduces the required frequency of tire changes and tire rotation and thus simplifies tire maintenance. We developed the ZEN 102ZE as a ribbed tire for users who demand especially high fuel economy in long-haul logistics. The 102ZE is a market leader in fuel economy, and it also features improved resistance to wavy wear.

Atomic force micrography reveals the improvement in rubber composition that results from the C'ROLL process.

Conventional processing



C'ROLL processing

The distribution of carbon particles (black in the micrographs) is more even in rubber produced with C'ROLL process than in conventionally processed rubber.