

## **Driving Towards Sustainability of Tire Industry Through Silica-Silane Technology and Bio-based Materials**

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### **Abstract**

Tire production consumes the largest portions of both natural and synthetic rubbers produced worldwide. Depending on tire sizes and categories, different types of rubber are formulated with fillers and additives to meet specifications and provide competitive performance. Like other industries, the tire industry is heading towards sustainability and responding to climate action through various approaches, such as a reduction of carbon dioxide and energy consumption during service, a decrease of VOCs during processing, the use of bio-based compounding ingredients, and an increase of durability to reduce tire wear particles and end-of-life tires. Our research focus is on silica-reinforced natural rubber (NR)-based tire tread compounds. Based on previous studies, the mixing process determines compound quality, and the mixing of silica-silane in non-polar tire rubbers requires an optimization of chemical reactions in addition to mechanical actions. There are several concurrent reactions involved during mixing including silanization, degradation, and premature crosslinking reactions. A good balance is essential to ensuring optimized mechanical and dynamic properties as well as processability. During mixing at high temperatures, the silanization needs to be optimized while the degradation should be minimized. Our recent investigations on the degradation during mixing of silica-natural rubber (NR) compounds by monitoring changes in viscoelastic responses will be elaborated. In addition to the advancement in silica-silane technology for energy-saving tires, the use of sustainable materials, including bio-based process oils and NR of various grades, in tire compounds will be discussed.