

Role of Chemistry in the Successful Development of Low Rolling Resistance Tires for Better Sustainability

Kannika Sahakaro^{a,*}, Wisut Kaewsakul^b, Chesidi Hayichelaeh^a, Wilma K. Dierkes^b, Anke Blume^b, and Jacques W.M. Noordermeer^b

^a*Department of Rubber Technology and Polymer Science, Faculty of Science and Technology, Prince of Songkla University, Pattani Campus, Pattani 94000 Thailand*

^b*Elastomer Technology and Engineering, Faculty of Engineering Technology, University of Twente, P.O.Box 217, 7500AE Enschede, The Netherlands*

*E-mail address: kannika.sah@psu.ac.th

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Tire development is moving towards sustainability through various approaches, for example, by developing lower rolling resistance tire tread and by utilizing more sustainable raw materials including polymers, fillers, and additives. This presentation will highlight the development of silica-reinforced natural rubber (NR) for low rolling resistance or energy-saving tires. The successful use of silica with a silane coupling agent requires an optimum silanization reaction occurring during mixing. By understanding the chemistry involved and the mechanical process, compounds with high silica-rubber interaction, low filler-filler interaction, and fine filler dispersion can be achieved. Moreover, as the silanization can be catalyzed by diphenylguanidine (DPG) which is normally used as a secondary accelerator for vulcanization but the decomposition of DPG gives toxic aniline, various amine alternatives have been investigated. Different types of aliphatic amines having alkyl or cyclic structures and similar pKa were explored. Linear aliphatic amines that have better accessibility toward the silica surface and a shielding effect provide better performance than the cyclic ones. Among various types of amines studied, octadecylamine (OCT) provides the properties of silica-reinforced NR compounds closest to the reference with DPG, showing its potential as an alternative for DPG.