tire technology EXPO 2018

20, 21, 22 FEBRUARY 2018

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11

10:15 Alternative to diphenylguanidine in silica-reinforced natural rubber tire tread compounds
Chesidi Hayichelaeh, PhD student, University of Twente (The Netherlands), THAILAND
Diphenylguanidine (DPG) is widely used in silica-reinforced rubber compounds to enhance the silanisation and vulcanisation reactions. Due to toxic aniline liberated by DPG under high processing temperature, safe alternatives are required. This work investigates octadecylamine (OCT) as a DPG alternative in silica-filled natural rubber compounds. The compound properties are comparatively assessed by taking the ones with DPG and without amine as references. Kinetics of the silanisation reaction between silica and silane in the presence of amines are studied based on model compounds. The use of OCT promotes interfacial compatibility combining chemical and physical interactions, resulting in good performance.

10:40 - 11:00 Break

11:00 Influence of network structure on elastomer properties
Anke Blume, university professor, University of Twente, NETHERLANDS
Considerable attention is paid to the influence of crosslink density and crosslink structures on the behaviour of elastomers. A very important parameter seems to be underestimated: the modifications to the polymer chains by curatives, formed by sulphur and fragments of accelerators. The present paper intends to draw attention to this important contribution to performance of spatial networks. The emulsion styrene-butadiene rubber (E-SBR) samples, cured with tetramethylthiuram disulphide and sulphur (TMTD/S8), and zinc dialkyl dithiophosphate with sulphur (ZDT/S8), were studied.

11:25 Silica-NR masterbatch as an alternative for tire raw materials
Dr Wisut Kaewsakul, assistant professor, University of Twente, NETHERLANDS
In the conventional mixing of silica-filled rubber compounds, the silica and silane coupling agent are added separately into the mixer during the second sequence, which is the most crucial step in achieving adequate hydrophobation on silica surface. However, there are drawbacks including difficult mixing control, long cycle time as well as high energy input and cost. In this study, alternative approaches are made by utilising pre-silanised silica and silica-NR masterbatch. Positive results are found in the latter case as it essentially overcomes the hassles encountered in conventional mixing, while slightly improving reinforcement efficiency.

11:50 Reactivity study of mercapto-silane and sulphide-silane with polymer
Masaki Sato, PhD student, University of Twente, NETHERLANDS
Mercapto-silanes enable an improved silica dispersion state compared with sulphide-silanes in tire tread compounds. However, they also have a tendency to cause processing difficulties. Therefore, as a possible influencing factor for the above-described phenomena, the silane/rubber reactions were investigated in a model system using alkenes instead of polymers together with silanes. The results reveal that mercapto-silanes and sulphide-silanes react in different ways depending on the type of double bond. Based on the findings, the reason for the different properties in silica-filled compounds with various polymer/silane combinations will be explained.

12:15 - 14:00 Lunch

12

14:00 - 15:40 Stream 12 - Young Scientist Developments *Casablanca 1 & 2*

14:00 Fatigue modelling of cord-rubber composites
Niraj Kumar Jha, PhD student, Leibniz University, GERMANY
Modelling of damage in elastomeric composite structures nowadays is a subject of growing interest mainly because of the high demand in automotive industries. Such structures are, for example, tires, hoses and air springs. This presentation will focus on accurate fatigue damage modelling for a cord-reinforced rubber structure. The potential failure modes, e.g. cord-rubber interface debonding, delamination, matrix damage or interacting damage mechanisms, will be explained. Also, numerical methods to assess durability will be explained with regard to the implementation in commercial finite element code ABAQUS.

14:25 Cavitation damage in tire rubber materials investigated by computed tomography
Eric Euchler, PhD student, Leibniz-Institut fuer Polymerforschung Dresden eV, GERMANY
Under constraint conditions, multi-axial stress states arise in rubber materials under tensile loading. They are responsible for cavitation phenomena as first steps in the failure process of the whole material. Micro computed tomography (µCT) enables the characterisation of the formation of reversible as well as irreversible cavities and their merging in the case of failure. By synchrotron small-angle x-ray scattering it is possible to investigate initial stages of the damage process. The results of these investigations can be compared and discussed, considering results achieved by dilatometry tests.

14:50 Multi-physical approach for tire contact and wear mechanisms modelling
Aleksandr Sakhnevych, PhD student, Università degli Studi di Napoli Federico II, ITALY
The experience gained through the development of physical models and continuous research into advanced and innovative testing procedures could finally lead to full characterisation and understanding of the tire thermodynamic behaviour. Taking into account the temperature and wear influence on both the tire structural and compound viscoelastic characteristics, expressed respectively in terms of interaction stiffness and performance level, as a function of tread temperature, sliding speed, road granularity and load history, the approach to a tire complete dynamic analysis and modelling can therefore be necessarily multi-physical.

15:15 Model-based sensitivity analysis of tire transient handling performance
Pavel Sarkisov, PhD candidate (former), TU Dresden (former), GERMANY
The paper represents an analysis of the effect chain between a tire's structural parameters and its transient handling performance. Eight tire parameters were considered (e.g. carcass lateral stiffness, tire dimension) and five model properties (e.g. number of brush elements). Handling performance was analysed with the help of seven criteria of tire performance (e.g. cornering stiffness, bore stiffness) and seven criteria of tire state (e.g. carcass deflection). This approach may be helpful for estimation of tire properties in the early phase of the vehicle development process as well as for tire model development.