Investigation of mechanical and fracture mechanical properties of elastomers filled with precipitated silica and nanofillers based upon layered silicates

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The presentation deals with mechanical and fracture mechanical investigations of filled natural rubber vulcanizates with varying filler contents (5 to 70 phr). Two different fillers were used: precipitated silica and a nanofiller based upon organophilic layered silicates. In both cases, silane was added to realize a certain degree of filler–polymer coupling.

Focus of the examinations was to determine the influence of filler type and filler content on the crack toughness as well as to quantify a possible anisotropy of crack initiation and propagation behavior by punching the specimens from plates in two directions. For this purpose, cyclic TFA tests, instrumented tensile-impact tests and quasi-static fracture mechanics tests were carried out. Results of these tests are tearing energy values $T$, crack toughness values $J_d$ and crack resistance curves with certain crack initiation and propagation parameters that describe the stable crack propagation behavior. By using these parameters, a grading of the vulcanizates regarding their cracking properties becomes possible. Furthermore, sample geometry (in)dependence and several applications of $J$ and $T$ as fracture criteria for elastomers are discussed.