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Biopolymer-Compounds with high-strength properties

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"BigBags", made of stretched standard polymer tapes (e.g. iPP, PE-HD, PET, and PA), are suitable packaging materials with the required mechanical properties for heavy loads, e.g. fertilizers in agricultural applications. Based on environmental aspects, synthetic highly-stretchable polymer tapes should be replaced by resource-saving Biopolymer tapes with high-strength properties. Thus, the goal of this study was to avoid polymer-waste, especially in agricultural applications. It is known that linear, unbranched polymer chains allow for a high stretchability, but unfortunately Biopolymers usually have a more complex structure compared to synthetic polymers. Until now no Biopolymer-compounds with high-strength properties are known and basic know-how about correlations between stretching parameters and materials properties is very scarce, especially for Biopolymers. Compounds of starch and Biopolyesters are promising materials for production of biodegradable products, because of their availability, renewability and biodegradability. However, compared to stretchable films made of synthetic polymers elongations at break of starches are lower by a factor of 100. Plasticizers are used to increase flexibility and stretchability of starch. Starch compounded with plasticizers is termed "thermoplastic starch" (TPS). The most common plasticizer is glycerol, which reduces the intermolecular bonding forces by increasing the inter(macro)molecular distance. In this study the influence of different starch pretreatments (e.g. acid degradation) and starch sources (potatoe, maize,) to the strechability and mechanical properties were investigated. The aim was to develop high-strength TPS-Biopolyester-compounds, which allow for a high stretchability and stiffness as required in BigBag-applications. Furthermore, correlations between material properties and stretching parameters of Biopolymer-compounds were evaluated. It was found that parameters, such as sample geometry, temperature, degree, as well as velocity of stretching have an influence on mechanical properties. Thick and narrow samples, higher temperatures and lower velocities of stretching result in better mechanical properties. Ultimately, results indicate that the degree of stretching should be lower than 100%.

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