SUMMARY

Compounding and compression molding of PE, RePE, with polyester, cotton and a blend of cotton and polyester fibers up to 50% by weight is conceivable. However, the processing of PP with organofibers are possible up to 10% fibre ratio only. The characteristics of all produced composites are closely linked to the qualities of their constituents such as fibre type and polymer matrix.

The flexural strength of composite materials composed of PE and RePE filled with organofibres increases as the fibre content increases. Among all categories of fibre reinforced composites that were produced, PE with cotton fibre showed the highest flexural strength, even higher than strength of virging PE. Introduction of 50% cotton fibres in to PE increased bending strength up to 200%. Similarly, with an increased content of fibre ratio, the modulus of elasticity improved, resulting in an extra rigidity of the material. In case of polypropylene, only PET fibres showed compatibility to be reinforced with PP matrix, whereas due to worst quality of composites produced by PP with above 10% cotton fibres, results were not achieved for flexural and tensile properties.

In terms of the structure of the composites containing organo fibres, the influence of fillers and matrix on different mechanical properties varies depending on the type and fraction of filler and matrix employed. SEM analysis shows that fillers were dispersed well in the PE/organofibres and RePE/organofibres composites and have a fairly homogenous morphology, with no voids, holes, or cracks. Whereas the general morphology of composites degrades dramatically when CF fibers are added to the PP matrix. As the fiber content in all types of composites increased, regardless of fiber type, the stiffness of the composites also increased. Consequently, tensile strength of composites decreases substantially. Also, composites become brittle and less durable. It is worth noting that, when compared to all pure matrices and generated composites, the impact strength of polypropylene fibre reinforced composites increased dramatically with the addition of cotton fibers. Furthermore, both PE and RePE-based composite materials are shown to be UV-resistant, with no significant changes in tensile properties as a result of the accelerated aging process.

The findings of the study revealed that waste textile fibers can be utilize as fillers or reinforcement material with polymer matrix such as PE, RePE and PP to make composites by compression molding method. However, the fibre ratio of cotton fibres in polypropylene is restricted to just 10% only. In addition, it is revealed that, the use of these organofillers with

neat poymer matrix as well as recycled polymers could be a cost-effective way to produce composites. Furthermore, these can be manufactured by one of the most economical technique of compression molding. These findings demonstrate that it is possible to prepare high-performance composite materials from waste without using coupling agent.

KOKKUVÕTE

Uuriti polüetüleeni (PE), ringlusse võetud polüetüleeni (RePE), puuvilla (CF), polüestri (PETf) ja nende kiudude segust (CF+PETf) komposiitide valmistamise võimalust kuumpressimismeetodil. Leiti, et PE ja RePE ning kiudude segust õnnestub komposiiti valmistada kuni 50 massiprotsendilise kiudude sisalduse korral. Polüpropüleeni (PP) segamine orgaaniliste kiududega on siiski võimalik ainult kuni 10% kiudainesisaldusega.

PE ja RePE täidisega komposiidi paindetugevus suureneb koos kiudude osakaalu suurenemisega. Samamoodi paraneb komposiitide tõmbetugevus ja paindejäikus. Kiu tüüpi arvestades parandatakse komposiitide mehaanilisi omadusi järgmises järjekorras: PETf < CF+PETf < CF. Puuvillakiududega PE näitas paindetugevuse paranemist kuni 600% võrreldes puhta PE-ga. Morfoloogiline uuring näitas, et täiteained olid orgaaniliste kiudude ja polüetüleeni komposiitides hästi hajutatud ning neil on üsna homogeenne morfoloogia, väheste tühimike või pragudega. Komposiitide tõmbetugevus ja sitkus langevad aga kiu sisalduse suurenemise korral drastiliselt. Selle tulemusena on komposiitide löögitugevus puhtast polümeermaatriksist oluliselt madalam. Samas on uuring näidanud, et nii PE- kui ka RePE-põhised.

PP maatriksit tugevdasid teataval määral ainult PETf kiud. Puuvillakiudude lisamine halvendas üldist morfoloogiat, mis väljendub materjalis esinevate tühimikena. PP-põhiste komposiitide painde- ja tõmbetugevus ning jäikus vähenevad kiudude kontsentratsiooni suurenemisel. Üllataval kombel suureneb puhta PP-ga võrreldes puuvillakiudude lisamisega polüpropüleenil põhinevate komposiitide löögitugevus.

Uuringu tulemused näitasid, et enamlevinud tekstiilkiude saab ringlusse võtta polümeermaatriksi, näiteks PE, RePE ja PP täiteainetena, et valmistada kuumpressimismeetodil jäätmetest jätkusuutlikke ja tasuvaid komposiite.

KOKKUVÕTE