Design of thermoplastic materials using cellulose as a base matrix

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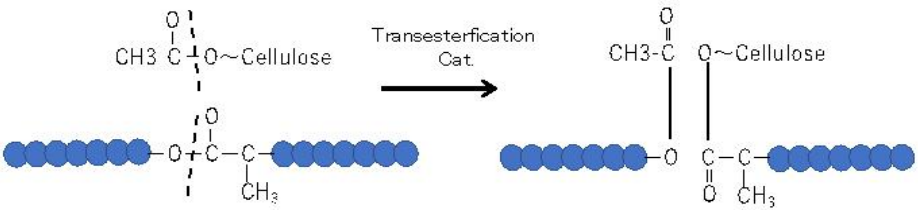
In recent years, pollution such as marine plastics and climate change are considered important global issues due to environmental aspects. Various measures to solve the environmental problem are being considered. As a countermeasure, the development of biodegradable plastics which has the potential to replace petroleum-based plastics such as polyethylene and polypropylene has attracted particular attention. Cellulose is one of the most abundant biodegradable polymer available in nature and exhibits excellent mechanical properties. However, cellulose does not have the thermoplasticity of general-purpose resins, which limits its utilization.

In this study, transesterification reaction by melt-kneading method was utilized to produce thermoplastic composite with commercialized cellulose acetate (CA) and polylactic acid (PLA). In general, CA has a high melting point of 250-300℃, and will be carbonized after melting. It's low thermoplasticity makes it difficult to use as a resin. PLA which is versatile biodegradable resin, a polyesters, and the transesterification reactions between molecular chains have been reported [1)]. Here-in, we focused on the transesterification reaction between the acetyl group of CA and polyester (Scheme 1). As shown in Fig.1, unlike PLA , the composite resin obtained by melt-kneading CA and PLA was incompatible, and no thermoplasticity was obtained. However, when 2-Ethylhexanoic Acid Tin(II) was added as a catalyst, a composite material showing thermoplasticity between CA and PLA was obtained under certain kneading conditions. Characterization results confirmed that PLA successfully grafted onto CA backbone.



Scheme 1.Transesterification reaction between the molecular chains of CA and PLA

Fig. 1.Sample after melt kneading

1) J. Yang et al. Polymer 83(2016)230-238.