

Green plastics: utilizing chicken feather keratin in thermoplastic polyurethane composites to enhance thermo-mechanical properties

Firoozeh Pourjavaheri¹, Oliver A.H. Jones¹, Farzad Mohaddes¹, Frank Sherkat¹, Arun Gupta² and Robert A. Shanks¹

¹ School of Science, RMIT University, VIC 3001, Australia

² Faculty of Chemical & Natural Resources Engineering, Universiti Malaysia Pahang, 25100, Kuantan, Pahang, Malaysia

ABSTRACT

A 'green', sustainable resource, in the form of chicken feather derived keratin, was used to enhance the thermomechanical properties of polyurethane bio-composites. Solvent–casting–evaporation method was used to incorporate three levels of chicken feather fibers (0, 10 and 20 %w/w) into a polyurethane matrix. The thermomechanical properties of the resulting composites were then assessed using differential scanning calorimetry, thermogravimetry, dynamic mechanical analysis and stress–strain measurements with hysteresis loops. The uniformity of the dispersion of the keratin fiber in the plastic matrix was investigated via macro photography and optical microscopy. Scanning electron microscopy of fracture surfaces was used to verify that the adhesion between fiber and polymer was effective. Addition of chicken feather fibers to the polyurethane matrix was found to decrease the glass transition temperature, recovery strain and mass loss of the composites but increase the elastic modulus, storage modulus, and char level. The results demonstrate that keratin derived from what is currently a waste product from the poultry industry (with significant disposal costs) can improve the thermo-mechanical properties of composites, simply and cheaply, with potentially large environmental benefits.

KEYWORDS

Environmental benefits; Evaporation method; Fracture surfaces; Polyurethane matrix; Stress-strain measurement; Sustainable resources; Thermomechanical properties; Thermoplastic polyurethanes

ACKNOWLEDGEMENTS

The authors acknowledge the facilities, and the scientific and technical assistance, of the Australian Microscopy & Microanalysis Research Facility at RMIT University for technical support, Baiada Poultry Pty Ltd for supplying the chicken feathers and Dr Michelle J.S. Spencer for helpful comments on the manuscript. One of the authors (FP) is grateful for an Australian Postgraduate Award (APA) administered by RMIT University