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CELLULOSE NANOCRYSTALS DERIVED FROM OIL PALM EMPTY FRUIT BUNCH REINFORCED NATURAL RUBBER LATEX NANOCOMPOSITES

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ABSTRACT

Natural rubber latex (NRL) has long been used in lots of application in elastomer industry. However, finished products may develop pinholes or tear easily while being used. Thus, cellulose nanocrystal (CNC) was used as reinforcing filler in NRL to overcome this problem. CNC from cellulose derived from oil palm empty fruit bunch (EFB) was isolated via sulphuric acid hydrolysis method. The CNC concentration added to the NRL was varied at 1, 3 and 5 wt.%. The effect of CNC addition and curing temperature of 70°C and 100°C of NRL on the mechanical properties, functional group presence, glass transition temperature (T_g) and swelling behaviour of CNC/NRL nanocomposite were studied. The morphology of CNC with needle-like shape, length of 672 ± 445 nm, and diameter of 103 ± 39 nm was determined by using field emission scanning electron microscopy (FESEM). The best nanocomposites performance with low CNC loading of 1 wt.% has successfully increased the tensile strength and elongation at break with 20% and 14% of improvement, respectively at 70°C of curing temperature.

Keywords: acid hydrolysis, cellulose nanocrystals, empty fruit bunch, nanocomposites, natural rubber latex.

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INTRODUCTION

One of the most significant elastomers with interesting strength, elasticity, durability, resilience, and abrasion resistance is natural rubber latex (NRL). NRL refers to the white sap that comes from the tree of *Hevea brasiliensis* and has low intensity, softens in warm weather and brittle in cold weather and is almost limited in use in its original uncured form (Vandenplas and Raulf, 2017). NRL will undergo vulcanisation, a chemical process where long chains of rubber molecules are cross-linked, transform the soft, weak plastic-like material into a strong elastic product with high and reversible deformability and good mechanical properties (Visakh *et al.*, 2012). There are some latex products that have been carried into finished products by inadequate manufacturing processes that will result into pinholes or tear easily during the application of latex products in their field of work. The mechanical properties of NRL can be improved and tailored by crosslinking and addition of reinforcing fillers (Gopalan Nair and Dufresne, 2003).

It is proven that cellulose nanocrystal (CNC) have a distinct advantage for improving the mechanical properties of nanocomposites. Favier *et al.* (1995) first reported on the use of CNC as reinforcing agents in polymer composites which enhanced the mechanical properties of poly(styrene-co-butyl acrylate) prepared via solvent casting processing of the corresponding latex. Their

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