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Mechanical Characterization of Polyurethane Elastomers: For Retrofitting Application against Blast Effects

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ABSTRACT: In recent years, structural and materials engineers have focused their attention to develop feasible, constructible and cost effective retrofitting techniques to enhance the structural capacity and to minimize the damage due to impulsive loadings such as blast and impact. In this aspect, elastomeric polymers offer a unique proposition as retrofitting material for civil infrastructures, due to their attractive characteristics and morphology such as high elongation and energy absorption capacity. However, comprehensive understanding and proper evaluation of their characteristics and behavior are vital prior to developing a feasible retrofitting technique based on these materials. This paper discusses on the findings of experimental investigations undertaken to evaluate the mechanical properties under uniaxial tensile loading of selected types of palm-oil based polyurethane which were prepared by varying the chain extender (Polyethylene glycol, PEG), for it to be utilized as a retrofitting coating material on reinforced concrete structures, to enhance their resistance to blast effects. It was found that the properties of polyurethane elastomer are within the desired range and there is a higher possibility to apply the material as a sustainable and feasible retrofitting application for reinforced concrete structures under impulsive loadings.

1 INTRODUCTION

Presently, consideration of utilizing polyurethane (PU) polymers for structural and infrastructural applications becomes a competitive area due to its captivating morphology and characteristics as a material: highly elastic, flexible and resistant to impact, abrasion and aggressive weather condition (Chattopadhyay & Raju, 2007). PU covers an extremely wide range of applications, such as in bedding materials, adhesives, thermal insulation, the manufacture of tires, as well as in structural elements. PU capitalizes on its wide range of mechanical properties due to the ability to alter its microstructure. PU is formed by the rapid chemical reaction of diisocayante [a monomer with at least two isocyanate (–NCO) functional groups] with diol [another monomer containing at least two alcohol (hydroxyl, or –OH) groups], in the presence of a catalyst (Chattopadhyay & Raju, 2007; Badri, 2012). Generally, PU is a linear segmented blocked copolymer comprising of “soft” and “hard” segments, and an increase in content of hard segment results in increased ultimate strength, and tensile flexural modulus