World's First Thermoplastic Bridges made of Recycled Plastics

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Summary

Deterioration of bridges has been well recognized throughout the world. The estimated repair and replacement cost is $229 billion for the U.S. highway bridges alone. Recently an innovative construction material made of recycled plastics was introduced to the market. This new sustainable material can provide a cost-effective solution to the currently deteriorating infrastructure and at the same time provide an excellent solution to the environmental issues of plastic waste.

Recycled plastic composite was first utilized for railroad crossties and recently extended its application to bridges. The world's first bridges made of nearly 100% recycled plastics for the U.S. Army were opened at Fort Bragg, North Carolina in 2009. The world's first railroad bridges made of the same material were opened at Fort Eustis, Virginia in 2010. The first thermoplastic bridge constructed in the U.S. highway system was opened in the State of Maine in 2011.

Keywords: Recycled Plastic; Railroad Bridges; Highway Bridges; Sustainability; Environmental; High Density Polyethylene; Rapid Construction; Thermoplastic.

1. Introduction

According to FHWA National Bridge Inventory, one third of nearly 600,000 U.S. highway bridges are classified as structurally deficient or functionally obsolete. A similar portion of 100,000 railroad bridges in the U.S. are facing the same problems. The estimated repair and replacement cost is $229 billion for the U.S. highway bridges alone. Since majority of the bridges were built out of wood, steel or concrete, the same conventional materials have been used for bridge replacement or rehabilitation.

However, new advanced construction materials are entering the market to address recent emphasis on durability, sustainability, accelerated construction and green products. High-density polyethylene (HDPE) based thermoplastic emerged in the United States marketplace in the early 1990's. Developed in conjunction with scientists at Rutgers University, a manufacturing company named Axion International was able to produce a thermoplastic composite material made of 100% recycled post consumer and industrial plastics that would otherwise be discarded into landfills [1].

The thermoplastic composite was first utilized for railroad crossties and recently extended its application to bridges. The first vehicular bridge that utilized an immiscible polymer blend of HDPE was built at Fort Leonard Wood, Missouri in 1998 (Figure 1a). The deteriorated bridge deck slab was replaced with the thermoplastic material, while the existing steel girders remained to support the deck. The replaced deck has not required any maintenance and has not shown any sign of degradation even after 13 years. The next vehicular bridge was built in Wharton State Forest, New Jersey in 2002 (Figure 1b). The bridge was designed to carry 33 tonnes of live load and replaced a chemically treated wood bridge. This bridge is the first to use thermoplastic I-beams for main girders. In early 2009, two bridges were built at Fort Bragg, North Carolina utilizing the latest thermoplastic composite (Figure 1c). This thermoplastic composite is made out of high density polyethylene (HDPE) with polypropylene encapsulated glass fiber reinforcement. The bridges were

https://doi.org/10.2749/222137912805111537