Florida Department of Transportation Research

Testing, Evaluation, and Specification for Polymeric Materials Used for Transportation Infrastructures

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Current Situation

Polymers (of which plastics are an example) hold tremendous promise for many transportation-related applications. A polymer may be lighter, stronger, less expensive, or more durable than traditional materials such as concrete, steel, or aluminum. However, because polymers are newer to transportation than their traditional counterparts, there are questions about how Florida's famous sunshine can affect specific polymers over time.

Research Objectives

Researchers from the University of North Florida and Drexel University (Philadelphia, PA) developed test protocols to predict the long-term effect of sunlight on polymeric materials. Specific materials were evaluated using the protocols.

Structural plastic can be used to protect bridge elements, like the fenders on this historic bridge, from marine vessel impacts.

Project Activities

The Florida Department of Transportation (FDOT) requires that any materials used in Florida transportation applications have a service life of 25 years in noncritical uses and 100 years in critical uses. All new materials, including polymers, must meet these requirements. FDOT has determined that sunlight is a primary concern for its potential to degrade polymers.

The researchers selected five polymer products to test: high density polyethylene (HDPE), polyester, polyurethane, polyolefin, and epoxy. These polymer materials were tested by exposure to sunlight outdoors and exposure to a xenon light weatherometer under controlled conditions in the laboratory.

In the laboratory testing, the polymer samples were exposed to three different light intensities for up to 5,000 hours (over 200 days). The researchers calculated that, depending on the light intensity, the length of the xenon exposures were the equivalent of roughly three to six times as much outdoor exposure, under prevailing conditions at the test location. For example, 1,000 hours of xenon light at the highest intensity was equivalent to over 6,500 hours of outdoor exposure.

The researchers used a variety of tests to look for changes in the polymer samples. They also compared changes in the polymers exposed to sunlight with those exposed to the xenon lamps. This helped determine whether xenon lamps could substitute for sunlight, which would help accelerate and standardize testing. For the HDPE, the oxidative induction time test was found to be the best indicator of degradation. For the other polymers, colorimetry was the most useful.

Project Benefits

Standardized testing of new materials helps assure that they will perform as expected and makes it possible to find new applications for which they can be beneficial.

For more information, please see www.fdot.gov/research/.