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| **UTC Project Information** | |
| Project Title | MPC-379 – Plastic-Aluminum Composites in Transportation Infrastructure |
| University | Colorado State University |
| Principal Investigator | Paul Heyliger, Professor |
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| Funding Agencies | USDOT, Research and Innovative Technology Administration |
| Agency ID or Contract Number | DTRT12-G-UTC08 |
| Project Cost | $92,000 |
| Start and End Dates | January 1, 2012 – December 31, 2013 |
| Project Duration | 2 Years |
| Brief Description of Research Project | Nearly all transportation structures in the United States have been built over the past decades on the basis of stiffness, strength, and longevity. To this end, the use of common structural materials, including but not limited to metals (usually structural steel), concrete, and wood, has been standard practice, and the existing transportation infrastructure reflects this practice. However, with changes in manufacturing processes, an increase in available material choices, and a shift in design priorities to minimize environmental impacts, the use of structural composites as main elements in statewide or nationwide transportation networks will likely play an increasing role.  In this study, a specific class of structural composite is investigated for use in a wide array of applications in transportation infrastructure. Composite sections comprised of aluminum sections (with high relative modulus and strength) embedded within a plastic matrix provide excellent alternatives to common structural materials with an important distinction: they are completely recyclable with very little effort. This class of building material is not yet well understood but has tremendous potential for use in everything from guard rails and bridge decking up to structural beams and columns (Hoel et al. 2007). There have been very few structural materials that have been added to the array of choices of the structural designer for transportation structures in the past 50 years, but these new materials have tremendous potential benefits over existing materials.  **Research Objectives:**  The goal of this project is to determine the feasibility and any limitations associated with using plastic-aluminum structural composites as an alternative for many if not most structural elements in transportation infrastructure. This study will combine numerical modeling of the basic mechanics (including structural performance and thermal behavior) along with basic testing of these elements. Comparisons of performance will be measured against common engineering materials, especially those used in rural areas that of the most interest to MPC institutions. Small scale testing of individual elements will be combined with environmental testing (primarily UV exposure and heat/cold cycling). Expected outcomes include strength, stiffness, and durability data that should provide a necessary foundation for future development of this class of material. |
| Describe Implementation of Research Outcomes (or why not implemented)  Place Any Photos Here | Highlights include the following:   * The web plastics with the three highest modulus values all have 38% talc filler content. * The metal deactivator addition had essentially no effect on the modulus values. The addition of the metal deactivator resulted in less than a 1.0% decrease in modulus between each comparison. * An increase in talc content from 0% to 20% in the flange plastics resulted in the modulus of elasticity almost doubling. * None of the beams exhibited tertiary creep. * The results over a range for Poisson’s ratio of 0.44-0.48 are consistent. * The load per deboss region that can be resisted before the plastic begins to yield and extensively deform matched experiments to within 10%. * The physical experiment resisted a higher load, supporting the likelihood of hoop stress existing around the flanges due to residual stresses induced during extrusion. |
| Impacts/Benefits of Implementation  (actual, not anticipated) | This type of material is one of the very few available that combines high stiffness, high strength, and full recovery when recycled. These composites could be used in many different applications, and could provide significant economic benefits depending on the application. |
| Web Links   * Reports * Project Website | <http://www.ugpti.org/resources/reports/details.php?id=869> |