Composites Research Network

Durability and Interfacial Quality of a Gelcoat and Concrete Mixed Coating of a UPE Sprayed-up Laminate – Phase 1

SUMMARY

Waterplay Solutions manufactures aquatic play features for children's parks. Since 1986 the company has completed over 3000 installations around the world, most surviving in a range of aggressive indoor and outdoor environments. Conditions can include direct sunlight heating, prolonged submersion in chlorinated water, impacts from dropped objects, and damage from unintended use. Typically these structures are manufactured from concrete, but composite materials—specifically glass fibre reinforced polymer (GFRP) manufactured using the spray-up technique—have long been considered as a substitute. Advantages of GFRP include lower material costs, highly variable geometries that are near net-shape, and lightweight structures that are simpler and cheaper to transport and install. Yet the performance of GFRP under typical operating conditions is difficult to determine in advance. Waterplay Solutions was unsure how to make appropriate comparisons between new and old technologies and turned to CRN for help.

Waterplay Solutions Corp.
Kelowna, British Columbia

Waterplay Solutions manufactures aquatic play features for children's parks. Since 1986, over 3000 installations have been completed around the world, from Canada to Australia. The company is based in Kelowna BC.

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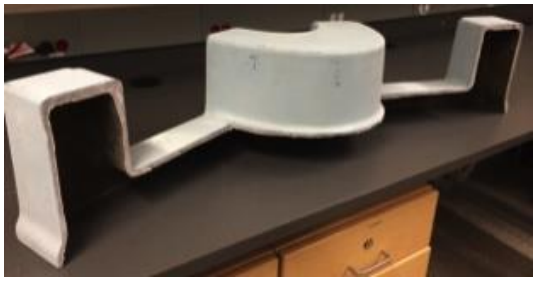
CHALLENGE

Waterplay Solutions has historically manufactured aquatic play features for children, many of which use concrete for the structures that are embedded in soil. The company wishes to move to GFRP materials to save on material, transportation and installation costs. However, because of limited experience, Waterplay Solutions is unsure how to qualify this new material for use. Additionally, the new designs have a modified gelcoat post-treated to give the texture and appearance of concrete. The performance of this material is an additional unknown.

APPROACH

Prior to performing any evaluations of material properties and performance, CRN considered the most likely failure modes of the new materials in use. Researchers determined that delamination caused by low-energy blunt impacts and subsequent exposure to water (leading to blistering) was the most significant damage mechanism. An initial literature review was conducted to provide a knowledge platform in these areas, complemented by experimental work to test material samples that Waterplay Solutions had developed with its supplier. Phase 1 of the project performed impact tests. Phase 2 is ongoing and involves long-term water exposure of undamaged samples in a blister tank test, to be followed by further impact testing.



Example aquatic play part from Waterplay Solutions, using the modified coating material.

OUTCOME

The initial impact tests on Waterplay Solutions' GFRP laminate identified that the leading failure mechanism is predominantly matrix cracking on the backside of the laminate. This outcome is typical for resin-rich laminates under low-energy blunt impacts. Further tests were performed using impact energies and sample thickness variations reflecting a realistic range of manufacturing and usage conditions. For a typical laminate thickness of 13 mm, the threshold for damage was approximately 8.75 J, providing a useful guide to Waterplay Solutions for further testing and quality control schedules.

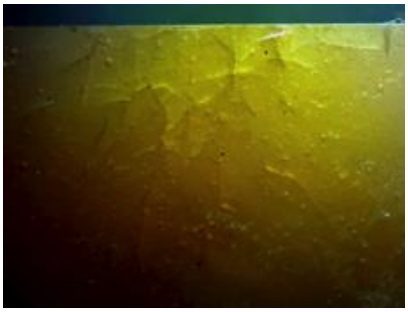


Photo of polymer matrix cracking on the backside of a sample tested under blunt, low-energy impact.

IMPACT

Waterplay Solutions now has a better understanding of the impact characteristics of its candidate materials. Using this knowledge, the company can more clearly plan subsequent development steps. Additionally, CRN has made additional recommendations aimed at producing a more suitable laminate for the proposed operating conditions. Recommendations include using layers of woven material to reduce back cracking, or the use of an alternate process method to produce higher-quality laminates.

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