Fire performance of GFRP façades

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Abstract: There is an urgent need to improve the fire performance of fibre composites so that they can be used in infrastructure applications. Nanoparticles from clay have been well known as a potential precursor of nanocomposites because of the significant improvement in mechanical properties and their availability. Most research projects on clay nanocomposites were carried out with more focus on their improvement of mechanical properties. However, the effect of nanoclay on the fire performance of hybrid composites has not been covered comprehensively. In this study, the effect of organoclay on the fire performance of the hybrid nanocomposite was investigated.

Introduction

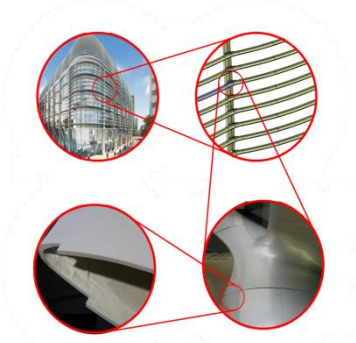
Composites from glass fibre reinforcement and polymeric matrix (GFRP) offer the possibility of a lightweight, flexible, cost effective material in comparison with aluminum and steel. However, the main obstacle limiting the applications of GFRP in buildings lies on its poor performance when exposed to fire. Nanoclay was found to improve the performance of the composites when exposed to fire. In this study, the effect of organoclay on the fire performance of epoxy-based composites was investigated.

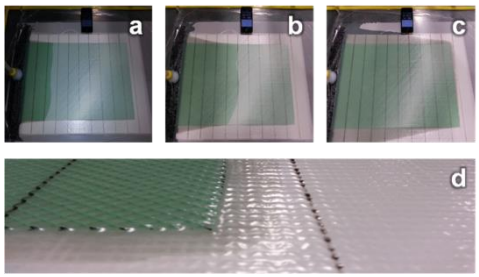
Methodology

Fire performance of the composite was investigated using Cone calorimeter method, which is one of the most effective bench-scale tests for heat release rate and smoke production of polymer based materials. Organoclay was added to the resin at three different replacement levels and the sample was fabricated by vacuum assisted infusion.

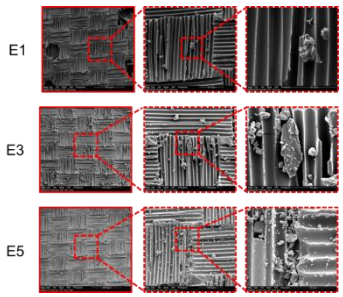
Discussions

- At low levels of nanoclay, the combustion of organic amine used as a surface modified agent is paramount
- Mass loss curve, THR and heat of combustion of samples with 3% nanoclay indicate the enhancement effect of nanoclay
- High percentage of nanoclay (5%) shows the best improvement in fire performance with the lowest THR and heat of combustion. This level (5%) of nanoclay contributes mostly to the delay of the PHRR compared to the control sample (E0).
- It is important from SEM images that not only increasing the amount of nanoclay but also minimizing agglomeration and optimizing the clay nanoparticles' distribution, is equally important to improve the flame retardancy of epoxy composites.





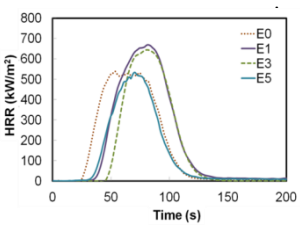
Pictures of vacuum assisted infusion procedure taken after (a) 1 minute, (b) 2 minutes, (c) 5 minutes and (d) 6 [illegible]

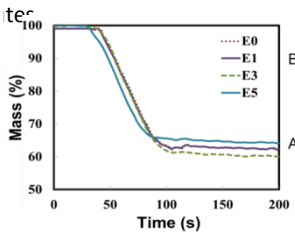


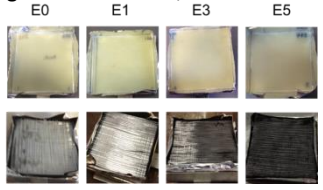
SEM images of samples at different magnifications: 200x, 800x and 3000x.

Hydrophilic inorganic clay

Hydrophobic organoclay







Images of samples before and after cone calorimetry tests