OPEN ACCESS

1st International Electronic Conference on Materials
26 May - 10 June 2014

http://sciforum.net/conference/ecm-1

Article

Effects of Composites due to External Fields

Akin C [1,*]

[1] Hindustan Institute of Technology & Science, Hindustan University, Chennai, Tamil Nadu, India; E-Mail: akin.akin766@gmail.com

* Author to whom correspondence should be addressed; E-Mail: akin.akin766@gmail.com

Received: 15 April 2014 / Accepted: 19 April 2014 / Published: 26 May 2014

Abstract: The properties of polymer differ when subjected to various external fields such as pH, temperature and light. As the external fields react with the polymer it results in deformation. In the present world construction industry plays a major role in using of composite materials. The composites such as FRP and polymer concrete deforms due to various external fields of nature. The focus on the present paper is the effects happen in composite materials due to external fields. Here in this paper the composite materials FRP and polymer concrete is subjected to external field and its effect is found with a case study.

Keywords: Composite materials; pH; temperature; light

1. Introduction

Sustainability approach plays a major role in every stream for future generation living. There is a major difference in global weather conditions due to greenhouse effects. As the population increases every day the demand for building construction also increases. In modern building construction, polymer composite materials such as fiber reinforced polymers [FRP] and polymer concrete [PC] are used as a building reinforcement and concrete. But these polymer composites when subjected to external fields such as pH, temperature and UV radiations there occurs some effects for deformation [1]. To rectify these effects it is found that at which stage the deformation takes place. The polymerization reaction in Composites due to external fields can be monitored by automatic continuous online monitoring of polymerization reactions (ACOMP) technique [2]. In this approach of finding the effects of composite materials, the development of sustainability is obtained in buildings.

2. Experimental Section

In the experimental section, the FRP and PC specimens were subjected to various environmental conditions such as pH, temperature and UV radiations to evaluate their effects on materials and structural properties of the specimens [4]. The present paper report results from the specimens and examines the durability of FRP and PC and its bond after exposure to these external fields.

- **pH**: Alkali solutions submersion in pH 10 and pH 12 of NaOH solution at 38^oC.
- **Temperature**: 4 cycles/day between -20^o C and + 40^oC in a dry chamber.
- **UV radiation**: exposure to UV-A lamp radiation at 156 watt/m^2 at 38^oC.

The specimens used in this study were FRP tensile coupon for Fiber reinforced polymer and FRP single lap bonded (SLB) for Polymer concrete specimens [1], [5]. The 25 x 175 mm FRP tensile coupons were made in accordance to ASTM D 3039. The 25 x 300 mm SLB specimens were prepared in accordance with ASTM D 3136 [1], [3]. The carbon fiber reinforced polymer [CFRP] and Glass fiber reinforced polymer [GFRP] are the components of FRP laminates.

Table 1. Properties of CFRP and GFRP

Properties	CFRP	GFRP
Ultimate tensile strength (MPa/layer)	850-950	490-560
Rupture strain (N/mm^2)	0.0142	0.0197
Nominal thickness of fabric (mm)	1.04	1.24
Weight of the fabric (gm/m^2)	658	923
Weight of FRP sheet (gm/mm^2/layer)	1660	2500
Coefficient of thermal expansion (^oC)	-0.5×10^{-6}	7.7×10^{-6}

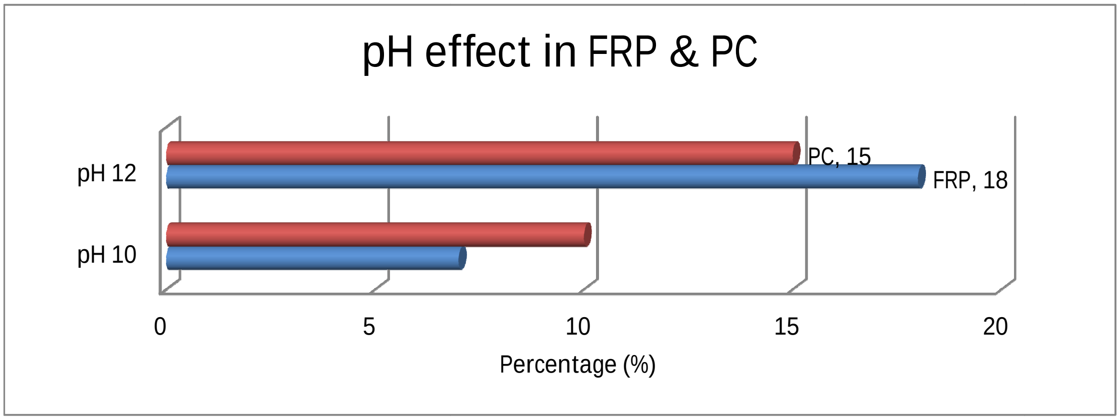
3. Results and Discussion

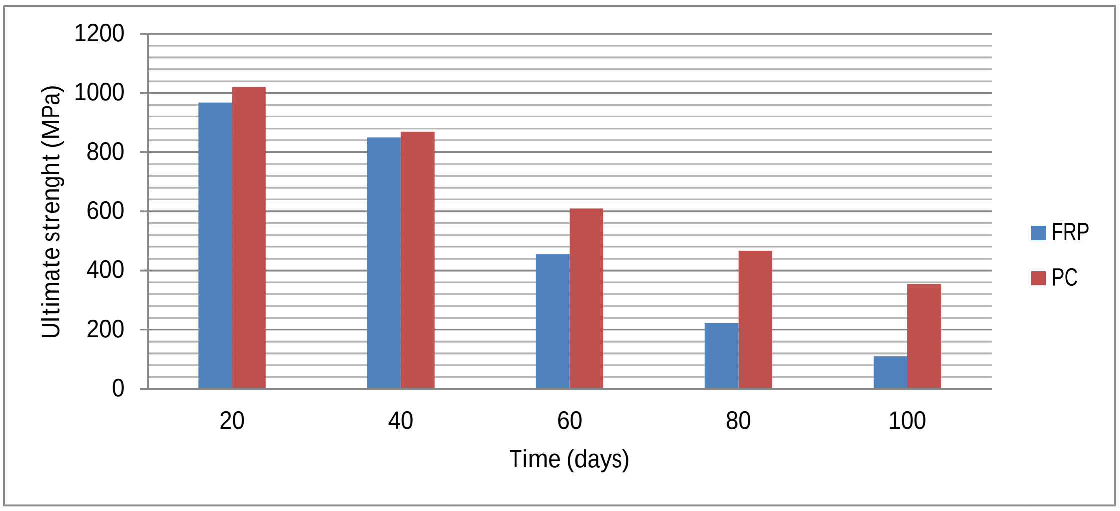
3.1. Results for FRP and PC

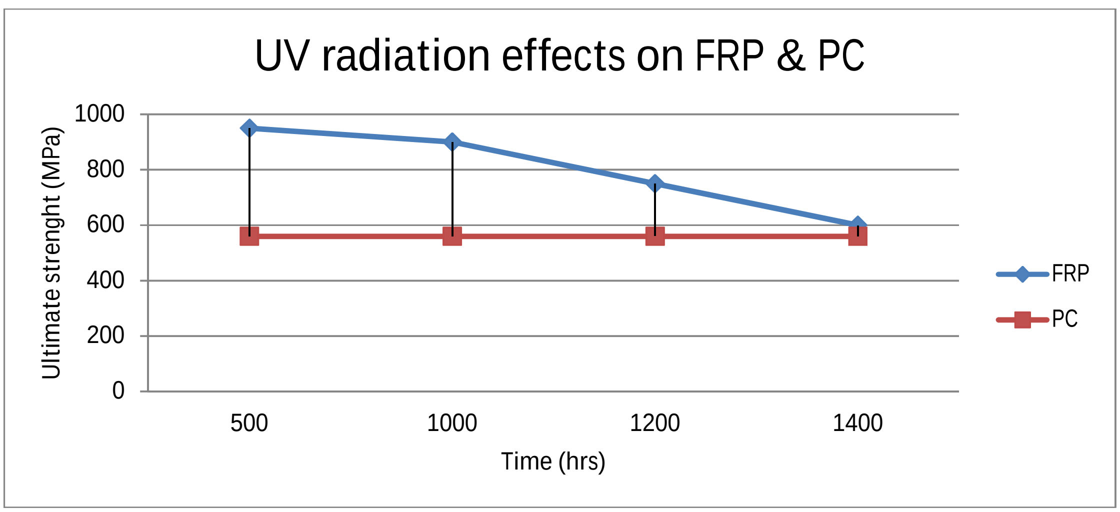
pH effect in FRP and PC:

In FRP, the pH effect is found by submersing the tensile coupon in the NaOH solution at 38^oC and made to test the Ultimate tensile strength. Finally the result obtained for FRP is 18% in pH 12 and 7% in pH 10 drop in strength. In PC, the pH effect is found by submersing the SLB in the NaOH solution at 38^oC and made to test the Ultimate compressive strength. Finally the result obtained for PC is 15% in pH 12 and 10% in pH 10 drop in strength.

Figure 1. (**a**) pH effect in FRP and PC. (**b**) Temperature effect in FRP and PC. (**c**) UV radiation effect in FRP and PC.







Temperature effect in FRP and PC:

In FRP, the temperature effect is found by keeping the tensile coupon in a dry chamber for 4 cycles/day between -20^o C and + 40^{o}C and made to test the Ultimate tensile strength. Finally the result obtained for FRP is the drop in strength after 84 days/320 cycles. In PC, the pH effect is found by keeping the SLB in a dry chamber for 4 cycles/day between -20^o C and + 40^{o}C and made to test the Ultimate compressive strength. Finally the result obtained for PC is the drop in strength after 84 days/336 cycles.

Light effect in FRP and PC:

In FRP, the tensile coupon was exposed to UV-A lamp radiation at 156 watt/m^2 at 38^{o}C. The ultimate tensile strength drops down between 1200 hrs and 1400 hrs. In PC, the SLB was to UV-A lamp radiation at 156 watt/m^2 at 38^{o}C. The Ultimate compressive strength of PC had no change in the UV lamp exposure [6].

4. Conclusions

The effects of composite materials due to pH, temperature and light are obtained using modern techniques in which the results gives the idea for sustainable development in building construction. The polymer composite materials like FRP and PC had more ultimate strength than the other common materials under UV radiation, temperature and pH. Polymer concrete is a good embodied energy saving material, where the waste slag silica fume is used for making PC. This mode of approach reduces the effect of global warming and greenhouse gases. Hence the effect of composite materials shows deformation due to various external fields.

Acknowledgments

The author would like to thank the Department of civil engineering of Hindustan University for valuable support, motivation and guidance for this research in the laboratory.

Conflicts of Interest

The authors declare no conflict of interest.

References and Notes

1. Homam, S. M., Sheikh, S. A., Pernica, G., Mukherjee, P.K. *Durability of fiber reinforced polymer (FRP) used in concrete structures,* Research report, Department of civil engineering, University of Toronto, January 2000, p.53.
2. Huceste C¸ atalgil-Giz, Ahmet Giz, Alina M. Alb, Wayne F. Reed, *Absolute Online Monitoring of Acrylic Acid Polymerization and the Effects of Salt and pH on Reaction Kinetics.* Journal of Applied Polymer Science, Vol. 91, 1352-1359, 2004.
3. Ehlen, M., *Life-Cycle Costs of Fibre–Reinforced-Polymer Bridge Decks,* Journal of Materials in Civil Engineering, August, 1999.

4. El-Mikawi, M., Mosallam, A.S., *A Methodology for Evaluation of the use of Advanced Composite in Structural Civil Engineering Applications*, Composites, Oxford, UK Vol 27 Issue 3, 1996.
5. Karbhari V.M. and Zhang S., *Durability of Fibre Reinforced Composites in Civil Infrastructure – Issues, Results and Implications*, Developments in Design Standards for Advanced Composites in Infrastructure Applications, CRC-ACS, Australia,1999.
6. Gowripalan N., *Fibre reinforced Polymer (FRP) Applications for Prestressed Concrete Bridges*, Proceedings of ACUN 1 Conference Composites: Innovations and Structural Applications, UNSW, Australia, 1999.