

DURABILITY OF EPOXY ADHESIVES USED TO BOND CFRP LAMINATES TO CONCRETE STRUCTURES

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SUMMARY

This work presents an experimental program undertaken in order to evaluate the durability of three types of commercial epoxy adhesives used for bonding carbon-fibre-reinforced-plastics (CFRP) to concrete structural elements on their rehabilitation.

Keywords: rehabilitation, concrete, epoxy, adhesives, CFRP

INTRODUCTION

The repair and strengthening of deteriorated, damaged and old concrete infrastructures has become an important challenge for civil engineers worldwide [1]. One of the techniques used in the rehabilitation of those structures is the external bonding of CFRP laminates by employing epoxy resin adhesives [2, 3].

In such applications, the applied materials are exposed to outdoor environmental conditions, including humidity, rain, saline and ground water and, also, high alkaline solutions originated by the chemical composition of the concrete itself [4]. Thus, it is of great relevancy to study the durability of the materials involved in such applications, not only the epoxy adhesives and CFRP laminates, but also, the integrity of the entire system subjected to those environmental conditions.

This work is part of a larger research being made to predict the long-term behaviour of several commercial CFRP laminate/adhesive systems used in concrete structures rehabilitation. In the overall project it was recognized that the durability of this rehabilitation scheme depends, on a great deal on the performance of the adhesives used for the bonding of the CFRP laminates to concrete. The present document brings into focus the part of the investigation concerning the durability of epoxy adhesives used to bond CFRP to concrete.

MATERIALS AND METHODS

The study developed to investigate the environmental effects on three types of epoxy adhesives commercially available is described. The changes in physic-mechanical

properties after exposure up to 18 months under different environmental conditions - immersion in demineralised water, salt and alkaline solutions at room temperature, 40°C and 60°C, as well as under constant-humidity condensation atmosphere at 40°C - are reported and discussed.

Characterization of adhesives was extensively performed by using different techniques, such as chemical (FTIR, EDX), thermal (DSC, DMA), mechanical, as well as morphology observation of materials by electronic microscopy (SEM).

RESULTS AND CONCLUSIONS

The experimental results showed that adhesives composition and their state of cure may strongly influence the performance of those materials in different ageing environments. Overall, the effect of salt solution exposure seems to have the least effect, whereas exposure to alkaline solution has the greatest deterioration effect.

Since the efficiency of strengthening of concrete structures by external bonding of CFRP laminates depends on the durability of the adhesive, the results obtained offer valuable information which can be used, not only to characterize the behaviour of epoxy adhesives, but also for a better understanding of the degradation mechanisms involved which is the basis for the design of service life-prediction models.

References

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