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Performance of a polymeric coating material applied to a concrete structure affected by internal expansive chemical reactions

João Custódio ^{a,*}, Helena Silva ^a, Maria Paula Rodrigues ^a, Susana Cabral-Fonseca ^a,
António Bettencourt Ribeiro ^a, Filipa Morais ^b^a LNEC – Laboratório Nacional de Engenharia Civil, Av. do Brasil, 101, 1700-066 Lisboa, Portugal^b Norscut – Concessão de Auto-Estradas, S.A., Rua Filipe Folgue, 10J, 1.º Dto., 1050-113 Lisboa, Portugal

Abstract

Currently, there is a significant number of large concrete structures with deterioration problems related to internal expansive chemical reactions (IECR), in Portugal and worldwide. This type of deterioration is related to the formation of expansive products inside the concrete causing its premature deterioration due to expansion and cracking, which in turn accelerates the ingress of moisture and other aggressive agents into the concrete, leading to further deterioration of the structure. Thus, IECR can reduce the service life of the structure and, ultimately, lead to its decommissioning or demolition. Two main mechanisms have been identified to cause the concrete swelling: Alkali-Silica Reaction (ASR) and Internal Sulfate Reaction (ISR, heat-induced internal sulfate reaction, also referred in the literature as delayed ettringite formation, DEF). A common requirement for their occurrence is the presence of sufficient moisture inside concrete. By controlling the humidity level in concrete, coatings applied to its surface may contribute to ASR and DEF mitigation, if they have adequate water permeability properties. This paper presents the general criteria that can be used for selecting polymeric coating materials to protect concrete structures affected by these types of expansive reactions, thus contributing to increase their durability and service life. Moreover, a case study is presented concerning the performance evaluation of a coating material, selected according to the above criteria, that was applied on a concrete bridge affected by ASR and DEF.

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* Corresponding author. Tel.: +351218443246; fax: +351218443023.

E-mail address: jcustodio@lnec.pt