Durability of Steel Fibre Reinforced Concrete (SFRC) exposed to acid attack – A literature review

Steel Fibre Reinforced Concrete (SFRC) is increasingly used in the construction of civil infrastructure. There is particular interest in the behaviour of SFRC under chemical and bio-chemical exposure, since it can be utilized, among others, for the construction of waste-water and agricultural infrastructure. However, the applicability of SFRC exposed to acidic environments is hindered by inconsistencies among international regulations. This paper reviews the published literature concerning the durability of SFRC exposed to acid attack. Research suggests that the exposure to acids of uncracked SFRC results in damage similar to what would occur in Plain Concrete (PC). There is insight into the non-critical corrosion of steel fibres embedded in the neutralized concrete layer, not entailing corrosion-induced cracking or spalling and steel fibres have been reported to limit secondary damage by bridging cracks and restraining the progress of the chemical-erosion front. However, there is limited data regarding the residual mechanical performance of cracked SFRC that has been exposed to acids. Published research suggests the existence of a critical crack width, below 0.3 mm, where the corrosion damage to the steel fibre is non-critical and there is a limited loss of fracture toughness. However, it has been observed that the exposure of cracked SFRC to acids leads to a larger deterioration of its residual mechanical performance compared to other exposures.
Steel fibre reinforced concrete (SFRC) is increasingly being used in the construction of civil infrastructure. However, there are inconsistencies among international standards and guidelines regarding the consideration of carbon-steel fibres for the structural verification of SFRC exposed to corrosive environments. This paper presents a review of the published research regarding carbonation- and chloride-induced corrosion of SFRC, and proposes a deterioration theory for cracked SFRC exposed to chlorides and carbonation, based on the damage at the fibre-matrix interface. The review confirms an overall
agreement among academics and regulators regarding the durability of uncracked SFRC exposed to chlorides and carbonation. Contrariwise, the durability of cracked SFRC is under discussion at the technical and scientific level, as there is a large dispersion on the experimental results and some of the mechanisms governing the corrosion of carbon-steel fibres in cracks and its effects on the fracture behaviour of SFRC are not fully understood.

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Corrosion resistance of steel fibre reinforced concrete – a literature review
Steel fibre reinforced concrete (SFRC) is increasingly being used in the construction of prefabricated segmental linings for bored tunnels, since it entails simplified production processes and higher quality standards. However, international standards and guidelines are not consistent regarding the consideration of steel fibres for the structural verification of SFRC elements exposed to corrosive environments, hampering the development of civil infrastructure built of SFRC. In particular, the long-term effect of exposure to chlorides is in focus and under discussion. This paper reviews the existing literature concerning chloride-induced corrosion on steel fibres, as well as the impact of steel fibre corrosion on the residual-tensile strength of SFRC. The review confirms the agreement among academics and regulators regarding the superior durability of un-cracked SFRC exposed to chlorides, relative to conventional reinforcement. However, the durability of cracked SFRC is still under discussion, as the mechanisms governing the corrosion of carbon-steel fibres in cracks and its effects on the fracture behaviour of SFRC are still unclear. Nevertheless, there is insight among several researchers concerning the existence of a critical crack width, below 0.20 mm, where corrosion of carbon-steell fibres is not critical and the structural integrity of the exposed SFRC can be ensured over the long-term. A doctoral project investigating chloride-induced corrosion of steel fibres on cracked SFRC has been initiated, in order to explore the governing deterioration mechanisms.

General information