

Proposals to Increase the Durability of Concrete Affected by Acid Mine Waters

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Abstract : There are many acidic environments that degrade structural concrete, such as those found in water treatment plants, sports facilities, and more, but one of the most aggressive is undoubtedly the water from acid mine drainage. This phenomenon occurs in all pyrite mining facilities and, to a lesser extent, in coal mines and is characterised by very low pH values and high sulphate, metal, and metalloid contents. This phenomenon causes significant damage to the concrete, mainly attacking the binder. In addition, the process is accentuated by the action of acidophilic bacteria, which accelerate the cracking of the concrete. Due to the damage that concrete experiences in acidic environments, the authors of this study aimed to enhance its performance in various aspects. Thus, two solutions have been proposed to improve the concrete durability, acting both on the mass of the material itself with the incorporation of fibres, and on its surface, proposing treatments with two different paints. The incorporation of polypropylene fibres in the concrete mass aims to improve the tensile strength of concrete, being this parameter the most affected in this type of degradation. The protection of the concrete with surface paint is intended to improve the performance against abrasion while reducing the access of water to the interior of the mass of the material. Sulpho-resistant cement has been used in all the mass concrete mixtures that have been prepared, in addition to complying with the requirements of the current Spanish standard, equivalent to the Eurocodes. For the polypropylene fibres, two alternatives have been used, with 1.7 and 3.4 kg/m³, while as surface treatment, the use of two paints has been analysed, one based on polyurethane and the other on asphalt-type paint. The proposed treatments have been analysed by means of indirect tensile tests and pressure sandblasting, thus analysing the effects of abrasion. The results obtained have confirmed a slight increase in the tensile strength of mass concrete by incorporating polypropylene fibres, being slightly higher for a ratio of 3.4 kg/m³, with an improvement of slightly more than 5% in the tensile strength of concrete. However, the use of fibres in concrete greatly reduces the loss of concrete mass due to abrasion. This improvement against abrasion is even more significant when paint is used as an external protection measure, with a much lower loss of mass with both paints. Acknowledgments: This work has been supported by MCIN/AEI/10.13039/501100011033/FEDER, UE, throughout the project PID2021-123130OB-I00.

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