Performance of 15 reinforced concrete mixtures in magnesium-sodium sulphate environments

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Construction and Building Materials
Vol. 9, Issue.3, 1995

Abstract: A review of the literature indicates that research on the durability of reinforced concrete in sulphate-rich environments has primarily been confined to studies on sulphate attack. Despite the small number of reports on the effect of sulphate ions on corrosion of reinforcing steel in concrete, the findings of these reports are controversial and inconclusive. Therefore, this investigation was conducted to assess the performance of 15 reinforced concrete mixtures in a mixed magnesium-sodium sulphate environment. These mixtures comprised a combination of three Portland cements, three mineral admixtures and two water-to-binder ratios. Deterioration of concrete due to sulphate attack and corrosion of reinforcing steel was evaluated by assessing the weight loss of concrete and measuring corrosion potentials and polarization resistance at periodic intervals. The results of this investigation indicated that plain cement concretes, irrespective of their C3A content, performed fairly well in terms of sulphate resistance; however, they failed to protect the rebars from corrosion. Blended cement concretes, particularly those made with fly ash and blast-furnace slag, exhibited an advanced degree of deterioration due to both sulphate attack and reinforcement corrosion. Despite its inferior performance in terms of sulphate resistance, silica fume cement concrete displayed the best performance with regard to corrosion protection. A reduction in the water-to-binder ratio was generally detrimental in terms of sulphate attack in plain and blended cement concretes.