# Experimental Assessment of Acid Attack Resistance and Chloride Permeability of Sustainable M80 Concrete

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## Abstract

High-strength concrete used in sewage, marine and industrial infrastructure requires durability against aggressive acids and chloride ingress in addition to high mechanical strength. This study evaluates M80-grade concrete incorporating fly ash (0–30% cement replacement), waste foundry sand (0–40% fine-aggregate replacement) and river pebble aggregate (0–20% coarse-aggregate replacement) through 31 mix designs. Specimens were assessed after prolonged exposure to 6% hydrochloric acid (HCl) and 3% sulphuric acid ($H_2SO_4$), while rapid chloride permeability was measured in accordance with ASTM C1202 for the control and selected ternary mix. Acid exposure produced compressive-strength losses of 3.17–7.42% under HCl and 5.12–15.13% under $H_2SO_4$, with corresponding mass losses of 3.50–23.33% and 8.70–26.65%. Mix 24 (20% fly ash, 30% foundry sand and 5% river pebble aggregate) retained 92.16 MPa after HCl and 88.39 MPa after $H_2SO_4$ exposure. Its RCPT charge decreased from 1080 C at 28 days to 520 C at 365 days, reaching the Very Low penetrability class. Nonlinear prediction further showed strong agreement between 365-day reference properties and acid-exposed responses: Gradient Boosting achieved $R^2$ values of 0.9428 for HCl-exposed compressive strength and 0.9935 for $H_2SO_4$-exposed compressive strength. The results demonstrate the durability potential of carefully proportioned fly ash–foundry sand–river pebble M80 concrete and the value of nonlinear models for estimating long-term acid-exposed performance.

## Keywords

Acid Attack, Chloride Permeability, Fly Ash, Foundry Sand, M80 Concrete.