

## Improving the resistivity of seawater-mixed concrete with the inclusion of nanoparticles and supplementary cementitious materials

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Concrete is the second-most consumed material after water on Earth, and production of concrete consumes 18% of the total industrial demand for freshwater annually. Water-stressed nations are in need to replace freshwater in concrete production and are attempting seawater-mixed concrete in the last decade. The inclusion of supplementary cementitious materials (SCMs), nanoparticles, the addition of fibers, and the usage of FRP reinforcement can increase the feasibility of producing concrete by seawater mixing. The current study focuses on developing durable concrete mixes with the inclusion of SCMs and nanoparticles that could enhance the resistivity of concrete against the ingress of aggressive ions. SWCs were produced by optimizing the composition of ternary-blended cementitious systems with class F fly ash (Fa), ground granulated blast furnace slag (BFS), and/or metakaolin (MK). Blended concretes consisting of fly ash (Fa: 10–30%), slag (BFS: 30–50%), and metakaolin (MK: 10–30%) were produced by substituting the CEM I 42.5 R (PC), and mixing with freshwater (FWC) and seawater. Between FWCs and SWCs, the compressive strength, surface resistivity, and bulk resistivity of SWCs increased by 10% at early ages (say < 28 days). Furthermore, the addition of nano-SiO<sub>2</sub> (3% bw), and nano-Al<sub>2</sub>O<sub>3</sub> (1% bw) in the ternary blended concretes CF20M10 and CS30M15 showed an increase in resistivity of the concrete by 10–25% within 28 days of moist curing. In conclusion, the potential of nano-modified seawater-mixed concrete with higher-resistivity is demonstrated, and the recommendations for long-term studies on durability of SWCs are highlighted.

*KEYWORDS: seawater-mixed concrete, supplementary cementitious materials, nanoparticles, concrete resistivity*

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