Using Seawater as Mixing Water in Concrete

Kamran M. Nemati, Fellow, ASCE, Tsuyoshi Saito, Yutaka Tadokoro, and Nobuaki Otsuki

Abstract:

Fresh water will soon become increasingly scarce. It has been said that in 2025, half of humankind will live in areas where fresh water is insufficient. Additionally, the United Nations (UN) and the World Meteorological Organization (WMO) are predicting that five billion people may have insufficient drinking water. There are currently some areas where seawater or sand containing chloride are used as mixing water both intentionally and unintentionally. The purpose of this research is to investigate the possibility of using seawater as mixing water in concrete. This paper will examine the various possibilities of using seawater as mixing water in reinforced concrete (RC) members.

Test results indicate that seawater can be used as mixing water in concrete if ordinary portland cement (OPS) is replaced by blast-furnace slag (BFS) or other blended cements, or if corrosion inhibitors and stainless steel or corrosion-resistant reinforcement are used.

Keywords: Seawater, Blast Furnace Slag (BFS) Cement, Corrosion, Corrosion inhibitors, Stainless steel, Hydration products, Corrosion-resistant reinforcement, Reinforced concrete, Compressive strength.

1. INTRODUCTION

Fresh water will soon become less abundant, even scarce. Studies show that in 2025 half of the world population will live in areas where fresh water is insufficient. The UN and the WMO are predicting that five billion people may have insufficient drinking water. There are presently some areas where seawater or sand containing chloride are used in concrete mixtures either intentionally or out of necessity.

The possibility of using seawater as mixing water in concrete should be investigated. Therefore, this paper will examine the various possibilities of using seawater as mixing water in RC members.

Aside from the possibilities discussed in the introduction, the authors have investigated the effect of chloride in marine environments. In these investigations, the authors compared the durability of concrete using OPC and BFS cement mixed with both fresh water and seawater. The results showed little difference in durability between the concrete mixed with fresh water and that mixed with seawater yet there was a significant difference between the concrete with OPC and BFS cement. Additionally, the BFS cement concrete mixed with seawater showed better durability than the OPC concrete mixed with fresh water.

Inspired by these findings, the authors believe there are various possibilities of using seawater as mixing water in reinforced concrete.

In this paper, the following concrete types are investigated:

I. Concrete mixed with pozzolanic materials (Blast furnace slag powder, etc.) expecting to fix the free chloride ion.

II. Concrete mixed with corrosion inhibitors.

III. Concrete reinforced with stainless steel or corrosion resistant reinforcement.

IV. Concrete used in very dry or submerged conditions.