STUDY ON THE EFFECT OF SEAWATER ON MAKING AND CURING OF UNREINFORCED CONCRETE APPLICATIONS

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Concrete, an essential component of worldwide infrastructure, depends significantly on fresh water for its manufacturing, contributing to freshwater scarcity in many regions. As construction demands increase, transitioning to alternative water sources is important to minimize environmental impact and ensure long-term sustainability. Traditional reinforced concrete structures can experience corrosion when they come into contact with seawater, as the chloride content in seawater can lead to the deterioration of the structures. As a result, seawater is not deemed suitable for these specific applications due to the potential damage it can cause. However, it is possible to use seawater in non-reinforced concrete applications, where there is no risk of corrosion. Existing studies present conflicting results regarding the effects of seawater on concrete, with some indicating positive impacts, while others report minimal or no impact on the mechanical properties of concrete. The main objective of the study is to investigate the effect of incorporating seawater in the production and curing processes of unreinforced concrete. Specifically, the study aims to compare and analyse the properties of concrete mixed with seawater and subsequently cured with seawater, in contrast to conventional freshwater concrete.

Fresh and hardened concrete properties were evaluated for the following scenarios: concrete mixed and cured with fresh water, concrete mixed and cured with seawater, and concrete mixed with freshwater but cured with seawater. The properties of fresh concrete, specifically slump and slump loss, were evaluated, while the hardened concrete properties, including compressive strength, splitting tensile strength, and drying shrinkage, were tested at four different curing ages (3, 7, 28, and 56 days). This was done to understand the influence of seawater on the hydration process and to assess the variation in these properties over time.

The results show that the mixing of seawater has a negligible effect on the slump but leads to an increased slump loss, indicating that the workability loss is higher in seawater-mixed concrete compared to freshwater-mixed concrete. The use of seawater in curing also shows a minimal impact on the properties of hardened concrete. In addition, there is a significant difference in the mechanical performance of concrete when comparing seawater and freshwater concrete. Seawater-mixed concrete shows higher compressive strength in early ages, however, in the later stages the variation becomes less significant between the two concrete types. Early age splitting tensile strength is slightly higher in seawater-mixed concrete however at later ages it becomes considerably low compared to freshwater-mixed concrete. Seawater-mixed concrete exhibits higher drying shrinkage over time compared to freshwater-mixed concrete. Based on the findings of this research, seawater could be recommended for curing unreinforced concrete.

For further research studies, it is recommended to investigate the long-term effect of the seawater on making and curing of unreinforced concrete, focus on the effect of seawater on other properties of concrete such as setting time, permeability, electrical resistivity, etc.

Keywords: Fresh properties, Hardened properties, Seawater concrete, Seawater curing

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Why is seawater needed for making and curing unreinforced concrete?

- Global threat of freshwater scarcity
- Advantageous from a sustainable perspective

Aim

Investigate the suitability of seawater for making and curing unreinforced concrete

Research Methodology

Identification of Major Parameters

- Variables
  - Concrete type
  - Curing age
- Properties
  - Slump
  - Slump Loss
  - Compressive Strength
  - Splitting Tensile Strength
  - Drying Shrinkage

Experimental Study

Concrete Mix Design → Sample Preparation → Curing → Testing

Testing

- Slump
- Compressive Strength
- Splitting Tensile Strength
- Drying Shrinkage

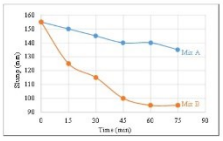
→

- BS ISO 1920-2:2016
- BS 1881-116:1983
- BS 1881-117:1983
- BS ISO 1920-8:2009

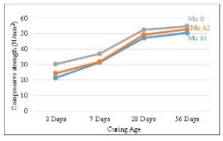
Results and Analysis

- No significant effect on the slump of concrete when using seawater as the mixing water

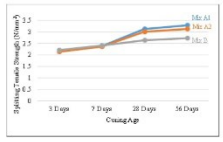
Slump Loss



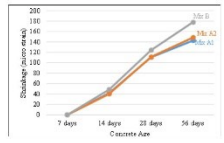
Compressive Strength



Splitting Tensile Strength



Drying Shrinkage



Mix A - Conventional freshwater mixed concrete Mix B - Seawater mixed concrete Mix A1 - Mixed with freshwater and cured with freshwater Mix A2 - Mixed with fresh water and cured with sea water

- No significant variation in the compressive strength, splitting tensile strength and drying shrinkage due to curing conditions
- Seawater-mixed concrete has a higher compressive strength in early ages, however, in the later stages the variation was less significant between the two concrete types
- Early age splitting tensile strength is slightly higher in seawater-mixed concrete however at later ages it becomes considerably low compared to freshwater concrete.
- Seawater-mixed concrete exhibits higher drying shrinkage over time compared to freshwater-mixed concrete

Recommendations

Seawater can be used for the curing of unreinforced concrete