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# Investigation of the Impact of Seawater on the Compressive Strength of Sandcrete Blocks: A Case Study of Nembe, Nigeria

Wenapere, Ambakederemo Dio
*Department of Civil Engineering, Niger Delta University, Wilberforce Island, Nigeria*

***Abstract***
*The durability and strength performance of construction materials in coastal environments are crucial for sustainable infrastructure. This study investigates the effect of seawater on the compressive strength of sandcrete blocks in Nembe, Bayelsa State, Nigeria. Sand and water samples were collected from Basambiri (seawater environment) and Amassoma (freshwater environment). Sandcrete blocks were produced using a cement-to-sand ratio of 1:8 and cured for 7, 14, 21, and 28 days with either freshwater or seawater. Compressive strength tests were conducted using a Universal Testing Machine in accordance with ASTM C140/C140M-20 and NIS 87:2000 standards. Findings show that seawater-cured blocks consistently exhibited lower compressive strength than freshwater-cured blocks, with average 28-day strengths of 2.70 N/mm² (Basambiri seawater) and 2.40 N/mm² (Amassoma freshwater). Water quality analysis ranked seawater significantly higher in salinity, total dissolved solids, electrical conductivity, and chloride concentration—parameters known to interfere with cement hydration. The study emphasizes the need to avoid untreated seawater in coastal construction and underscores long-term risks associated with saline exposure.*
***Keywords:*** *Sandcrete blocks, seawater, compressive strength, coastal construction, Niger Delta.*

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## I. Introduction

Sandcrete blocks are widely used as low-cost building materials in Nigeria, especially within coastal communities such as Basambiri and Amassoma. These regions experience high salinity, humidity, and frequent exposure to seawater, all of which threaten the performance of cement-based materials. In some coastal communities, seawater is used in block production due to limited freshwater availability, despite its uncertain long-term effects on structural integrity.

While previous studies indicate that seawater adversely affects the hydration of cementitious materials, the specific impact on sandcrete blocks in the Nembe region remains insufficiently documented. This study evaluates the effect of seawater on sandcrete block compressive strength and provides data to support sustainable construction practices in coastal environments.

## II. Materials and Methods

### 2.1 Materials

a. **Cement:** Ordinary Portland Cement (OPC) conforming to NIS 444-1:2003.
b. **Fine Aggregate:** River sand, sieved through a 4.75 mm sieve and free from organic impurities.
c. **Water:**
   i. Freshwater collected from Amassoma
   ii. Seawater collected from Basambiri creek

### 2.2 Sample Preparation

Sandcrete blocks were cast using standard steel moulds (450 × 225 × 150 mm) at a cement-to-sand ratio of 1:8. Mixing was done manually until workable consistency was achieved. Blocks were demoulded after 24 hours and cured with their respective water types by daily sprinkling for 7, 14, 21, and 28 days.

### 2.3 Compressive Strength Testing

Compressive strength tests were performed using a Universal Testing Machine (UTM) following ASTM C140/C140M-20 and NIS 87:2000. Three blocks were tested at each curing age, and the average value was recorded.

The compressive strength was computed as:

$F_c = P/A$

where:
**P** = failure load (N)
**A** = net cross-sectional area (mm²)

### 2.4 Water and Sand Quality Analysis

Water samples were analyzed for pH, salinity, total dissolved solids (TDS), electrical conductivity (EC), and chloride content.
Sand samples were tested for silica content, clay content, organic matter, and bulk density.

## III. Results

### 3.1 Compressive Strength of Sandcrete Blocks

**Table 1. Average Compressive Strength (N/mm²) of Sandcrete Blocks**

| Curing Period (days) | 7 | 14 | 21 | 28 |
|---|---|---|---|---|
| Seawater (Factory A) | 1.81 | 2.36 | 2.35 | 2.58 |
| Seawater (Factory B) | 1.51 | 1.92 | 2.49 | 2.52 |
| Freshwater (Amassoma) | 1.58 | 1.78 | 2.38 | 2.40 |

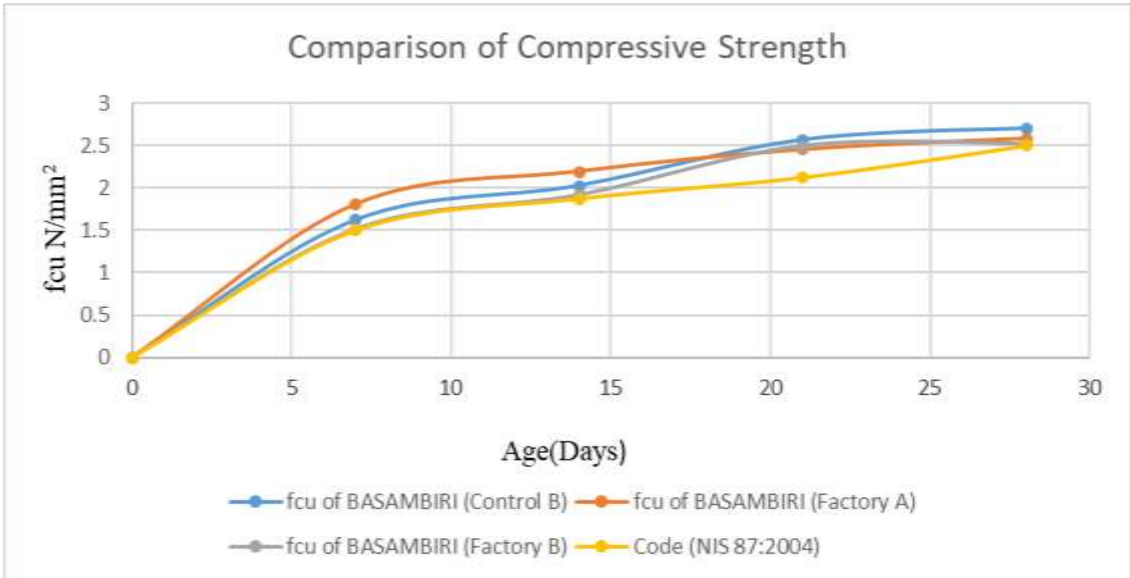


Figure 1: Compressive strength development of seawater and freshwater sandcrete blocks over curing periods.

### 3.2 Water Quality Parameters

| Parameter | Freshwater (Amassoma) | Seawater (Basambiri) |
|---|---|---|
| pH | 6.83 | 7.44 |
| Salinity (%) | 0.24 | 3.65 |
| TDS (mg/L) | 24 | 8,179 |
| EC (µS/cm) | 48 | 16,360 |
| $Cl^-$ (mg/L) | 100 | 3,386 |

Seawater from Basambiri exhibited significantly higher salinity and TDS, conditions known to deteriorate cement hydration.

## IV. Discussion

Compressive strength increased with curing age in all samples, confirming normal hydration behaviour. However, seawater-cured blocks consistently recorded lower strength values than freshwater-cured blocks. The high chloride and ionic content in seawater disrupt cement hydration, encourage formation of deleterious compounds such as calcium oxychloride, and cause internal cracking.

Since sand quality was similar in both locations, water type was the major factor influencing strength variation. The observed trend agrees with findings by Oyekan & Kamiyo (2008), Ikponmwosa & Salau (2010), and Ede & Joshua (2015), who reported 20–30% strength reduction in concrete exposed to saline environments. Environmental conditions in Nembe—high humidity and saline-laden air—may further exacerbate long-term durability issues.

## V. Conclusion

1. Compressive strength of sandcrete blocks increases with curing time.
2. Seawater-cured blocks exhibit lower compressive strength compared to freshwater-cured blocks.
3. Salinity, TDS, and chloride concentration play significant roles in reducing block durability.
4. Sand quality contributed minimally to observed strength variations; water quality was the dominant factor.

## VI. Recommendations

1. Untreated seawater should not be used for sandcrete block production.
2. Pre-treatment of seawater or incorporation of pozzolanic additives is recommended to minimize strength loss.
3. Local block manufacturers should be educated on the long-term risks of seawater use.
4. Future research should evaluate durability beyond 28 days and include reinforced or stabilized blocks.

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