2024 ENGINEERING INSTITUTION OF ZAMBIA SYMPOSIUM

Strength and durability analysis of ternary blended cement concrete using industrial and mine wastes.

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Avani Victoria Falls Resort, Livingstone, Zambia

INTRODUCTION

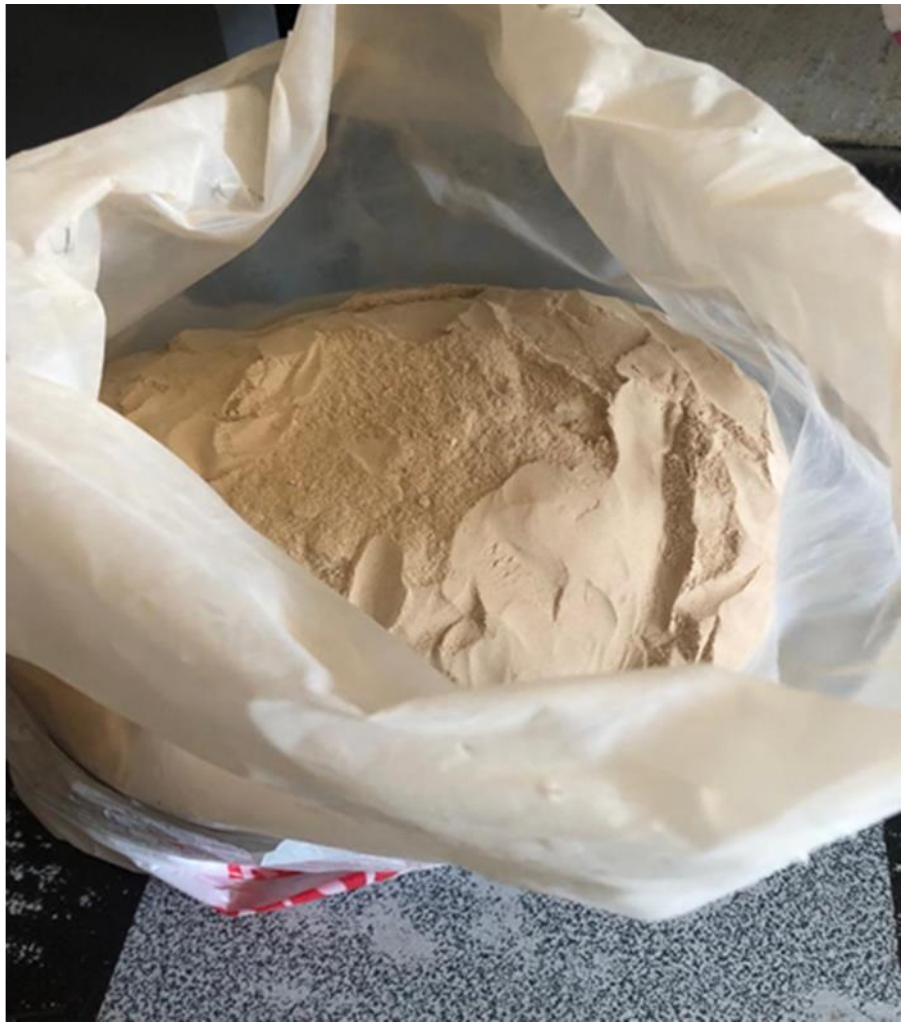
- Concrete is one of the most common, important and versatile construction material in any civil engineering structure with an annually production of 4.5 billion metric tonnes worldwide, its strength and durability characteristics make it the most desirable construction material as such providing concrete with the best strength and durability characteristics is of utter importance.
- The increase in the amount of waste from industries and disposal is proving a great problem for environmentalist worldwide. Hence, the use of industrial waste in the construction industry has the double benefit of creating sustainable eco-friendly concrete while also reducing environmental pollution.

INTRODUCTION

- Ternary blended concrete involves a mixture of three products, i.e., Portland cement plus two supplemental cementitious materials (SCMs) as binding materials.
- Fly ash and copper tailings are the wastes from industries and mines respectively.
- They possess cementitious properties for example pozzolanic reaction which allow them to be used as a partial replacement for cement. pozzolanic properties.
- These properties are attributed to the alumina and silica it contains these two compounds that are responsible for giving it cementitious properties.

FLY ASH

COPPER TAILINGS



OBJECTIVES OF STUDY.

Main Objective:

- To evaluate the strength and durability characteristics of ternary blended cement to make concrete.

Specific Objectives:

- To analyze the physical properties of ternary blended.
- To determine the compressive strength and the split tensile strength for ternary concrete mix and compare the strength with the conventional mix.
- To analyze the durability properties of ternary concrete mix and compare it with conventional mix.

EXPERIMENTAL PROCEDURES

1. Proportioning and batching of concrete mixes.

EXPERIMENTAL PROCEDURES

2. Slump test and casting of concrete cubes and cylinders .

EXPERIMENTAL PROCEDURES

3. Curing of concrete cubes and cylinders .

EXPERIMENTAL PROCEDURES

4. Compressive strength and split tensile strength tests.

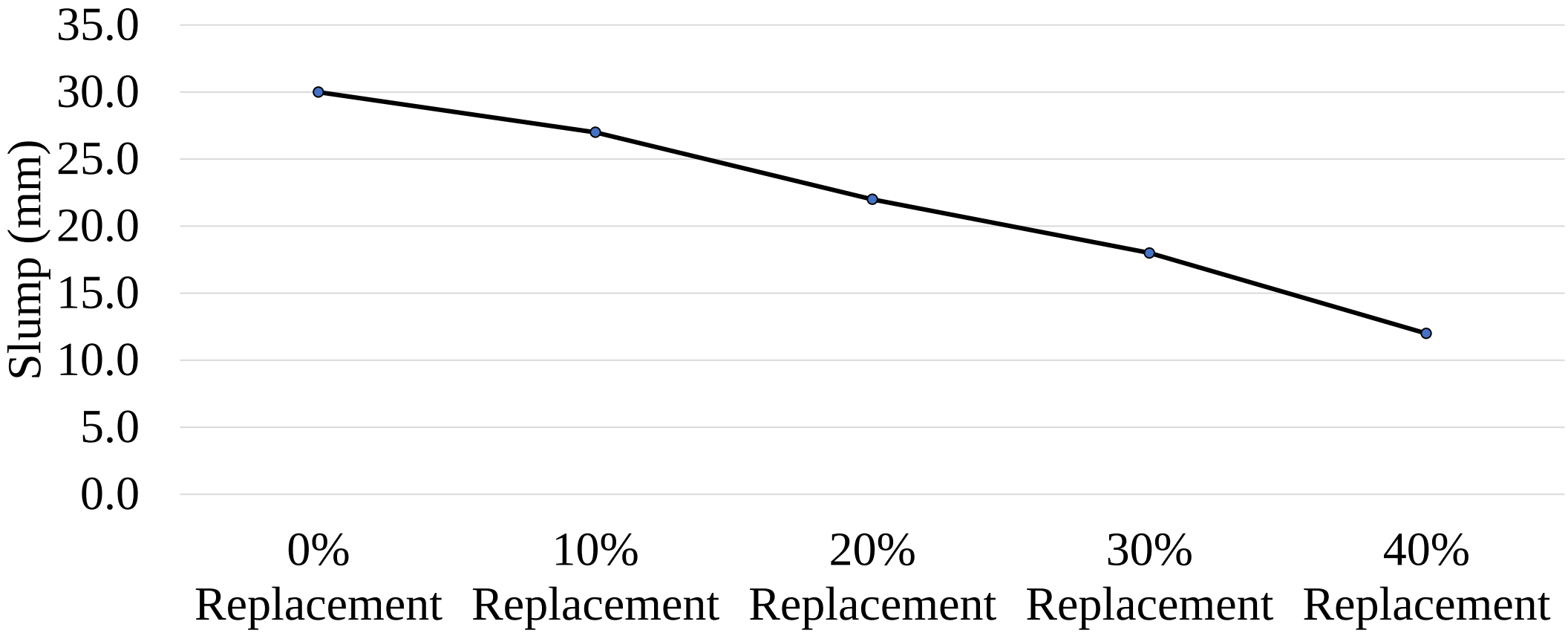
EXPERIMENTAL PROCEDURES

5. Water absorption and sulphate attack tests.

RESULTS AND DISCUSSIONS.

Physical tests:

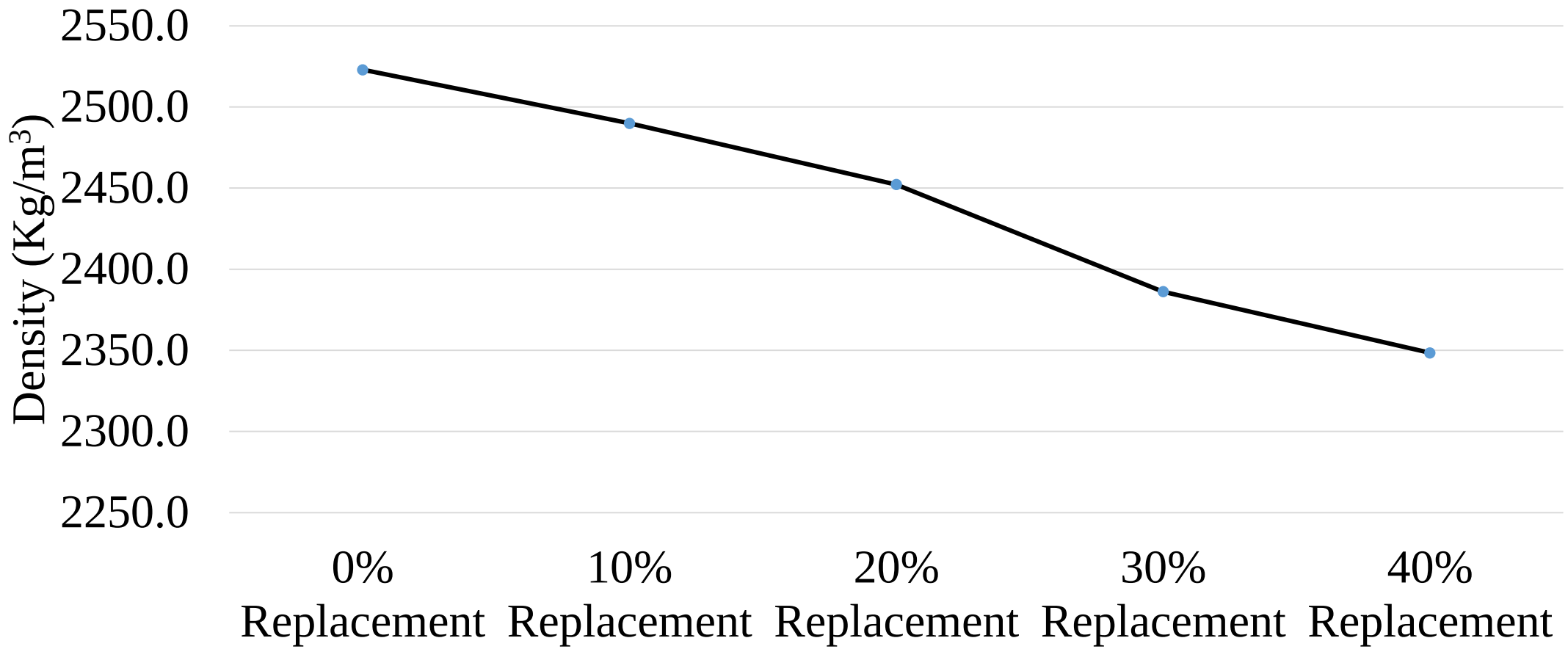
- Analysis of slump test.



RESULTS AND DISCUSSIONS.

Physical tests:

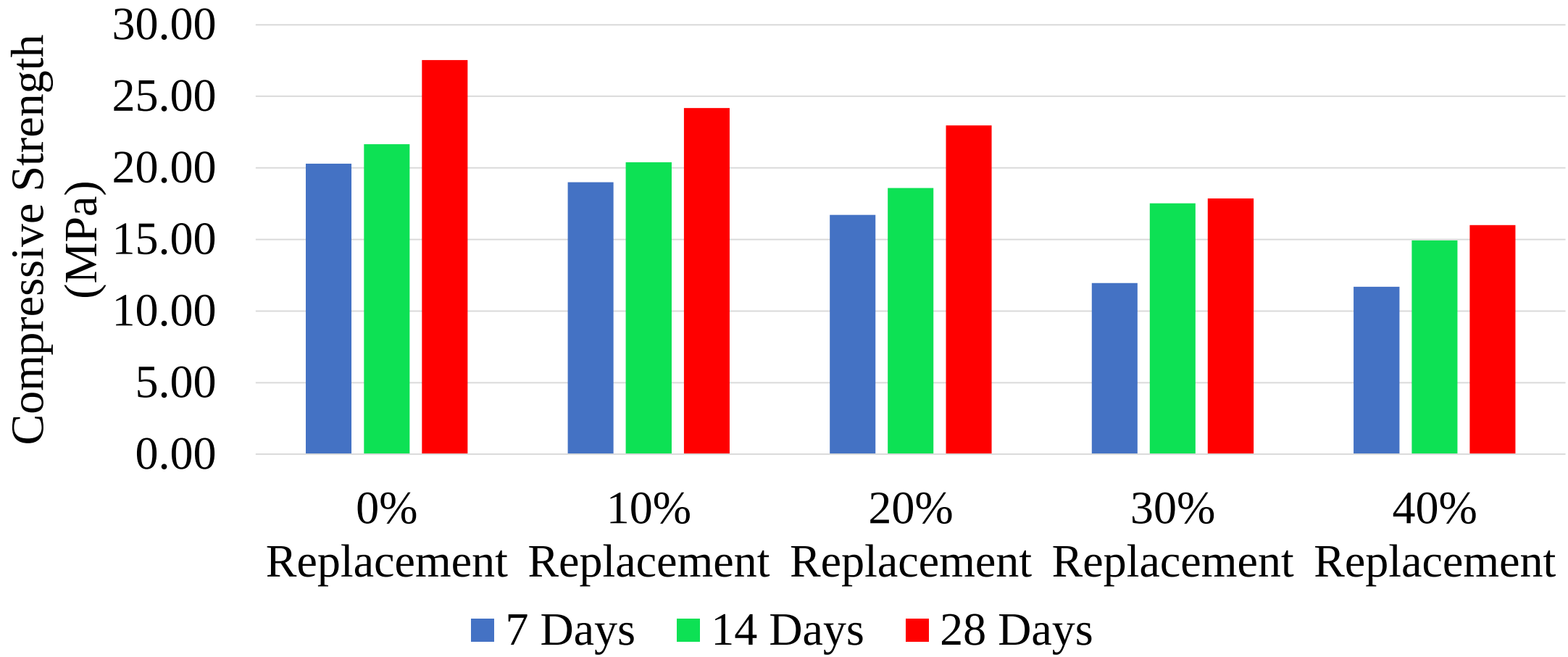
- Analysis of the density test.



RESULTS AND DISCUSSIONS.

Strength tests:

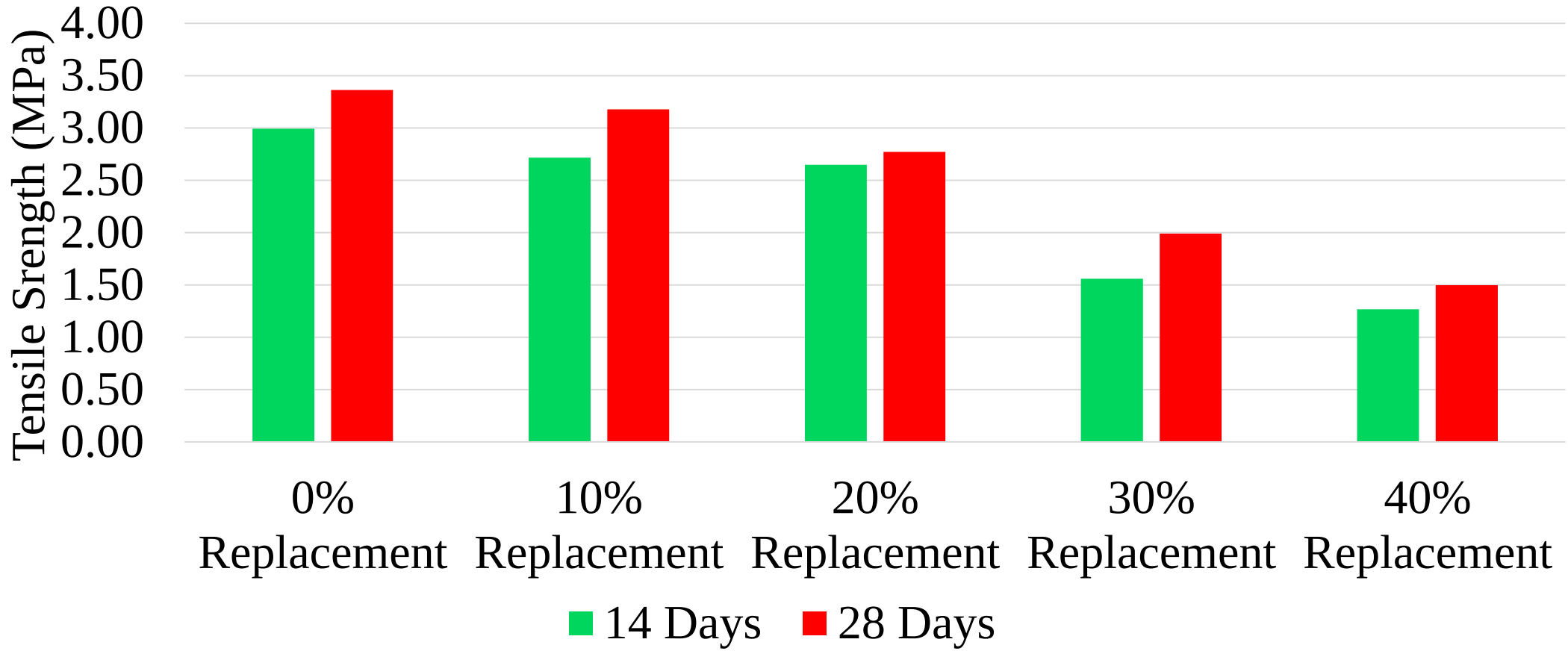
- Analysis of the compressive strength test.



RESULTS AND DISCUSSIONS.

Strength tests:

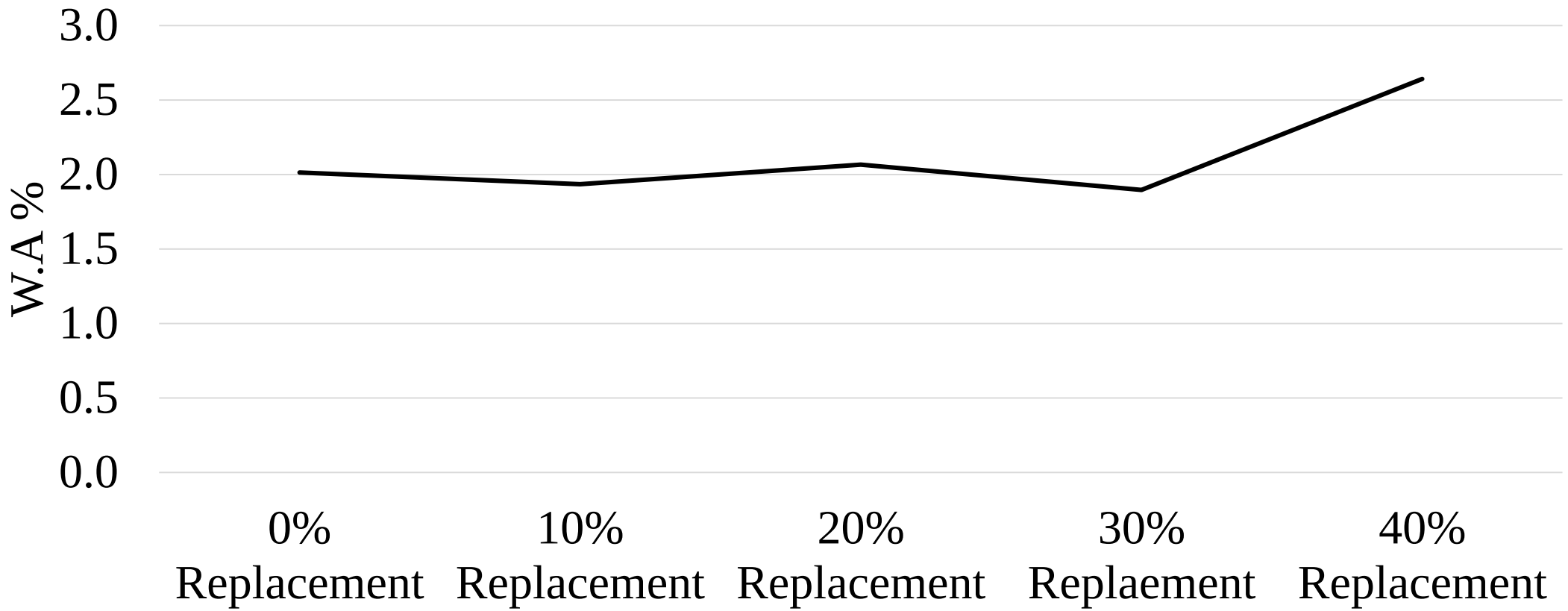
- Analysis of the split tensile test.



RESULTS AND DISCUSSIONS.

Durability tests:

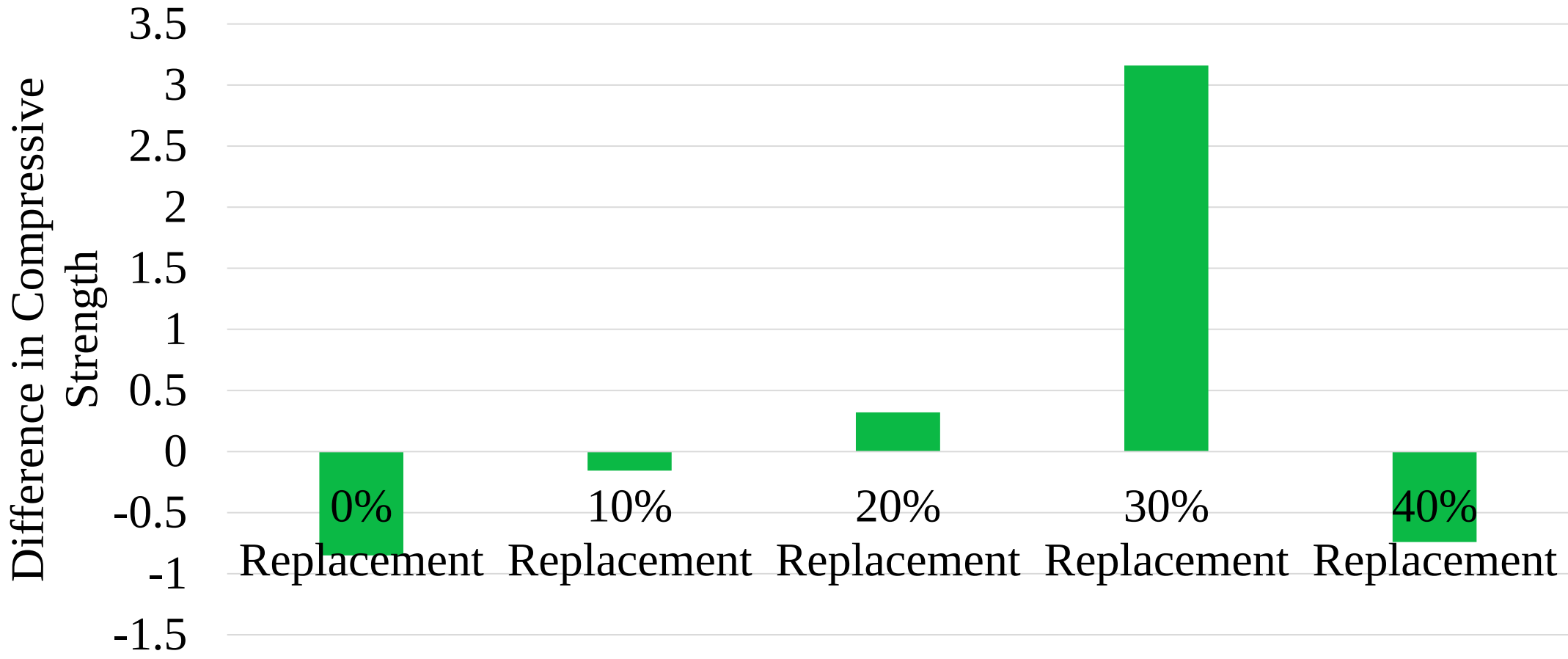
- Analysis of the water absorption test.



RESULTS AND DISCUSSIONS.

Durability tests:

- Analysis of the sulphate attack test.



CONCLUSION.

- The physical, strength and durability properties of ternary blended concrete were successful explored and it was determined that ternary blended concrete of up to 30% cement replaced by fly ash and copper tailings is more durable than ordinary concrete, this shows that we can use ternary blended concrete in construction and hence, reduce the effect of dumping these wastes.
- The compressive strength and split tensile strength tests showed that only the control 0% mix gave results above the characteristics strength at 28 days of curing for the compressive test while 0%, 10% and 20% were above the optimum for the split tensile test.

CONCLUSION.

- The water absorption of the mixes was found to be within the recommended limit of less than 3% from BS 6349 for all the mixes, with the 30% mix having the lowest of 1.895%. Therefore, all the mixes are durable enough to be used in water-logged environments.
- The sulphate attack test showed that the 0%, 10% and 40% mixes experienced strength loss after immersion in sulphate attack while the 20% and 30% mixes experienced a small gain in strength.
- The use of fly ash and copper tailings is great initiative and should be explored further. The incorporation of these industrial waste in the construction industry leads to a greener environment and sustainable construction.

CONCLUSION.

Recommendations:

- Incorporation of chemical admixtures in ternary blended concrete such as super-plasticizers which improvement in the strength and durability of concrete.
- Further investigations on the effect of the ternary blended concrete such as leaching into the environment and its effect on the internal structure of the concrete should be studied.
- Investigations of the ternary blended concrete properties at greater ages of curing more than 28 days and use of copper tailings and fly ash from different sources.

The End

THANK YOU FOR YOUR ATTENTION.