

LESS CEMENT AND CO₂ IN CONCRETE BY MECALITHE® TECHNOLOGY

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ABSTRACT

Atmospheric greenhouse gas (CO₂) is a potential gas in causing global warming which is a serious environmental challenge. The manufacturing of one ton of Portland cement emits approx. 927 kg of CO₂. A standard pre-fab concrete recipe with 230 kg/m³ (two types of cement) was compared with a Mecalithe® recipe with 28% less cement. The compressive strength (CS) of the reduce cement recipe indicates 14.30 % extra strength over values of the standard recipe. Values of CO₂ emission due to reduced cement content is calculated at 44 kg/m³. More research can lead to further reduction in cement quantities and CO₂ emission in the system.

INTRODUCTION

This study targets in reduction in cement quantities in a Mecalithe® based pre-cast concrete system for multifaceted advantages. Cement reduction is linked with reduction in the atmospheric greenhouse gas CO₂. Cement production stands at the third largest source of anthropogenic emission of CO₂¹ (approx. 8%). 1 Ton of Portland cement emits approx. 927 kg of CO₂ during its production process.

Accordingly, concrete samples with Mecalithe® and with 28% less cement, with different water-cement-factors (wcf) have been tested. The compressive strength (CS-N/mm²) that is achieved in 24 hrs. and 28 days remains the basis of comparative evaluation of strength (CS) between the standard (cement at 230 kg/m³) and reduced (cement at 165 kg/m³) Mecalithe® recipes to ascertain whether the same or more strength can be achieved (details in Materials and Methods).

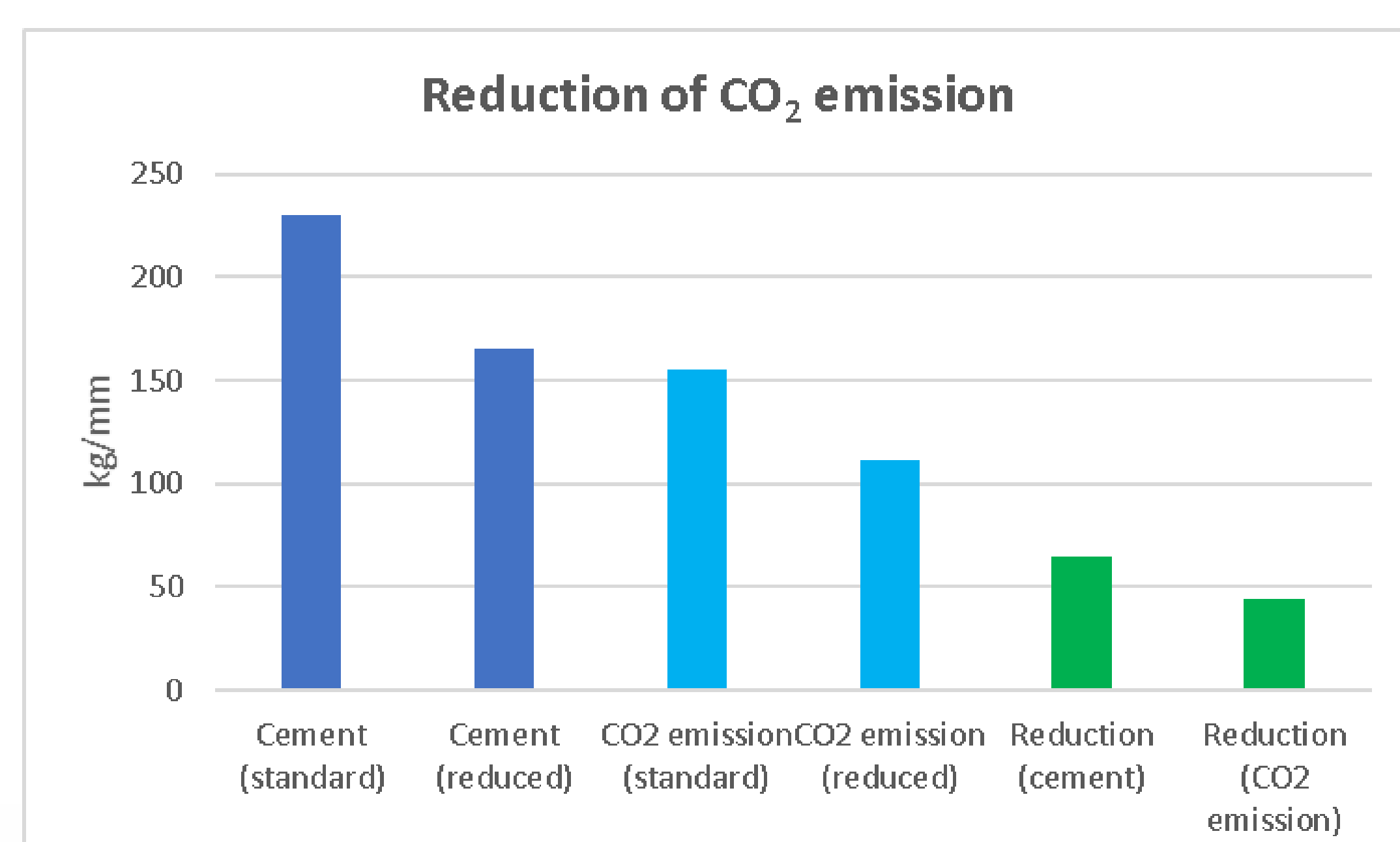
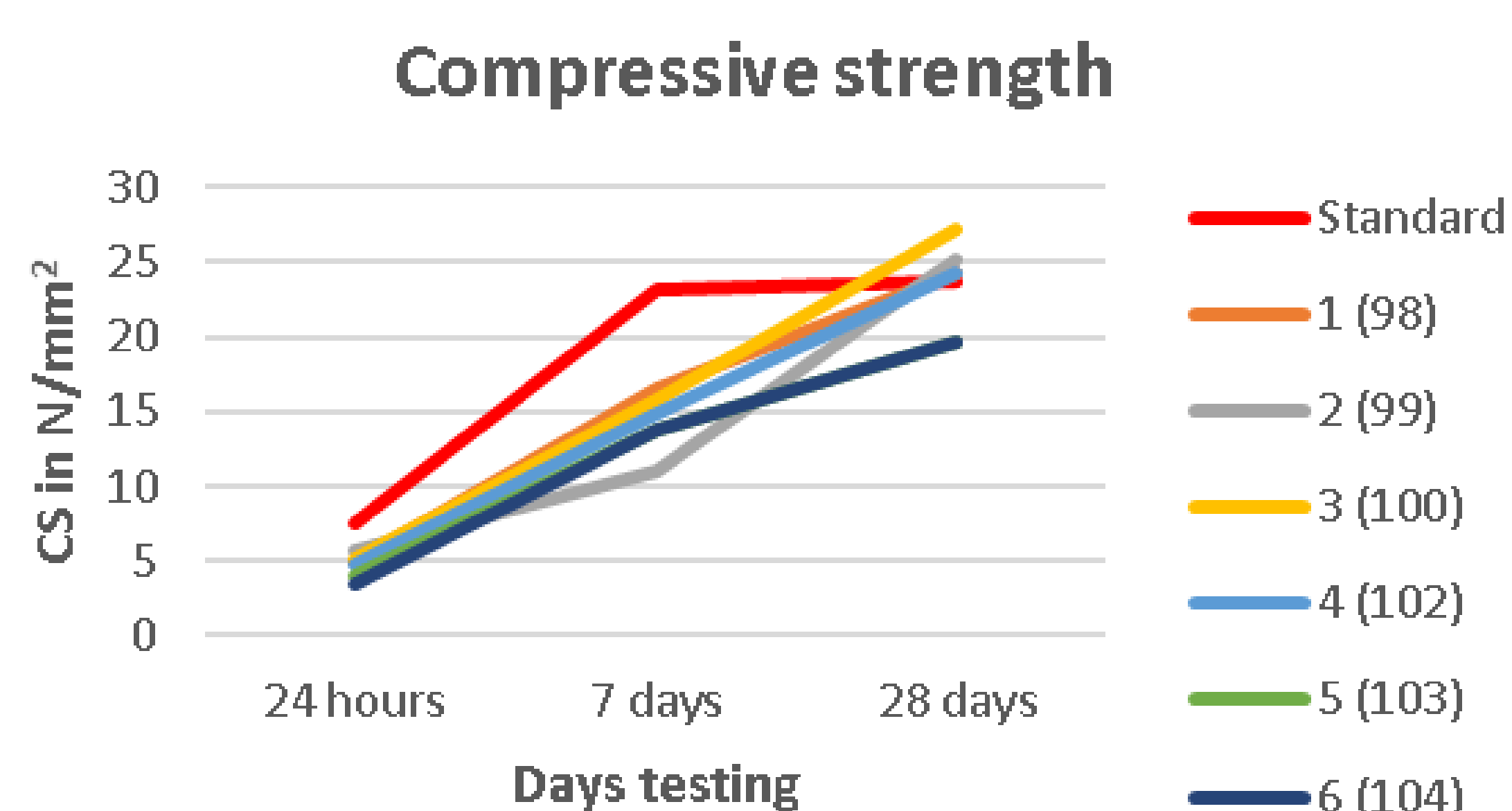
METHODS AND MATERIALS

Materials: Standard sand (0-4) mm - 55%, gravel (2-8mm) - 45%, CEM II 52.5 N and CEM III/B 42.5 N, Mecalithe® (25 kg/m³), Mecalithe® activator (2.5 kg/m³), fillers (re-cycled material) (100 kg/m³).

Methods: A standard recipe with two types of cement (total 230 kg/m³) and a Mecalithe® recipe with reduced two types of cement at (165 kg/m³ in total) were taken. The ingredients were mixed with water for approx. 90 sec. Prisms were made and cured at 20 +/- 2 °C. The density determination according to NEN-EN 12390-7 and the compressive strength (CS) testing according to NEN-EN12390-3 at 24 hrs. and 28 days.

RESULTS AND DISCUSSION

The standard recipe with 230 kg/m³ cement yielded a CS of 7.44 N/mm² in 24 hours and 23.76 N/mm² in 28 days. Mecalithe® recipes with 28% less cement, yielded 5.12 in 24 hours and 27.16 N/mm² in 28 days with a wcf of 1.0. Mecalithe® recipes yielded 31 % lower strength (CS-N/mm²) after 24 hours but eventually in 28 days, had gradually jumped to gain an extra strength (CS-N/mm²) of 14.30% over the standard. This study concludes that Mecalithe® recipes with 28% less cement yield 14.30% extra compressive strength and conforms to the reduction of 44 kg/m³ of atmospheric CO₂ emission, as calculated on the basis of percentage of Portland cement.



CONCLUSIONS

1. This study reveals that 65 kg/m³ of cement reduction is achieved through Mecalithe® Technology on the basis of comparative strength (CS) in 28 days.
2. The compressive strength with a standard mixture and a Mecalithe® recipe with 28% less cement had 23.76 and 27.16 N/mm² respectively in 28 days, achieving 14.3% extra strength.
3. This leads to reduction in CO₂ emission of 44 kg/m³ with possibilities of enhancement of these values with more research.
4. Multifaceted advantages includes, cost-reduction due to saving in cement quantities, reduction in CO₂ emission, cost reduction due to less transportation, less storage and ease of handling etc;
5. Control of greenhouse gas CO₂ leads to containment of global warming, is seen as a step towards sustainable environmental protection.

REFERENCES

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