Evaluation of the Technical Feasibility of Recycled Aggregates Derived from CDW for Use in Sustainable Reinforced Concrete

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1 INTRODUCTION

Europe's construction sector still depends heavily on virgin materials, with only 10.6% of inputs coming from recycled sources, most of which are used in low-value applications rather than concrete production. Enhancing the incorporation of recycled aggregates (RA) into concrete is therefore essential to advance circular economy strategies and reduce the environmental impact of construction. Concrete manufacturing is highly energy-intensive and contributes significantly to greenhouse gas emissions due to the use of non-renewable energy during material extraction, transport, mixing, and curing.

In this context, the reuse of Construction and Demolition Waste (CDW) in concrete represents a sustainable alternative. CDW composition varies across Europe depending on construction practices, climate, and building characteristics, making its characterization crucial for reuse assessment. Previous studies have demonstrated the feasibility of incorporating recycled materials into concrete, including macroplastic fibers from food packaging waste, which improve toughness and post-crack behavior despite slight reductions in mechanical strength (Vaccaro et al., 2021). The present study investigates the use of recycled concrete aggregates, evaluating their effects on the mechanical, physical, and environmental performance of the resulting concrete.

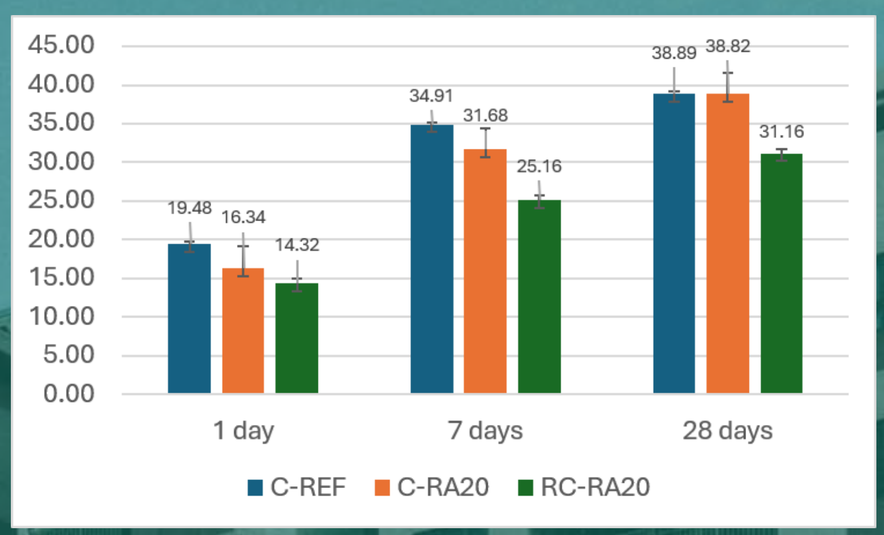
2 MATERIAL AND TEST METHODS

Three concrete mixtures were produced using low-CO_2 CEM III/A cement: a reference concrete with natural aggregates (C-REF), a concrete with 20% recycled aggregate replacement (C-RA20), and a concrete with 20% recycled aggregates plus 2 kg/m³ of synthetic plastic fibers (RC-RA20)
Compressive strength tests were performed according to EN 12390-3 at 1, 7, and 28 days of curing.

Mix	Description
C-REF	Reference concrete with natural aggregates
C-RA20	20% recycled aggregate replacement
RC-RA20	20% recycled aggregates + 2 kg/m³ plastic fibers

3 RESULTS AND DISCUSSION

The incorporation of recycled aggregates slightly reduced early-age compressive strength compared to the reference concrete. However, at 28 days, the recycled aggregate mixture achieved almost identical compressive strength to the control mix, demonstrating that a 20% replacement ratio does not significantly affect long-term mechanical performance. The addition of plastic fibers caused a greater reduction in compressive strength, mainly due to reduced workability and increased void content. Despite this decrease, fiber-reinforced concrete still reached suitable values for structural and non-structural applications while potentially improving toughness, crack resistance, and ductility.



4 CONCLUSIONS

The results demonstrate that recycled aggregates derived from CDW can be effectively incorporated into sustainable concrete without significantly compromising compressive strength. Although plastic fibers reduced strength, they may provide important durability and post-cracking benefits. Overall, the combined use of recycled aggregates and recycled fibers contributes to reducing environmental impact and supports the development of more sustainable construction materials.

REFERENCES

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Acknowledgements

This communication is part of Project CPP2023-010639 funded by MICIU/AEI/10.13039/501100011033/ FEDER, UE.