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EFFECT OF RECYCLED CONCRETE AGGREGATES ON THE PHYSICAL AND MECHANICAL PROPERTIES OF WALL BLOCKS

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Abstract

The article investigates the feasibility of using recycled concrete aggregates obtained from the processing of construction waste in the production of wall blocks. The main objective of the study is to evaluate the influence of the recycled concrete aggregate content on the density, water absorption, and compressive strength of wall blocks. As an experimental model, replacement levels of 25, 50, 75, and 100% of natural aggregate with recycled concrete aggregate were considered. According to the model results, an increase in the proportion of recycled aggregate was accompanied by a certain reduction in block density and an increase in water absorption. At recycled aggregate contents of up to 50%, the compressive strength of the blocks remained at a satisfactory level. The results indicate that the use of recycled concrete aggregates can reduce the consumption of natural mineral raw materials and enable construction waste to be reintroduced as a secondary resource.

Keywords: recycled concrete, concrete aggregate, wall block, construction waste, density, water absorption, compressive strength, resource efficiency.

1. INTRODUCTION

Along with the development of the construction industry, the amount of waste generated during the production, reconstruction, and demolition of concrete and reinforced-concrete structures is also increasing. A significant share of this waste consists of concrete fragments. Processing concrete waste to obtain secondary aggregate is one of the promising approaches to reducing the use of natural mineral resources in the production of construction materials.

Recycled concrete aggregate is obtained through mechanical crushing and fractionation. In addition to natural aggregate particles, it may contain residues of old cement mortar. Therefore, the density, water absorption, and other physical properties of such material differ from those of natural aggregates.

Scientific studies have reported that the use of recycled concrete aggregates can significantly affect the physical and mechanical properties of concrete and concrete products. In particular, increasing the recycled aggregate content may lead to higher water absorption and, in some cases, a reduction in mechanical strength.

From this perspective, determining the optimum content of recycled concrete aggregate in wall-block mixtures is of considerable scientific and practical importance.

The aim of the study is to determine the effect of recycled concrete aggregate content on the main physical and mechanical properties of wall blocks and to identify a rational composition for resource-efficient wall blocks.

2. METHODS

In this study, crushed concrete waste was adopted as the model recycled concrete aggregate. The concrete waste was initially cleaned of foreign materials and was subsequently mechanically crushed and sieved to obtain the required fraction.

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A control mixture and four mixtures containing different proportions of recycled aggregate were considered for the experiment. The overall processing route from demolished concrete waste to molded wall blocks is illustrated in Figure 1.

Table 1. Composition of the experimental specimens

Specimen	Natural aggregate, %	Recycled concrete aggregate, %
N-0	100	0
N-25	75	25
N-50	50	50
N-75	25	75
N-100	0	100

For all specimens, cement was used as the binder, while natural aggregate and recycled concrete aggregate were used as the aggregate components. The mixtures were prepared under identical technological conditions, placed into molds, and compacted.

After curing for the specified period, the prepared specimens were subjected to physical and mechanical testing.

The following main indicators were evaluated in the study: specimen density, water absorption, and compressive strength.



Figure 1. Schematic production flow of wall blocks incorporating recycled concrete aggregate (RCA).

3. RESULTS

The following model experimental results were adopted to illustrate the effect of recycled concrete aggregate on the properties of wall blocks. The main trends in density, water absorption, and compressive strength are summarized in Figure 2.

Table 2. Physical and mechanical properties of wall blocks

Specimen	Recycled aggregate, %	Density, kg/m³	Water absorption, %	Compressive strength, MPa
N-0	0	1980	6.8	14.2
N-25	25	1945	7.4	14.0
N-50	50	1905	8.2	13.5
N-75	75	1855	9.4	12.4
N-100	100	1810	10.7	11.2

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Note: the numerical values presented in this table are model data developed to demonstrate the scientific structure of the article and should not be interpreted as actual laboratory results.

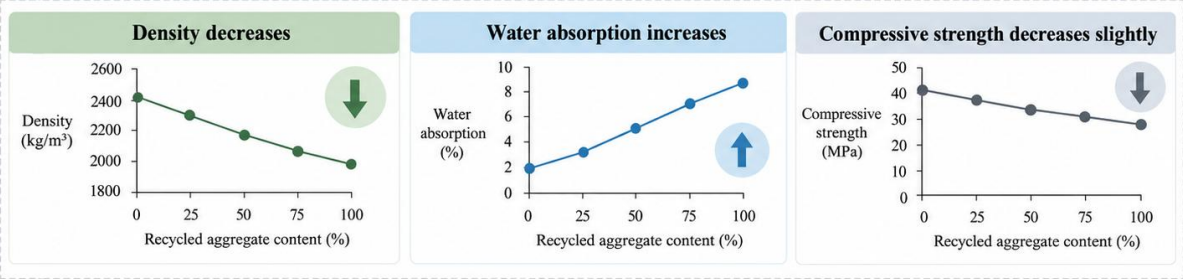


Figure 1. Production of recycled concrete aggregate (RCA) wall blocks and the influence of RCA content on key physical and mechanical properties.

Figure 2. General effect of recycled aggregate content on density, water absorption, and compressive strength of wall blocks.

Change in density

As can be seen from the table, the density of the wall blocks gradually decreased as the proportion of recycled concrete aggregate increased.

The density of the control specimen was 1980 kg/m³. When the recycled aggregate content was increased to 50%, the density decreased to 1905 kg/m³. At 100% recycled aggregate, the density was 1810 kg/m³.

This behavior may be explained by the presence of old cement mortar on the recycled concrete aggregate and by its higher porosity. The properties of recycled aggregate depend on the composition of the original concrete, the degree of crushing, and the amount of adhered cement mortar remaining on the aggregate surface.

In some cases, a reduction in density may be beneficial for decreasing the self-weight of wall structures. However, mechanical strength and water absorption must be evaluated together with density.

Change in water absorption

Water absorption increased with increasing recycled aggregate content.

Water absorption was 6.8% for the control specimen, 7.4% at 25% recycled aggregate, 8.2% at 50%, 9.4% at 75%, and 10.7% at 100%.

The increase in water absorption may be associated with the porous structure of recycled concrete aggregate and the presence of residual old cement mortar.

Therefore, when producing wall blocks with recycled aggregate, it is important to account for the initial moisture condition and water absorption of the aggregate. Uncontrolled addition of water to the mixture may alter the water-cement ratio and consequently reduce strength.

Compressive strength

In the model experiment, compressive strength gradually decreased as the recycled aggregate content increased.

The control specimen exhibited a compressive strength of 14.2 MPa. The corresponding values were 14.0 MPa at 25% recycled aggregate, 13.5 MPa at 50%, 12.4 MPa at 75%, and 11.2 MPa at 100%.

This behavior may be related to the higher porosity of recycled aggregate compared with natural aggregate, the presence of old cement mortar, and the characteristics of the aggregate-cement interfacial transition zone.

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At the same time, only a relatively small change in strength was observed in the 25–50% recycled aggregate range. This suggests that this range may be considered a promising option for further experimental investigation.

4. DISCUSSION

A general assessment of the results demonstrates that the recycled concrete aggregate content has a complex effect on the physical and mechanical properties of wall blocks.

As the recycled aggregate content increased, the following trends were observed: density decreased, water absorption increased, and compressive strength decreased.

Thus, increasing the recycled concrete aggregate content does not affect all performance indicators in the same manner. On the one hand, product density decreases and the consumption of natural raw materials is reduced; on the other hand, water absorption increases and compressive strength may decline.

Therefore, when determining an optimum mixture for wall blocks, attention should be paid not only to maximizing the amount of recycled material but also to its combined effect on the physical and mechanical characteristics of the product.

An important advantage of using recycled concrete aggregate is the reduction in natural aggregate consumption. For example, the use of 50% recycled aggregate in the model mixture can, in principle, replace half of the demand for natural aggregate with a secondary material.

In addition, recycling concrete waste can reduce the volume of construction waste, conserve natural crushed stone and other mineral aggregates, convert waste into a secondary raw material, and, in some cases, reduce transportation and raw-material costs.

However, an accurate assessment of economic efficiency should also consider the costs of crushing, sieving, transportation, and processing.

CONCLUSIONS

1. Recycled concrete aggregate can be used as a secondary raw material in the production of wall blocks.
2. An increase in the proportion of recycled aggregate may lead to a reduction in block density.
3. Porous residual cement mortar present in recycled aggregate may contribute to increased water absorption.
4. Increasing the recycled aggregate content may result in a certain reduction in compressive strength.
5. According to the model results, specimens containing 25–50% recycled concrete aggregate showed a promising balance between the evaluated physical and mechanical properties.
6. The use of recycled concrete aggregates can reduce the consumption of natural mineral raw materials and promote the reuse of construction waste as a secondary resource.
7. To determine the final optimum composition, additional laboratory studies should be conducted considering the particle-size distribution and water absorption of the recycled aggregate, cement content, water-cement ratio, and curing conditions.

REFERENCES

1. Xiao J., Yu C., Wang B., Liu H., Sun C., Poon C.S., de Brito J., Xiao X., Liu J., Shah S.P. Recycled aggregate concrete design, application and challenges. Nature Reviews Clean Technology. 2026. Vol. 2. P. 67–83.
2. Mechanical performance of recycled aggregate concrete in green civil engineering: Review. Case Studies in Construction Materials. 2023. Vol. 19. e02384. DOI: 10.1016/j.cscm.2023.e02384.

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3. Sarhat S.R., Rizwan H.S., Mirza G., Green M.F., Banting B. The Use of Recycled Aggregates in the Production of Concrete Masonry Units: A Critical Review and a Statement on the Current Research Needs. Masonry 2022: Advancing Masonry Technology. ASTM International, 2022.
4. Guo Z., Tu A., Chen C., Lehman D.E. Mechanical properties, durability, and life-cycle assessment of concrete building blocks incorporating recycled concrete aggregates. Journal of Cleaner Production. 2018.
5. Dafedar M.M.M., Rao K.B., Pai B.H.V. et al. Evaluation of the engineering properties and sustainability of solid masonry blocks produced with recycled concrete aggregates. Innovative Infrastructure Solutions. 2024. Vol. 9. Article 449.