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ABSTRACT BOOK

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Urban mining for sustainable ceramics: Minero-petrographic characterisation of ceramic formulations based on Recycled Raw Materials (RRM)

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This research aims to develop eco-sustainable ceramic formulations by integrating recycled raw materials (RRM) into ceramic mixtures. Various waste streams - including mining residues, fired ceramic production waste, and construction and demolition waste - have been assessed and characterized with the dual aim of reducing reliance on Critical and Strategic Raw Materials (CRM/CSM) and lowering the high energy demand of the ceramic industry. At the same time, the research seeks to mitigate the environmental impacts associated with conventional raw material extraction by promoting a circular production model inspired by Urban Mining principles. The Italian ceramic sector, recognised nationally and internationally for its industrial excellence, faces increasingly pressing challenges in terms of environmental sustainability, resource management and production process optimisation. In this context, the study emphasizes the preliminary characterization of RRM using optical microscopy (OM), X-ray diffraction (XRD), and portable X-ray fluorescence (p-XRF). These techniques enable a detailed mineralogical, petrographic, and chemical assessment to determine the suitability of RRM as alternative feedstocks for ceramic production. Following this analytical phase, ceramic formulations are developed and experimentally tested, with evaluation of both aesthetic qualities and key technical properties, including linear firing shrinkage and water absorption. The research adopts an eco-design approach based on a threefold sustainability strategy - recovery, recycling, and valorization of RRM - supporting the transition toward a circular and resource-efficient ceramic industry. The proposed approach is expected to enhance material circularity, environmental sustainability, and industrial competitiveness, while ensuring high performance in compliance with European standards (International Organization for Standardization, 2024a; 2024b) and facilitating alignment with Industry 5.0 paradigms.

International Organization for Standardization (2024a) - Circular economy - Vocabulary, principles and guidance for implementation. ISO Standard No. 59004:2024, <https://www.iso.org/standard/80648.html>.

International Organization for Standardization (2024b) - Circular economy - Measuring and assessing circularity performance. ISO Standard No. 59020:2024, <https://www.iso.org/standard/80650.html>.