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Use of Activated Carbon from Olive Stone for CO_2 Capture in Porous Mortars

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Abstract : Climate change is one of the most significant issues today. Since the 19th century, the rise in temperature has not only been due to natural change, but also to human activities, which have been the main cause of climate change, mainly due to the burning of fossil fuels such as coal, oil and gas. The boom in the construction sector in recent years is also one of the main contributors to CO_2 emissions into the atmosphere; for example, for every tonne of cement produced, 1 tonne of CO_2 is emitted into the atmosphere. Most of the research being carried out in this sector is focused on reducing the large environmental impact generated during the manufacturing process of building materials. In detail, this research focuses on the recovery of waste from olive oil mills. Spain is the world's largest producer of olive oil, and this sector generates a large amount of waste and by-products such as olive pits, “alpechín” or “alpeorujo”. This olive stone by means of a pyrosilisis process gives rise to the production of active carbon. The process causes the carbon to develop many internal spaces. This study is based on the manufacture of porous mortars with Portland cement and natural limestone sand, with an addition of 5% and 10% of activated carbon. Two curing environments were used: i) dry chamber, with a humidity of 65 ± 10% and temperature of 21 ± 2 ºC and an atmospheric CO_2 concentration (approximately 0.04%); ii) accelerated carbonation chamber, with a humidity of 65 ± 10% and temperature of 21 ± 2 ºC and an atmospheric CO_2 concentration of 5%. In addition to eliminating waste from an industry, the aim of this study is to reduce atmospheric CO_2. For this purpose, first, a physicochemical and mineralogical characterisation of all raw materials was carried out, using techniques such as fluorescence and X-ray diffraction. The particle size and specific surface area of the activated carbon were determined. Subsequently, tests were carried out on the hardened mortar, such as thermogravimetric analysis (to determine the percentage of CO_2 capture), as well as mechanical properties, density, porosity, and water absorption. It was concluded that the activated carbon acts as a sink for CO_2, causing it to be trapped inside the voids. This increases CO_2 capture by 300% with the addition of 10% activated carbon at 7 days of curing. There was an increase in compressive strength of 17.5% with the CO_2 chamber after 7 days of curing using 10% activated carbon compared to the dry chamber.

Keywords : olive stone, activated carbon, porous mortar, CO_2 capture, economy circular
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