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Eggshell: a potential raw material for ceramic wall tiles

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Waste management is one of the most emerging problems of food processors and the amount of generated waste, as well as the cost of its disposal, is increasing worldwide. The industrial manufacture of egg products (e.g. powder, liquid, frozen forms) offers benefits such as the extension of the product shelf life favouring its transportation/storage. In 2018, *c.a.* 8.5 million tons of eggshell waste were generated worldwide and mainly disposed of in landfills. Therefore, the development of added-value applications for this waste is of the most importance. The eggshell's structure comprises mainly a network of protein fibres (organic membrane, 5 wt.%) associated with crystalline calcium carbonate (95 wt.% of the shell weight). Wall tiles ceramic pastes are composed of sand, clay, kaolin and, between 10 and 15 wt.%, of limestone ($CaCO_3$). In 2018, the global ceramic wall tiles market was evaluated at 60.5 billion € with an expected annual growth rate of 6.1% (2019 - 2025). Therefore, the ceramic wall tiles industry has a very high consumption of limestone and can be a viable solution for eggshell waste valorization. Taking into account the principles of circular economy and the need to reduce virgin raw materials consumption, this work aims to demonstrate the feasibility of the use of eggshells as a bio-based raw material for the ceramic tile industry. For this purpose, some of the main activities of the EGGSHELLENCE project are: i) development of a prototype to separate the membrane from the eggshell by a simple and low-cost process; ii) production of ceramic wall tiles with eggshell waste substituting the limestone (0, 25, 50, 75 and 100 wt.%), the natural raw material used nowadays; and iii) implementation of the circular economy concept through an industrial symbiosis between egg-processing companies and ceramic companies (spray-driers and tile producers) as well as determining the economic benefits for both sectors.