

Natural Stone industry waste for soil improvement in road construction: moving forward circular economy by using an industrial waste in the construction sector

by Erick Gutierrez | Jose Luis Pastor | Miguel Cano | University of Alicante | University of Alicante | University of Alicante

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Large amounts of waste are generated every year. Spain generates about 129 million tons of waste per year, which represents 5% of the waste production in the European Union. About 83% of this waste is treated, but 53% of the treated waste is put in dumpsites, only 37% is recycled and 6% is used for fillings. Simultaneously, greenhouse gases are generated by industrial activities. The estimated amount of gases produced in 2021 was 288.8 Mt, which was an increase of +6.1% from the previous year, with 22.4% of total emissions generated by the industrial sector. Within this sector, mineral production processes (exploration, extraction, transformation, etc.) have a great impact on the environment in waste generation and greenhouse gas emissions. Spain is one the biggest natural stone producers in the world, with a yearly production of about 3.49 Tm. One of the objectives set by the Spanish circular economy strategy is to alleviate the environmental impact by reducing waste generation by up to 15%. During the natural stone extraction process, a series of machinery, installations, and equipment are required for the extraction of the blocks, which will later have finer cuts. On the one hand, this activity generates employment and contributes to economic development. On the other hand, during the entire cutting and polishing process for the production of construction materials, it is estimated that approximately 25% of a limestone block becomes mud. This by-product is a non-biodegradable material and therefore reusable. Although it is an inert waste, the uncontrolled dumping of the sludge will affect the surrounding municipalities, having a visual and landscape impact as well as its inevitable affectation on the flora and wildlife due to the accumulation of the waste. The impact caused by cutting and polishing the ornamental stone can be reduced by expanding its usefulness. Studies show that the waste of ornamental rock dust can be used as an appropriate raw material resource to produce ceramic pieces for civil construction. One way to reintroduce this residue to the economic circuit could be through its recovery for using it in road embankments, particularly by evaluating the possibility of using it to stabilize clayey soils. Wide research has been done to evaluate the properties of the mixed soil, natural soil and natural stone waste, to be used for road embankments. The laboratory results show an improvement in the geotechnical properties of the soil when the stone waste is added. The main results obtained are the use of the by-product reduces the swelling of clayey soils, increases compressive strength, and reduces de

deformability of the soil. These results show great potential for natural stone waste to be used as a stabilizing agent, which would have a positive environmental effect by reducing the amount of waste dumped into landfills and by avoiding or reducing the use of traditional binders for clayey soil stabilization.

KEYWORDS: circular economy, natural stone industry, waste, soil improvement