Research on Sustainable Bituminous Mixture for Permeable Wearing Layers in Road Pavements

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Abstract. A surface layer of permeable bituminous mixture has been laid on an existing pavement section. This layer, in addition to providing the pavement with draining characteristics and acoustic comfort, incorporates a residue that is difficult to apply, the ladle furnace steel slag. The tests carried out show that the designed mixture meets the requirements in terms of mechanical properties, resistance to the action of water, and porosity. Furthermore, in-situ tests on the completed layer demonstrate its excellent permeability, as well as a surface texture suitable for use on roads and highways. The introduction of the ladle furnace slag makes it possible to design a high-performance, but also environmentally sustainable, mix.

Introduction

There is a compelling demand within the scientific community to support the fields of civil engineering, construction, and architecture in pursuit of a future in which resource sustainability can be assured [1-4].

In the field of sustainable construction, one of the most prolific lines of research is that which proposes the substitution of natural resources with other types of waste or by-products from the industrial sector [5]. Road construction, which consumes large volumes of materials, is one of the sectors that have tended to reuse a greater volume of waste [6]. Thus, there are different experiences that prove successful uses in the construction of highways and roads, of residues such as reclaimed asphalt pavement, steel slags, recycled fibers or construction and demolition waste [7, 8].

The steel sector, with a constant growth of its production over time, generates different types of waste, the most important of which are blast furnace slags, electric arc furnace slags and converter slags [9]. Ladle furnace steel refining is a methodology that is increasingly gaining ground, both in the refining of steels from oxygen converters and electric arc furnaces. In this refining process, Ladle Furnace Slag (LFS) is produced at a rate of approximately 80 kg per ton of steel produced [10]. This material is still considered a waste and has little applicability, apart from limited experience with its use in cement production [11], and its final destination is usually landfill, generating serious environmental impacts.

The University of Burgos in Spain has carried out different studies for the application of this waste in construction materials [12-14]. The reuse of this waste is intended to contribute to combating climate change by reducing the exploitation of natural aggregates, waste disposal and CO_2 emissions (carbon footprint).

The early stages of research of this product, porous mixture with ladle furnace slag, had given very satisfactory results at laboratory level, arousing an evident interest of the scientific community, supported by its publication in international scientific journals of the highest level [15].