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Investigation on the use of foamed plastic waste as natural aggregates replacement in lightweight mortar

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Abstract:

The large growth of plastic consumption and consequently of plastic waste, requires new forms of recycling, avoiding landfill disposal. Polymeric aggregates obtained from recycled materials are often used for the production of lightweight mortars whose properties are widely reported in the literature. In this work, a new kind of polymeric aggregates with a particular set of properties are used to replace natural sand in the preparation of lightweight mortars. In particular, starting from end of waste materials, a process of extrusion - melt foaming was applied to produce polymeric particles characterized by high porosity and surface roughness. The process also allowed to tailor the particles size in order to accurately substitute natural sand particle size distribution in the mortar samples. Natural quartz sand was replaced by artificial aggregates at two volume fractions (10 and 25%) both in saturated and unsaturated conditions. Moreover, two different w/c ratios were investigated (0.45 and 0.50). The high porosity and rough surface of foamed aggregates resulted in a good adhesion with the cement paste. SEM investigations revealed the presence of interlocking positions onto aggregates surface and an ITZ very similar to that between natural aggregates and cement paste. At increasing sand replacement a reduction of mortar consistency was observed and, as expected, also a mechanical properties decrease. The use of artificial plastic aggregates, obtained by foam extrusion process, provides some advantages: reduction of natural sand consumption, use of plastic waste otherwise not used, decrease of structures dead-weight and improved aggregates/cement paste ITZ.

Keywords:

A. Foams; B. Adhesion; D. Recycling; D. Mechanical testing; Lightweight aggregates.

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