NUMIX Project

High performance lightweight aggregate for concrete from the recycling of urban waste

waste management | packaging | Waste sorting | recovery of waste

PROJECT DESCRIPTION

The NUMIX project has promoted an optimized industrial process to produce, from the scraps remaining after the plastic waste's selection, two innovative materials, **Densified Flake** and **Expanded Granule**, with such morphology and properties that enable it to replace part of the traditional light aggregates (e.g. expanded clay) usually present in concrete. The project takes its cue from a data, recorded by the European Union, according to which in 2008 12.1 million tons of plastic waste was sent to landfills and not recycled by the member states, due to the waste's heterogeneity and poor mechanical properties.

After the separate collection of waste and selection of some types of "pure" plastic waste (eg PET, PP, PE), the remaining waste can be mechanically recycled, while the by-products generated during the selection are generally sent for incineration or landfill. Since concrete is the second most used material in the world, the availability of recycled plastic aggregates for concrete production can effectively contribute to reducing the amount of plastic waste destined for landfills.

PROJECT PHASES

The plastic waste from separate collection (mostly packaging) is selected in special processing centers. The mixed fraction is then sent to a dehydrator for the elimination of excess moisture and then to a densifier. The so obtained material is then shredded to obtain flakes of 1-10 mm. Finally, the flakes are processed by extrusion with the addition of a foaming chemical agent, to obtain expanded granules.

To achieve the final project goal and introduce new products to the market, the NUMIX project has:

- performed a test to define the parameters for the industrialization of the Expanded Granules' and Densified Flakes' production process;
- optimized the production process through developing and testing pilot extruders specially designed to increase production capacity on an industrial scale;
- performed the validation and characterization tests of the product (geometric, physical-mechanical, chemical, thermal conductivity, bacterial content, and release test) necessary to obtain the CE marking for Expanded Granules and Densified Flakes;
- identified environmental indicators to evaluate the sustainability of the process and to conduct an LCA (life cycle analysis) study on the environmental impact of the product in terms of use of raw materials, natural resources, and energy during the product's whole life cycle, from production to disposal.

PROJECT RESULTS

The light aggregates of NUMIX comply with the European standard EN 12667 and have a **thermal conductivity of about 25% lower than that of the expanded clay**. The tests carried out within the project show that the NUMIX products are suitable for replacing traditional aggregates in the production of lightweight concrete or other materials in which thermal insulation constitutes a critical issue.

Properties of densified flake:

- granulometry: 1-12 mm
- water absorption: 11% (apparent, the material is hydrophobic)
- pile density: 330 kg/m3
- bulk density: 800-1000 kg/m3
- thermal conductivity: 0.067 ? [W/m*K]

Properties of expanded granule:

- granulometry : 8-11 mm
- water absorption: 23% (apparent, the material is hydrophobic)
- pile density: 330 kg/m^3
- bulk density: 600-650 kg/m^3
- thermal conductivity: 0,077 ? [W/m*]

The characterization and validation tests have shown that NUMIX aggregates can be used for light cement conglomerate mixtures with a **density varying between 1560 and 1860 kg/m3, with average mechanical compressive strength varying between 10.5 and 30 N/mm2,** thus perfectly **comparable with traditional concrete**. Thanks to the NUMIX aggregates, it is possible to create light mixes for single-layer screed with **thermal insulation characteristics 25-30% higher than that of the products on the market**. It was demonstrated within the NUMIX project that these aggregates can be used for manufacturing other products where lightened aggregates are necessary for **structural and non-structural applications**, for example:

- lightweight single-layer sound-absorbing screeds
- lightened substrates
- lightened structures
- bricks
- panels
- partitions
- flooring

The results of the life cycle analysis of the NUMIX products have shown that these have **lower environmental impact than traditional aggregates**: 66% less CO2 emissions, 75% less toxicity for humans, and 50% less ozone depletion.

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Acronym
NUMIX

Number of reference
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Reference Programme
COMPETITIVENESS AND INNOVATION FRAMEWORK PROGRAMME (CIP) ECOINNOVATION

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743.516,00

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2008

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