POLITECNICO DI TORINO

Honors thesis

MASTER'S DEGREE COURSE IN
ARCHITECTURE FOR SUSTAINABLE DESIGN

Abstract

CONCRICE.

RECYCLING OF A BY-PRODUCT PLANT IN BUILDING.

Use of the rice husk in order to produce a concrete with high thermal performances.

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Currently one of the most widely used building material is concrete, not only to erect works and bearing structures, but also for the realization of complements as the facades increasingly otherwise texturized of prefabricated panels, in the form of blocks for load-bearing walls or fences realizations and partitions, tiles, paving blocks, elements of urban furniture and for interior, even for the realization of sculptures. The concrete industry for several years is increasingly moving towards the application of a more sustainable operating system such as taking significant strategic responses aimed at lessening the impact that the production done, use and disposal of this material bears environment and human health. Among these promoted solutions, the use of alternative aggregates, mostly recycled, can be an alternative to those are usually employed for the realization of concrete. On this solution was focused the entire work of this experimental thesis which was addressed to the reuse of an agricultural by-product, the rice husk, as natural and recycled aggregate in order to realize a concrete with higher thermal performance and to compared it to a common light concrete. The rice husk in fact have some physical and chemical characteristics that had favored its use for the preparation of lightweight insulating concrete. Among the physical characteristics rice husk have a particular concave and oblong shape which had guaranteed the development of a macroporous system which favored a cement mix more porous than thus lighter and more insulating from the thermal point of view. This particular conformation was kept inside the mixture thanks to the lignin which is contained in it. This last feature led to greater solidity, which guaranteed the development of the macroporous system described. The testing, which was conducted at the Laboratory of Research and Development of the company Buzzi Unicem to Trino Vercellese (VC), began with the characterization of each component required for the preparation of concrete (aggregates including rice husks, cement, water and additive), and it continued with the preparation of mortars and of concretes containing rice husk as an aggregate. Eleven different mortars (10 experimental and a standard reference) were done with a gradual substitution in volume of the silica sand with rice husk. The tests conducted with the mortar such as definition of fluid density and mass of hardened, air content, flow and compressive strength according to the national law, were done in order to deduce the general characteristics of the compounds and the more efficient replacement with rice husks. It is therefore continued with the preparation of three different concretes (one standard and two experimental which contained one 30% and the other 60% of rice husk in substitution always to the fine aggregate). By preliminary tests on these concrete were deducted fluid density, hardened resistance to compression and withdrawals at different intervals of time according to national law. Very important is the test to deduce the thermal performance of COCNRICE concrete which highlighted that: the integration of the rice husk can significantly decreased thermal conductivity compared to standard concrete. Through these tests was deduced how the experimental concrete made can be defined as a lightweight insulating concrete and that, compared to other similar concretes which are today most used in construction, so heat-insulating lightweight concrete with aggregates plant (like the wooden concrete), COCNRICE had thermal performances similar and even better. In order to test the practical effectiveness of the experimental product, it had been employed as component filler, thermal insulation and lightening in the realization of a prototype lightened concrete panel.

Improvement strategies in order to improve these experimental cocrete were advanced and tested (washing of the rice husks in water and in the pre mixture of NaOH solution) and these manifested that: they effectively improved the mechanical performance, making it a lightweight insulating concrete that could be used for the construction of structures armed and / or weakly armed.

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