

Building and recycling materials

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Paper sludge, by product of paper-manufacturing, is made by water, ashes, minerals (kaolin, carbonates, aluminium, iron, zinc, manganese, copper, chrome, nickel, etc.), wood and cellulose fibre, organic and inorganic binders.



The hypothesis of recycling such sludge is particularly interesting as it offers satisfying residual potentiality characteristics and a presumed versatility of use in different areas, and particularly in that of the building industry. The initial inputs have been provided by previous experiments in the sector of bricks, of thermoacoustic insulation panels, of cements and of combustible materials for urban tele-heating in Italy, U.S.A. and France (CTP of Grenoble). The aim of this thesis, therefore, is that of examining the possible different use of paper sludge in the manufacturing of products for the building industry and in the direct use in building as a material for filling (for example for the extradossal filling of vaults, in the historical buildings).

According to the application "vocation" of this material, the initial work hypothesis concerned two prospects of use:

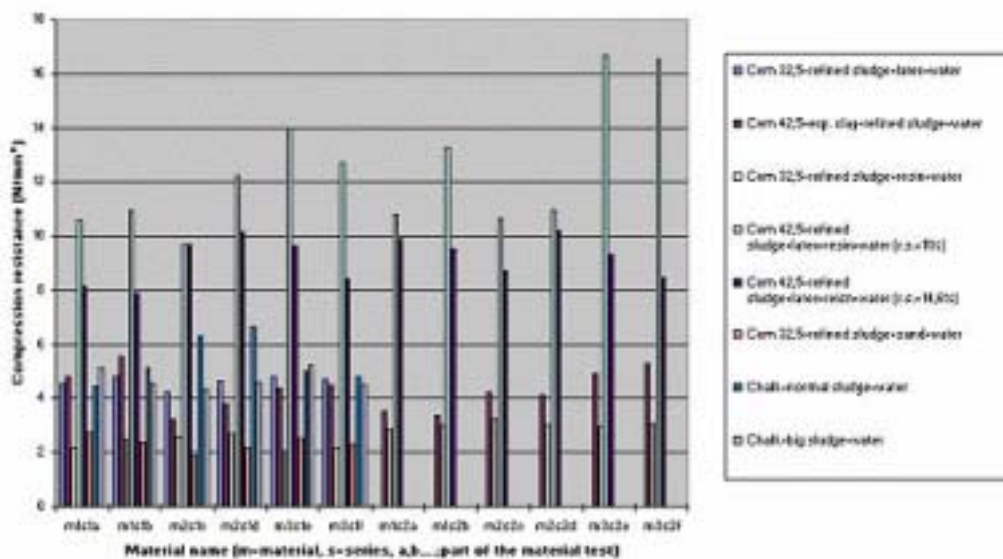
- * achievement of materials with suitable characteristics of mechanical resistance;
- * achievement of materials with low thermal conductivity.

The experimental operative proposals have mainly concerned:

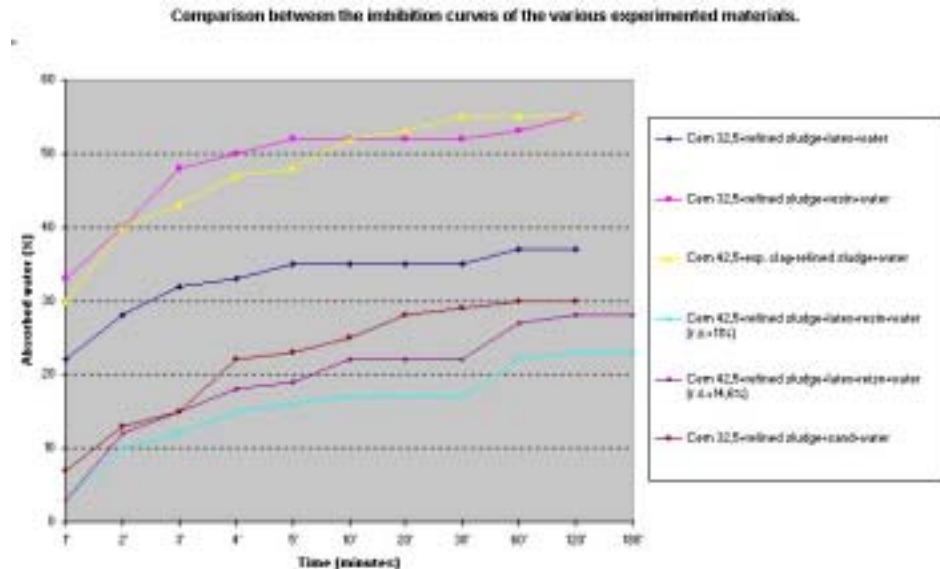
- ☛ specification of simplified techniques of stabilization of the paper sludge (it is well known that such material has a tendency to decay) and following reduction into dried granules (see the picture) through "seiving" and/or "breaking" in processes similar to those of cylinder mills;
- ☛ optimization of the physical-mechanical and thermo-insulating properties of mixtures made by different dosages of: binders, additives for concretes, water end paper sludge reduced into dried granules and sometimes added with expanded clay, through laboratory experiments with universal machines for the determination of the mechanical (resistance to flexion and compression) and thermo-insulating characteristics (thermal conductivity).

The optimization of the physical-mechanical characteristics, with values of resistances to compression of 12-13 N/mm² (see graphic nr. 1) and of 4,5-5 N/mm² to flexion, has been achieved with a mixture of cement of the kind II/A-L 42,5 R, paper sludge dried up into granules (granulometry \cong 1,5-2 mm) in percentage of 11% on the total weight of the mixture components, rubber latex, epossidic resin and water.

Comparison of the compression resistance of the various experimented materials.



Concerning the physical characteristics, I have also considered the impermeability of the material through a test of soaking and I have ascertained at the end of the process, an absorption approximately equal to that of the products commonly used in a brickwork (see graphic nr. 2).



The optimization of the characteristics of thermal insulation, instead, has been reached through a composite solution realized with the coupling of a panel of the material obtained by the paper sludge with a stratum of expanded polyuretan.

According to the results of the experimental tests the research has concerned the following topics:

- ☛ hypothesis of realization of building elements through the study of superficial applications, shapes and finishings to the materials obtained from the recycling of the paper sludge and, at the same time, to check their versatility;
- ☛ hypothesis of a balance costs/profits of the production of building and semi-manufactured elements derived by the re-use of the paper sludge through indirect comparisons with products of analogue use, traditionally employed in the building industry.

Finally I believe that the peculiar feature of this thesis, is that of "starter" in a subject which has not been investigated enough yet, but which has considerable potentialities of development mainly regarding the necessity of preserving pretious raw materials for the future generations and of reducing the environmental pollution to a lower level.

Translated by Maria Elena Tibaldi.