On the effective permeability estimation of a composite materials for the shielding of low frequency magnetic field.

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In literature the shielding of electromagnetic field (EMF) has been largely addressed, above all considering the exposition of human beings to high frequency EMF [1]. On the other hand, epidemiologic study has proven a possible interaction for magnetic fields acting at extremely low frequencies (ELFs) as well, especially in the industrial range (0-300 Hz). Consequently, the development of shielding screens for indoor environments has been object of investigation: in last years, the research has moved through the development and adoption of new building materials with absorption capabilities. In particular, the use of composite building materials, obtained by adding to common mortars iron grain or synthetic polymeric structures have been tested, and a magnetic shielding material, based on the addition of ferromagnetic particles to the mortars usually used to refine the wall of our houses, has been patented. A complete mathematical theory to determine the performance of these mixtures is still lacking, thus making the shielding assessment an experimental characterization. On the other hand, the simulation of the shielding properties for these materials is a difficult problem, since the fine structure characterizing the material requires a small scale simulation, which is not compatible with the use of an electromagnetic CAD for the design of magnetic shield screen inside a building representing a large scale domain. A possible approach to solve the problem is to establish a relationship between the mixture composition parameters (i.e. the volume fraction) and its electromagnetic properties, by representing the material under study with an equivalent homogenous one [2-4]. In this talk this issue will be addressed, establishing both the limitations of the traditional strategy and the strategy to overcome this problem by exploiting numerical simulation and experimental validations.

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