TITLE: **Heat transfer and thermal energy storage enhancement by foams and nanoparticles: flow stability in metallic foams saturated by non-Newtonian fluids**

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RESEARCH PROJECT

The proposed research is focused on the development of innovative heat transfer devices, namely heat exchangers and thermal energy storages, by utilizing new techniques based on foams and PCMs integrated with innovative heat transfer fluids, e.g. nanoparticles loaded fluids. The main focus of the research activities is the development of components with different scales for applications in thermal storage of buildings, to design energy equipped walls, in renewable based systems and in compact heat exchangers for automotive or electronic cooling. The scientific activity is devoted to the study, carried out by employing analytical and numerical techniques, of the thermal convection in porous media saturated by non-Newtonian fluids. The nanoparticle loaded fluids, in fact, can show a non-Newtonian rheological behaviour. The investigation of the most suitable rheological model to be employed is carried out. The linear and non-linear analysis of the onset of convective instability in porous media subject to an external thermal forcing is performed. An important aspect of this research is the non-linear analysis which allows one to investigate the thermal performances of the system when convective motion is triggered. Applications are foreseen to devices/systems requiring high cooling/heating performance.

ACTIVITY PLAN

The project is divided in two phases:

Phase 1. Analysis of the state of the art.

In this first phase, a detailed analysis of the literature relative to the onset of thermally induced convective instability in metallic foams saturated by non-Newtonian fluids will be performed.

Phase 2. Stability analysis of non-Newtonian fluid saturating metallic foams.

This second phase is focused on the stability analysis of a metallic foam saturated by a non-Newtonian fluid undergoing thermal forcing. In particular, the influence of the non-Newtonian rheology on the threshold for the onset of convective instability will be investigated.