Thermal Analysis for the Solar Concentrating Energy and Induction Heating for Metals

A. Rojas-Morín[1], Y. Flores-Salgado[2], A. Barba-Pingarrón[1], R. Valdéz-Navarro[1], F. Mendéz[1], O. Alvarez-Brito[3], M. Salgado-Baltazar[1]

[1]Facultad de Ingeniería, Universidad Nacional Autónoma de México, Ciudad Universitaria, D.F. México

[2]DGTIC, Universidad Nacional Autónoma de México, Ciudad Universitaria, D.F. México

[3]Programa de Posgrado en Ingeniería, Universidad Nacional Autónoma de México.

Abstract

One of the most efficient technologies for the heating of metals uses inductive heating, with thermal efficiencies up to 90% compared to 60% of those technologies that use gas. Although thermal efficiencies of induction heating are high, consumers, demands are also very high. In order to reduce the consumption of electric power supplied to the induction furnace, it has been proposed to provide concentrated solar energy that preheats the metal through a parabolic solar dish concentrator. After the metal preheating temperature is reached, the induction heating is applied. A numerical simulation for solving Maxwell's equations coupled (AC/DC Module) and transient heat transfer condition (Heat Transfer Module) has been developed thanks to COMSOL Multiphysics®. In this case, electric field distributions and temperature distributions of a cylindrical shape magnetic metal are obtained for two dimensions determining also the metal heating time. In the first part of the simulation, heating is only supplied with concentrated solar energy, and in the second part induction heating is applied, in combination with the first one. Several comparisons of the distributions of electric fields, magnetic and temperature experienced by the metal sample with concentrated solar energy, and induction heating can be made from the results, thereby obtaining the optimum heating. It is expected to conclude that applying a concentrated solar preheating result in a considerable saving of electric energy using an induction heating, which is high. This combined system is to be used in melting metals in a controlled manner, because by using concentrated solar energy exclusively, metal samples undergo oxidation on the surface.