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# 14 Effects of Nanofluids on Convection in Porous Media

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## 14.1 INTRODUCTION

The term *nanofluid* (as it is commonly used today) was first suggested by Choi (1995) in his paper presented at the *ASME Winter Annual Meeting*. It refers to a liquid containing a dispersion of sub-micronic solid particles (nanoparticles) whose characteristic dimension is of the order of tens or hundreds of nanometers. The fluid can be water or an organic solvent. The particles are commonly metallic oxides. One obvious effect is that due to the fact that the nanoparticles usually have high thermal conductivity relative to that of the base fluid, although that effect is somewhat offset by the increased viscosity due to the presence of the particles. The first Science Citation Index journal article on nanofluids (Lee et al., 1999) was published by Choi's group in 1999. One of the most interesting features of nanofluids is the enhancement of thermal diffusivity that according to some data may exceed the limits predicted by conventional macroscopic theories of suspensions (Choi, 2009; Choi et al., 2001, 2004; Das et al., 2008; Eastman et al., 2001). The enhancement of effective thermal conductivity was confirmed by experiments conducted by many researchers, including Masuda et al. (1993), although the level of enhancement is still a subject of a debate (Rea et al., 2009). The unique properties of nanofluids suggest the possibility of using nanofluids in a variety of engineering systems, from advanced nuclear systems (Buongiorno and Hu, 2005; Buongiorno et al., 2008; Kim et al., 2009) to drug delivery (Kleinstreuer et al., 2008). It has been shown (Alizad et al., 2012; Shafahi et al., 2010a,b) that a nanofluid can substantially improve the performance of a heat pipe.