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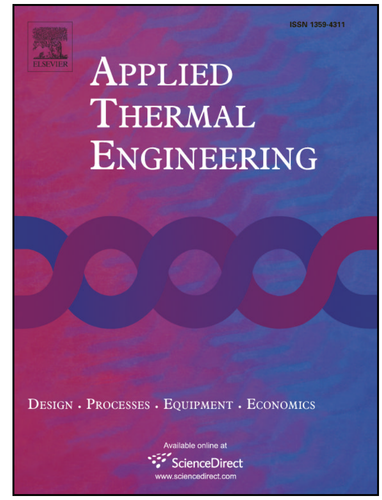

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ACCEPTED MANUSCRIPT

Solar steam in an aqueous carbon black nanofluid

Edda T. Ulset[a], Pawel Kosinski[a], Boris V. Balakin[b,c,*]

[a] *University of Bergen, Dept. Phys. Tech., Norway*
[b] *NRNU Moscow Engineering Physics Institute, Dept. Therm. Phys., Russia*
[c] *Western Norway University of Applied Sciences, Dept. Mech. Mar. Eng., Bergen, Norway*

Abstract

A limited number of experimental studies report intensive steam generation in direct adsorption solar collectors with nanofluids. Most nanofluids used for these applications are produced with expensive gold nanoparticles. This contribution proposes a low-cost alternative solution made of water and carbon black nanoparticles. Our nanofluid-generated yet nanoparticle-free steam is produced in a parabolic collector with 73% efficiency and 25°C superheat under the solar conditions in the Nordic region.

Keywords: nanofluid, solar steam, boiling, solar collector, carbon black

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1. Introduction

The first successful attempt of sun-enabled, *in-situ* steam generation of nanofluids (NF) was reported by Neumann et al. (Rice University) [1] less than decade ago. Using low-concentration aqueous suspension of golden nanoparticles (NP), they demonstrated evaporation efficiency of around 80% and relatively high steam temperature (120-130°C) [2]. The developed "nano-steam" technology was utilized in a pilot experimental rig for effective off-grid disinfection. Another important contribution comes from prof. Wen's group [3] (Beihang University), where the solar steam was produced at natural irradiation of 220 sun (Fresnel lens) from an electrolyte containing up to 13 ppm of 20-nm Au particles. Even though the obtained efficiencies of the process were similar to [1], the nanofluid temperature did not rise to the same superheat values. The practical applicability of the considered NFs could be strongly criticized because of the high cost of gold NPs and lack of information on potential toxicity of the solar steam that may contain NPs. An alternative solution [4] was proposed by Ni et al. (MIT) based on carbon black (CB) NPs, studying different CBNFs under artificial radiation. The degree of light concentration and volume fraction of the particles were insufficient to obtain notable superheat while still providing reasonable evaporation efficiency up to 60%. Another interesting contribution from the Hubei University considers a mixture of graphene oxide-Au NPs in water under the lens-concentrated natural heating

*corresponding author
Email address: `Boris.Balakin@hvl.no` (Boris V. Balakin)

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