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# Influence of rice husk based nanosilica in rheological and stability of binary mixture fluid

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ABSTRACT

In this work, an organic derived nanofluid has been developed from bio-origin resources. Rice husk derived nanosilica has been prepared via a simple two-steps thermal process with minimum energy (low temperature and reaction time) using solar assisted plasma furnace. A low density nanosilica (112.3 kg/m$^3$) has been prepared. The nanosilica was characterized by using TEM and XRD to verify the surface morphology and crystallinity structure respectively. Nanofluids comprised of nanosilica and EG/water binary mixture has been prepared at various concentration such as 0.2 – 1.0 vol% of nanosilica. Flow curve of nanofluids showed that at minimum inclusion of nanosilica enhanced the stress of the fluid significantly. Moreover, dynamic viscosity measure shows that addition of nanosilica stabilized the properties of the fluid compared to virgin fluid. The present product offers greener approach for nanofluids which derived from natural resources and environmentally friendly (very low percentage of nanoparticle, 0.2 vol% equivalent to 0.0215 wt%). Apart from that, the stability and rheological properties fluids were improved with the inclusion of nanoparticle.

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## 1. Introduction

Nanofluid consists of nanometer-sized particles (nanoparticles) and fluids. Normally, base fluid such as engine oil, ethylene glycol and water are use in industrial sectors including transportation, electronics as well as energy supply and production, and [1]. Conventional base fluids have poor heat transfer efficiency, which has restricted their use [2]. To counter the downsides, nanosized solid particles act as an additive that suspend in the base fluid can help to enhance rheological properties and heat transfer [3]. The first report on the combination of nanotechnology and fluid in thermal engineering was coined by Choi (1995), where "nanofluid" has been proposed to meet the cooling challenges [4]. In terms of stability, nanofluids become more stable compared to conventional fluids due to Brownian motion as well as the size effect of particles in liquid. Ultrafine nanoparticles could probably assists the movement of the particles evenly in a microchannel without clogging and the size of the heat transfer system can be minimized for the use of nanofluids with high heat transfer efficiency [5]. In the past few decades, there are voluminous report on the nanofluids have been published. In most of the reports, metal oxides such as alumina [6], ZnO [7], $TiO_2$ [8] and $SiO_2$ [9] have been used for the studies. Alumina nanofluids have been prepared by Beck, Sun [10] by using ultrasonic mixing for several to obtain the consistent distribution and claims that results of the dispersion stay consistent due to surface charges on the particles. According to Raykar and Singh [11], they have prepared ZnO nanofluids by synthesized water soluble ZnO nanoparticles and discovered that nanofluids was stable for 9 months to 1 year. They also discovered that size of the nanoparticles was reduced from 150 nm to 80 nm because of the reaction occurred. Meanwhile, Longo and Zilio [12] have tested the dispersion of alumina and titanium oxide with water as based fluids to produce nanofluids. They proved that ultrasound treatment for that kind of nanofluids demonstrates greater dispersion efficiency than mechanical stirring, and both nanofluids have more than one month of stability. Further to this, Fazeli, Hashemi [13] has dispersed $SiO_2$ nanoparticle in distilled water to prepare $SiO_2$

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