Effects of Thermophysical, Hydrodynamics and Thermal Characteristics of Well Stable Metallic Nanofluids on Energy Transportation

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Abstract

The chemical synthesis of zinc oxide (ZnO) and preparation of ZnO dispersed in ethylene glycol@distilled water mixture (ZnO-EG@DW) based nanofluids for investigation in the enhancement of heat transfer of a square shaped heat exchanger. The steady and uniform dispersion of ZnO nanoparticles was achieved using high probe sonication at varying wt.% concentrations like (0.1wt.% ; 0.075wt.% ; 0.05wt.% and 0.025wt.%) with 100% vol. of ZnO nanoparticles in ethylene glycol and distilled water mixture at 50:50. Also, the ZnO particles were synthesized by using a typical Sonochemical assisted technique, where sodium hydroxide (NaOH) and zinc acetate ($ZnC_4H_6O_4$) were used as raw materials. For the verification of ZnO synthesis numerous characterizations like UV-vis, XRD, FTIR, and FESEM analysis were carried out. The changed wt.% concentrations of ZnO-EG@DW based nanofluids were considered to check their effects on thermos physical properties, dispersion, stability, and heat transfer (Nusselt Numbers) at varying Reynolds numbers ranging from 4550 to 20360 inside the square heat exchanger. A positive increase in thermal conductivity was observed by the addition of ZnO in the ethylene glycol@distilled water (50:50) mixture. The highest thermal conductivity of 1.0 W/m.K was noticed at a maximum of 0.1 wt.% concentration which is about more than that of the base fluid (EG@DW) at the 45°C. The maximum pressure drop of 2400Pa/m at Reynold number 20360 and higher friction loss of 0.045 for Reynolds number 4550 was noticed at 0.1 wt.% concentration. The highest improvement in heat transfer was recorded at 0.1 wt.% is 550 to 2830 W/m²K which is 63% greater of the base fluid, while others wt.% illustrate improved heat transfer coefficient of about 550 to 2170 W/m²K, 550 to 1750 W/m²K, and 550 to 1500 W/m²K, respectively at highest Reynolds (Re) when it compared with the base fluid EG@DW).

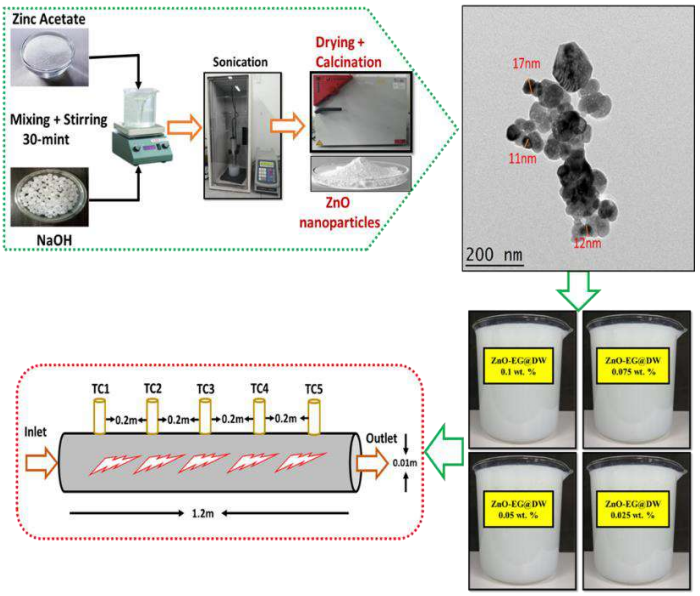


Biography

Dr Waqar Ahmed has earned a Ph.D. degree in Material Physics (Distinction + GOT Excellence award with 10 ISI papers + 1 Patent) from the University of Malaya world QS ranking 65. As a Ph.D. researcher at the Institute for advanced studies at the University of Malaya, he has led his research activities to synthesize metal oxides, graphene, carbon nanotubes, and their binary and ternary composite for energy-related varying applications like (Energy storage, sensors, energy transportation, Heat, and Mass Transfer, Heating, and cooling of Electrical and electronic systems, which helps him to solidified his interest in the area of materials and nanofluids. These experiences have reinforced his keen interest in materials which inspired his goal for a career in synthesis and applications of nanomaterials. I was able to use my analytical skills to organize and assess the data for future academic and research activities.

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Image



Recent Publications

1. Ahmed, W., Kazi, S. N., Chowdhury, Z. Z., Johan, M. R. B., Mehmood, S., Soudagar, M. E. M., ... & Ahmad, M. S. (2021). Heat transfer growth of Sonochemically synthesized novel mixed metal oxide ZnO+ Al2O3+ TiO2/DW based ternary hybrid nanofluids in a square flow conduit. Renewable and Sustainable Energy Reviews, 145, 111025.**Impact Factor 15.10**
2. Ahmed, W., Sidik, N.A.C., Mehmood, S. *et al.* Effects of thermophysical, hydrodynamics and thermal characteristics of well stable metallic nanofluids on energy transportation. *J Therm Anal Calorim* **147**, 13879–13900 (2022). https://doi.org/10.1007/s10973-022-11696-8 , **Impact Factor 4.6.**
3. Ahmed, W., Chowdhury, Z. Z., Kazi, S. N., Johan, M. R. B., Abdelrazek, A. H., Fayaz, H., ... & Khan, T. Y. (2021). Experimental evaluation and numerical verification of enhanced heat transportation by using ultrasonic assisted nanofluids in a closed horizontal circular passage. Case Studies in Thermal Engineering, 26, 101026. **Impact Factor 4.9**
4. Ahmed, Waqar, Omer A. Alawi, Ali H. Abdelrazek, Zaher Mundher Yaseen, Mayadah W. Falah, Omar A. Hussein, Mahmoud Eltaweel, Raad Z. Homod, and Nor Azwadi Che Sidik. "Numerical and experimental evaluation of thermal enhancement using zinc nano-suspensions in a square flow passage." *Journal of Thermal Analysis and Calorimetry* (2022): 1-20. **Impact Factor 4.6.**
5. Ahmed, W., Chowdhury, Z. Z., Kazi, S. N., Johan, M. R., Akram, N., & Oon, C. S. (2020). Effect of ZnO-water based nanofluids from sonochemical synthesis method on heat transfer in a circular flow passage. International Communications in Heat and Mass Transfer, 114, 104591. **Impact Factor 5.**