PERFORMANCE INVESTIGATION OF SOLAR COLLECTOR WITH COTTON-BASED CNC AND GRAPHENE HYBRID NANO FLUIDS

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DOCTOR OF PHILOSOPHY

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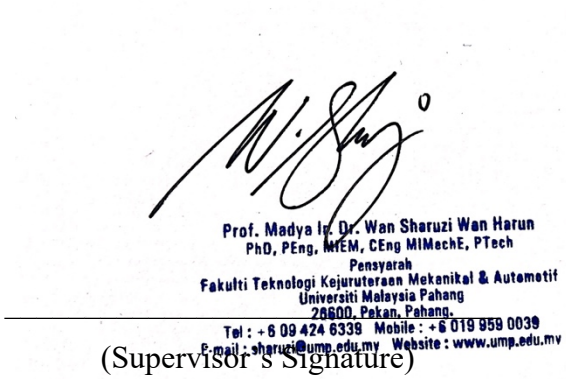

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ABSTRAK

Penggunaan sumber semula jadi yang cekap seperti kapas buangan semakin penting yang mempunyai setiap kelebihan kewangan dan alam sekitar. Nanozarah ke dalam struktur bendalir terma telah diambil kira secara meluas sebagai teknik yang menjanjikan untuk menghiasi pemindahan haba dan peningkatan kecekapan haba. Matlamat penyelidikan ini menyiasat kesan penggunaan cecair nano hibrid termaju baharu sebagai cecair yang mengalir dalam pengumpul suria plat rata (FPSC) untuk menggantikan cecair berasaskan air tradisional. Kajian ini mencerminkan peluang tenaga boleh diperbaharui. Tindakan penting untuk meningkatkan kecekapan pengumpul solar adalah untuk mereka bentuk semula pengumpul solar plat rata, pengumpulan sisa kapas, penyediaan nano-selulosa daripada kapas sisa berputar. Dengan menghidrolisis asid sulfurik daripada sisa kapas, nanoselulosa telah dicipta. Kedua, graphene berasaskan etilena glikol, CNC, dan cecair nano hibrid telah digunakan untuk menggantikan cecair kerja di dalam tiub pengepala dan tiub riser, kepekatan volum berbeza nano dan cecair nano hibrid dianggap seperti 0.1%, 0.3%, dan 0.5% . Akhirnya, prestasi terma medium pengangkutan baharu ini dalam pengumpul suria plat rata telah disiasat. Penyiasatan ini dibahagikan kepada beberapa fasa, termasuk pengukuran dan penilaian sifat termofizikal yang berbeza bagi graphene, CNC, dan cecair nano hibrid seperti kestabilan, kekonduksian terma, kelikatan, haba tentu, ketumpatan dan pH; pelaksanaan cecair nano dalam pengumpul suria; simulasi berangka berdasarkan reka bentuk eksperimen; pengukuran peratusan peningkatan kecekapan oleh persamaan matematik yang berbeza dan pengoptimuman terakhir proses. Secara keseluruhan, kelikatan pergi ke arah aliran menurun dalam hal suhu. Sisihan kelikatan maksimum ditunjukkan dalam suhu 30°C pada 0.5% CNC nanobendalir berbanding dengan graphene dan cecair nano hibrid dan minimum ialah bendalir asas. Haba tentu graphene 0.1% garisan ke atas graf dan 0.1% CNC hampir bahagian bawah graf. Antara cecair nano hibrid 0.1% memberikan hasil yang tinggi dan pilihan tertinggi pada 80°C. Telah ditunjukkan bahawa ketumpatan cecair nano sentiasa stabil sekitar 1 g/m3. Analisis Terma: Pada cecair nano hibrid 80°C sebanyak 0.3% dan 0.5%, pecahan isipadu mempunyai kekonduksian terma 0.86 Wm-1K-1 dan 0.89 Wm-1K-1 masing-masing. Kekonduksian terma meningkat dari segi suhu dan cecair nano hibrid graphene menyerap lebih banyak haba daripada cecair lain. Bendalir nano Hibrid Graphene 0.3% menunjukkan nombor Nusselt tertinggi di kalangan hibrid pada suhu 30°C, yang menghasilkan kebanyakan perolakan pemindahan haba. Kedudukan tertinggi ialah 0.3% CNC pada suhu 30°C nombor Prandtl yang menggambarkan resapan haba yang lebih cepat. Refleks cecair nano hibrid yang lebih besar dan boleh dipercayai perolehan tenaga dan peningkatan kecekapan serta titik pilih tertinggi ialah 80°C, kecekapan cecair nano hibrid 0.5% 15.86% dan keuntungan tenaga 128.39. Sebaran berangka parameter yang dipilih domain pengiraan, seperti jenis mesh dan teknik pengiraan, telah dianalisis dan dibandingkan dengan simulasi CFD dalam ANSYS. Akhirnya, kecekapan terma teori bagi pengumpul suria plat rata telah dikira dan dibandingkan dengan penyelidikan lain dan hasilnya mendedahkan bahawa hibrid graphene dan graphene dapat meningkatkan prestasi pengumpul suria plat rata dengan berkesan.

ABSTRACT

Efficient use of natural resources such as waste cotton is getting increasingly essential that have each financial and environmental advantages. Nanoparticles into thermal fluid structures have been extensively taken into consideration as a promising technique to decorate heat transfer and heat efficiency enhancement. The aim of this research investigates the impact of using new advanced hybrid nanofluids as running fluid in a flat plate solar collector (FPSC) to replace the traditional water-primarily based fluid. The study reflects the renewable energy opportunities. The significant action to enhance the efficiency of the solar collector is to redesign the flat plate solar collector, cotton waste collection, nano-cellulose preparation from spinning waste cotton. By hydrolysing sulphuric acid from waste cotton, nanocellulose was created. Secondly, ethylene glycol-based graphene, CNC, and hybrid nanofluids have been used to replace the working fluid inside the header and riser tubes, the different volume concentrations of nano and hybrid nanofluids were considered such as 0.1%, 0.3%, and 0.5%. Finally, the thermal performance of these new transport mediums in flat plate solar collectors has been investigated. This investigation is divided into several phases, including measurement and evaluation of distinct thermo-physical properties of graphene, CNC, and hybrid nanofluids such as stability, thermal conductivity, viscosity, specific heat, density, and pH; implementation of nanofluids in the solar collector; a numerical simulation based on the experimental design; measurement of the efficiency enhancement percentage by different mathematical equation and at last optimization of the process. Overall, the viscosity goes to the downtrend in regards to temperature. The maximum viscosity deviation shows in the temperature 30°C at 0.5% CNC nanofluid compare with graphene and hybrid nanofluids and minimum was base fluid. Specific heat of graphene 0.1% line going top of the graph and 0.1% CNC almost bottom of the graph. Among the hybrid nanofluids 0.1% gave high result and highest pick at 80°C. It has been shown that nanofluid density is always steady around 1 g/m^3. Thermal Analysis: At 80°C hybrid nanofluid of 0.3% and 0.5%, volumetric fraction possesses thermal conductivity of 0.86 Wm-1K-1 and 0.89 Wm-1K-1 respectively. Thermal conductivity increases in terms of temperature and graphene hybrid nanofluid absorb more heat than other fluids. 0.3% Graphene Hybrid nanofluids showed highest Nusselt number among the hybrid at temperature 30°C, which created most convection of heat transfer. Highest position was 0.3% CNC at the temperature of 30°C of Prandtl number which illustrated quicker heat diffusion. Hybrid nanofluids reflex more considerable and reliable energy gain and efficiency enhancement and highest pick point was 80°C, 0.5% hybrid nanofluids efficiency 15.86% and energy gain 128.39. CFD simulations in ANSYS were used to analyze and compare the numerical dispersion of the computational domain's selected parameters, such as mesh type and calculation approaches. The results show that graphene and graphene hybrids can significantly boost the performance of flat plate solar collector. The theoretical thermal efficiency of the flat plate solar collector has finally been computed and compared with other study.

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