Konservasi Energi Gedung Menggunakan Closed Loop Pulsating Heat Pipe sebagai Solar Water Heater dengan Fluida Kerja De-Ionized (DI) Water = Utilization of Closed Loop Pulsating Heat Pipe in Energy Conservation on Buildings for Solar Water Heater Application

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Abstrak

Indonesia secara geografis dilalui garis khatulistiwa, sehingga Indonesia menjadi negara yang menerima sinar matahari secara kontinu dan merata. Setidaknya sebanyak 60% panas dari sinar matahari memasuki bangunan gedung melalui atap. Kondisi tersebut menyebabkan ketidaknyamanan penghuni, peningkatan cooling load, dan peningkatan emisi karbon yang dihasilkan oleh bangunan. Konservasi energi termal dari sinar matahari dapat dijadikan solusi tepat untuk mengatasi permasalahan tersebut. Energi termal yang berhasil dikonservasi dapat dialokasikan untuk aplikasi pemanasan tepat guna, seperti solar water heater. Penelitian ini menggunakan Closed Loop Pulsating Heat Pipe (CLPHP) sebagai heat exchanger pada sistem solar water heater. Closed Loop Pulsating Heat Pipe (CLPHP) akan menyerap panas yang diterima atap bangunan. Fluida kerja di dalam Closed Loop Pulsating Heat Pipe (CLPHP) akan bergerak ke bagian condenser dengan bantuan gaya gravitasi, dan memindahkan jumlah panas tersebut untuk memanaskan air. Eksperimen ini akan menggunakan fluida kerja De-Ionized (DI) Water. Filling ratio dengan variasi 40%, 50%, 60%, 70%, dan 80% menjadi variabel eksperimen. Eksperimen dilaksanakan dengan representasi iradiasi matahari sebesar 1.322 W/m2 sebagai heat input. Hasil eksperimen menunjukan bahwa filling ratio 50% menunjukkan hasil paling optimum dengan nilai resistansi termal (0,35 °C/W), waktu start-up sistem (11,43 menit), dan perolehan suhu akhir air di dalam tangki condenser (41,65 °C).
.....Indonesia is located near the equator line, making it a country that receives abundant and continuous sunlight. At least 60% of the heat from sunlight enters the building through the roof. These conditions cause occupant discomfort, increased cooling loads, and increased carbon emissions produced by buildings. Conservation of thermal energy from sunlight can be the right solution to overcome these problems. The conserved thermal energy can be allocated for appropriate heating applications, such as solar water heaters. This research will use Closed Loop Pulsating Heat Pipe as the heat exchanger of the system. Closed Loop Pulsating Heat Pipe will absorb the thermal energy from the solar irradiance, and with the help of working fluid and gravitational force the heat will be transferred from evaporator to condenser section to complete the heating process of water. The working fluid used in this experiment is De-Ionized (DI) Water. Filling ratio with variations of 40%, 50%, 60%, 70%, and 80% will be used as variables to obtain the optimum design of the solar water heater system with CLPHP, using representative optimum solar irradiance in Depok, at 1.322 W/m2 as the heat input. The experimental results show that the filling ratio of 50% shows the most optimum results with the lowest thermal resistance value (0.35 °C/W), the fastest system start-up time (11.43 minutes), and the highest final water temperature gain in the condenser tank (41.65 °C).