

ABSTRAK

Penelitian ini bertujuan untuk meneliti pengaruh jenis nanofluida Al_2O_3 , CuO , dan TiO_2 dengan tingkat laju aliran 10, 12, dan 14 liter/min terhadap efektivitas perpindahan panas (ϵ), koefisien perpindahan panas keseluruhan (U), dan *pressure drop* (ΔP) pada *Shell and Tube Heat exchanger* tipe *Floating Head*. Fluida dasar untuk nanofluida menggunakan air murni, volume konsentrasi pada ketiga nanofluida diatur konstan pada 1%. Nanofluida berperan sebagai fluida pendingin dengan temperatur *inlet* 20°C , sedangkan fluida panas menggunakan air murni dengan temperatur *inlet* 40°C . Pengaturan aliran pada *heat exchanger* diatur untuk mengalir secara *counter flow*.

Hasil menunjukkan bahwa nilai efektivitas perpindahan panas (ϵ) dan koefisien perpindahan panas keseluruhan (U) tertinggi didapati pada nanofluida TiO_2 . Hal ini dikarenakan nanofluida TiO_2 memiliki stabilitas yang baik (tidak mudah mengendap) sehingga menghasilkan nilai laju perpindahan panas ($\dot{Q}$) yang tinggi. Sedangkan nanofluida CuO dan Al_2O_3 memiliki stabilitas yang rendah sehingga nilai laju perpindahan panas ($\dot{Q}$) yang didapati lebih rendah dibandingkan fluida air. Peningkatan nilai laju perpindahan panas ($\dot{Q}$), efektivitas perpindahan panas (ϵ), dan koefisien perpindahan panas keseluruhan (U) linier seiring meningkatnya laju aliran fluida.

Nilai *pressure drop* pada fluida air memiliki hasil yang sangat fluktuatif. Hal ini dikarenakan massa jenis dan viskositas fluida air cenderung lebih rendah dibandingkan ketiga nanofluida. Nilai viskositas dan massa jenis yang rendah cenderung menghasilkan bilangan Reynolds (Re) yang tinggi, fluida air lebih mudah mengalami turbulensi dibandingkan nanofluida.

Kata kunci: Nanofluida TiO_2 , CuO , Al_2O_3 , *floating head heat exchanger*, *shell and tube heat exchanger*, efektivitas perpindahan panas, koefisien perpindahan panas keseluruhan, *pressure drop*.

ABSTRACT

This study aims to investigate the effects of Al₂O₃, CuO, and TiO₂ nanofluids at flow rates of 10, 12, and 14 lpm on heat transfer effectiveness (ϵ), overall heat transfer coefficient (U), and pressure drop (ΔP) in a floating head shell-and-tube heat exchanger. Pure water was used as the base fluid, while the volume concentration of all nanofluids was maintained at a constant value of 1%. The nanofluids were utilized as the cooling fluid with an inlet temperature of 20°C, whereas pure water with an inlet temperature of 40°C was employed as the hot fluid. The flow arrangement within the heat exchanger was configured in a counter-flow mode.

The results indicate that the highest heat transfer effectiveness (ϵ) and overall heat transfer coefficient (U) were achieved using the TiO₂ nanofluid. This phenomenon is attributed to the superior stability of the TiO₂ nanofluid, which exhibited lower sedimentation tendencies and consequently produced a higher heat transfer rate ($\dot{Q}$). In contrast, the CuO and Al₂O₃ nanofluids demonstrated lower stability, resulting in lower heat transfer rates ($\dot{Q}$) compared to water. Furthermore, the heat transfer rate ($\dot{Q}$), heat transfer effectiveness (ϵ), and overall heat transfer coefficient (U) increased linearly with increasing fluid flow rate.

The pressure drop values obtained using water exhibited highly fluctuating behavior. This condition is associated with the lower density and viscosity of water compared to the three nanofluids. Lower viscosity and density tend to produce higher Reynolds numbers (Re), causing water to transition into turbulent flow more readily than the nanofluids.

Keywords: *TiO₂ nanofluid, CuO nanofluid, Al₂O₃ nanofluid, floating head heat exchanger, shell-and-tube heat exchanger, heat transfer effectiveness, overall heat transfer coefficient, pressure drop.*