4th World Conference on Mechanical Engineering

Berlin, Germany 13 -15 March 2025

Thermal and Flow Characteristics of Five-Row Parabolic and Flat Surface Toroidal Solar Collectors

Gulenay Alevay Kilic

Yalova University/ Yalova University Vocational School/ Electricity and Energy Department/ Yalova/ Turkiye

ABSTRACT

This study investigates the thermal and hydrodynamic characteristics of five-row parabolic and flat surface toroidal solar collectors through numerical analysis. The research focuses on understanding the complex flow patterns and heat transfer mechanisms in multi-row configurations using computational fluid dynamics (CFD) simulations with ANSYS-Fluent software. The investigation examines the effects of different surface geometries on system performance, analyzing heat transfer patterns and flow distribution across the five-row arrangement. Temperature distribution analysis reveals the thermal interactions between consecutive rows and their impact on overall system efficiency. The study particularly emphasizes the relationship between surface geometry and flow uniformity, demonstrating how different surface designs affect thermal stratification and heat transfer characteristics. Results show that the five-row configuration presents unique flow dynamics and thermal patterns that significantly influence collector performance. This comprehensive analysis provides valuable insights for optimizing the design of multi-row solar thermal systems for large-scale applications.

Keywords: efficiency, flow distribution, heat transfer, numerical methods, validation