Title: Statistical analysis of periodic MHD chemically radiative casson flow over an inclined cylinder with entropy optimization.

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Abstract: Statistical analysis (SA) stands as an indispensable tool in materials science and engineering, aiding in the understanding and optimization of heat and mass transport processes. This study delves into the interplay between periodic magneto-hydrodynamics (MHD) and chemical reactions concerning entropy generation over an inclined porous cylinder (IPC). We employ a statistical approach, amalgamating the robust 6th order Runge-Kutta (R-K) integration algorithm with the Nachtsheim-Swigert (N-S) shooting iteration method, subsequent to converting the governing equations into Ordinary Differential Equation (ODE) form. The primary objective of this study is to analyze the behavior of entropy generation, unveiling the intricate relationship between entropy dynamics, radiative periodic MHD on IPC, and chemical processes. The numerical findings encapsulate the dynamics of temperature, velocity, and entropy generation, visually portrayed across various dimensionless parameters. The primary findings of this investigation indicate that Casson fluid flow generates 18.99 % more entropy in comparison to Newtonian fluid flow. Furthermore, entropy is 9.87 % larger in an inclined cylinder than in a level cylinder. In contrast, entropy production falls by 3.34 % in the presence of periodic MHD as opposed to non-periodic MHD. Regression study reveals a genuine and significant interaction between variables inside the entropy-generating systems, as well, with a correlation value (R2) of 99.82 % at a 95 % confidence level. The correlation study shows that there is a significant 98.13 % relationship between entropy generation and chemical processes. Understanding the heightened entropy associated with Casson fluid flow benefits tissue engineering, drug delivery systems, and renewable energy. Increased entropy in inclined cylinders aids in optimizing drainage systems, pipeline design, and aerodynamic efficiency in aerospace engineering.

Keyword: Entropy Generation, Periodic MHD, Casson Fluid, Thermal Radiation, Chemical Reaction, Statistical Analysis.

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