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Entropy Generation Analysis for a Thin Couple Stress Film Flow over an Inclined Surface with Newtonian Cooling

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Abstract: In this article, a computational approach to monitor entropy production in a fully developed gravity-driven couple stress film flow on an inclined heated surface subjected to convective cooling is examined. The free end of the thin film is maintained in a manner that follows the Newtonian law of cooling. Exact solutions of the dimensionless boundary-value problems (BVP) are obtained and utilized for the entropy expression and the heat irreversibility ratio along the heated plate. The effects of pertinent parameters on the flow and thermal build up are shown graphically and explained based on physical laws. Most importantly, the rate of heat transfer is shown to be a decreasing function of the couple stress inverse while the skin friction remains constant along the heated wall. The present computation is relevant in coating and drying processes and several metallurgical engineering.

Keywords: Thin film, Convective cooling, Couple stress, Inclined surface