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Evaluation of Heat Irreversibility in Couple Stress Falling Liquid Films along Heated Inclined Substrate

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Abstract: In the present work, the analysis of entropy generation in a gravity-aided thin couple stress liquid film in an inclined heated substrate is investigated. The thin substrate layer is assumed to be porous and governed by Darcy law. Exact solutions of the dimensionless field equations are obtained and used to determine the rate of entropy is produced along the inclined plate. Velocity, temperature, entropy generation and Bejan profiles are presented for different parameter cases. The result of the analysis revealed the significance of both slip and porous permeability parameters on entropy generation rate and the effects of both modified Navier slip and porous permeability parameters on the entropy generation rate turns out to be large at the free surface of the porous substrate and must be controlled for sustainable and efficient production.

Keywords: Couple stress film, Entropy generation, Energy conservation, Inclined substrate