

# Theoretical Analysis of Roll Coating of Couple Stress Fluid with Wall Slip

Mumtaz Ali<sup>1</sup>, Zuhaibuddin Bhutto<sup>2</sup>, Muhammad Asif<sup>3</sup>

<sup>1</sup>Department of Basic Sciences, Balochistan UET, Khuzdar, Pakistan

<sup>2</sup>Department of Computer System Engineering and Sciences, Balochistan UET, Khuzdar, Pakistan

<sup>3</sup>Department of Mathematics and Statistics, International Islamic University, Islamabad, Pakistan

Corresponding Email: mumtaz.ali@buetk.edu.pk

**Abstract**—This paper presents an analysis of coating a fluid with a couple stresses on moving the substrate. The equation of motions are first converted into dimensionless form and then simplified under lubrication approximation theory. And there is a certain degree of slip between the fluid and the solid boundary. The slip condition is first converted into dimensionless form and then used to find the exact expressions for pressure gradient and velocity. The engineering quantities are numerically computed with the help of the Runge-Kutta method and generalized Leibniz rule. The outcomes show that the roll coating process is significantly affected by the presence of slip. The maximum pressure observed in the vicinity of the nip region decreases with increasing the slip parameter. The engineering quantities such as roll-separating force and power input decrease in the presence of slip parameter. Moreover, the separation point with slip is smaller than its counterpart for the no-slip case.

**Keywords** — roll coating, wall slip, couple stress fluid, Runge-Kutta method