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Experimental Study of Single and Paired Flexible Fiber Settling at Low Reynolds Number

Harish N. Mirajkar[1†], Chandra Shekar[1], Yevgen Melikhov[1], Piotr Zydel[1], Maria L. Ekiel-Jeżewska[1]*

[1] *Institute of Fundamental Technological Research, Polish Academy of Sciences, ul. Pawińskiego 5B, 02-106 Warsaw, Poland.*

**Email: mekiel@ippt.pan.pl*

The dynamics and deformation of immersed flexible fibers are central to many industrial and biological processes. While the sedimentation of a single fiber in a viscous fluid has been extensively studied [1], [2], [3], and pairs of fibers have also been investigated [1], [3], [4], [5], the dynamics of sedimenting flexible fiber pairs remain complex and not yet fully understood. In this work, we experimentally investigate the settling dynamics of single and paired semi-flexible fibers under gravity in highly viscous silicone oil at a Reynolds number much less than unity ($Re \ll 1$). The fibers are modelled using millimeter-sized ball chains, released in three initial configurations: vertical, horizontal, and co-linear. Using synchronized cameras, we capture their motion and deformation, systematically varying the number of balls (N) in the ball chain from 3 to 20.

The experiments are designed to examine how fiber length and initial configuration influence sedimentation behaviour. Ball chains are released in a controlled manner, and their motion is recorded using a dual-camera setup to capture both shape evolution and relative movement. Examples of the observed dynamics including shape transitions, settling velocities, and interactions between chains will be presented to illustrate the complex behaviour of flexible fibers in viscous fluids.

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†Currently at: School of Engineering and Applied Science, Ahmedabad University, Gujarat, India.