INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: **Numerical Simulation Of Particle Migration Of Concentrated Suspension In Symmetric Bifurcation Channels**

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SHORT ABSTRACT

Suspensions of solid rigid particles in viscous fluids are commonly encountered in many industries, biological processes, natural settings, and in several daily life products such as cosmetics, food stuffs. In many of these applications the goal can be to generate uniform distribution of suspended particle in the finished product. Thus, the knowledge and understanding of their flow behavior is very important and this has motivated numerous theoretical, numerical, and experimental studies. The modeling of concentrated suspensions is a challenging task due to multi body interactions. Experimental characterization of these suspensions is also difficult because several complex phenomena such as wall slip and shear-induced migration can take place during their flow. Shear induced particle migration leads to in-homogeneities in particle concentration and generates segregation in poly-disperse systems. This has been observed in many flows and leads to problems in many industrial processes. Shear-induced particle migration in simple and unidirectional geometries like straight channels and tubes have received wide attention but studies in complex geometries and channels with bifurcations are very few. Suspension flow through such bifurcation channels is often encountered in biological systems such as flow of blood through network of branched arteries and veins. In biomedical application, the design of artificial valves requires knowledge of distribution of blood cells in different branches. In the present work, we have investigated the shear induced migration of neutrally buoyant suspensions in symmetric bifurcation channels using the Diffusive flux model (Phillips *et al*. 1992). We have studied the effect of particle concentration, angle of bifurcation, flow rate on velocity, concentration profile and wall shear stresses. The suspension flow profiles showed considerable differences over the Newtonian fluid profile of same viscosity as that of suspension. The velocity and concentration profiles in the daughter branches were observed to be asymmetric. Degree of asymmetry and bluntness of velocity profile varies with particle concentration and bifurcation angle. Wall shear stress level was found to be the highest near the bifurcation region. We have carried out computational fluid dynamics simulations of suspension flow through symmetric 3D bifurcating channel (T Shape) using the diffusive flux model of shear induced particle migration (Phillips *et al.* 1992). The velocity, concentration and wall shear stresses were studied at various sections in the upstream and downstream sections of the bifurcation. In the diverging flow the symmetric profile in the inlet branch becomes highly asymmetric in the side branch which progressively becomes more symmetric. On the other hand, in case of a converging channel symmetric and peak-valley-peak type of pattern emerges in the downstream of bifurcation whose nature depends on the inlet velocity and concentration. The velocity profile in the inlet branches were fully developed but blunted near the converging section and shifted towards the bottom wall. Particle concentration profile was maximum at the center of channel due to shear induced migration. The locations of merging the two streams in case of the converging flow were also computed. The velocity streams are merging very early but concentration streams takes longer time in the outlet section. This knowledge is required in many applications involving network of branching system to design mixing devices as well as better understanding of system failures in piping networks relevant to industry and physiology.