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Numerical Estimation of the Variation of the Fluid Element area in Shear and Elongation Flow Field in Co-rotating Twin Screw Extruder

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Two important flow fields in conventional mixers and compounders such as twin screw extruders are Shear and Elongation flow fields and it is desired to distinguish between the effects of these two flow field on mixing. In the present study, intermeshing section of a co-rotating twin screw extruder was considered in the study and flow field considered for one phase flow and Newtonian fluid was obtained for this geometry using Finite Element Method (FEM). Deformation rate tensor was obtain through the FEM solution and was split into two deformation rate tensors: Shear and Elongation deformation rate. Residence time distribution (RTD) was also obtained for this geometry using Numerical Particle Tracing method (NPT). Having RTD and deformation rate tensors, we calculated the increase in the element areas caused by Shear and Elongation flow separately. (Using RTD and deformation tensors, the increase in the element areas caused by Shear and Elongation flow separately was calculated.) Moreover, the total increase in the element area was calculated and two qualities (variables) were introduced: Shear Flow Area Increment (SFAI) and Elongation Flow Area Increment (EFAI). Through SFAI and EFAI, the contribution of both elongation and shear flow contribution in mixing were obtained. It was observed that SFAI and EFAI can be used as good criteria for determining the quality of the mixing in different mixers such as TWEs.