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STUDY OF VISCOELASTIC EFFECTS IN EXTRUSION USING A MESHLESS TECHNIQUE

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For two decades, researchers have been working on the modeling of viscoelastic flows using traditionally techniques, such as the finite element and finite volume methods. Although some complex flows have been successfully simulated, they are still limited to low Weissenberg number (We) values while requiring high computational times. Meshless techniques such as the Radial Functions Method (RFM) offer a novel and an interesting approach to study viscoelasticity. RFM is a meshless technique that does not require homogeneous grid points. In particular, this work is focused in viscoelastic effects in extrusion, such as the secondary flows that appear in straight non-circular ducts. The magnitude of the secondary flows is usually many orders lower than the axial flow. However, as discussed in the literature, they may produce significant impacts in practical applications including the modification of temperature distributions, the modification of the deformation pattern of the extrudate at the die exit and the generation of elastic layer rearrangement in multilayer coextrusion. Non-circular ducts appear in several steps of the extrusion process, such as the metering zone of an unwrapped extrusion screw channel and some extrusion dies. Viscoelastic models that take into account the second normal stress differences are considered, including the Giesekus model. The meshless technique successfully modeled the flow through square tubes reproducing the secondary flows observed experimentally by other researchers. Furthermore, the results are in agreement with finite element and finite volume numerical approaches. Additionally, the viscoelastic effects on the flow and temperature development in the metering zone of an extrusion screw channel and some extrusion dies with different geometries are studied.