Computational fluid dynamic simulations are used to examine incompressible flow through twisted elliptical and helically-coiled cylindrical fibers for typical flow Reynolds numbers employed in membrane filtration processes (Re < 200). The resulting flow fields are compared in terms of the distributions of vorticity and wall shear rate, the pressure drop, and the azimuthally-averaged normal velocity in the vicinity of the wall. The secondary flow in twisted elliptical fibers generates significant recirculation flow leading to near-wall velocities directed normal to the surface of the membrane (below figure). The azimuthally-averaged normal velocity near the wall of a twisted elliptical fiber is found to be two to four orders of magnitude larger than typical ultrafiltration velocities. For Re < 75, the average wall shear rate and normal velocity near the wall are found to be significantly higher in twisted elliptical fibers compared to their helical counterparts. These findings highlight the potential for mass transfer and flux enhancement using twisted elliptical hollow fiber membrane systems, which could provide a low cost, and linearly scalable module with improved performance.

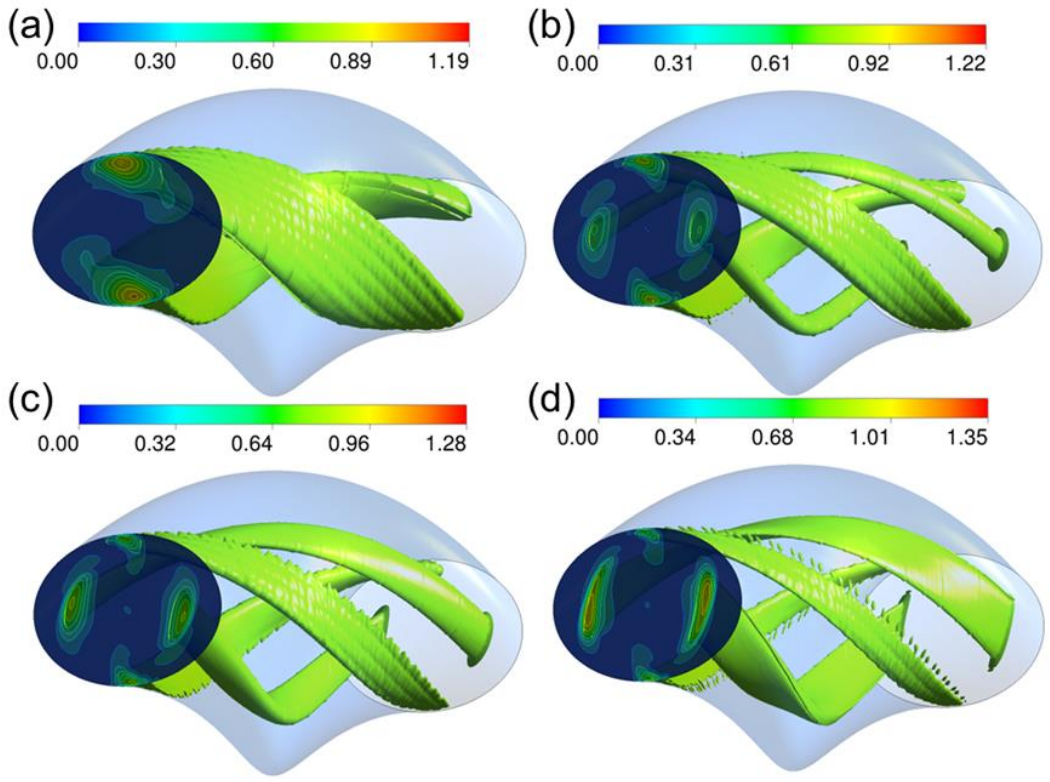


Figure 1 - Vortical structures in a twisted elliptical fiber identified by iso-surfaces corresponding to 60% of maximum swirling strength for (a) *Re* = 10, (b) *Re* = 50, (c) *Re* = 100, and (d) *Re* = 200.