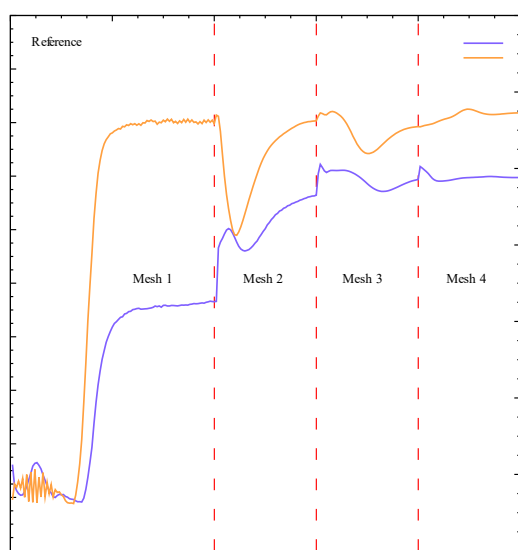


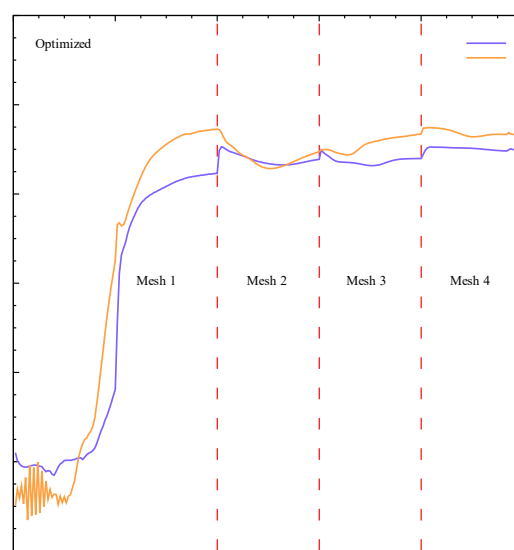
Turbulence Enhancement and Mixing Analysis for Multi-Inlet Vortex Photoreactor for CO₂ Reduction

Level of Mesh Selection.

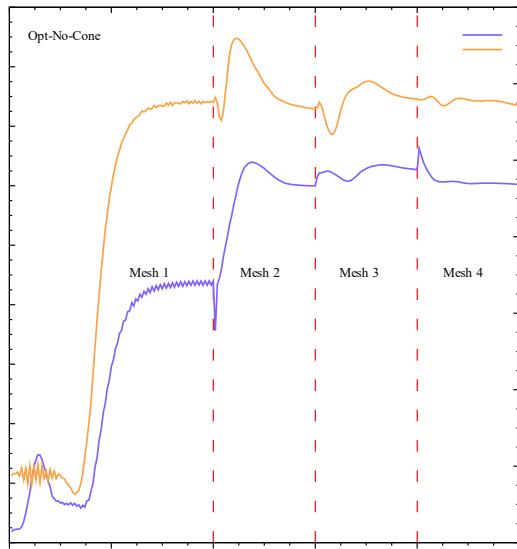
For the steady-state study, the level of mesh selection was based on the SolidWorks Flow Simulation goals convergence criterion, the mesh size increase at certain iterations during the study, the behavior of the goals convergence dictates the best level of mesh. The study was executed with mesh level 1 for iteration 1 to 100, then the mesh level was increased every 50 iterations up to mesh level 4, this procedure was used for the Reference reactor, the Optimized reactor, the Opt-No-Cone reactor, and the One-Inlet reactor. Two goals were selected, the Volume Flow Rate that passes through the top surface of the photocatalyst bed and the maximum Velocity in the reactor. Figure 1 shows the convergence of goals for the proposed reactors. Mesh level 4 for the four reactors has a low change through the study, this level was used for all the reactors and configurations at work.



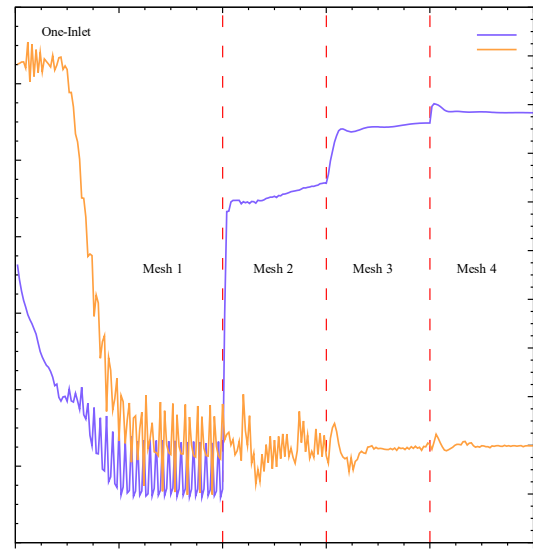
(a)



(b)



(c)



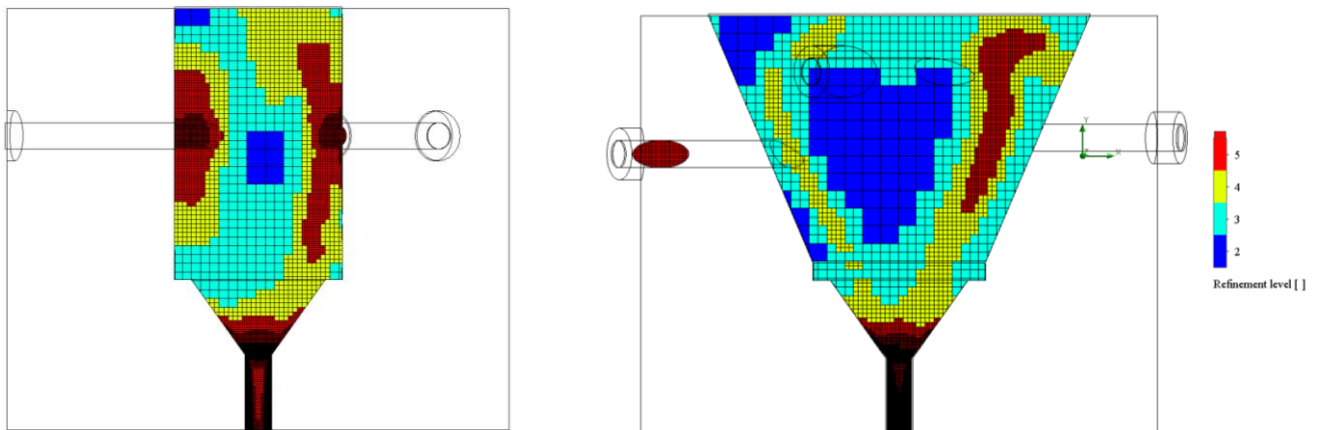
(d)

Figure S1. Mesh independence test: (a) Reference photoreactor; (b) Optimized photoreactor; (c) Opt-No-Cone; (d) One-Inlet.

SolidWorks Flow simulation has the ability to refine the mesh adaptatively, based on a tree structure, where the larger cells are refined into smaller daughter cells in regions with higher variables gradients. Figure 2 shows a cross-section of the mesh used for the studies. An automatic initial mesh was activated, with advanced narrow channel refinement. The evaluation of minimum gap size was set to automatic, as well as the evaluation of the minimum wall thickness. Table 1 shows the number of cells for each reactor.

Table S1. Number of cells for the studied reactors.

Reactor	Number of Cells
Opt-3-Tuned	992701
Opt-3-Tuned-No-Cone	1801628
One-Inlet	68613
Reference	1387339



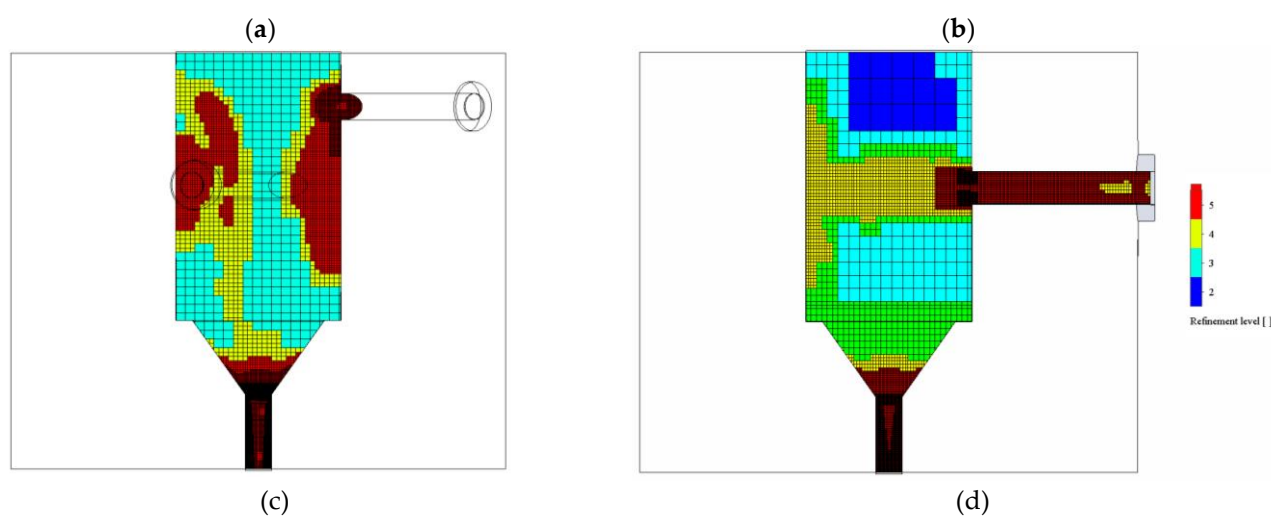


Figure S2. Mesh cross-section: (a) Reference photoreactor; (b) Optimized photoreactor; (c) Opt-No-Cone; (d) One-Inlet.

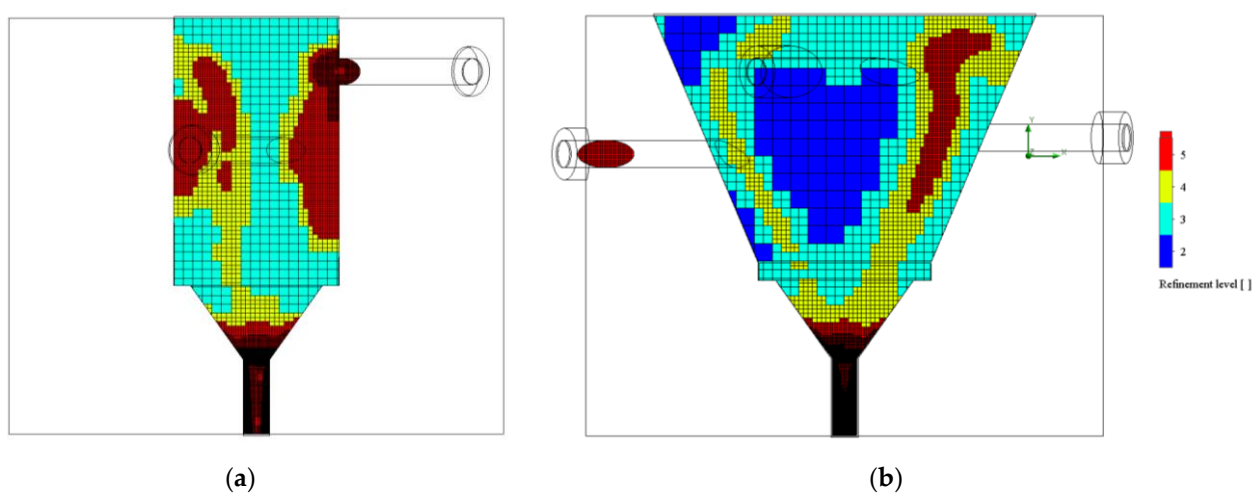


Figure S3. Mesh cut refinement: (a) For the reference photoreactor; (b) For the optimized photoreactor.