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FLOW DISTRIBUTORS OPTIMIZATION IN A TUBULAR REACTOR

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Introduction

Photoelectrocatalytic processes allow pollutant degradation and simultaneous production of hydrogen. However, the practical application of these processes requires the design of reactors which work under optimal hydrodynamic conditions to favor the reactions on the electrodes surface. For this reason, evaluation of hydrodynamic behavior is a required step. In this work the improvement made to a tubular reactor in order to reduce input / output geometry effects and thus optimize the reactions that occur in the process is shown.

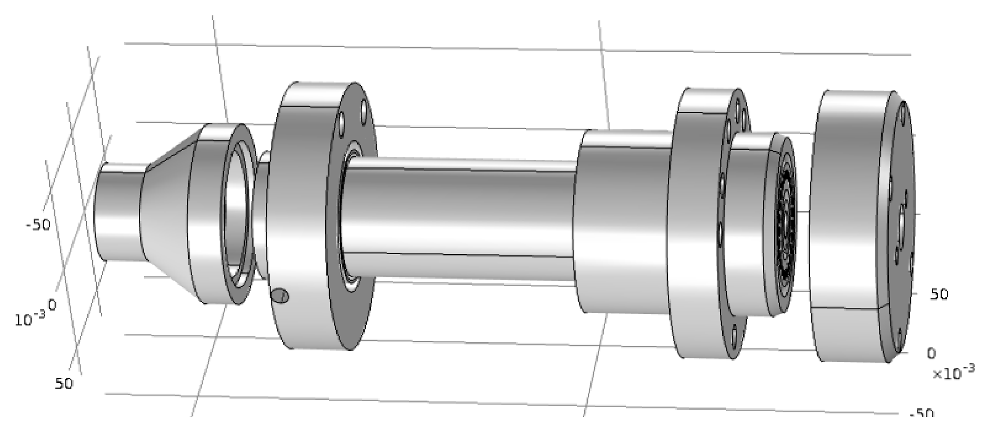

Figure 1. Reactor UIS GIMBA 002.

Computational Methods

Simulation conditions that were taken into account are: laminar fluid, viscosity and fluid density, average flow velocity at the inlet to the reactor and the reactor outlet pressure. Equations solved using COMSOL® are as follows:

$$\rho\frac{\partial \mathbf{u}}{\partial t} - \nabla\cdot\eta\left(\nabla\mathbf{u} + \left(\nabla\mathbf{u}\right)^{T}\right) + \rho\left(\mathbf{u}\cdot\nabla\right)\mathbf{u} + \nabla p = 0$$

$$\nabla\cdot\mathbf{u} = 0$$

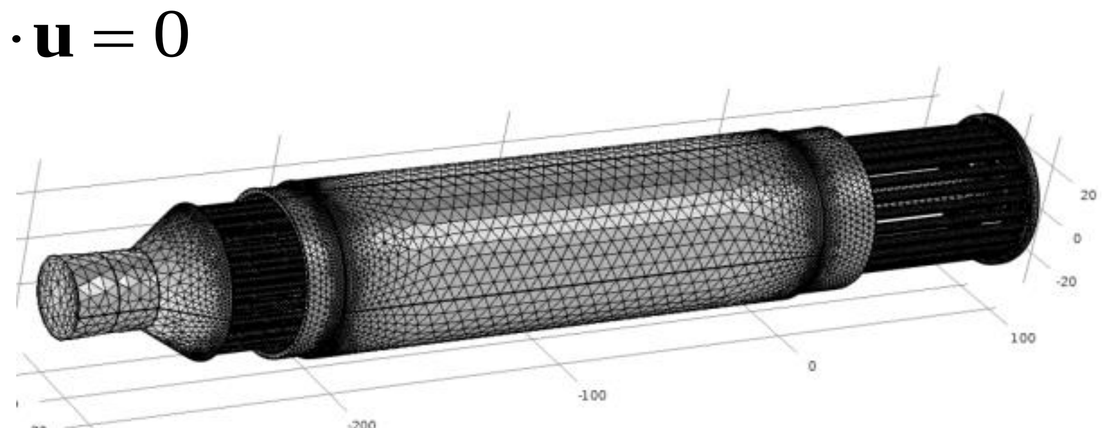

Figure 2. Reactor UIS GIMBA 002.

Results

Before optimization

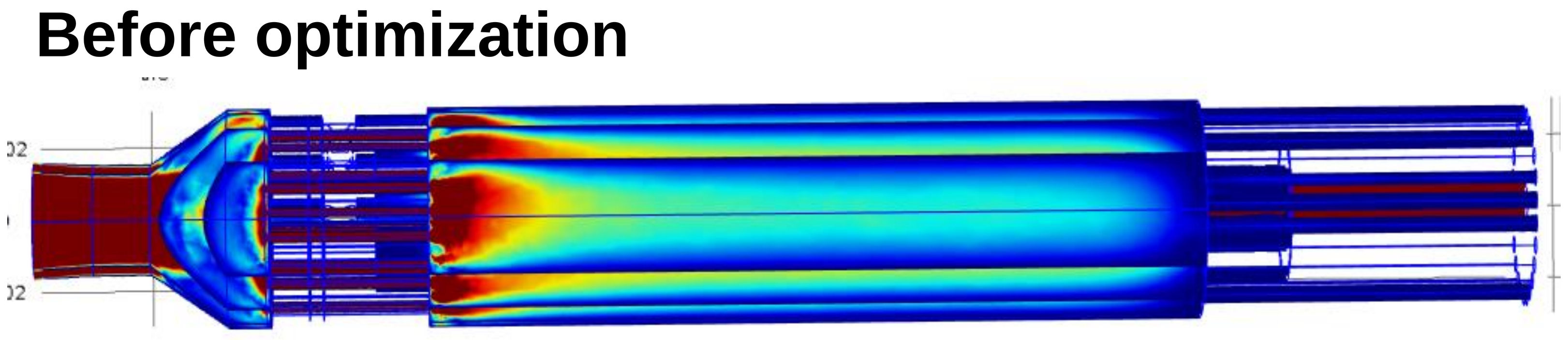

Figure 3. Reactor UIS GIMBA 002.

After optimization

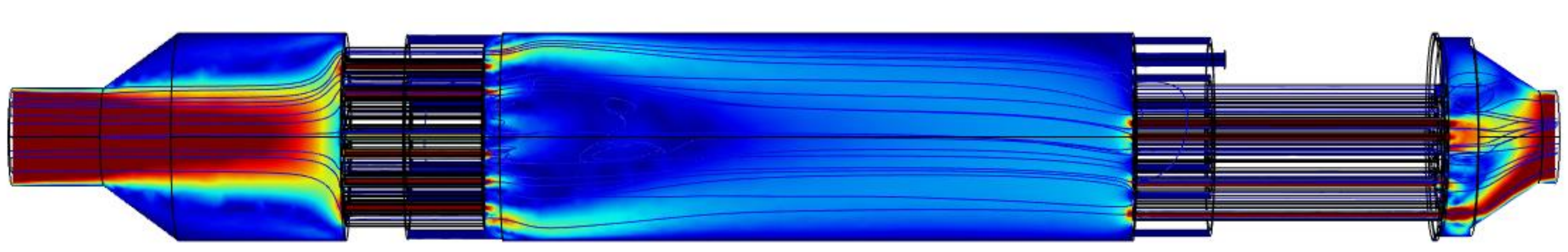

Figure 4. Modified Reactor UIS GIMBA 002 .

1. INLET HEADER

Before optimization

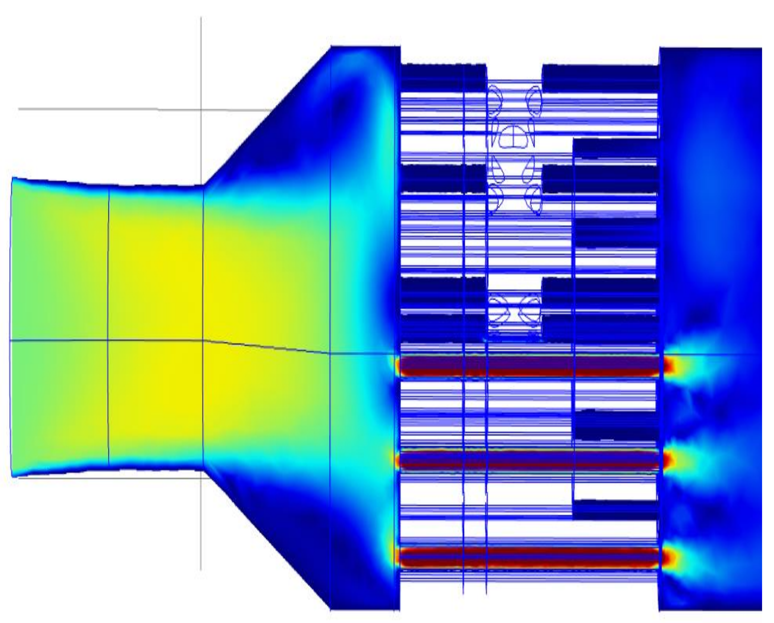

Figure 5. Before Inlet header

After optimization

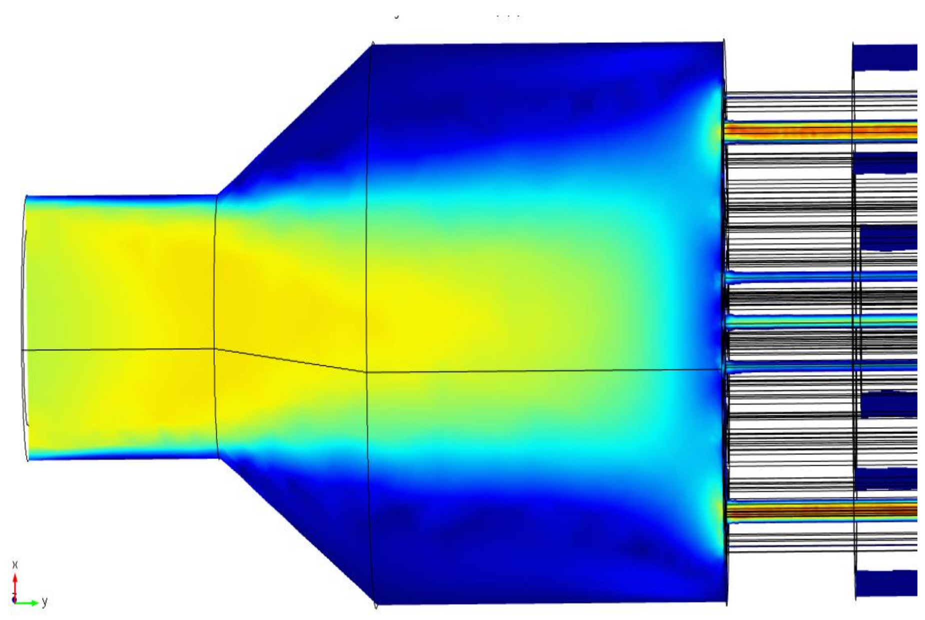

Figure 6. Before Inlet Header modified reactor.

2. CENTRAL ZONE REACTOR

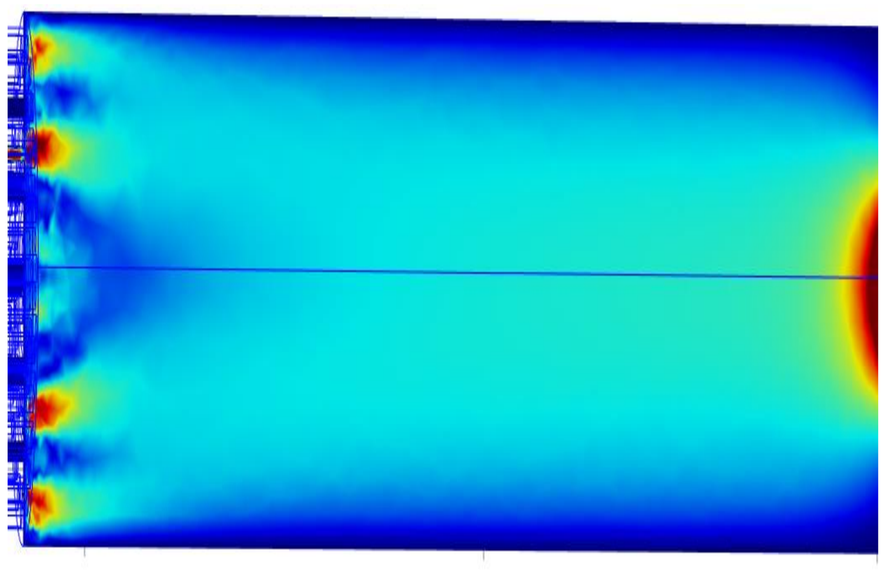

Figure 7. Central zone reactor UIS GIMBA- 002

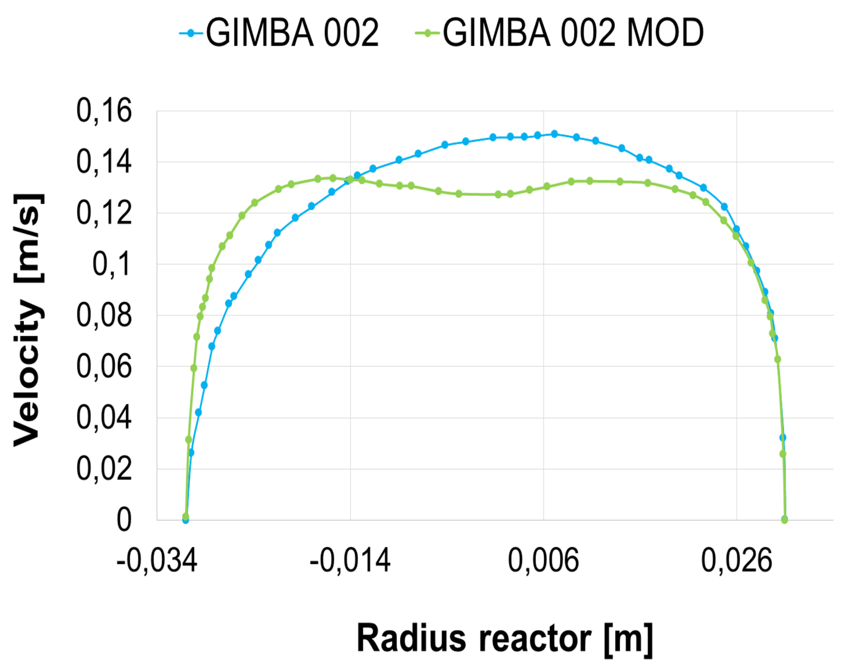

Figure 8. Comparison of velocity profiles

3. EXIT HEADER

Before optimization

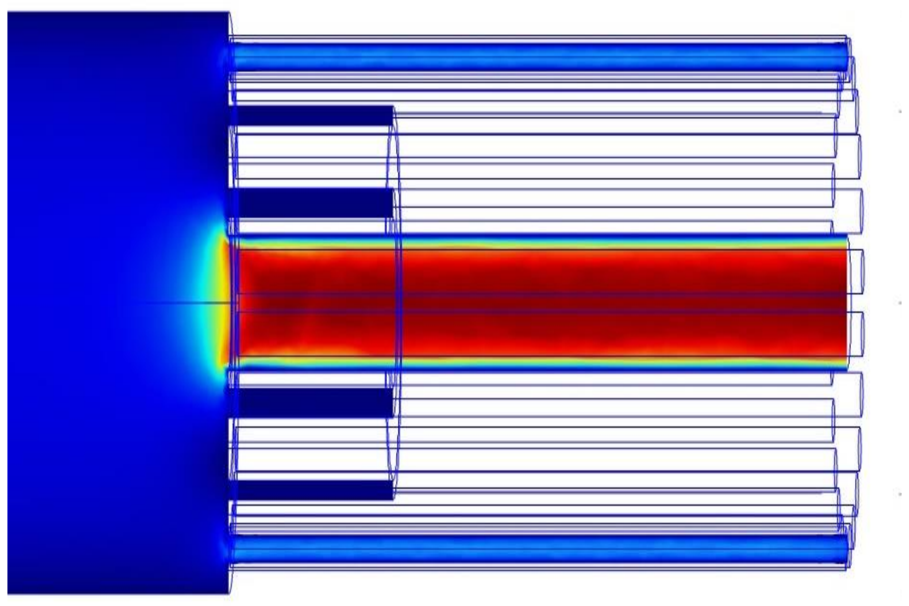

Figure 9. Velocity profile before head out.

After optimization

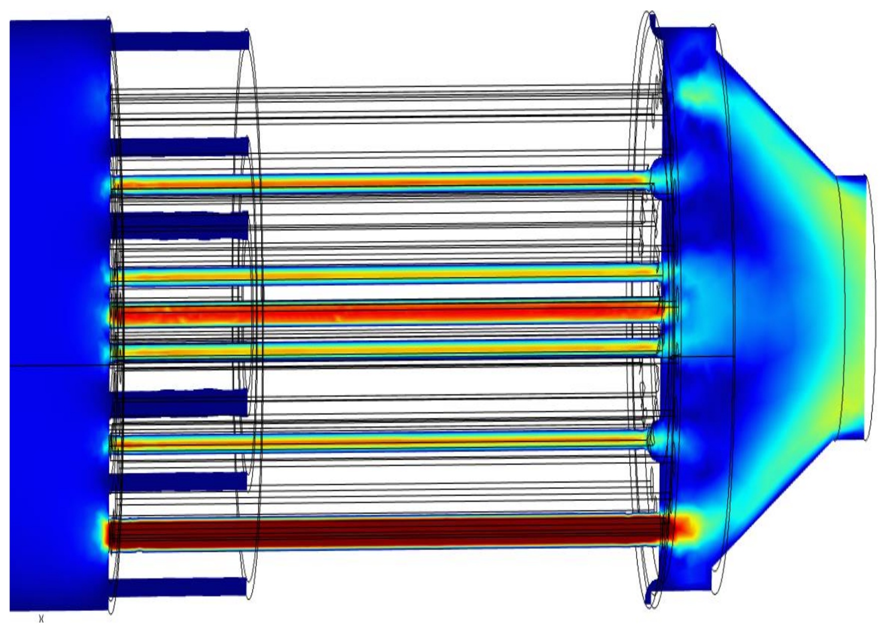

Figure 10. Head out modified reactor.

Conclusions

Reactor geometry changes allowed more uniform flow by reducing the input / output effect, thereby increasing the reactive zones inside the reactor. Furthermore, kinetic study coupling is recommended to evaluate factors such as reaction rate, residence time and distance between the mesh electrodes, thus they will help to define geometric modifications from the viewpoint of reactor efficiency and optimization.

References

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