

## COMPUTATIONAL FLUID DYNAMICS STUDY OF CREC RISER SIMULATOR: MIXING PATTERNS

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The CREC Riser Simulator Reactor is a novel mini-fluidized reactor. This novel device was invented by de Lasa 1. The applications of this unit has shown to be of great value to establish catalyst performance and kinetic models for a diversity of gas phase catalytic reactions. This has been the case, given that the CREC Riser Simulator is excellent with respect to particle and fluid mixing<sup>2</sup>.

This study establishes using CFD (Computational Fluid Dynamics), the CREC Riser Simulator mixing flow patterns. CFD simulations were developed using the COMSOL Multiphysics® module. Fig.1a reports the geometric characteristics of the CREC Riser Simulator including the impeller, the basket containing the catalyst and the external baffles. The proposed CFD model was validated using experimental data obtained in a basket as shown in Fig.1a. For instance, for an impeller speed of 4000 rpm, the outer annulus experimental gas velocity<sup>2</sup> was ~0.9 m/s and the simulated CFD gas velocity<sup>2</sup> was ~1.3 m/s.

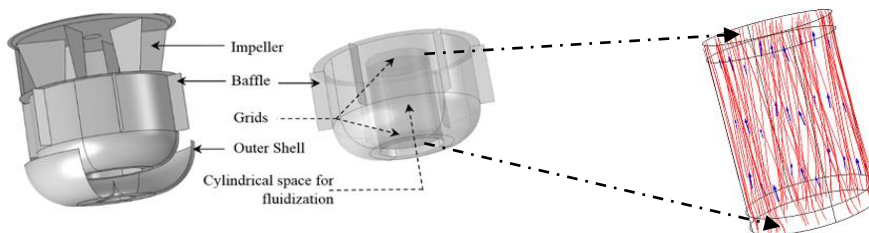
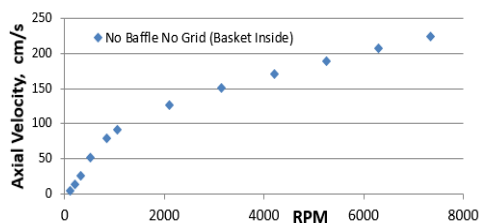


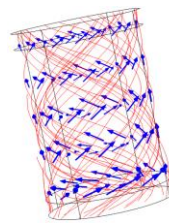
Fig.1a: Geometry of the Riser Simulator ;  
Basket ID: 1.6 cm

Fig.1b: Fluid Spiral in Catalyst Basket  
at 4000 rpm

Fig.2b reports a fully developed fluid spiral at a 2100 rpm impeller speed, for a carefully designed basket with no baffles. CFD results lead, in all cases, to mass balance closures of less than 2% (deviation between inner and outer gas flows). CFD data also confirmed both intense gas and catalyst mixing. Fig. 2a, shows the change of the simulated average gas axial velocity with the impeller speed.



(2a) Axial velocity vs RPM Inside the  
Basket



(2b) Fluid Spiral in Catalyst Basket at  
2100 rpm

Figure 2. CFD Simulation-for a CREC Simulator with a Bottom Nose Shaped Basket and no Baffles.

Fig.2a reports an axial velocity of 1.26 m/s at 2100 rpm. This yields 250 cm<sup>3</sup>/s volumetric flow and 0.20s mixing time. This makes of the CREC Riser Simulator, an ideal mini-fluidized unit for catalytic studies needing 1s-10s reaction times.

### REFERENCES

1. de Lasa H.I. Riser Simulator. 1992.
2. A. Pekediz, D. W. Kraemer, J. Chabot and H.I. de Lasa. Mixing Patterns in a Novel Riser Simulator. 1992;225:133-146. doi:10.1007/978-94-011-2747-9\_6.