MODELING A TRANSPIRING WALL REACTOR FOR SCWO PROCESS WIH CFD. EVALUATION OF DIFFERENT DESIGNS

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Supercritical Water Oxidation (SCWO) is an efficient process that makes possible the destruction of organic wastes with efficiencies higher than 99% and residence times of a few seconds. Nevertheless, the successful commercialization of this process has found difficulties by operational problems related with high temperature, energy integration and especially with salt deposition and corrosion problems.
All these limitations can be overcome by the design of new reactors for the process and the use of appropriate construction materials. As experimentation in this technology is rather expensive, modeling of new reactor designs is essential to correct beforehand the design defects and to make a correct planification of experiments.
Modeling a SCWO reactor is not a simple issue. Together with the complicate designs, it is necessary to cope with the correct calculations of the properties in the surrounding of the critical point. Commercial programs as Fluent are usually not prepared for coping with these limitations.
Previously, CFD simulations of the transpiring wall reactor (TWR) have been presented. But the comparison of the predictions with experimental results was not completely successful due the obligation of using approximations for the calculation of the heat capacity of the reacting mixture. In this work the TWR is again modeled using the commercial software Fluent. For improving the performance of the program a User Defined Function that introduced a source term in the enthalpy balance has been programmed. This term, consisting in the residual enthalpy calculated using the PR EoS with the translated volume, corrects the energy balance that Fluent normally performed considering the mixture as an ideal fluid.

The model reproduces the TWR developed in the University of Valladolid. This reactor has been studied experimentally, having available a great amount of experimental temperature data. The comparison of the experimental temperatures with the predicted ones will confirm the good performance of the model. The model gives as other information such as the existence of dead areas, back mixing and other peculiarities impossible to know in other way.

The good performance of this model describing correctly this well known reactor is a starting point in the modelling of other reactor designs of which no experimental information is still available.