MODELLING APPROACH OF A DEVOLATILIZATION-COMBUSTION PROCESS IN A WELL STIRRED REACTOR

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ABSTRACT

Object of this work is the definition of the optimal operative parameters of an experimental industrial burner working in flameless conditions. To reach this objective the main steps are described in the following. First, a parametrical optimization of the carbon oxy-combustion process in pressurized environment was performed. When carbon is injected in the combustor in slurry form, the particles break due to the combined effect of the shear stress induced by the injected air swirled and of the particle devolatilization process. In this phase, the carbon volatile species evolves and, successively, burns. In Figure 1 an example of the devolatilization products (char, tar and light gas) evolution with time is reported.

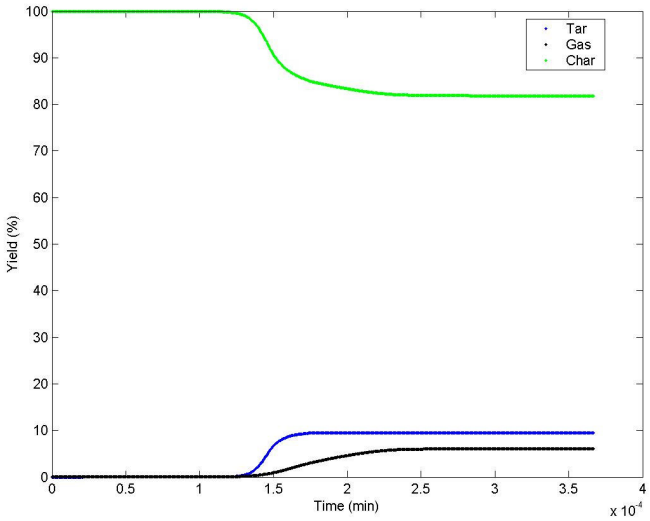

Figure 1 – Evolution of the devolatilization process with time.

The optimization was carried out by analyzing the chemical species generated after the devolatilization and their dependency on the main operative parameters, like temperature and pressure, which rule the process. The analysis needs acquisition of chemical and physical knowledge about the phenomenon of devolatilization and was performed with a dedicated

scientific software. The kinetic parameters of the devolatilization process were obtained by assuming a single step kinetic model and by using the Arrhenius equation to correlate the data. An example of the kinetic parameters identification step is reported in Figure 2.

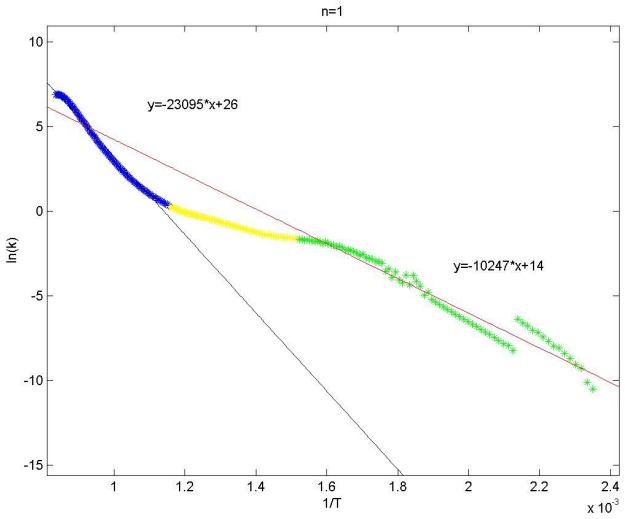

Figure 2 – Devolatilizazion kinetic parameters identification.

The simulated composition of the volatile species and the definition of the fundamental parameters of the combustor, necessary to study the feasibility of a plant at the industrial size, allowed to perform a sensitivity analysis for the evaluation of the most efficient kinetic configuration of the combustion. The analysis was carried out with a commercial fluid-dynamic software appropriately tailored and the results of the simulations were validated against the analysis of solid and gaseous emissions. This work allows the definition of an acceptable configuration of the combustor and provides a new starting point for the development of the mild technology applied to coal combustion. With the obtained results as starting point, the feasibility of testing the combustor for a 5 MW plant will be evaluated and the possibility to use this process with a wide set of carbon types will be considered.

Keywords: Devolatization, Oxy-combustion, coal combustion
Proposed Topic: Oxy-combustion