PRELIMINARY NUMERICAL ANALYSIS OF THE MILD COMBUSTION OF LIQUID HYDROCARBONS

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Abstract
MILD technology allows to significantly reduce the emissions of pollutants that can be produced by a combustion process, by making use of a strong preheating of the combustion chamber and an intense recirculation of exhaust gases. CFD simulations can reduce the costs in terms of time and money related to the experimental investigation of MILD combustion. In fact, a CFD model is able to predict the results of an experimental test without actually carrying out it or, vice versa, allows performing simulations whose results are the starting point for the design of new experiments. Scientific literature contains many studies on CFD modelling of MILD furnaces operated with gaseous fuels, while the same does not apply for the use of liquid fuels. This is a limit because a large number of commonly used fuels are available in liquid state. Modelling MILD combustion in these conditions, however, is rather complex; different variables are introduced, which are often not present with gaseous fuels: chemical complexity, atomization of liquid droplets and vaporization phenomena. Liquid fuels, at ambient conditions, are often molecules constituted by a high number of atoms; when they are burnt, they often follow a complex reaction mechanism, which must be modelled using sufficiently detailed kinetic schemes and implemented in the CFD code. Since combustion occurs in vapor phase, a liquid fuel must be sprayed inside the burner to reduce its surface area and then favor its vaporization; therefore, also these operations have to be described. The objective of this work was therefore the CFD modelling of the combustion of liquid n-heptane using detailed kinetics, occurring inside a laboratory-scale burner operating in MILD conditions. Preliminary results were satisfactory, as a reasonable agreement between model predictions and experimental data was found.