SUSTAINABILITY OF MILD COMBUSTION IN A CYCLONIC BURNER. INFLUENCE OF THERMAL POWER.

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Abstract

Autoignition and stabilization of distributed combustion regimes have been proved to occur when a sufficient entrainment of hot species in the fresh oxidant and fuel jets, by means of an efficient turbulent mixing, is reached.

The study presents the performance of cyclonic burner operated in MILD combustion. The cyclonic flow has been achieved by means of two pairs of oxidant/fuel jets that feed a prismatic combustion chamber in an anti-symmetric configuration thus realizing a centripetal cyclonic flow field with a top-central gas outlet.

Experimental campaigns have been performed for propane/air combustion without external dilution by systematically varying average residence times of the gases and nominal thermal power. Temperature measurements inside the chamber and gas sampling analysis were carried out in order to evaluate the operability range of the cyclonic burner and its performance.

It has been demonstrated that MILD Combustion regime can be established in a wide range of operating conditions even feeding the cyclonic burner with undiluted air. Stable MILD combustion regimes, not achievable from frozen conditions, can be obtained by exploiting an observed hysteresis behavior.

The residence time of the streams inside the chamber plays an important role on the reactive structure stabilization and combustion performance, especially in terms of emissions. In particular, slightly fuel-lean conditions resulted, for the explored conditions, to be the optimal working point in order to minimize CO and NOx, simultaneously.

In addition, the sustainability of the process in absence of oxidant flow preheating has been demonstrated for several values of the nominal thermal load. It has been showed that it is possible to achieve a complete fuel conversion and low pollutant emissions for nominal thermal powers up to 6 kW. Such condition ensures very good performance in terms of stable working conditions of the cyclonic burner, thermal efficiency and eco-compatibility.

It has been shown that the cyclonic burner is a flexible, stable and efficient burner in a wide range of working conditions.