EFFECT OF STEAM ON THE DYNAMICS OF NO FORMATION DURING CH_4 COMBUSTION IN THE PERFECTLY STIRRED AND PLUG FLOW REACTORS

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Abstract: This work is devoted to the calculation of the dynamics of NO formation during combustion of the premixed air–methane stoichiometric mixtures ($\phi = 1$) in the perfectly stirred and the plug flow (PFR) reactors at the presence of steam. It is shown that in both types of the reactors, the increase of the H_2O/CH_4 ratio from 0 to 5 reduces the concentration of the emitted NO. The power of the relative decrease of NO concentration followed the increasing of H_2O/CH_4 ratio does not depend on the reactor type. However, it is found that the absolute concentrations of NO, determined at the time corresponding to the maximum temperature, are always lower in the case of PFR and is due to the lower residence time of the combustion products in the high-temperature zone. According to this study, the kinetics of NO formation in PFR can be described by a two-staged process called in the present work as the "fast" and "slow" reactions that correspond, respectively, to the flame and postflame zones. It is also shown that the effect of steam, added to the initial mixture, on the rate of chemical reactions producing NO is significant only in the case of PFR and only at the initial time (fast) of combustion ($\leq$ 30 ms). At the same time, it is shown that the concentration of molecular nitrogen in the initial mixture also affects the chemistry of NO formation, but in both stages.

Keywords: methane; steam; combustion; NO; perfectly stirred reactor; plug flow reactor

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