

NO removal by Gas Reburning and Selective Non-Catalytic Reduction (SNCR) using ammonia: An experimental study in a semi-industrial reactor.

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Nitric oxides (NO_x) including nitric oxide (NO), nitrous oxide (N₂O) and nitrogen dioxide (NO₂) are one of the most important air pollutants generated from high temperature combustion processes. NO_x have been drawing wide attention because of their particular environmental hazard and difficulty of reduction. Many technologies have been developed and commonly used to reduced the NO_x emissions. Among them, the Reburning and Selective Non-Catalytic Reduction (SNCR) processes have been demonstrated to be very effective with low investment costs techniques.

The aim of this work consists in an experimental study of the influence of the working parameters on the Gas Reburning and SNCR processes which use, respectively, CH₄ and NH₃ as reducing agent for NO removal. The experiments have been performed in a semi-industrial reactor that consists in a 1.1 meter long tube with inner diameter of 8 cm, equipped with 13 accesses allowing temperature measurements and gas sampling. A methane-air flame seeded with known amounts of NO (from 0 to 1400 ppm) stabilized at atmospheric pressure on a Mc Kenna flat flame burner with constant equivalence ratio ($\phi = 0.91$) has been used to generate smokes of known compositions and features. The reducing agent mixture (CH₄/N₂ or NH₃/N₂) was injected in flue gas by a device constituted by four water cooled perforated tubes. Five electric heaters were placed along the reactor in order to control working temperature (maximum of 1213 K). Gas sampling was performed by using a specific probe connected to an experimental set-up allowing experimental measurements by Fourier Transform InfraRed spectroscopy (FTIR). Chemical species such as NO, CH₄, CO, CO₂ and NH₃ which play important roles in the process have been measured.

A complete experimental study on Gas Reburning using methane has been performed. Several working parameters such as: reburn zone stoichiometry, residence time, injection temperature, and initial NO concentration were analyzed. As a result, very high efficiencies (up to 88%) of NO reduction have been achieved in the optimal conditions. By using NH₃ as reducing agent, although a competition between NO reduction and NH₃ oxidation phenomena was occurring, a NO removal efficiency up to 82% has been noted. Lastly, the coupling Reburn/SNCR in a Hybrid technique in which NH₃/CH₄/N₂ mixture is directly injected in flue gas has been tested. As a result, the coupling approach induces a shift of the reaction temperature to lower points and allows a widened optimal temperature window.

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