Selective catalytic reduction of NOx with NH3 in unsteady-state reactors.

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Selective catalytic reduction of NO_x with NH_3 in unsteady-state reactors

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The feasibility of Selective Catalytic Reduction (SCR) of NO_x with ammonia in unsteady-state reactors was studied by means of numerical simulations and experimental investigations. The reverse-flow reactor (RFR) with a catalyst that strongly adsorbs ammonia was proposed even recently for this process as the RFR operation enables trapping of the ammonia in the bed and minimising its emissions. One of the main problem of such a mode of reactor operation is the emission of ammonia occurring at each switch, due to the reversal of the flow direction.

A reactors network (RN) with periodical change of the feeding position was shown to be an alternative to the RFR as in this system the flow direction is never changed, thus allowing for a further reduction in ammonia emissions, beside fulfilling the requirements on NO_x removal. The influence of the switching time and of the switching strategy in the RN on the mean outlet concentration of NH_3 and NO_x was investigated, proving that the RN can be competitive with the RFR, allowing for high conversion and achieving lower emissions of NH_3, whose level is subject to even stricter restrictions. Moreover, the possibility of achieving autothermal operation both in the RFR and in the RN when feeding gas at low temperature was also addressed as the adiabatic rise in NOx removal is usually of the order of 10-20 K, but, the temperature rise in a RFR (as well as in a RN) will be a multiple of this value. In this conditions, the choice of the switching time will be affected also by the dynamic of the heat wave, as too long switching time will lead to reaction extinction, due to the heat removal from the catalyst. The response of these devices to perturbations in the pollutant feed flow rate and concentration was also investigated.