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Impact of Soot on NH3-SCR, NH3 Oxidation and NH3 TPD over Cu/SSZ-13 Zeolite

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Abstract : Ammonia Selective Catalytic Reduction (NH3 SCR), is one of the most efficient post combustion abatement technologies for removing NOx from diesel engines. In order to remove soot, diesel particulate filters (DPF) are used. Recently, SCR coated filters have been introduced, which captures soot and simultaneously is active for ammonia SCR. There are large advantages with using SCR coated filters, such as decreased volume and also better light off characteristics, since both the SCR function as well as filter function is close to the engine. The objective of this work was to examine the effect of soot, produced using an engine bench, on Cu/SSZ-13 catalysts. The impact of soot on Cu/SSZ-13 in standard SCR, NH3 oxidation, NH3 temperature programmed desorption (TPD), as well as soot oxidation (with and without water) was examined using flow reactor measurements. In all experiments, prior to the soot loading, the fresh activity of Cu/SSZ-13 was recorded with stepwise increasing the temperature from 100°C till 600°C. Thereafter, the sample was loaded with soot and the experiment was repeated in the temperature range from 100°C till 700°C. The amount of CO and CO2 produced in each experiment is used to calculate the soot oxidized at each steady state temperature. The soot oxidized during the heating to next temperature step is included, e.g. the CO+CO2 produced when increasing the temperature to 600°C is added to the 600°C step. The influence of the two factors seem to be of the most importance to soot oxidation: ammonia and water. The influence of water on soot oxidation shift the maximum of CO2 and CO production towards lower temperatures, thus water increases the soot oxidation. Moreover, when adding ammonia to the system it is clear that the soot oxidation is lowered in the presence of ammonia, resulting in larger integrated COx at 500°C for O2+H2O, while opposite results at 600 °C was received where more was oxidised for O2+H2O+NH3 case. To conclude the presence of ammonia reduces the soot oxidation, which is in line with the ammonia TPD results where we found ammonia storage on the soot. Interestingly, during ammonia SCR conditions the activity for soot oxidation is regained at 500°C. At this high temperature the SCR zone is very short, thus the majority of the catalyst is not exposed to ammonia and therefore the inhibition effect of ammonia is not observed.

Keywords : NH3-SCR, Cu/SSZ-13, soot, zeolite
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