Effect of flow conditions on characteristics and morphological variations of urea deposits during preliminary stage in Urea-SCR Systems–A study using SEM and XRD

Sadashiva Prabhu S (✉ ss.prabhu97@gmail.com)

Manipal Institute of Technology <https://orcid.org/0000-0002-5364-7647>

Nagaraj Shivappa Nayak

KBAT Technologies Pvt. Ltd., Pune

Kapilan Natesan

Nitte Meenakshi Institute of Technology

Research

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Abstract

Urea-Water Solution (UWS) is sprayed into the diesel engine exhaust gases of automobiles to generate reducing agent NH_3 in Urea-SCR system adopted to diesel engines of modern automobiles for the mitigation of NO_x . Although, it is a very efficient technique, the deposit formation at low temperature is a major concern. The growth of deposits not only reduces the efficiency of NH_3 generation, but also generates non-depleting complex compounds. The temperature and Reynolds number have significant effects on these deposit formation. The compositional variation and crystallinity of deposits were experimentally investigated using EDX and XRD with respect to variation in temperature and flow rate at the preliminary stages. The elemental analysis done for different samples using EDX indicates urea as a major constituent in most of the deposits up to 250 °C for overdosed conditions. The XRD results indicate the evolution of various traces of urea related compounds at different temperature and flow rate. Using Scanning Electron Microscopy (SEM), the morphological variations were studied. The comparative study of morphology of deposits during the initial stages of deposit formation indicates an extent to which growth can take place and probable areas of deposits for further growth for varying exhaust gas flow rates.

Full Text

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Figures

Figure 1

Experimental setup showing UWS injection and deposit formation

Image not available with this version

Figure 2

Image is not available with this version

Figure 3

Powder XRD(Voltage-20-40V, Current-2-15mA along with chiller water circulation

Figure 4

EDX results of urea deposits formed at a) pure urea,150°C-34.74kg/h, 86.86 kg/h, 121.6 kg/h b) pure urea,2000C-34.74kg/h, 86.86kg/h c) pure urea, 2500C-34.74kg/h.

Figure 5

The comparison XRD Results of tested at various flow rates 150°C

Figure 6

The morphology of samples tested at various flow rates at a) Pure Urea b) 150°C-34.74kg/hr c) 150°C-86.86kg/hr d) 150°C-121.6kg/hr

Figure 7

The comparison XRD Results of tested at various flow rates 200°C

Figure 8

The morphology of samples tested at various flow rates at 150°C a) 34.74kg/hr b)86.86kg/hr

Figure 9

The comparison XRD Results of tested at various flow rates 250°C

Figure 10

The morphology of samples tested at various flow rates for the sample tested at 250°C at 34.74kg/hr