Cite abstract as Author(s) (2009), Title, European Aerosol Conference 2009, Karlsruhe, Abstract T033A10

HCl-Aerosols in Industrial Gas Cleaning Processes

G. Brosig[1], M. Bittig[1], J. Lindermann[1], S. Haep[1], M. Luckas[2] and K.-G. Schmidt[1]

[1]Institute of Energy and Environmental Technology, Bliersheimer Straße 60, 47229 Duisburg, Germany
[2]Thermal Process Engineering, University Duisburg-Essen, Lotharstraße 1, 47057 Duisburg, Germany

Keywords: absorption, aerosol modelling, heterogeneous condensation.

The aim of this work was to examine and to model the behavior of flue gases from incineration processes during the passage of wet scrubbers. At waste incineration plants equiped with a wet scrubber system to absorb HCl it was observed that the emitted gas contained significantly higher concentrations of HCl than expected and designed. The reason for this increase in HCl-amount could be traced back to the generation of fine HCl-droplets generated during the passage of the scrubber.

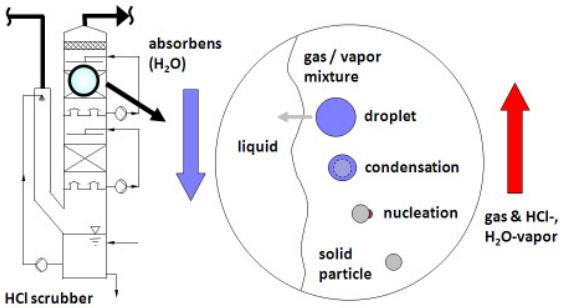

Figure 1. Physical model of the droplet generation during the passage in a HCl-scrubber.

In spite of modern separating systems the discharge of fine dust cannot be eliminated completely. The very tiny particles remaining in the exhaust gas are seeds for the fog formation. This nucleated seeds will grow inside the scrubber because of condensation to micron droplets (Fig. 1) but remain in a growth class where the droplets are very difficult to separate. Because of this carrier effect the HCl-fog passing the scrubber can cause problems of precipitation, damage the catalysator and cause corrosion in following plant units. Eventually there is the risk that the specification limits of the exhaust gas concerning HCl cannot be hold.

To support the plant manufacturer of scrubbing systems a flexible and broad applicable simulation program based on a rigorous process model was developed. The program has the ability to model the thermodynamical states and complex transfer processes in the scrubber. For this the balance equations for mass, components and energy was established according to a segmented non-equilibrium-stage-model. This model contains correlations for mass and energy transfer between gas, liquid, and particle phase. For computing the stationary solution the numerical equation solver LIMEX from ZIB (Zuse Institute Berlin, Ehrig *et al.*, 2002) was used.

The program was then successively validated. Initially the physical consistency of the model and the exactness of the program were checked by means of more simple units like heat exchanger, humidifier and HCl-absorber. Finally validating calculations of the total complex process model were carried out. Therefor experimental data from literature (Vogt, 2001; Haep, 2000; Ofenloch, 2005) were utilised as well as measurement results obtained from experiments at the technical scale plant erected for this purpose at IUTA (Institute for Energy and Environmental Technology). In all cases the simulation showed a good agreement with the experimental results. As one example the measured particle diameter at the end of the scrubber is compared with the calculated one (Fig. 2).

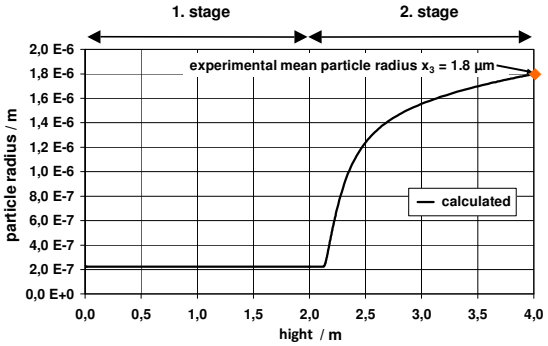

Figure 2. Good agreement for the particle radius between simulation and experiment

This work was supported by grants from BMWi via the German Federation of Industrial Research Associations AiF; No. 11756 & 13526.

Ehrig, R, Ofenloch, O., Schaber, K. & Deuflhard, P. (2002). *Chem. Eng. Science*, 57, 1151-1163

Vogt, U. (2001). *Konditionierung und Abscheidung submikroner Partikeln in Füllkörperkolonnen*. Kaiserslautern, Germany: Fortschritt-Berichte Mechanische Verfahrenstechnik und Strömungsmechanik, Band 4, Aerosolabscheidung

Haep, S. (2000). *Bildung und Wachstum von Aerosolen unter Bedingungen der nassen Rauchgasreinigung*. Düsseldorf, Germany: Fortschritt-Berichte VDI, Reihe 3, Verfahrenstechnik, Nr. 641, VDI-Verlag.

Ofenloch, O. (2005). *Entstehung und Verhalten von Aerosolen in Gaswaschanlagen*. Düsseldorf, Germany: Fortschritt-Berichte VDI, Reihe 3, Verfahrenstechnik, Nr. 832, VDI-Verlag.