



## Droplet concentration (LWC) and its chemical composition after gas cleaning in the lignite fired power plant Jänschwalde (FRG)

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New gas cleaning act is directed to a further drastic reduce of SO<sub>2</sub> emissions in Germany. All power plants must be equipped in 1998 with flue gas desulphurization equipment. The Vereinigte Energiewerke AG (VEAG) owned power station at Jänschwalde is a base load power generating plant which uses lignite from the Lausitz region (3000 MW capacity). In 1991 an order was placed with the company NOELL-KRC for the construction of flue gas desulphurizer (FGD) trains to desulphurize the power plant flue gases by means of the wet scrubbing method. The first of this trains has been taken into service in 1995, the last one in 1996. The SO<sub>2</sub> absorption efficiency by the gas cleaning process is 98 %. The reaction product of all the trains, gypsum, is dewatered at a common dewatering station. Limestone slurry that is generated at the power stations own grinding plant is used as the absorbent. Figure 1 present the flow diagram of the twin sections (absorber and quencher) FGD. In order to prevent the loss of absorption solution, in the upper part of the absorber are

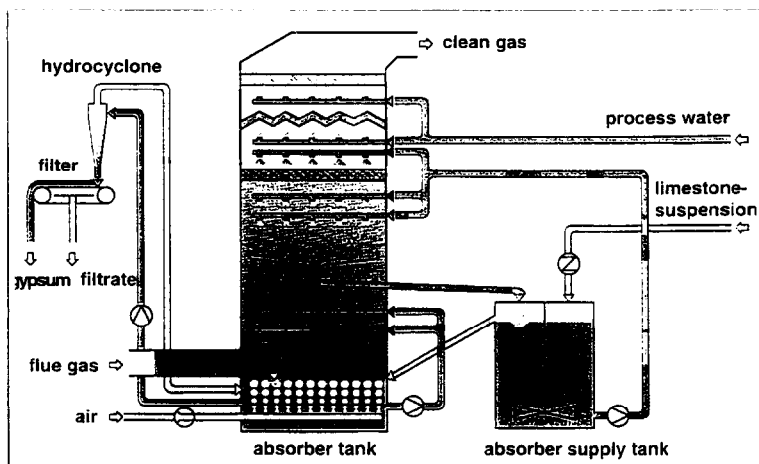


Figure 1: Flow diagram of the flue gas desulphurization wet scrubbing process

installed mist eliminators for coarse and fine droplets. This eliminators must be flashed periodically by process water to prevent the separators from blocking itself by gypsum particles.

The research problem was formulated by VEAG company to find out the loss of droplet volume, which will leave the FGD and to identify the sources of the loosened droplets.

We used three different and independent methods for the calculation of the droplet loss and the analysis of solute trace compounds as well as cesium being a tracer for the identification of droplet sources. First the averaged LWC was calculated from the sampled droplet volume of an active cloud water collector (Eigenbrodt Company) to be  $54 \text{ mg Nm}^{-3}$ .

Second, the fine structure of droplet spectra change were measured in the time resolution of 1 second by the laser spectrometer FSSP 100 in the droplet diameter range from  $0,5 - 47 \mu\text{m}$ . We only found droplets in the diameter range between  $1$  and  $16 \mu\text{m}$ . Droplets with larger diameter practically were not detected by the spectrometer. The integrated droplet water content was calculated in the range  $1 - 16 \mu\text{m}$  to  $\text{LWC} = 41 \text{ mg Nm}^{-3}$ . In agreement to the droplet collection we calculated the integrated droplet water content in the range  $4 - 16 \mu\text{m}$  as  $\text{LWC} = 39 \text{ mg Nm}^{-3}$ .

The droplet number concentration significantly decreased if the mist eliminator sections were flushed by process water. Simultaneous with the decreasing droplet number the droplet volume increases. Looking to volume distribution of droplets we find in the range between  $1$  and  $5 \mu\text{m}$  diameter a volume loss whereas in the range between  $6$  and  $16 \mu\text{m}$  diameter a significant increase of the droplet volume was detectable. This spectral shifting of the droplet number concentration and the droplet volume may be explained by condensation of humidity due to the temperature gradient between the flashing process water ( $15 \text{ }^\circ\text{C}$ ) and the ambient temperature in the clean gas ( $67 \text{ }^\circ\text{C}$ ). We calculated the effective increase of the droplet volume caused by water condensation to  $\text{LWC}_{\text{condensation}} = 19 \text{ mg Nm}^{-3}$ .

Third, for the source identification of possible process water and absorber solution losses we marked the process water with cesium. As the concentration of this tracer element was normally in the process water and in the absorption solution below the detection limit of the ICP-MS analysis method. Solute CsCl was added to the process water and the Cs concentration as well as the concentrations of solute B, Al, Ca, Mn, Fe, Zn were analysed by ICP-MS in the samples of process water, absorber solution, quencher solution, collected droplets and condensed / impacted water from the wall of the clean gas channel.

In spite of the high Cs concentrations of about  $2000 \mu\text{g/l}$  in the process water we found in the droplet samples only  $\text{Cs}^+$  concentrations of about  $0,1 - 0,2 \mu\text{g/l}$  (or equivalent  $2 * 10^{-9} \text{ g/Nm}^3$ ). In dependency from the flashing of the mist eliminators we analysed in the wall condensate solution of the clean gas channel Cs concentrations from  $1$  up to  $12 \mu\text{g/l}$ .

The concentrations of Cs and the other trace compounds in the droplets and in the wall condensate solution suggest, that the sources of these compounds are neither process water nor absorber solution. We conclude, that the droplets within the flue gas after FGD will mainly be formed by condensation onto fly ash particles. The loss of process water and sorbent solution is neglectable. Thus the installed mist eliminators for coarse and fine droplets work with high efficiency in the flue gas desulfurizer in the power plant Jaenschwalde.