Characterisation of gypsum from lignite coal burning power plant

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Gypsum is a by product of the coal burning flue gas desulphurisation process. There are many uses for FGD gypsum, including agriculture, gypsum panel products, highway construction, mining applications, cement production, water treatment and glass making. Gypsum may also contain trace and major elements at concentrations that limit the use of gypsum, therefore it is important to quantify these elements and their species and determine the origin of these elements. The origin of the elements is due to the presence of trace elements in flue gases, limestone and water used in the FGD system. In the FGD slurry complex physical and chemical processes may results in precipitation, sorption, and dissolution of elements that are partitioned between different particle sizes of the gypsum.

The present work will present the results of the gypsum characterisation study for over 45 elements, including mercury as the target toxic metal, at the lignite burning power plant Šoštanj, Slovenia, having five power blocks in the past with combined power of 775 MW. At present time there are two blocks, new supercritical B6 with 650 MW and the old B5 with 325 MW in stand-by mode. They use lignite from the local mine as a fuel. Gypsum samples were obtained from FGD units for removing SO_2; the first covering blocks 1-4 while the second covers block 5. Both are using the wet limestone process with forced oxidation and are equipped with ESP. The process of desulphurization is almost identical in both WFGD units; the differences are in the setup (number of pumps, one or two hydro cyclones and different position of the air inlet for oxidation). Two different boilers are used; The Babcock Benson Boiler on units 1-4, while unit 5 uses a Sulzer mono-pipe vertical rig boiler. The third WFGD scrubber (block 6) is equipped with a selective catalytic reduction (SCR) DeNOx system for controlling nitrogen oxide emissions (NO_x), ESP to eliminate particles and WFGD units for removing SO_2.

Comparison of trace and major elements in gypsum obtained from three FGD systems indicate that the partitioning among different size fraction in gypsum is similar to all of them, where concentrations are orders of magnitude higher in smaller fractions (<0.1um particle size) compared to coarse fraction. The enrichment factor in smaller particle size fractions is highest for Hg and Se in all FGD samples. In FGDs of Blocks 1-4 and 5, levels of Cl and Br are also highly enriched, however this is not the case for Block 6. As the smaller fraction represents only a minor mass fraction of the gypsum, physical separation of a smaller size fraction may be used to reduce the presence of toxic metals in bulk gypsum.

The paper will also address uncertainties related to sample preparation on overall quality of data, particularly the methodologies for separation of different size fractions. Examples of speciation of Hg will also be presented and critically assessed.