1st Post Combustion Capture Conference

Evaluation of emissions of substances other than CO_2 from Power Plants with Post Combustion Capture.

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1. Introduction

One of the possibilities to reduce carbon emissions to the atmosphere is the application of Post Combustion Capture (PCC) technologies to large power plants. Although PCC will reduce CO_2 emissions, it will also have an effect in the emission levels of other substances (regulated or not) that are also emitted in power stations. Generating accurate information on these substances (i.e. SOx, NOx, trace metals, solid and liquid waste) is important in order to evaluate the environmental impact of PCC and to design appropriate waste management. There are two complicating issues:

- Most of the information available in public domain is related to specific power / pilot plants. This means that the emissions reported are specific to the fuel type used and technology related parameters, such as boiler type, plant efficiency, emissions controls. Therefore it is not possible to use this information directly for the estimation of emissions of a given case.
- The emissions of many trace substances (such as metals) are uncertain due to lack of data, uncertainties in the analytics and uncertainties in the models of power plants.

In this study, a clear overview is given of the waste and emissions generated by PCC. First, a methodology that addresses the key issues mentioned above is introduced. Then, the work evaluates the emissions to land, air and water of two different power plants (coal fired and gas fired) covering all substances that originate from the gas feed to the post combustion capture unit. However, the emissions of solvent and solvent derived materials have been excluded due to the complexity of their evaluation. This study gives a harmonized overview of public domain emissions and serves as the basis for future LCA studies and waste management.

2. Methodology: Literature Harmonization, modeling and waste estimation

Figure – 1 shows a scheme of the methodology followed in this study. The method by which emission data are transformed to the same reference basis is called *"Harmonization*". This methodology has been used to analyse all

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public domain information regarding emissions of power plants with and without PCC. Two power plant cases were used as reference for Harmonization.

Key plant performance (process and utility balances) were obtained by simulation with commercial software. The estimated parameters (plant efficiency, CO_2 recovery, CO_2 product conditions) were used to harmonize the data. For those substances that are not commonly monitored (i.e amine reclaiming waste, trace metals, specific gas components such as SO_3, NO_2) a parametric model has been developed based on the latest literature findings. Uncertainties are covered by sensitivity analysis of key parameters.

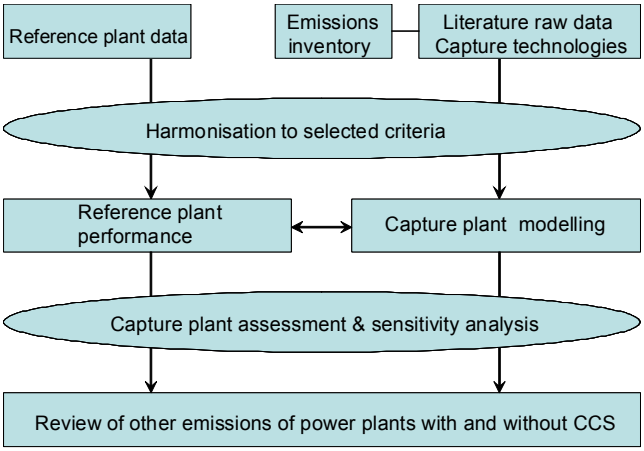


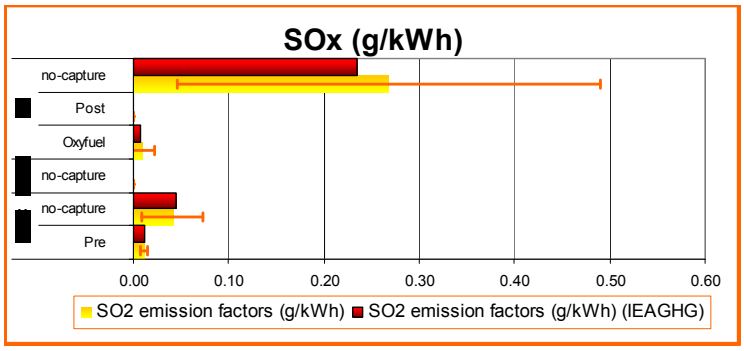
Figure-1 Work flow of this study

3. Base Cases and Results

The following power plant systems have been studied extensively:

- Natural gas-fired Combined Cycle Gas Turbine plant
- Ultra Supercritical Bituminous coal-fired plant

An example of the results of the literature, harmonization studies and modeling can be found in the Figure -2.
It is evident that harmonization results show a large standard deviation that can be explained by different phases of the projects (demo vs commercial), different processes and technologies and different flue gas cleaning. Nevertheless, harmonization is clearly a methodology which can be used to gather greater insights into this field. The information obtained will be useful for the further improvement of post combustion capture systems as well as for permitting and regulations.



The harmonized emissions have been completed with the results of the parametric modeling of emissions that are lacking in the literature. The presentation will show the gaps and issues regarding the monitored emissions and the estimated values with state-of-the art technology.

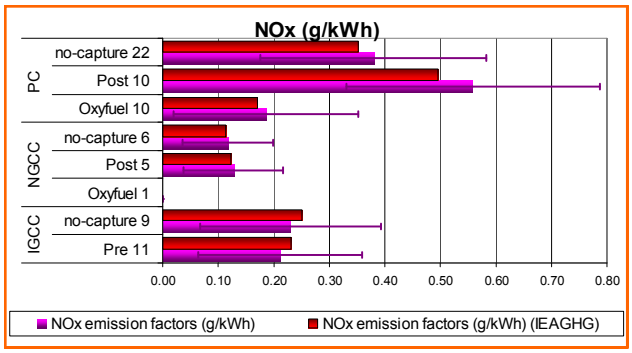


Figure – 2 (Up) Harmonised emissions of SO_x
(Right) Harmonized emissions of NO_x