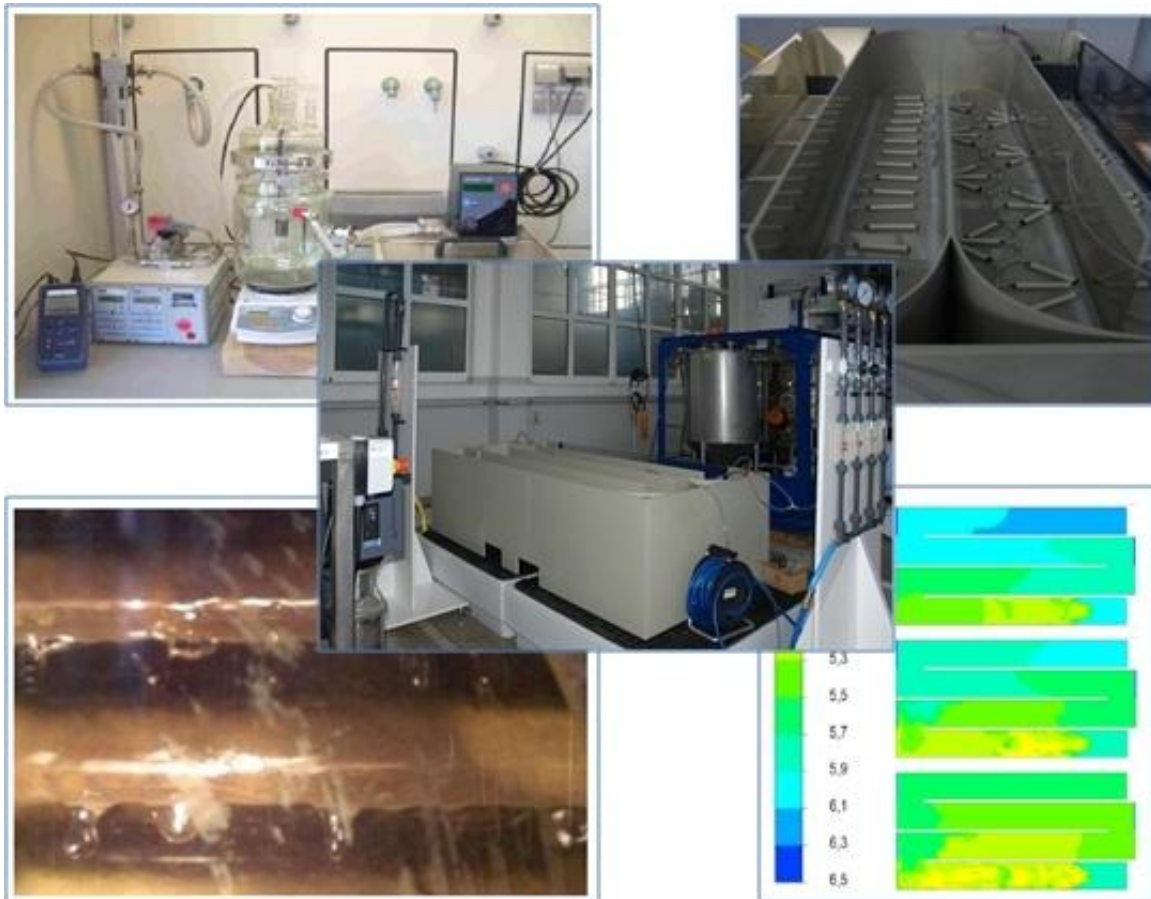


## Summary of Results

**Studies on the technique of flue gas desulfurization with seawater  
focused on a simultaneous generation of electricity and  
drinking water**

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The research project of the VGB Research Foundation was funded by the German Federal  
Ministry of Economics and Energy



via the national organization AiF.



AiF is promoting applied research and development benefiting Germany's small and  
medium-sized businesses (AiF project no. 17118 N).

*The research project was carried out by three research centres*

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## VGB Project No. 353

### Summary of results

In this project, the effects of the use of concentrates from the drinking water (brine) production on the absorption of  $\text{SO}_2$  in flue gas scrubbers and the oxidation in a downstream oxidation basin of seawater FGD were investigated.

In determination of the data of chemical media for the absorption of  $\text{SO}_2$  in electrolyte systems it was found and proved that in the liquid phase the complex  $\text{SO}_2\text{Cl}^-$  is formed whose consideration, when modelling the concentration of sulphur species in the liquid phase, is significantly more accurate than currently available data in literature. However, this accuracy decreases with increasing the complexity of the electrolyte system, as is the case with the use of seawater.

A quantitative determination of low sulphite concentrations in complex electrolyte systems cannot be done with ion chromatography due to the existing interference with other ions. Therefore iodometric determination method was established.

For the modelling of sulphite oxidation in the oxidation basin the reaction kinetics was determined. It could be shown that above 10% of the dissolved oxygen concentration, the oxygen concentration does not affect the reaction rate and that in this region the reaction order for the sulphite oxidation is 1.5. With increasing salt content increases the reaction rate too, while in the presence of calcium chloride a slowdown occurs. This is probably caused due to the precipitation of calcium sulphite. The oxidation rate shows at pH 6.5 a maximum and the temperature dependence is a linear relationship. As a result of these investigations the dimensioning of the Oxidation basin shall have a height / width ratio of 1: 2 and a minimum residence time of 10 minutes.

In modelling the effects of ab- and desorption,  $\text{O}_2^-$ , sulphite-, salt concentration and pH as well as the hydrodynamics of a two-phase flow under consideration of bubble size and bubble floating-up and mass transfer with Henry- and mass transfer coefficients must be taken into account. Transition metals have the potential to catalyze sulphite oxidation. However, significantly for this project was only the inclusion of iron in the modelling.

Considering all the above conditions it could be built a suitable model to describe the reactions in the oxidation basin. It has been found that the use of brine results in an increase in the performance of the oxidation basin in particular due to an increase of the pH and temperature. With the model it is possible to optimize the place for addition of brine so that the maximum pH value can be reached at the output of the oxidation basin. It was shown also that for dimensioning it has to be made sure that a good radial and only a small axial mixing should be achieved by the use of baffles.

For the modelling of the  $\text{SO}_2$  absorber the same simulation model as for the oxidation basin could be used, but the image of a drop of rain was used instead of bubble floating-up and the time step was reduced by a factor of 200 to consider the reduced residence time.

A combination of both models (absorber and oxidation basin) will not appear useful, since no improvement compared to the individual models is detected, the time steps are significantly different and there is no positive feedback of both models. It is sufficient to transfer the values from one model to the other.

In the modelling of the scrubber, which is mainly based on literature data, it was found that the use of the brine leads not to an improvement of the performance of the absorber. Both, the dissociation of  $\text{SO}_2$  and the Henry coefficient were adversely affected, thus the rate of

absorption decreases significantly. This can also not be compensated with the higher buffer capacity by the carbonate content of the added brine.

As a result of the modelling of the oxidation basin it could be shown a positive effect on the reaction rate of sulphite oxidation by the use of brine. In preliminary investigations to the experiments in the oxidation basin, under defined conditions with synthetic seawater and concentrates prepared out of it, the positive effect on the rate of sulphite oxidation could be confirmed. In the experiments in the oxidation basin on a pilot scale, however, could not determined a significant difference between the use of synthetic seawater and the concentrates. It is possible that flow effects and locally arising turbulences caused by the aeration, the effects of different salt concentrations of the used media are superposed.

The investigations carried out in this project and the developed model can be used as a basis for process coupling. For dimensioning of a pilot plant the consideration of the real medium is recommended.

The objectives of the project were achieved.