# Modeling Mass Transport Properties of Oxyfuel-Relevant Species in the Porous Structure of Solid Biomass Fuel Particles

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A promising approach to reduce $CO_2$ emissions in energy conversion processes is the substitution of solid fossil fuels for biomass in combination with an oxyfuel-combustion atmosphere. The resulting flue gas consists almost exclusively of $CO_2$, which can be separated by carbon capture, utilization, and storage (CCUS) technologies. Combining biomass energy with a CCUS unit (BECCS) could even lead to net-negative $CO_2$ emissions. Along with the novel solid biomass fuel properties (e.g., high mineral and volatile content) and the highly reactive oxyfuel atmosphere, the significantly changed combustion characteristics are an important subject of research. A considerable impairment of the reaction kinetics in biomass conversion is related to the limiting effect of gas transport in the porous structure of particles. In frequently applied char conversion models, the intraparticle diffusion of reactive gases is usually expressed by an effective diffusion coefficient. The effective diffusion coefficient is either treated as an adjustable parameter or is reduced to the contribution of Knudsen diffusion, which entails additional assumptions of pore structure parameters. However, considering the strong impact of pore structure on the mass transport of gases and the altered porosity influenced by the high proportion of volatiles in biomass chars, the currently available description of diffusion and mass transport is not sufficient.

The claim of this work as part of the collaborative research center OXYFLAME, which is funded by the German research foundation DFG, is to find a physically more meaningful description of the mass transport of relevant gases in the porous structure of the particles. The pore-structure-dependent kinetic adsorption (PSK) model by Wedler and Span [1] serves as a basis for further investigations. The PSK model predicts the pore-structure-dependent, adsorptive mass transport of relevant oxyfuel gases based on comprehensive kinetic adsorption measurements and pore surface area data for the underlying biomass chars. This study investigates different variations and extensions of the PSK model for different oxyfuel components considering their individual adsorption characteristics and the possibilities for modeling their mass transport properties.

## References

1. Wedler C, Span R. A pore-structure dependent kinetic adsorption model for consideration in char conversion – Adsorption kinetics of CO2 on biomass chars. Chemical Engineering Science 2021;231:116281