Characterization of Sorbents for Hot Gas Desulfurization in Biogas-Fueled SOFC Systems

Master Project (30 ECTS)/Semester Project (10 ECTS)

Administrative

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Project description

Solid Oxide Fuel Cells (SOFCs) are a promising technology in the context of the energy transition, offering high efficiency and fuel flexibility due to their use of a solid-state electrolyte that enables operation at elevated temperatures. An advantage of this high-temperature operation is the ability to utilize a variety of fuel gases derived from biogenic waste. However, SOFCs are highly sensitive to fuel impurities, particularly sulfur compounds such as hydrogen sulfide (H_2S), which can poison the anode and degrade performance even at concentrations of 1 ppmv. Therefore, advanced gas cleanup technologies are essential to ensure reliable operation.
Hot gas desulfurization (HGD) is particularly attractive, as it enables sulfur removal at elevated temperatures (≃ 500 °C), thereby eliminating the need for gas cooling and heat exchangers and improving overall process efficiency [1]. Different sorbents have already been tested, and some of them can lead to useful byproducts [2], [3].

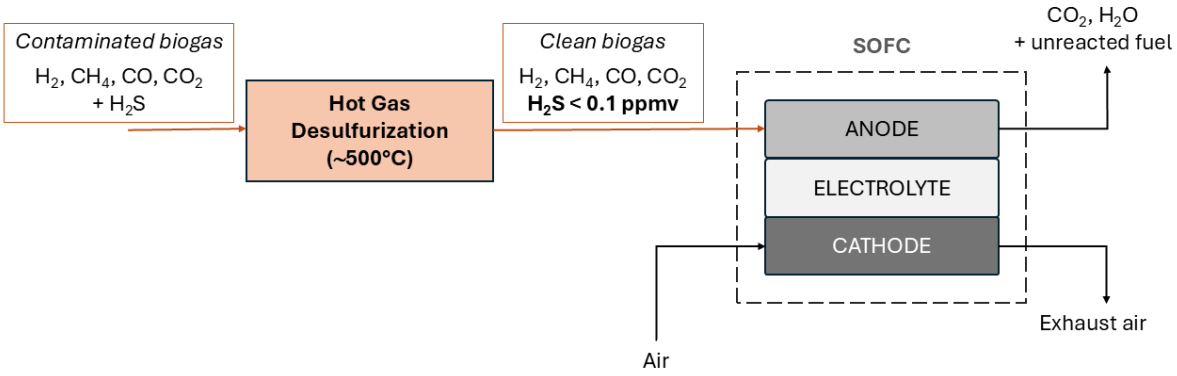

Figure 1 - Simplified scheme: HGD + SOFC

Your tasks

The objective of this project is to evaluate various sorbents for sulfur removal from contaminated biogas under different operating conditions, such as temperature and gas flow rate. This screening aims to identify the most effective sorbents and optimal HGD conditions to maximize H_2S removal efficiency and ensure compatibility with SOFC operation.

The work will include the following tasks:

a) Literature review about HGD process and selection of most suitable sorbents.
b) Introduction to the laboratory and the experimental stations.
c) Experimental characterization of the selected adsorbents.
d) Analysis of the results.

References

[1] X. Meng, W. de Jong, R. Pal, and A. H. M. Verkooijen, “In bed and downstream hot gas desulphurization during solid fuel gasification: A review,” *Fuel Process. Technol.*, vol. 91, no. 8, pp. 964–981, Aug. 2010, doi: 10.1016/j.fuproc.2010.02.005.

[2] L. Barelli, G. Bidini, E. Hernàndez-Balada, J. Mata-Álvarez, and E. Sisani, “Performance characterization of a novel Fe-based sorbent for anaerobic gas desulfurization finalized to high temperature fuel cell applications,” *Int. J. Hydrog. Energy*, vol. 42, no. 3, pp. 1859–1874, Jan. 2017, doi: 10.1016/j.ijhydene.2016.09.070.

[3] P. R. Westmoreland and D. P. Harrison, “Evaluation of candidate solids for high-temperature desulfurization of low-Btu gases,” *Environ. Sci. Technol.*, vol. 10, no. 7, pp. 659–661, Jul. 1976, doi: 10.1021/es60118a010.