Porous materials & processes for the conditioning of industry-relevant streams

Kyriakos Fotiadis[1, 3], Penelope Baltzopoulou[1], Dimitris Koutsonikolas[1], George Karagiannakis[1] and Vasileios Zaspalis[2.3]

[1]Advanced Renewable Technologies & Environmental Materials in Integrated Systems' (ARTEMIS), CPERI/CERTH, P.O. Box 60361, 57001, Thessaloniki, Greece

[2] Laboratory of Inorganic Materials (LIM), CPERI/CERTH, P.O. Box 60361, 57001, Thessaloniki, Greece

[3]Department of Chemical Engineering, Aristotle University, P.O. Box 1517, 54006, Thessaloniki, Greece

(*kfotiadis@certh.gr)

ABSTRACT

The current study consist of two parts related to refining processes of industrial streams. The first scale aims to evaluate the adsorptive desulfurization ability of a commercial activated carbon and modified by-products of it, for real diesel fuel in batch and continuous conditions. The modification of the adsorbent increased its desulfurization performance despite the significant reduction of their specific surface area (BET). It is also noted that the adsorbent showed inferior performance for the continuous operation as the residence time of the fuel in the adsorbent bed had a definitive effect in the process. Finally the commercial activated carbon was evaluated for its regeneration ability in continuous desulfurization-regeneration cycles. The regeneration was achieved by washing the saturated adsorbent with a binary solvent (50% v Methanol/ 50% v Toluene) and then heated up to 200^{o}C under vacuum. [1],[2]

In the second section, ceramic membranes are studied for their separation ability that scopes in hydrogen purification of exhaust gas stream derived from biogas steam reforming process. The membranes utilized were tubular shaped silica membranes of 10mm outer diameter and 250mm length. The membranes were modified in order to narrow their pore size which resulted in increased specific H_2/CO_2 selectivity from 15 to 40.The modification was achieved with CVI (Chemical Vapor Infiltration) method using TEOS and O_2. Furthermore, the design of a polycanal scale up membrane shell, able to accommodate four ceramic membranes of 10mm outer diameter and 500mm length is finalized.[3][4]

KEY WORDS: Activated Carbon, Adsorptive desulfurization, Ceramic membrane separation, Hydrogen recovery.

References

[1] Fotiadis, K., Kostoglou, M., Baltzopoulou, P., Zaspalis, V., & Karagiannakis, G. (2024). Activated carbon modification for real diesel adsorptive deep desulfurization: experiments and modeling. Chemical Engineering Communications, 1–17. https://doi.org/10.1080/00986445.2024.2341265

[2] Penelope Baltzopoulou, Kyriakos X. Kallis, George Karagiannakis, and Athanasios G. Konstandopoulos Diesel Fuel Desulfurization via Adsorption with the Aid of Activated Carbon: Laboratory- and Pilot-Scale Studies Energy & Fuels 2015 29 (9), 5640-5648 doi: 10.1021/acs.energyfuels.5b01133

[3] Koutsonikolas, D.; Kaldis, S.; Sakellaropoulos, G.P. A low-temperature CVI method for pore modification of sol–gel silica membranes. J. Membr. Sci. 2009, 342, 131–137

[4] Koutsonikolas, D.; Kaldis, S.; Sakellaropoulos, G.P.; van Loon, M.H.; Dirrix, R.W.J.; Terpstra, R.A. Defects in microporous silica membranes: Analysis and repair. Sep. Purif. Technol. 2010, 73, 20–24.