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Synthesis of activated carbon from high-carbon coal fly ash and its hydrogen storage application

Nicholas M.Musyoka[a], Magdalena Wdowin[b], Khavharendwe M.Rambau[a], Wojciech Franus[c] Rafał Panek[c], Jarosław Madej[c], Dorota Czarna-Juszkiewicz[b]

[a] HySA Infrastructure Centre of Competence, Energy Centre, Council for Scientific and Industrial Research (CSIR), Pretoria, South Africa

[b] Mineral and Energy Economy Research Institute, Polish Academy of Sciences, Wybickiego 7A, 31-261, Krakow, Poland

[c] Department of Geotechnical Engineering, Faculty of Civil Engineering and Architecture, Lublin University of Technology, Nadbystrzycka 40, 20-618, Lublin, Poland

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Abstract

Activated carbons (ACs) have desirable characteristics that make them attractive for many industrial applications. In order to reduce their production cost, there is always a need to find alternative low-cost feedstock precursors. Nowadays zero-waste technologies play an important role in sustainable development, therefore using of coal by-product as source of AC is strongly recommended. In this study, coal fly ash (CFA) sample with a high unburned carbon content was used to synthesize ACs. The effect of acid pre-treatment of the CFA sample using HF and HCl prior to thermochemical activation using KOH was also investigated. The acid washing was found to be effective since it removed most of the inorganic components found in the CFA, as was confirmed by EDS and XRF. The resulting carbon-rich feedstock had relatively high content of meso-/macropores as well as with relative increase in specific surface area (46.19 m2/g - 81.20 m2/g). The obtained AC sample was found to exhibit high specific surface (946.77 m2/g) that was dominated by high microporosity and was tested for hydrogen storage. The H2 uptake (1 bar, 77 K) was found to be 1.35 wt% and with a predictable potential for even higher capacity when measurements are conducted at high pressures.