HYDROGEN ADSORPTION IN CRYOGENIC CONDITIONS: RELATIONSHIP BETWEEN THE POROUS TEXTURE AND THE PARAMETERS OF THE MODIFIED DUBININ-ASTAKHOV EQUATION

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Hydrogen adsorption on activated carbons (ACs) requires smaller tanks than those needed for pure compression up to 20 MPa. Indeed, storing 5 kg of hydrogen by pure compression at 20 MPa and room temperature requires a tank of volume 340 L, whereas a volume of 263 L filled with ACs would be necessary in the same conditions. Due to the exothermic nature of hydrogen adsorption on ACs, cryogenic conditions further enhance their hydrogen storage capacities. Hydrogen physisorption is enhanced on microporous carbons presenting high specific surface areas. The maximum storage capacity and the specific surface area of ACs are related with each other through "Chahine's rule", which assumes that the hydrogen uptake on ACs increases linearly by 1 wt.% per 500 m^2/g of specific surface area at 77 K.

In the present study, hydrogen adsorption on four commercial ACs having different textural characteristics was investigated in the range of temperature 77 – 273 K and up to 15 MPa. The relationship between the textural properties and the hydrogen adsorption capacity of these ACs was analyzed by using the modified Dubinin-Astakhov equation. In addition, enthalpy and entropy of adsorption were investigated by using the sorption isosteric method applied to eleven isotherms in the temperature range 77 – 273 K. This approach allowed us to analyze the temperature dependence of such thermodynamic quantities, which are essential for developing and designing efficient cryo-adsorptive hydrogen storage systems.

Preferred participation: Poster presentation