

EFFECT OF ROTATION ON THE ADSORPTION PROCESS

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Rotation can intensify a number of industrial processes resulting in an increase in production efficiency and a decrease in energy consumption and environmental footprint. Although, several studies have focused on rotating packed beds, only a few have examined the effect of rotation on the adsorption process.

In this work, CO₂ adsorption on activated carbon under rotation is investigated. To this end, a special device has been developed allowing rotation at a maximum speed of 5,000rpm while the pressure difference is recorded by a pressure transducer at constant temperature. An amount of 3,6g of commercially available activated carbon with surface area of ~1000m²/g is used as an adsorbent. A vacuum of 10⁻³mbar is achieved and CO₂ is introduced at a starting pressure of 5,665mbar to the system. A long equilibration time of 95h, at room temperature of 25°C±1°C is allowed. After that, the system is rotated at maximum speed for 60s and left to rest for 52hours. A new rotation is conducted under the same conditions and further 27hours rest is attained. Figure 1 shows the result. Rotation facilitates an additional adsorption of more than 11%. Lower temperatures are expected to enhance the process.

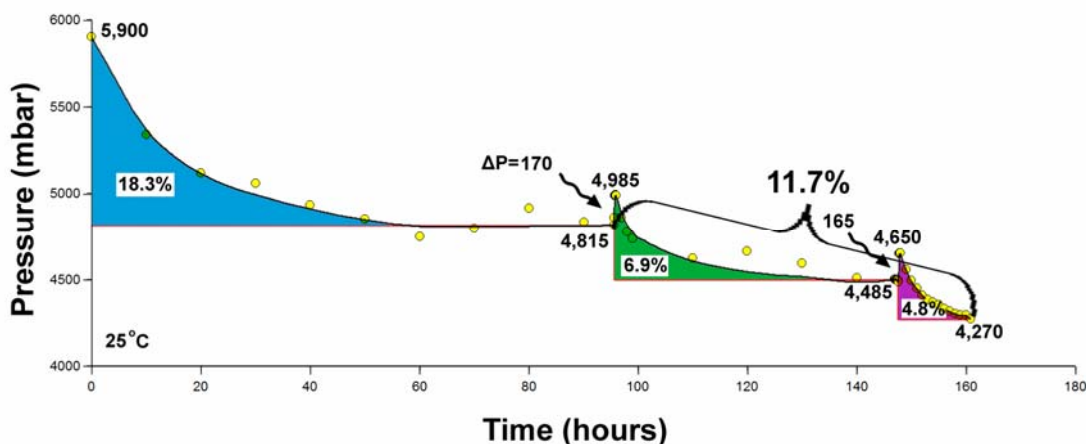


Fig. 1: Effect of rotation on gas adsorption. The blue area shows the adsorption achieved without rotation (18,3%). Green area corresponds to additional adsorption (6,9%) achieved after first rotation. Magenta area corresponds to even further adsorption (4,8%) after second rotation. Please note that the given percentages are differential (not cumulative). ΔP peaks are attributed to temperature increase due to rotation friction.

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References: “A rotating sample cell for in situ measurements of adsorption with x-rays”, Ramonna I. Kosheleva et al, Rev. Sci. Instrum. 89, 123113 (2018).