SUPPLEMENTARY DATA

ADSORPTION OF HYDROGEN SULFIDE, CARBON DIOXIDE, METHANE AND THEIR MIXTURES ON ACTIVATED CARBON

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**Absolute adsorbed amounts**

 Absolute adsorbed amounts were obtained after rearranging the equation used to account gravity force balance acting in the adsorption system (Keller and Staudt, 2005), shown by:

|  |  |
| --- | --- |
| $$m\_{exp}=m\_{a}+m\_{s}+m\_{sc}-ρ\left(V\_{a}+V\_{s}+V\_{sc}\right)$$ | (S.1) |

where: *mexp* is the mass shown in display of the balance (kg); *ma* is the absolute amount adsorbed (kg); *ms* is the adsorbent mass (kg); *msc* is the mass of sample container (kg); *ρ* is the density of gas phase (kg m‑3), calculated with Peng-Robinson Equation of State (Peng and Robinson, 1976); *Va* is the volume of adsorbed phase (m³); *Vs* is the volume of solid (m³); *Vsc* is the volume of sample container (m³).

 The volume of adsorbed phase can be calculated using:

|  |  |
| --- | --- |
| $$V\_{a}=\frac{m\_{a}}{ρ\_{a}}$$ | (S.2) |

where *ρa* is the density of adsorbed phase (kg m-3), considered equal to compound liquid density at its triple point. Table 1 in manuscript show *ρa* utilized in this work for CO2 and CH4.

 *Vs* can be calculated utilizing:

|  |  |
| --- | --- |
| $$V\_{s}=\frac{m\_{s}}{ρ\_{s}}$$ | (S.3) |

where *ρs* is the adsorbent density (kg m-3), determined experimentally.

 Considering the reduced isotherm, Ω (Keller and Staudt, 2005), given by:

|  |  |
| --- | --- |
| $$Ω=m\_{exp}-m\_{s}-m\_{sc}+ρV\_{sc}$$ | (S.4) |

and substituting in Equation 2, expression for absolute amount adsorbed is obtained:

|  |  |
| --- | --- |
| $$q\_{eq}=\frac{1}{M}\frac{\left(\frac{Ω}{m\_{s}}+\frac{ρ}{ρ\_{s}}\right)}{\left(1-\frac{ρ}{ρ\_{a}}\right)}$$ | (S.5) |

where: *qeq* is the absolute amount adsorbed per adsorbent mass (mol kg-1); *M* is adsorbate molar mass (kg mol-1).

**Extent of chemisorbed quantity**

Hysteresis effect was determined through calculation of deviation in amount adsorbed at vacuum, Δ*qeq*(mol kg-1), for all temperatures studied, given by:

|  |  |
| --- | --- |
| $$∆q\_{eq}=q\_{eq}^{ads}-q\_{eq}^{des}$$ | (S.6) |

where: $q\_{eq}^{ads}$ and $q\_{eq}^{des}$ are the amounts adsorbed in adsorption and desorption experiments (mol kg-1), respectively.

**Density of adsorbed phase**

 In Table S1, liquid density at triple point for H2S, CO2 and CH4, used in Equation S.5, are shown.

**Table S1.** Liquid density at triple point for H2S, CO2 and CH4.

|  |  |  |
| --- | --- | --- |
| Compound | *ρa* (kg m-3) | Literature |
| H2S | 992.955 | Goodwin (1983) |
| CO2 | 1178.53 | Span and Wagner (1996) |
| CH4 | 451.53 | Setzmann and Wagner (1991) |

**References for Supplementary Data**

Goodwin, R. D. (1983). *Hydrogen Sulfide Provisional Thermophysical Properties From 188 to 700 K at pressures to 75 MPa, NBSIR 83-1694*.

Keller, J., & Staudt, R. (2005). *Gas Adsorption Equilibria. Experimental Methods and Adsorption Isotherms*. Springer Science + Business Media, Inc.

Peng, D.-Y., & Robinson, D. B. (1976). A New Two-Constant Equation of State. *Industrial & Engineering Chemistry Fundamentals*, *15*(1), 59–64. https://doi.org/10.1021/i160057a011

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