Gravimetric Analyser for Selective Sorption Measurement of Multi-Component Gas or Supercritical Mixtures in Fluidised-Bed or Liquid Sorbents

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Since decades sorption processes are used for cleaning or purification of gases. Nowadays, with rising interest in renewable energy supply, requirements for gas cleaning and storage are rising particularly for bio- and hydrogen containing gases. Design and optimisation of these processes need precise instruments for sorption measurements, because the accurate knowledge of sorption isotherms is essential for any process layout.

For high pressure gravimetric measurements the magnetic suspension balance (MSB) is widely used. Conventional MSBs with gas dosing units are able to measure pure gases or binary mixtures, but in natural- or bio-gas applications data for multi-component gas mixtures including water are required. To measure selective sorption in such multi-component mixtures an apparatus precisely generating gas / water vapour mixtures is needed. To design such an apparatus still is a challenging task by itself. However, the main problem is the continuous high pressure sampling for gas concentration analysis.

Therefore, we present a fully automated gravimetric analyser consisting of three main parts. The first part is a MSB with new measuring principle that allows for the first time for gravimetric sorption measurements in high pressure fluidised beds. Measurements with liquid samples, i.e. ionic-liquid sorbents, are possible up to 50 times faster with the new flow-through system. The second part is a gas / vapour dosing unit dynamically generating atmospheres with up to four gases and two vapours in the pressure range from vacuum to 40 MPa and at temperatures up to 200° C. The third part is a continuous sampling system for the pressure range from 0.1 to 40 MPa and temperatures up to 200° C that compares the composition of two flows, in this case of the inlet and outlet flow of the measuring cell. Based on the integrated concentration differences the selective sorption of each component can be calculated.

Based on the example of a sorption measurement with a four component gas mixture and an ionic liquid as sorbent the evaluation of the measured data will be presented to the point of calculating selective sorption isotherms.