Adsorption of CO_2 and H_2O on supported amine sorbents.

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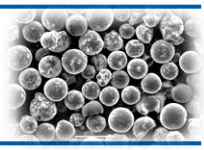


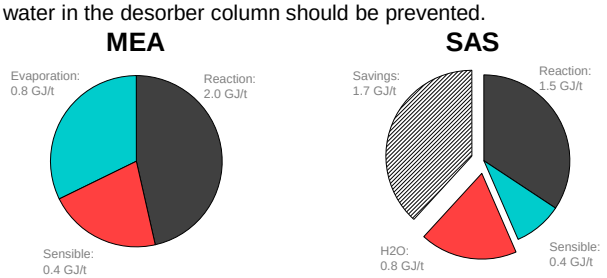
Objective

To develop an adsorption based PC capture process with lower capture costs than the MEA based reference process.
A supported amine based process is envisioned to have:

- Lower thermal energy required
- Lower capital investment

Implications of co-adsorption of H_2O

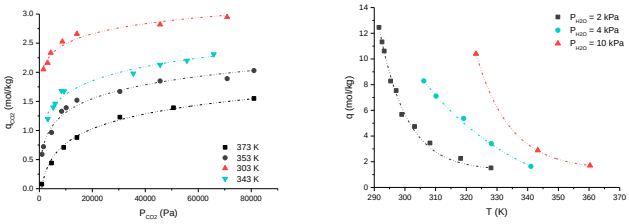
The co-adsorption of water can have a large impact on the process energy demand. Hence the desorption of co-adsorbed water in the desorber column should be prevented.



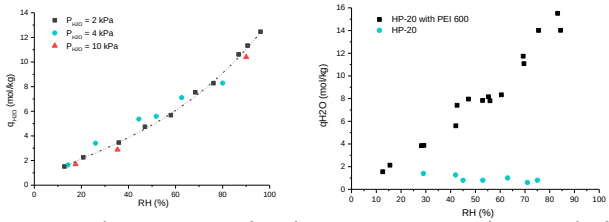
Split-up of heat demand of MEA and SAS process

Adsorption of H_2O and CO_2 on supported amine sorbents

Lewatit VP OC 1065 can adsorb much more H_2O than CO_2. The highest observed H_2O capacity is close to the capacity for a filled pore space. CO_2 capacity is limited by the amount of active sites.



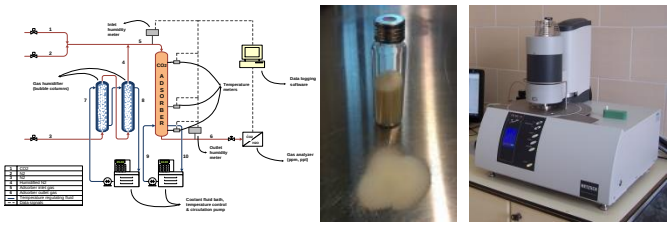
The H_2O capacity is found to be only a function of RH% which also suggest that condensation is the main adsorption mechanism. Furthermore, H_2O adsorption measurements were performed for PEI impregnated styrene-divinylbenzene. The H_2O capacity of the impregnated support material is clearly much high than that of the support only.



Hence, the presence of amine groups causes increased affinity towards the adsorption of H_2O. This will make it difficult to make a hydrophobic sorbent material with amine functionality.

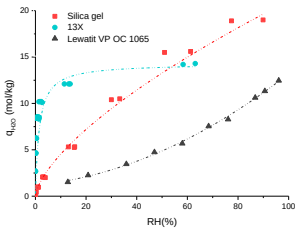
Experimental

Fixed bed adsorption experiments were combined with TGA analysis. Single component adsorption experiments for both CO_2 and H_2O were performed as well as co-adsorption of CO_2 and H_2O to asses differences in adsorption capacity.



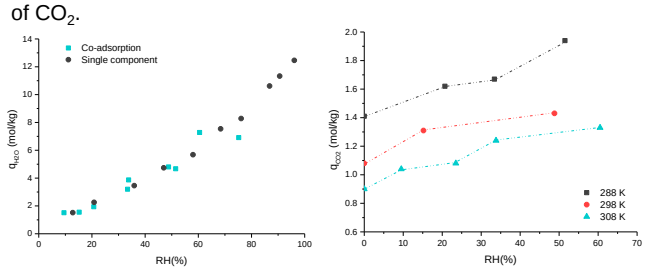
Adsorption of H_2O and CO_2 on supported amine sorbents (continued)

The heat of adsorption is much lower for H_2O than for CO_2. For water the calculated adsorption heat is close to the evaporation heat of water.



	ΔH (KJ/mol)
CO_2	67-72
H_2O	38-40

H_2O does not seem to compete with CO_2 but does interfere in the adsorption process of CO_2 and slightly enhances the CO_2 capacity. The H_2O is not affected by the simultaneous adsorption of CO_2.



Main findings

- The sorbents can adsorb much more H_2O than CO_2.
- Adsorption of water is supply limited. Hence, the sorbent will adsorb all incoming water given enough adsorption time.
- The best strategy to prevent the co-adsorption of large quantities of water is to lower the dewpoint of the incoming flue gas. Lowering the dewpoint of the flue gas to 303 K will reduce the energy penalty for water adsorption to 0.2 GJ/t.

Acknowledgements
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