David Farrusseng, Cécile Daniel,
Cristian Cardenas

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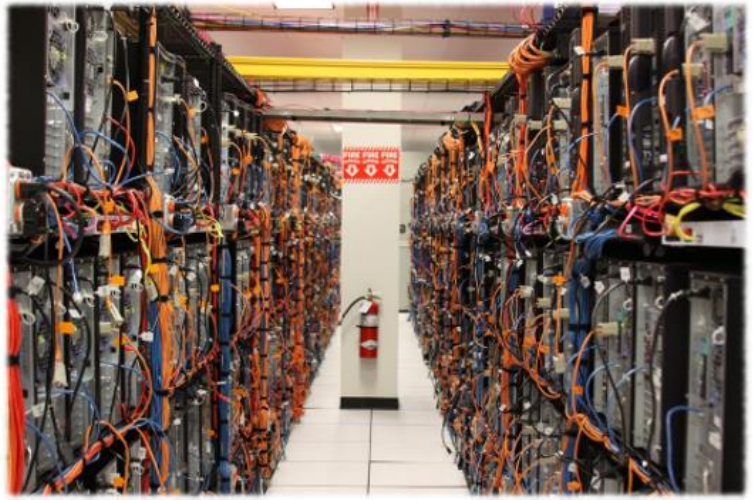
Electricity consumption of datacenter is ~300 TWh or ~1.5% of worldwide electricity consumption

Maximum CPU temperature ~70°C



The energy for cooling takes up 40% of total energy for datacenter

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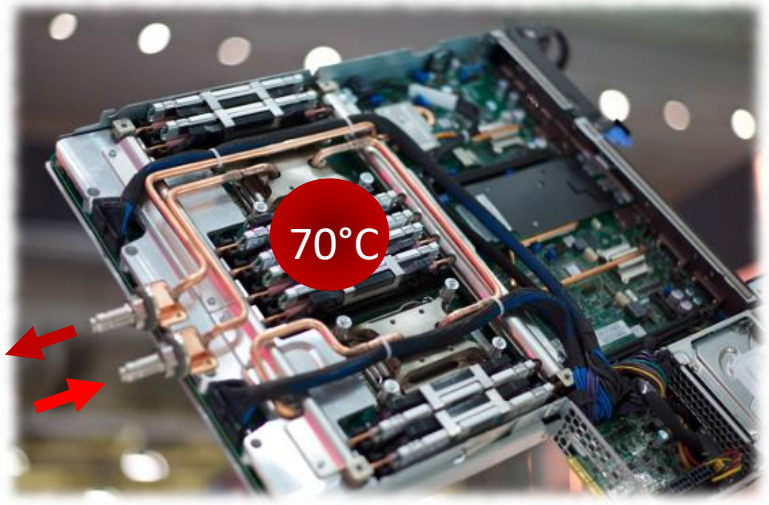
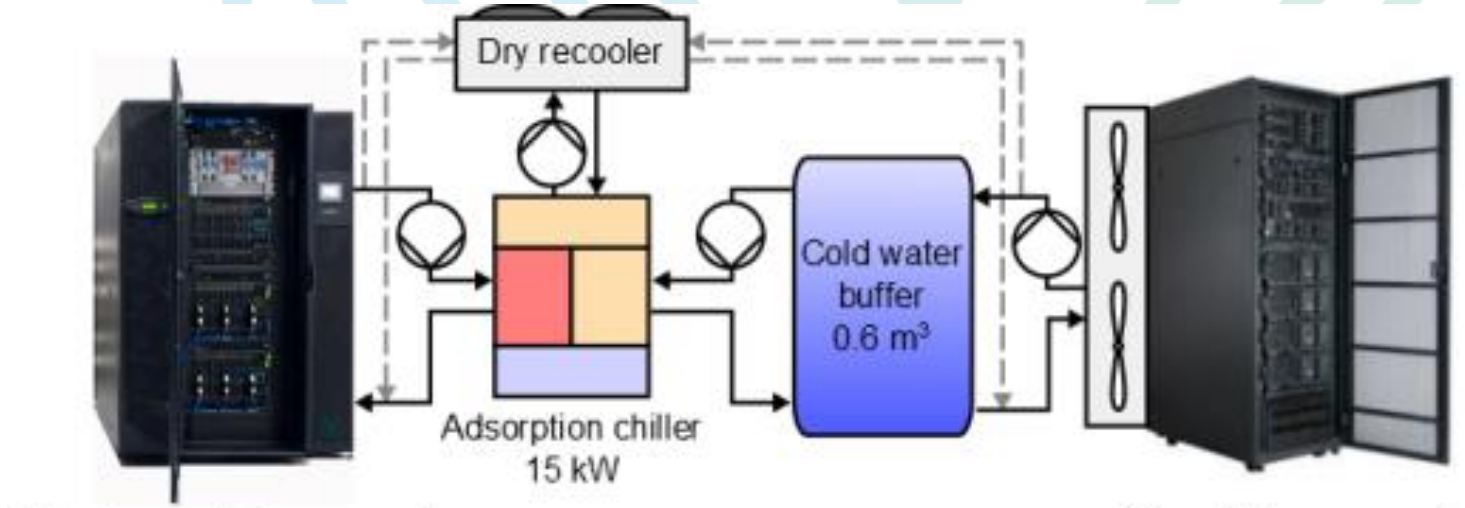
Leibniz with IBM developed a Smart Data Center concept using a water adsorption Heat-Pump to convert wasted heat in cooling energy



Hot-water cooled CPU



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Technical-economic study on the "SuperMUC" in Leibniz

Large CAPEX -> ROI of 6 years « poorly economically attractive »

Requirements to get down to ROI of 3 years

CooLMUC-2 and adsorption chiller installation

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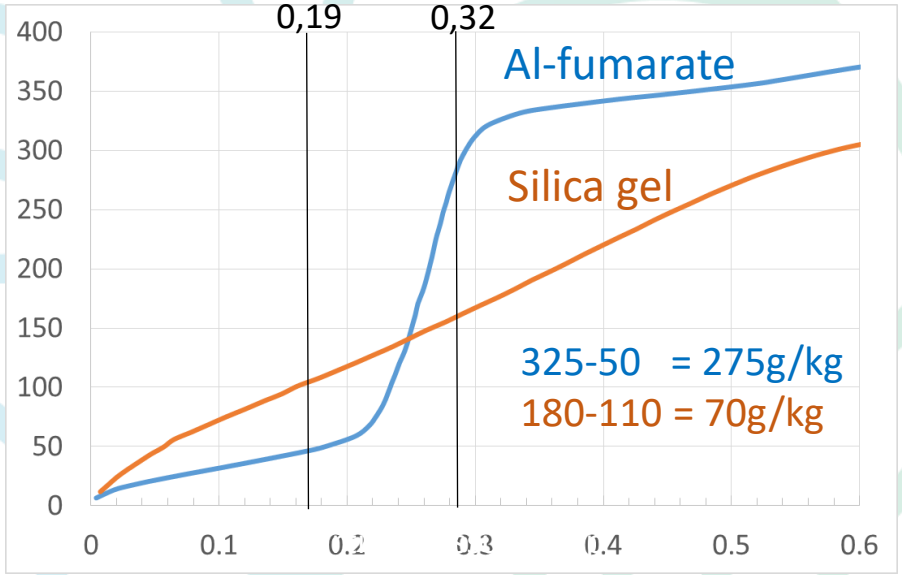
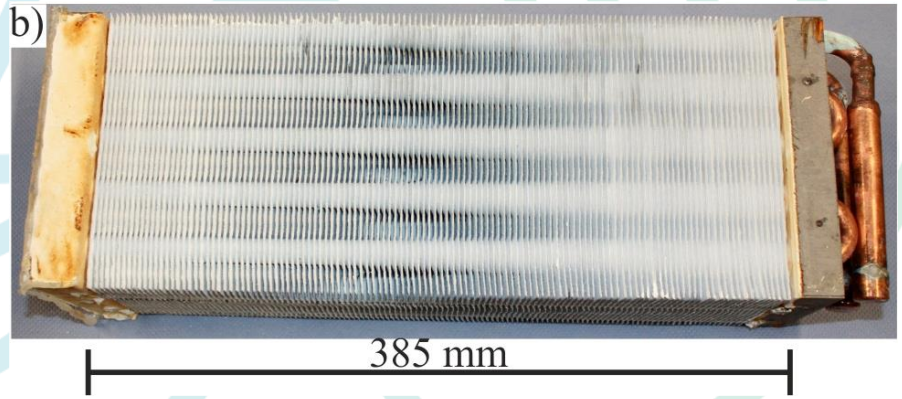
Prons

Demo. on coatings for high cooling power
But…





Chem. Res… …398
…ss Transfer, 2017, 114, 62…

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From laboratory (TRL 2-3)..... .....to pilot line (TRL 6-7)

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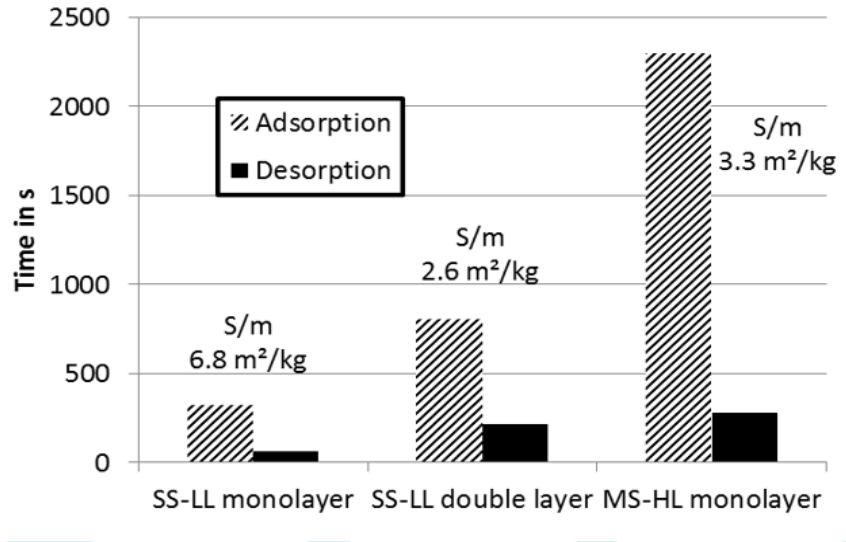
Minor impact of shaping on water capacity

But strong impact on kinetics



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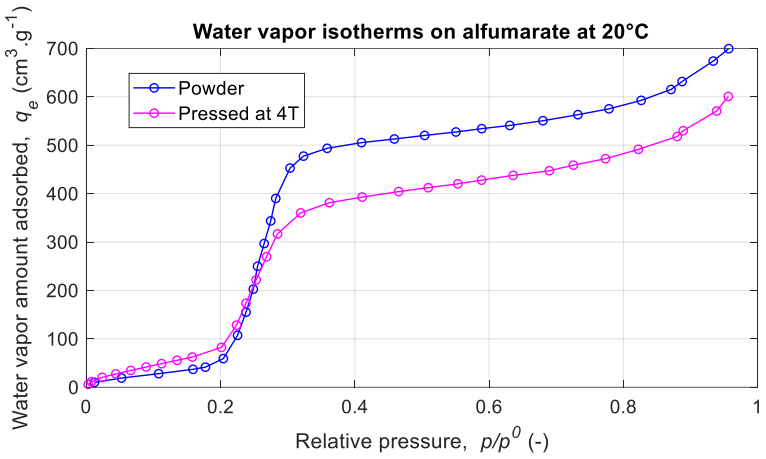

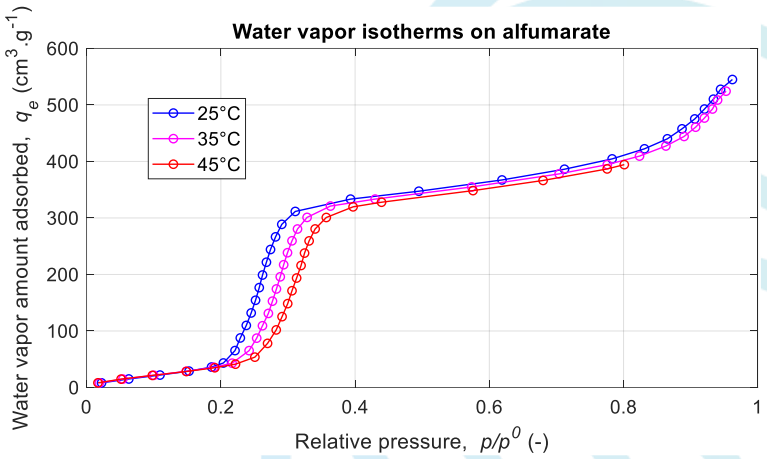

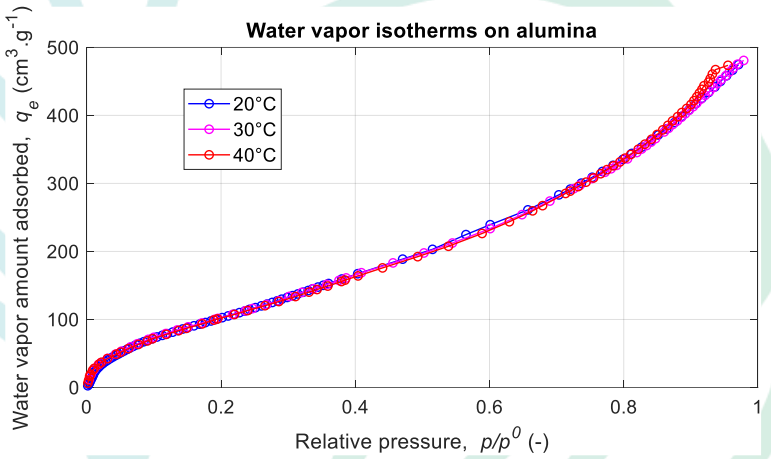

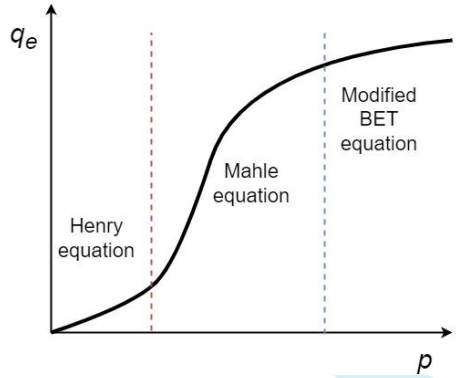

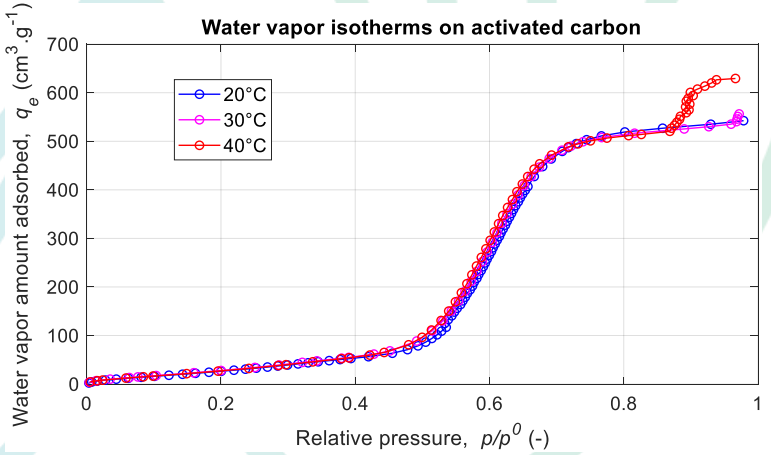

q_e

$q_e =$

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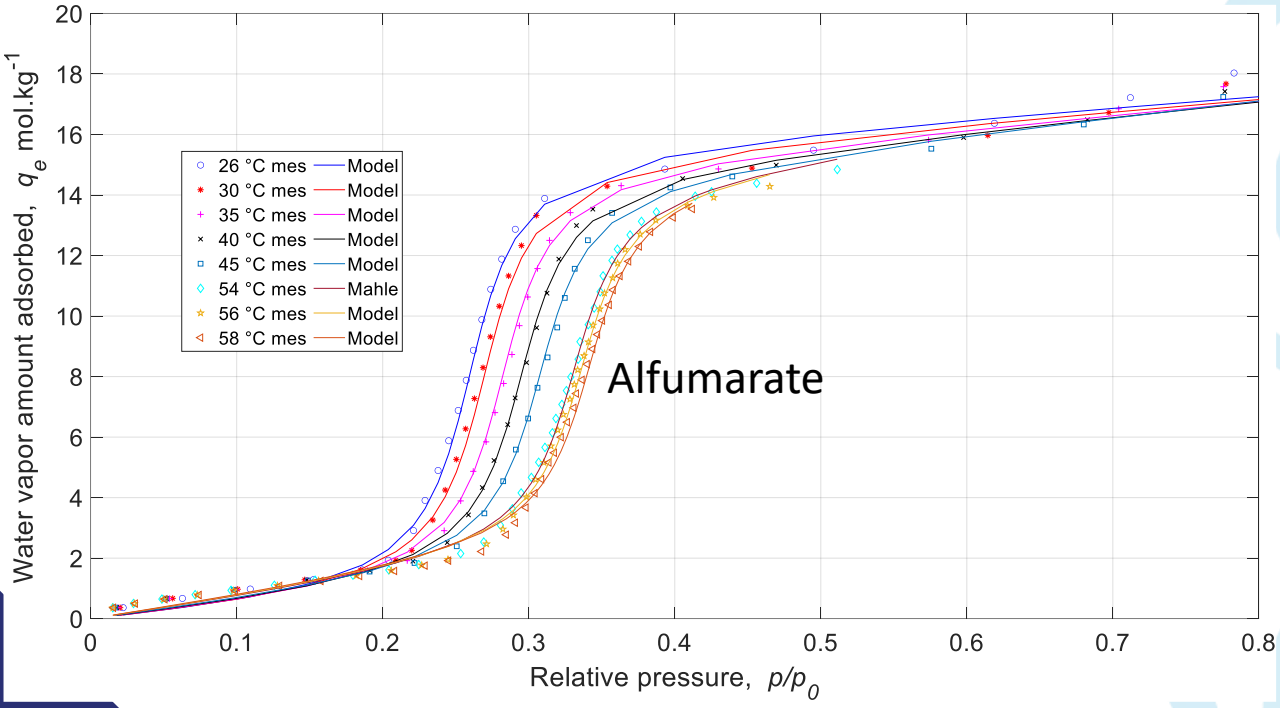

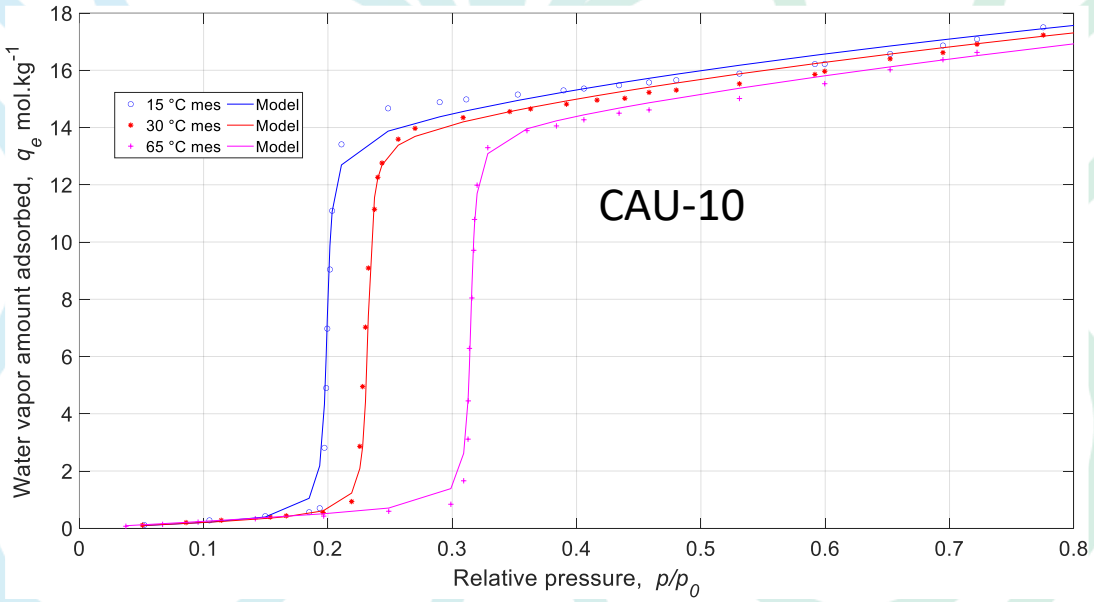

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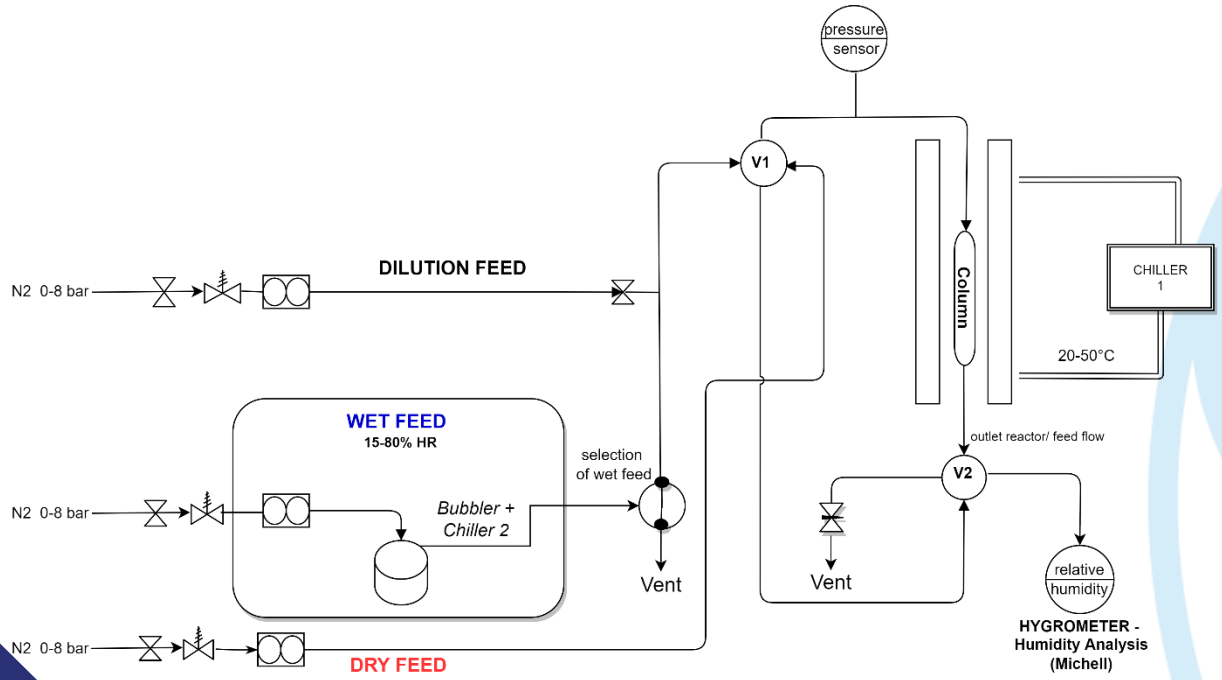

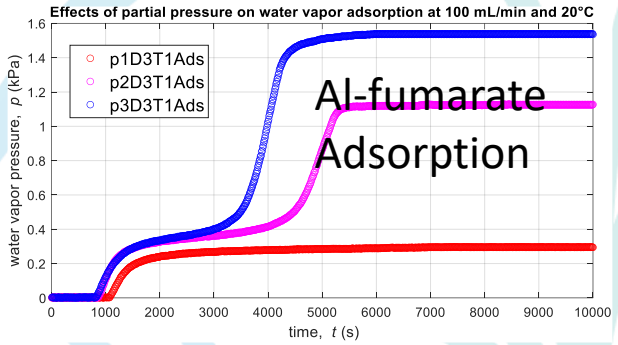

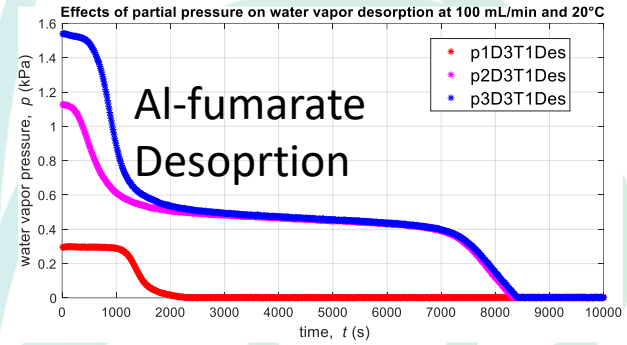

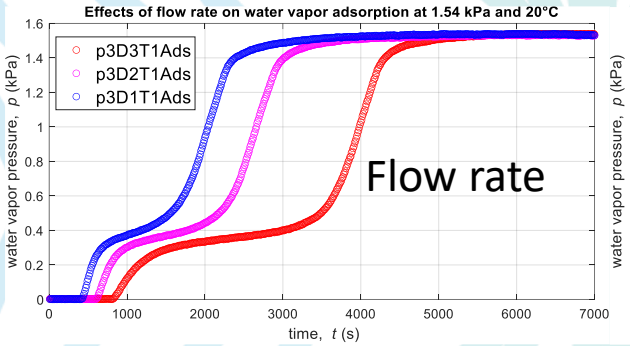

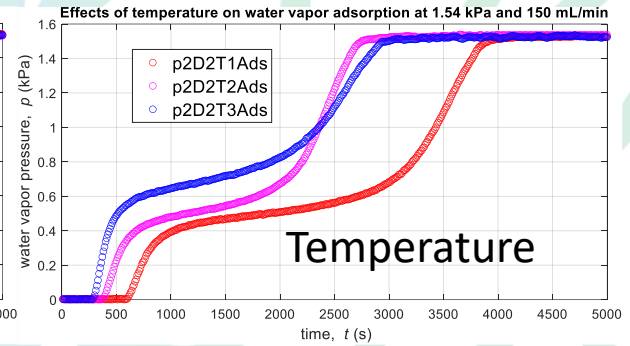

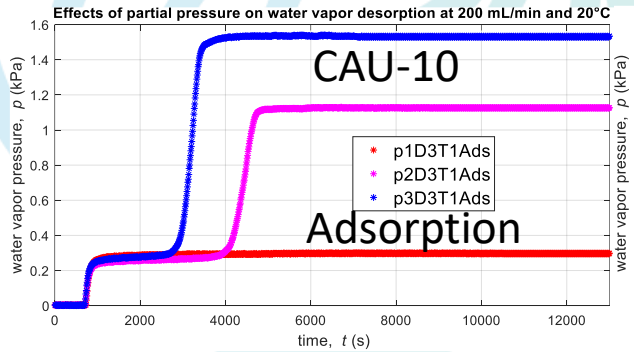

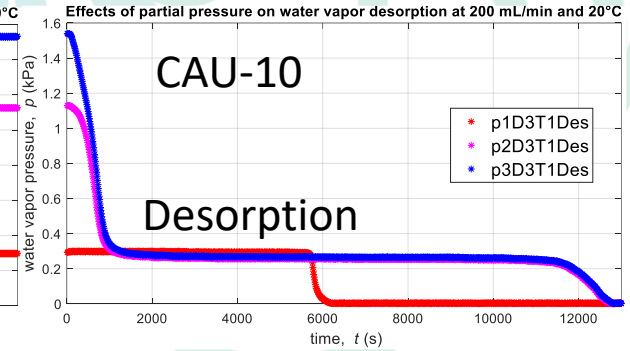

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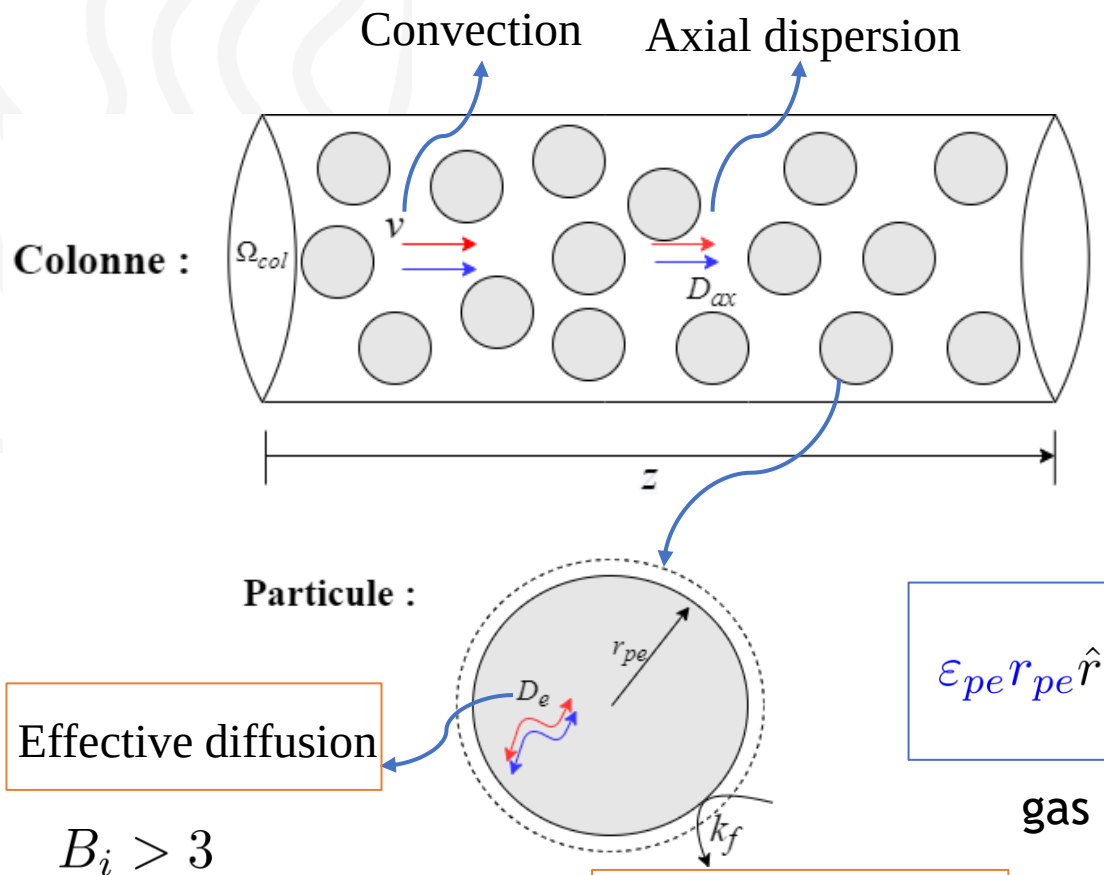
Modeling water vapor adsoption



Mass balance in the bed column:

$$\frac{\partial c}{\partial t} - D_{ax}\frac{\partial^2 c}{\partial z^2} + \frac{\partial (vc)}{\partial z} = -\frac{(1-\varepsilon_b)}{\varepsilon_b}\frac{\partial \hat{\bar{q}}}{\partial t}$$

$$\frac{\partial \hat{\bar{q}}}{\partial t} = \frac{3}{r_{pe}} k_f \left(c - c_{pe|_{\hat{r}=1}}\right)$$

Mass balance in the particle:

$$\varepsilon_{pe} r_{pe} \hat{r}^2 \frac{\partial c_{pe}}{\partial t} + (1-\varepsilon_{pe})\, r_{pe} \hat{r}^2 \frac{\partial \hat{q}}{\partial t} = D_e \frac{\partial}{\partial \hat{r}}\left(\hat{r}^2 \frac{\partial c_{pe}}{\partial \hat{r}}\right)$$

gas — solide — Diffusion

Effective diffusion

$B_i > 3$

$$B_i = \frac{r_{pe} k_f}{5 D_e}$$

Film mass transfer

$B_i < 0,1$

$$\frac{\partial \hat{q}}{\partial t} \approx k_1 (q_e^* - \bar{q})$$

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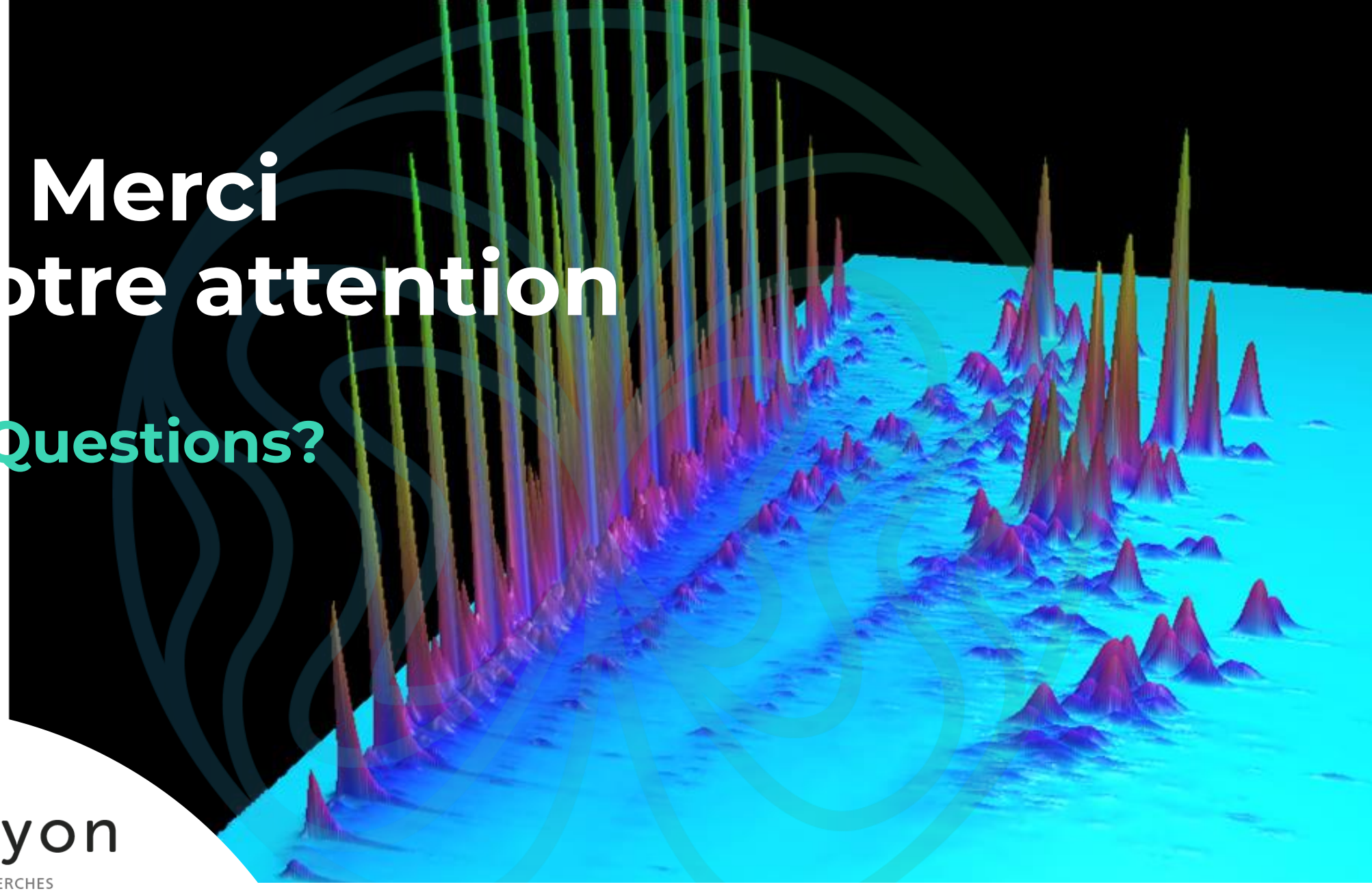
Merci
otre attention

Questions?



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