

# Sorption cooling systems for PEM fuel cell buses



## SFU updates

Mission Innovation Heating and Cooling - Sorption Heat Pump Systems

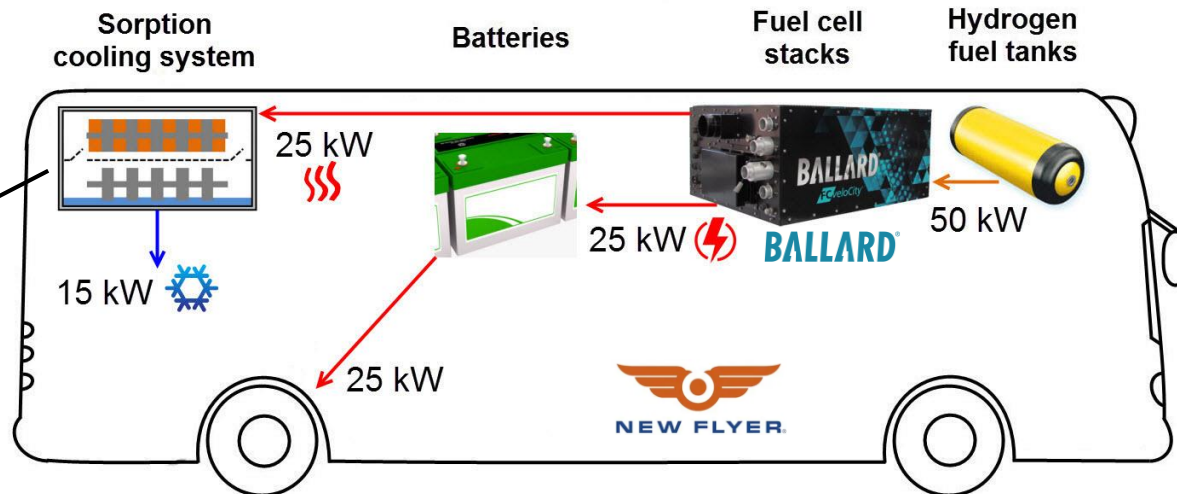
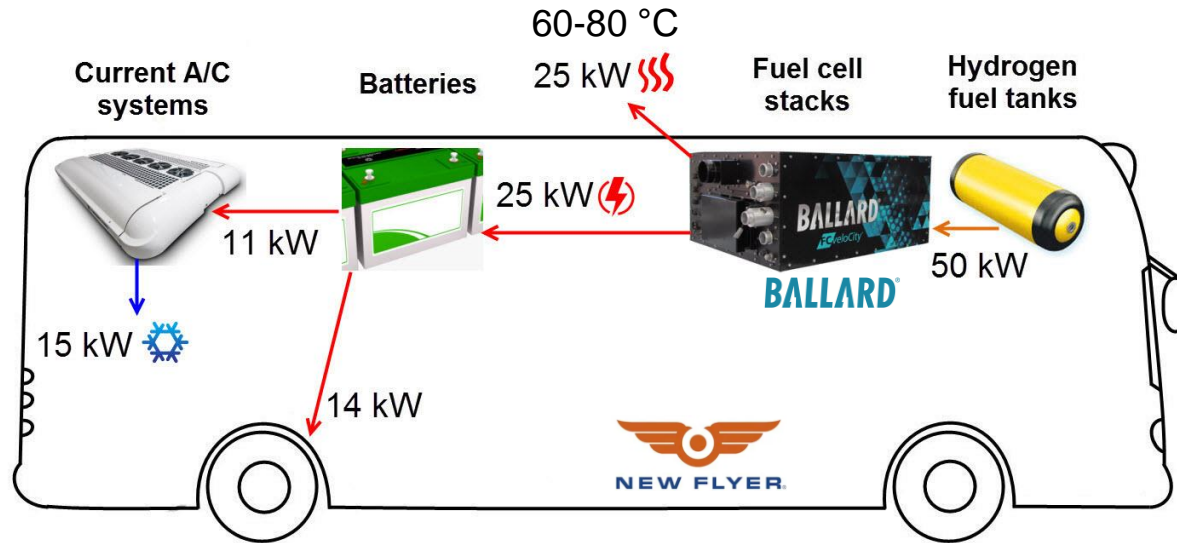
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SIMON FRASER  
UNIVERSITY  
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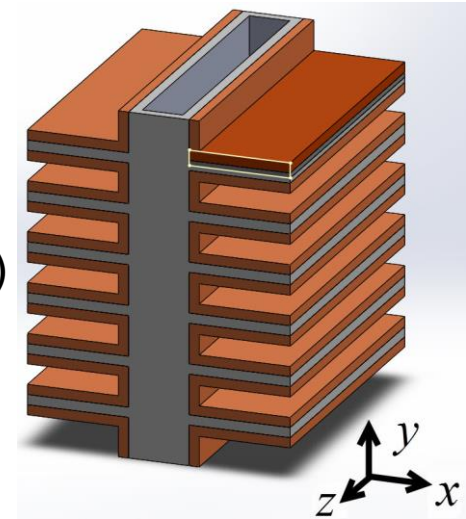
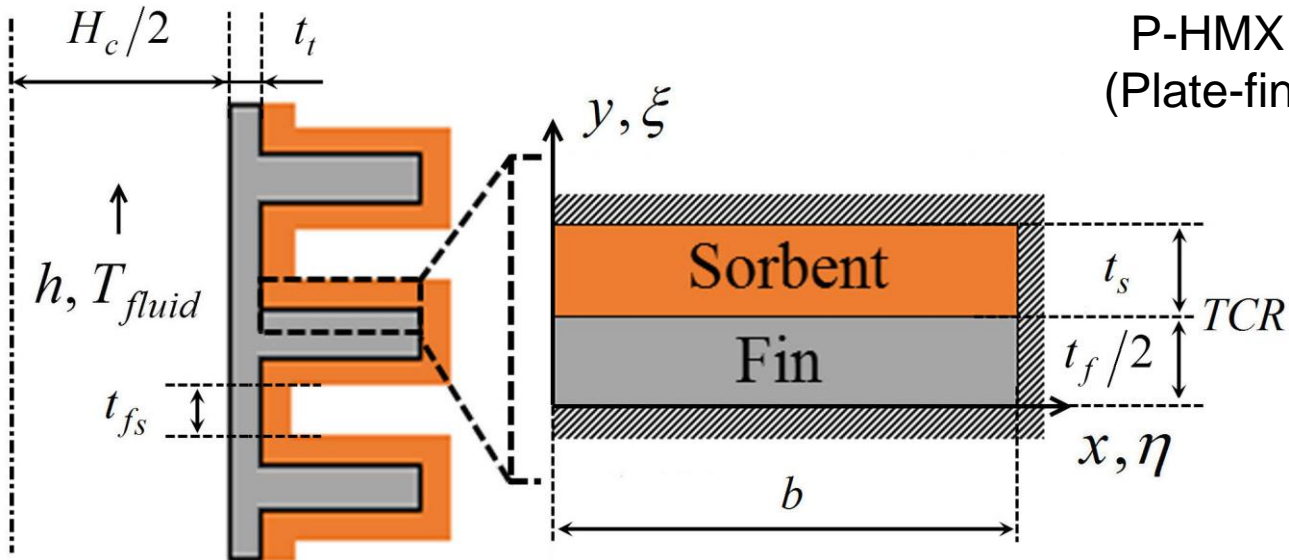




$$COP = \frac{15}{25} = 0.6$$

$$SCP = 700 \text{ W/kg}$$

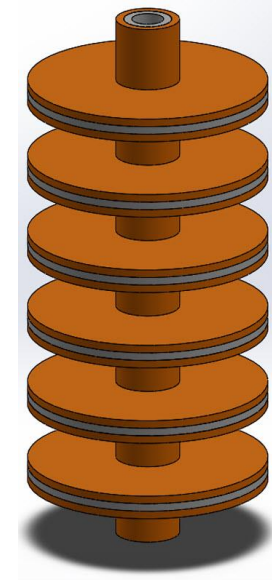
P-HMX and F-HMX due to relatively high SCP and COP

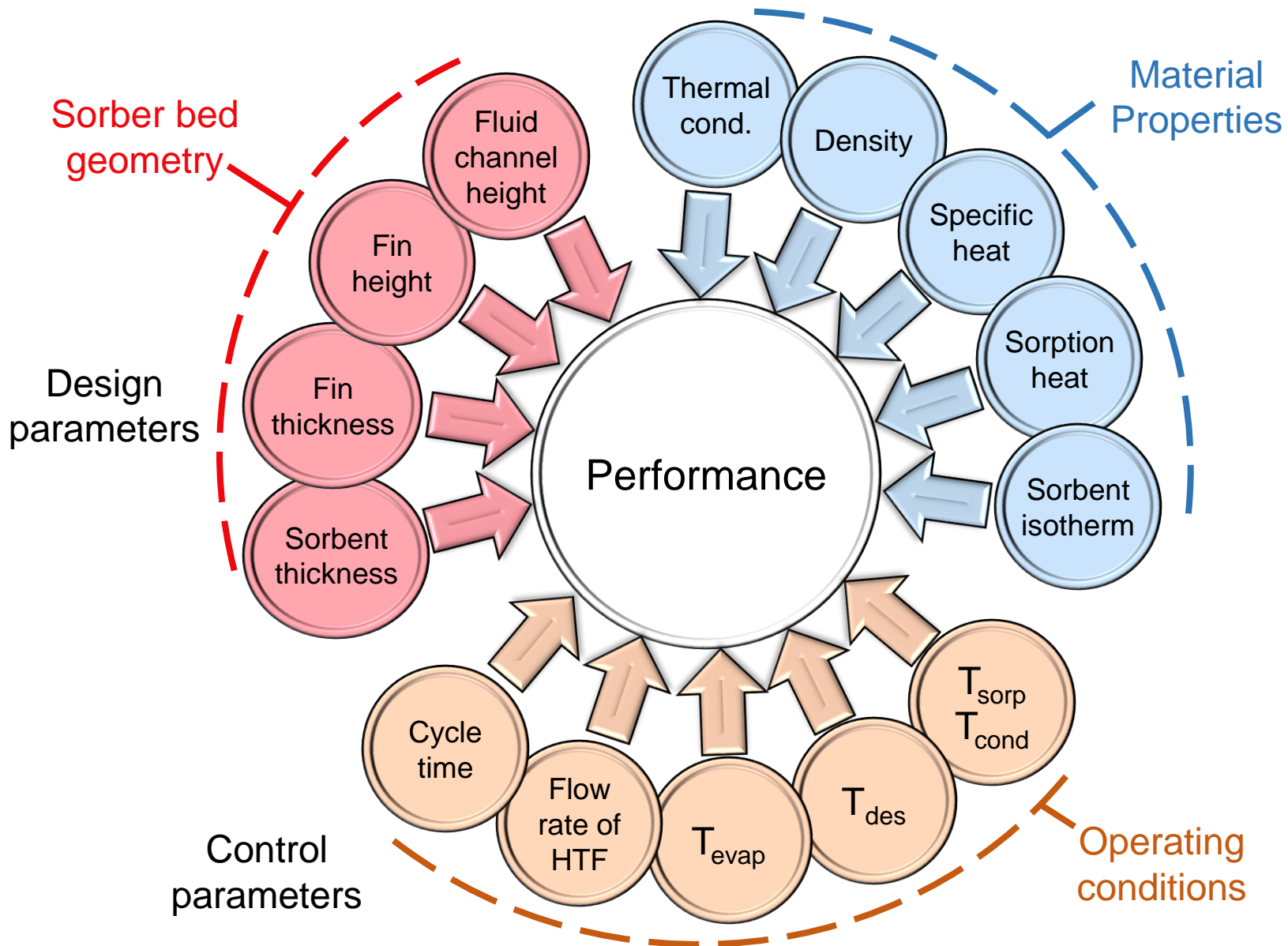


Eigenfunction Expansion Method

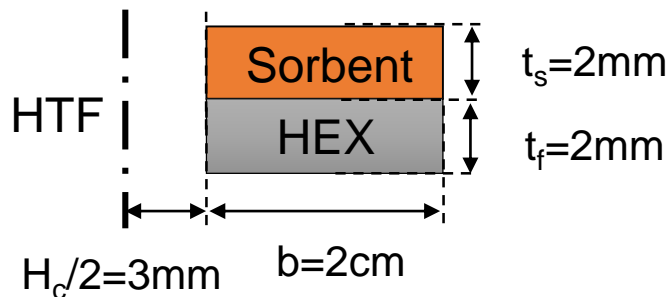
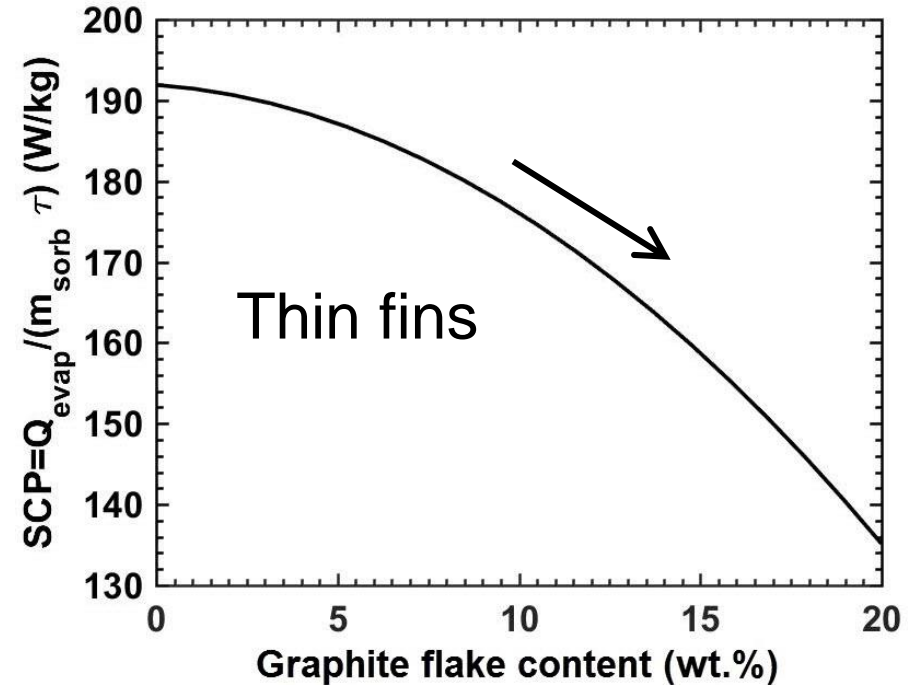
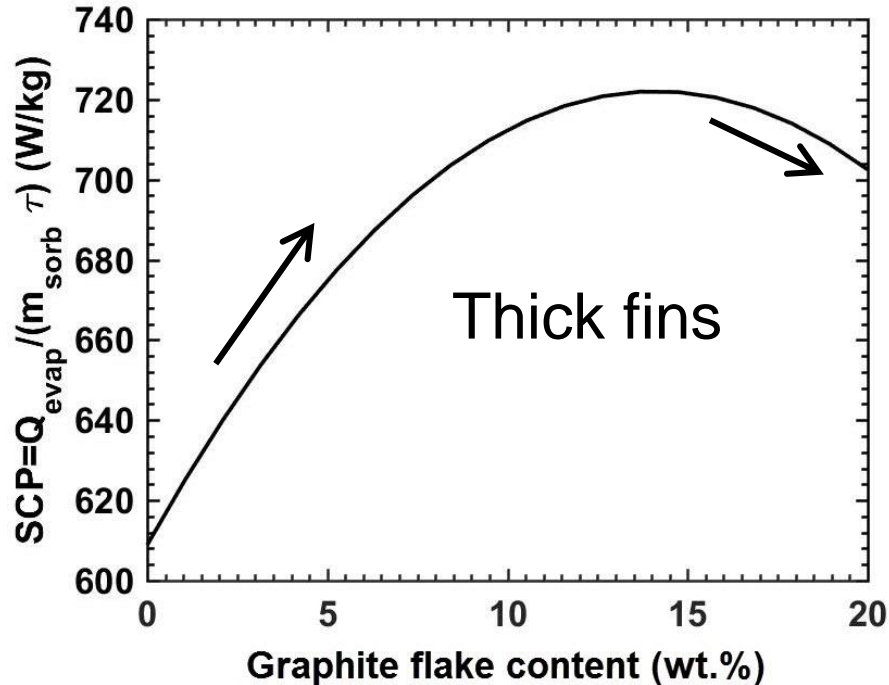
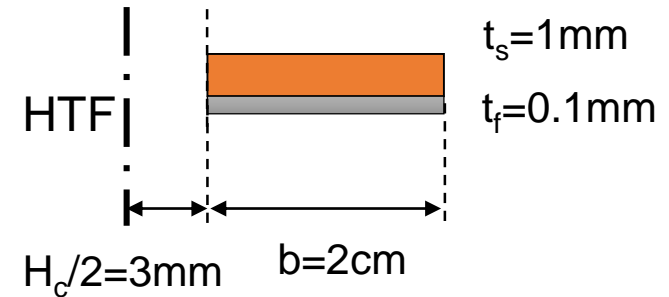
$$\theta(\eta, \xi, Fo) = \sum_{n=1}^{\infty} \sum_{m=1}^{\infty} X_n(\eta) \psi_{nm}(\xi) \Gamma_{nm}(Fo)$$

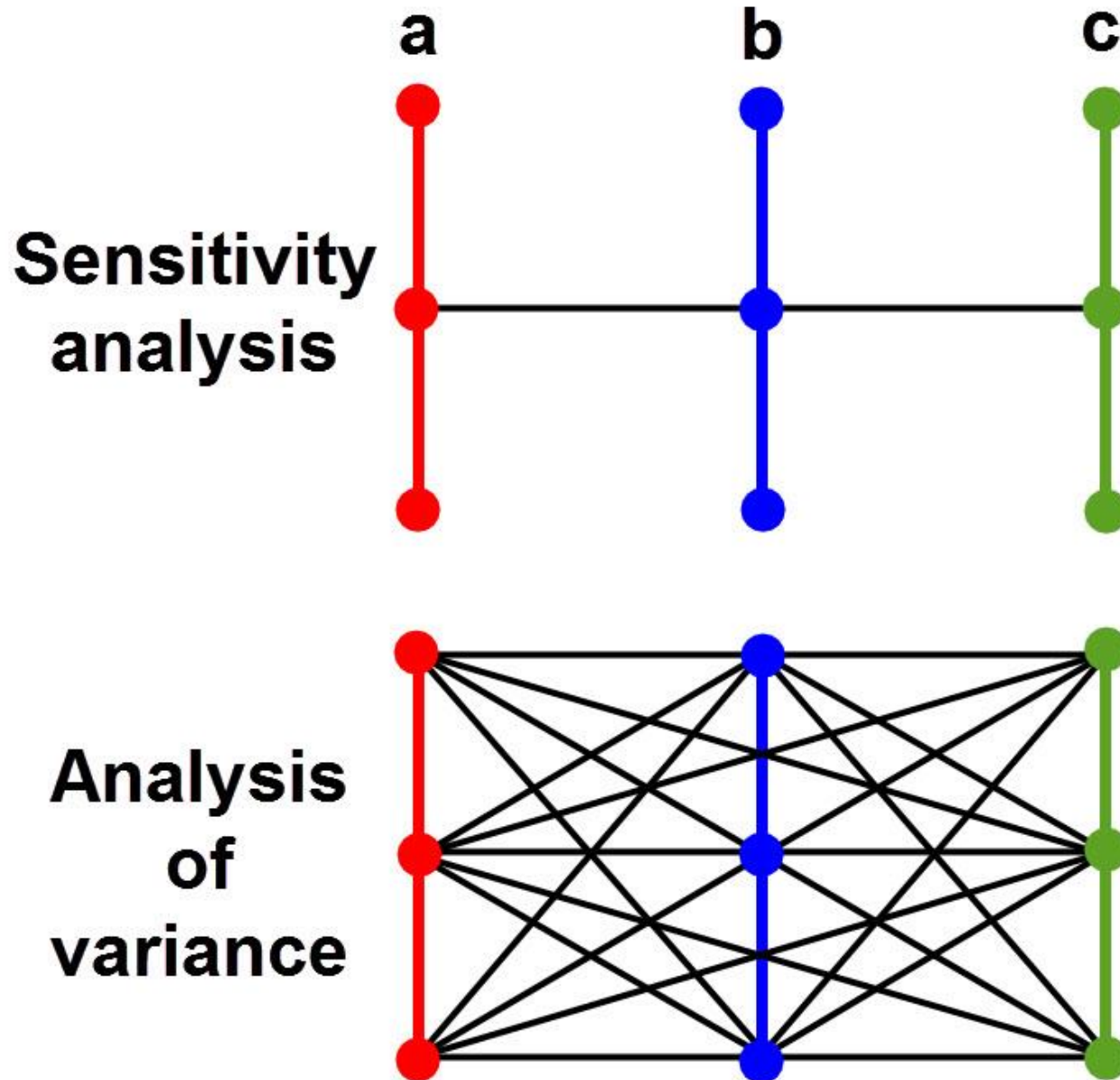
F-HMX (Finned-tube)

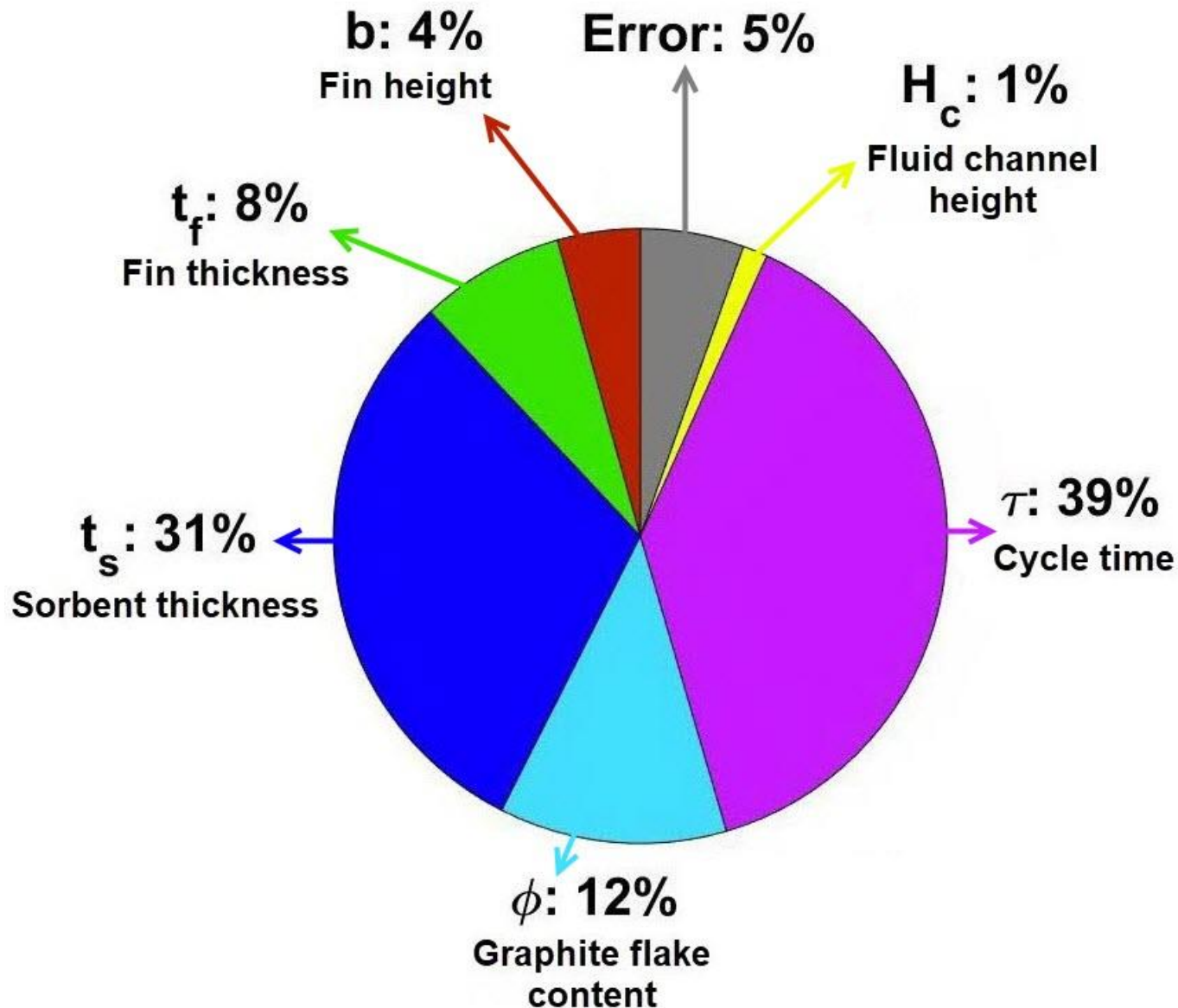


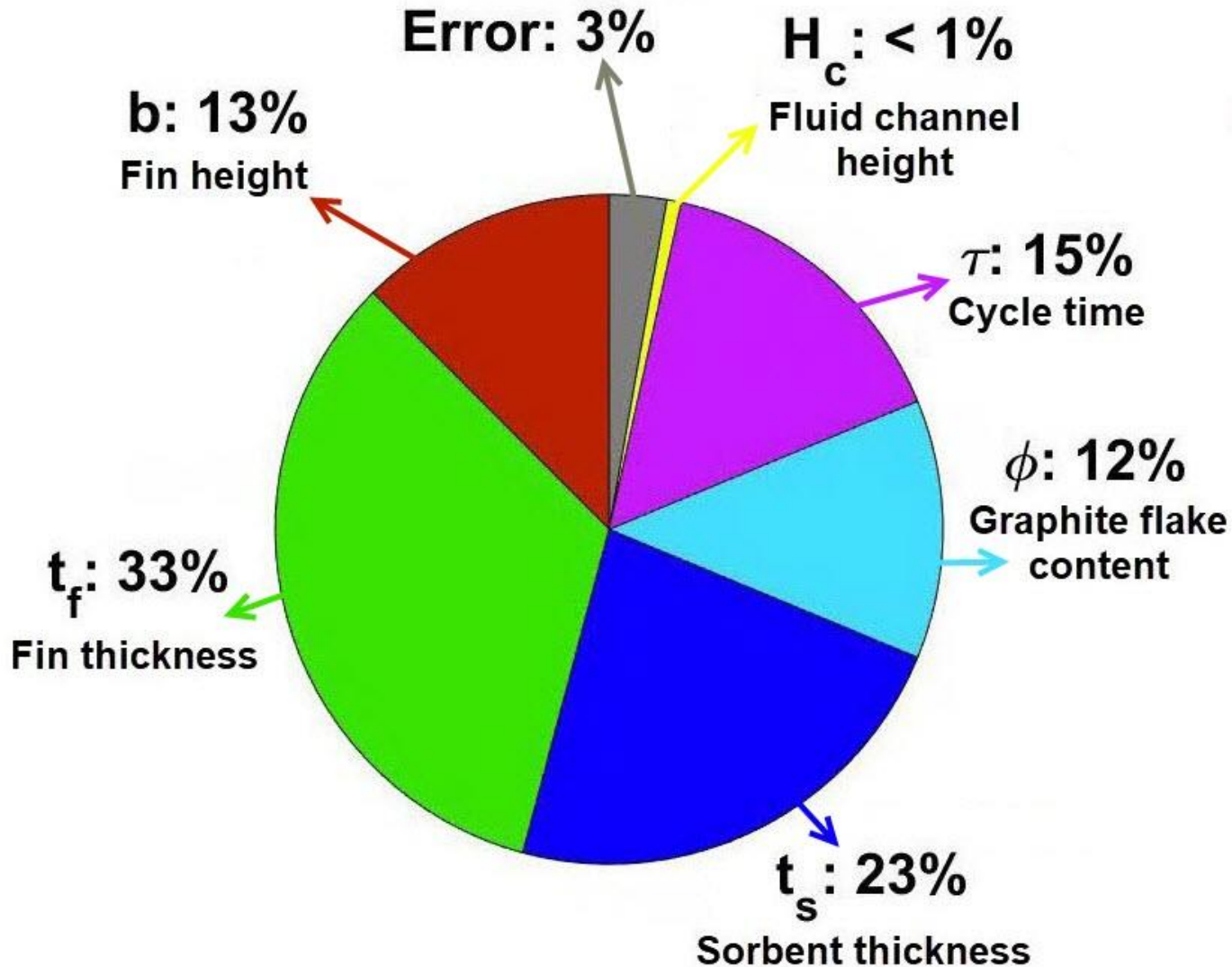


- Simultaneous optimization of sorbent, heat exchanger, heat transfer fluid
- One large resistance can limit the performance


 $\tau = 15\text{ min}$ 










$$1 \leq b \leq 3\text{cm}$$

$$0.5 \leq t_f \leq 3\text{mm}$$

$$1 \leq t_s \leq 3\text{mm}$$

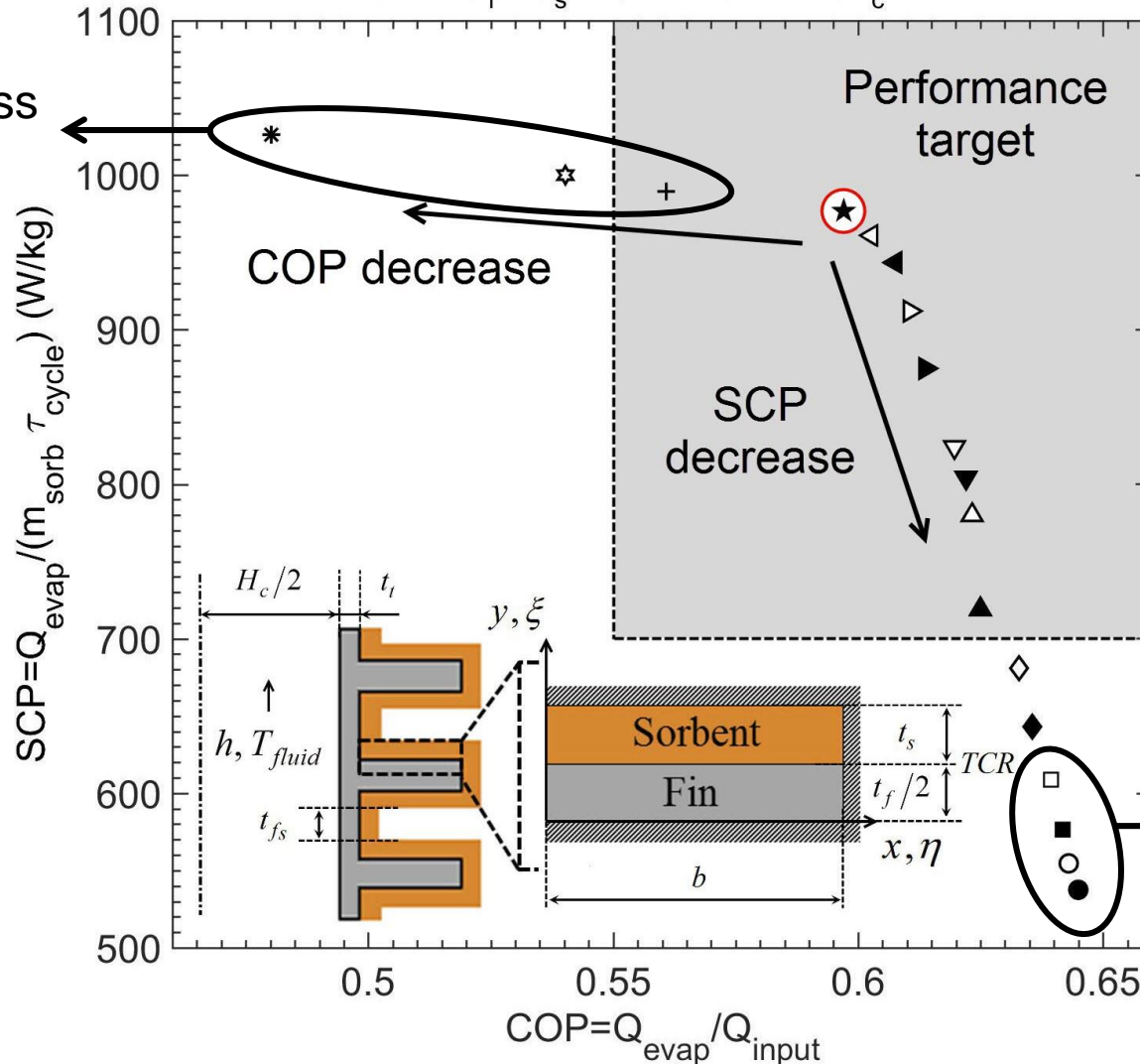
$$0 \leq \phi \leq 20\text{wt.}\%$$

$$10 \leq \tau \leq 20\text{ min}$$

$$4 \leq H_c \leq 8\text{mm}$$

$$\star b=1, t_f=1, t_s=2, \phi=12.1, \tau=10.2, H_c=4$$

Limited mass  
or volume

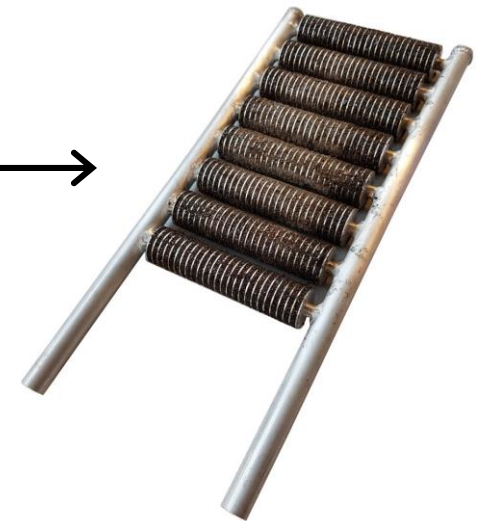
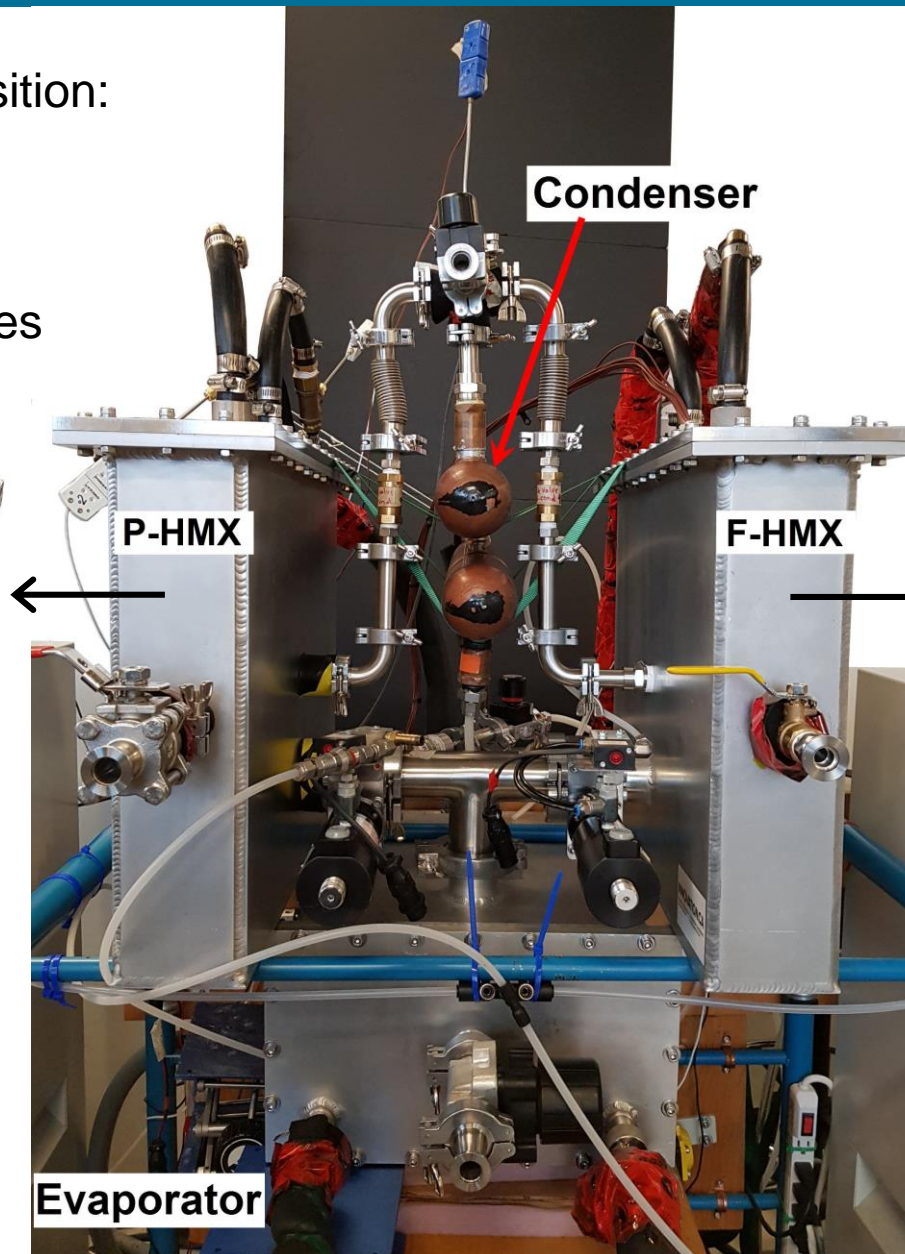


Sorbent composition:

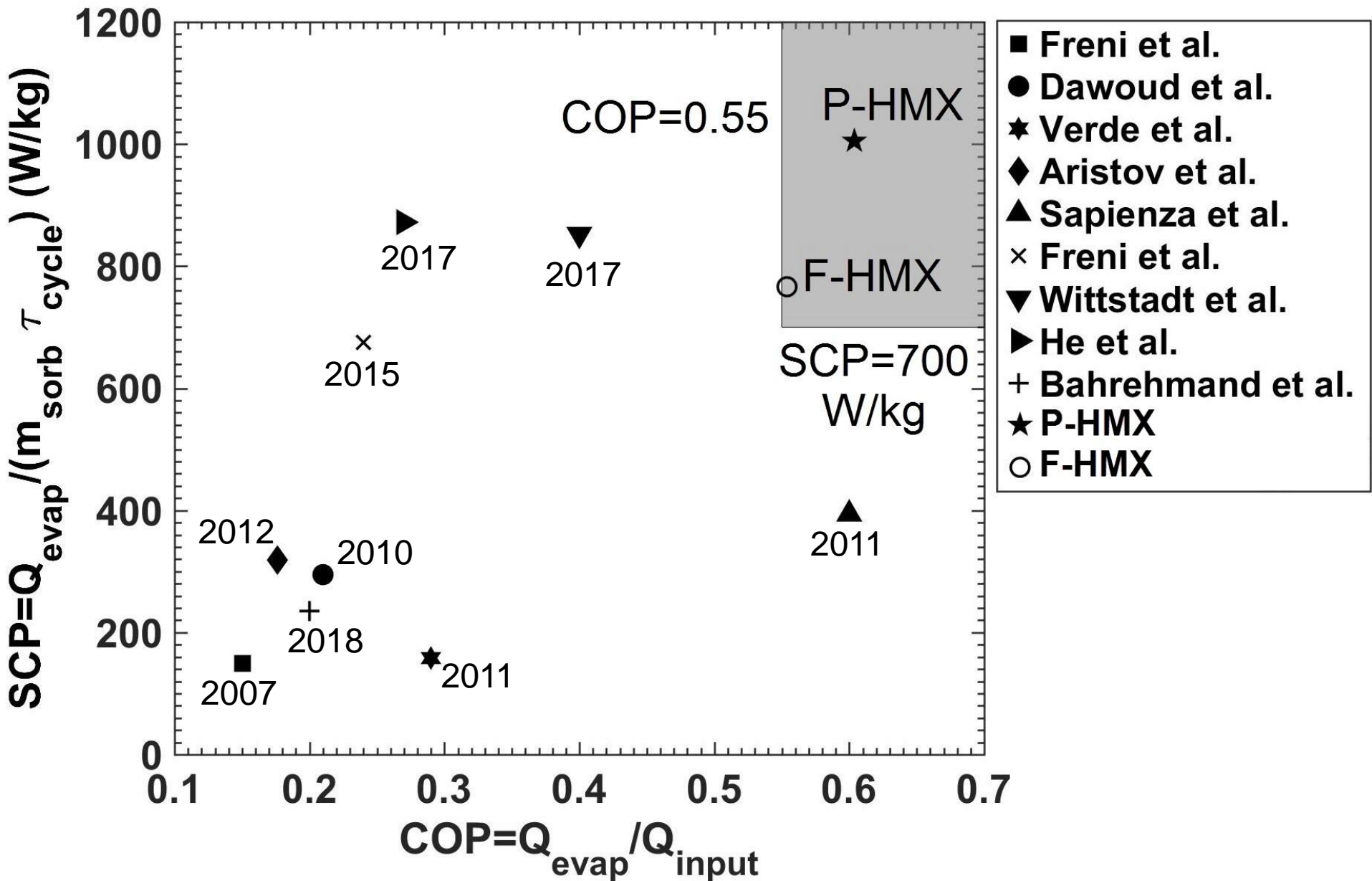
- Silica gel
- $\text{CaCl}_2$
- PVA
- Graphite flakes

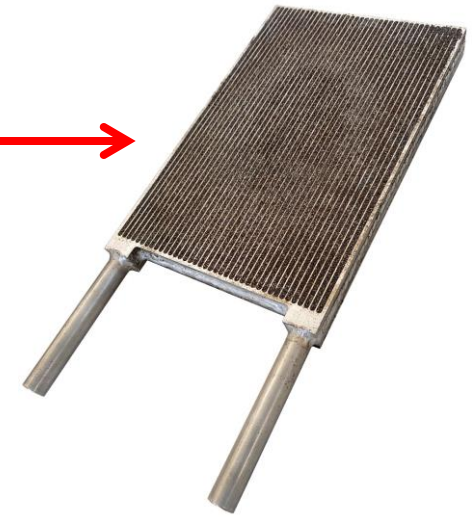
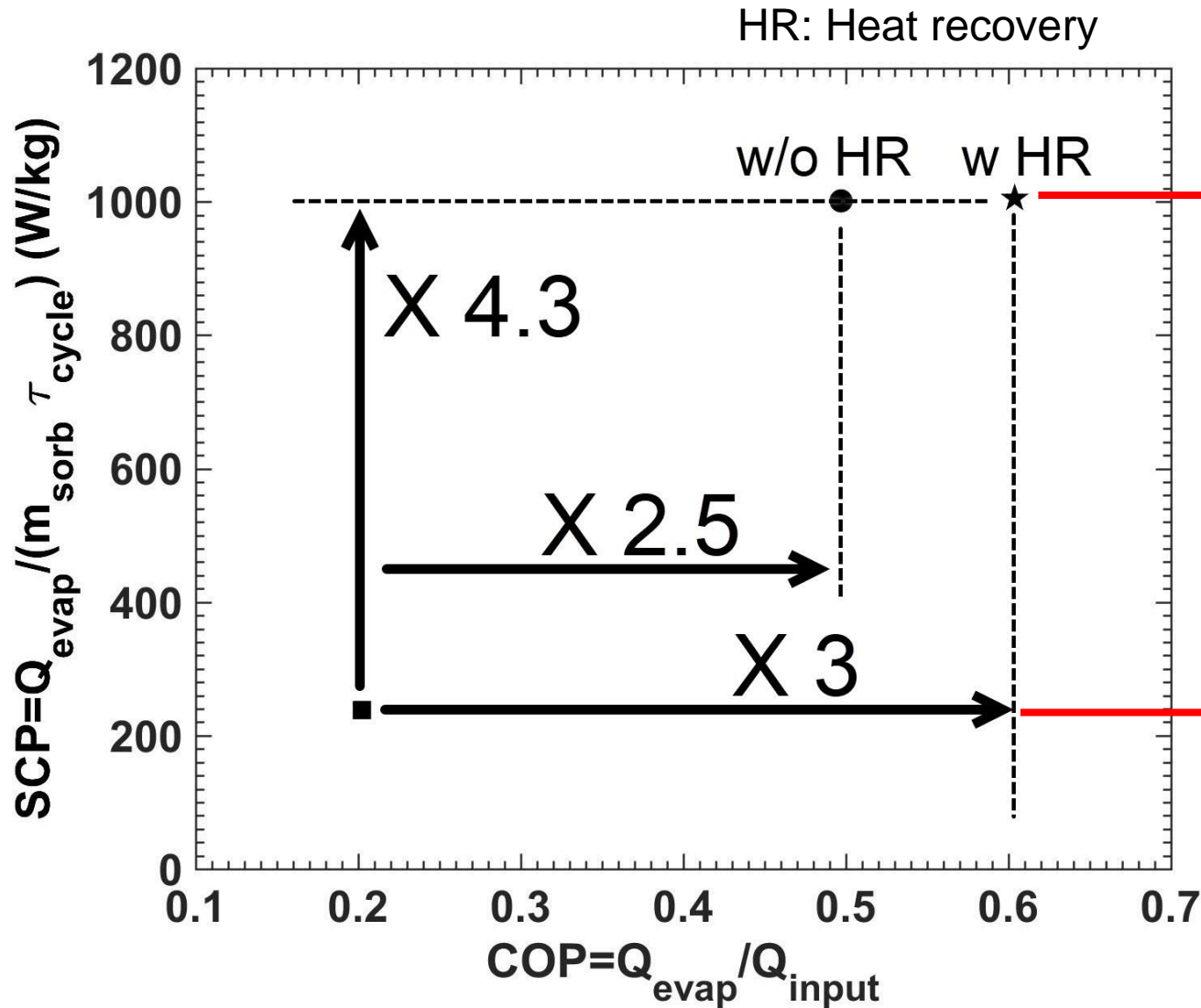


P-HMX  
(Plate-fin)



F-HMX  
(Finned-tube)





Thank you for  
your attention

Questions/comments?