

balance of plant (bop) modelling for PEM electrolyzer

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Channel models

- Anode channel
- Cathode channel

Electrolyzer stack

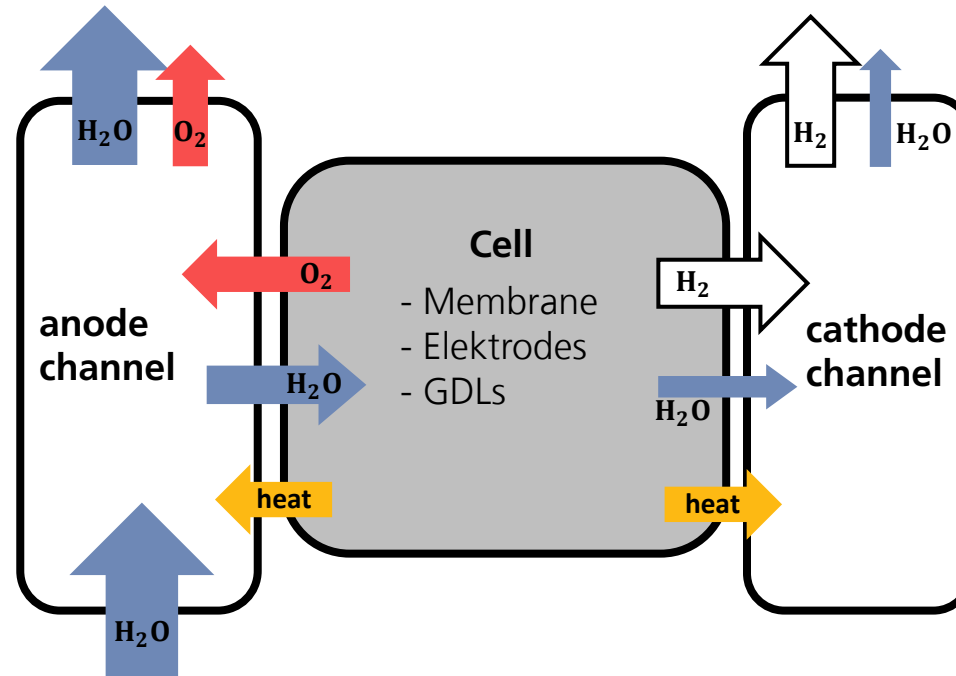
Additional components

Conclusion

Channel models

Models take into account

- Mass transport
- Heat transport
- Phase changes of H_2O
- Gas / liquid volumes



Anode channel

Model based on
(Bahrami et al., 2021)

Simplifications

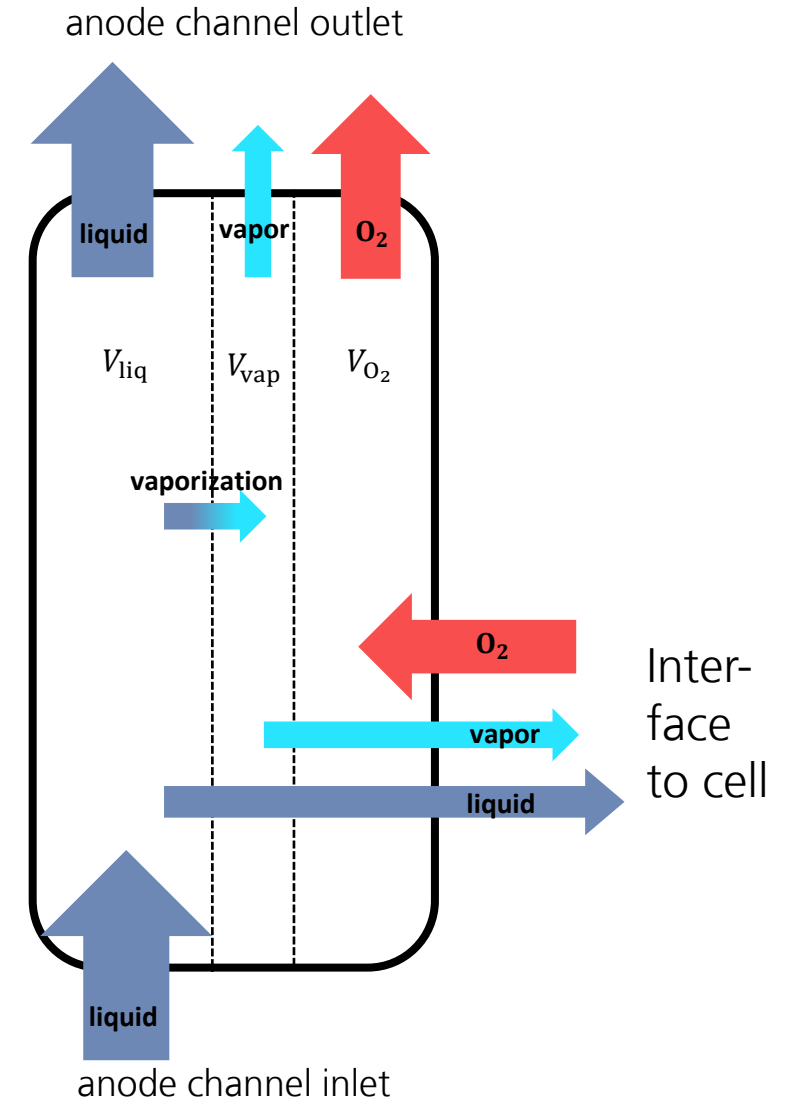
- Lumped variables
- O_2 always saturated
- Neglecting gas compression

State variables

- Volume of liquid water V_{liq}
- Temperatures of anode plate and anode channel

Formulas used

- Mass balances for vapor, liquid and O_2
- Ideal gas law
- $Q_{gas/liq} = f(\Delta p, V_{gas/liq})$
- Fourier's Law
- Enthalpy balance of anode channel



Cathode channel

Model based on (Bahrami et al., 2021)

Simplifications

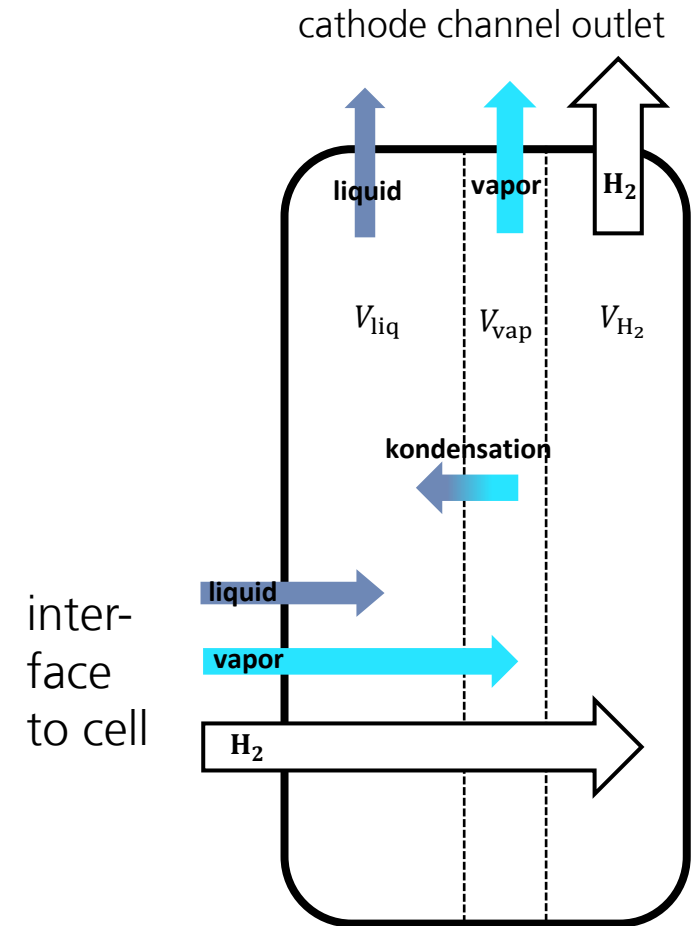
- Lumped variables
- Storage term for gas phase neglected

State variables

- Water content
- Temperature of cathode plate

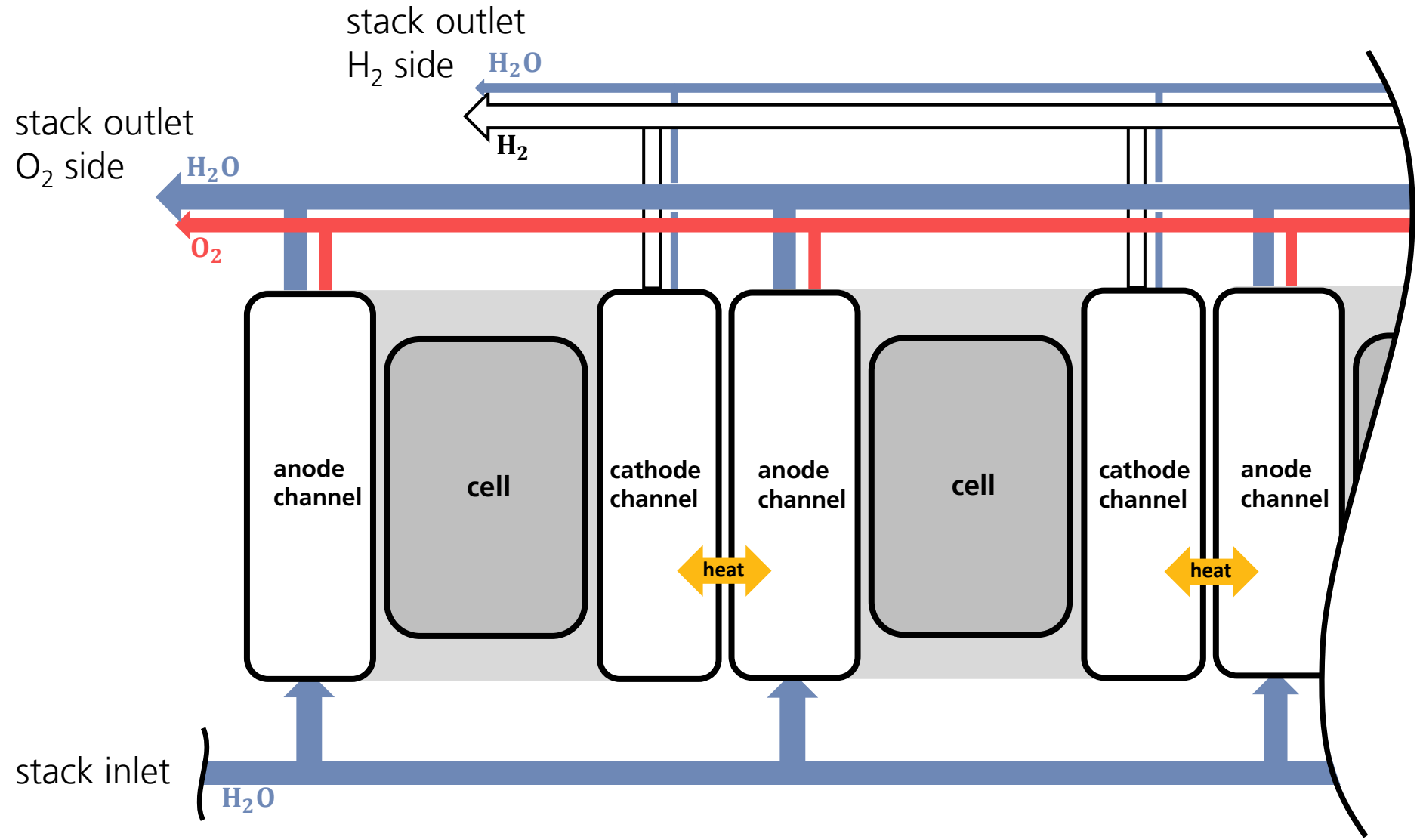
Formulas used

- Mass balances for vapor, liquid and H₂
- Ideal gas law
- $Q_{\text{liq}} = f(\Delta p, V_{\text{liq}})$
- Fourier's Law



Electrolyzer Stack

- Heat transfer between channel plates
- Hydraulic connection in parallel



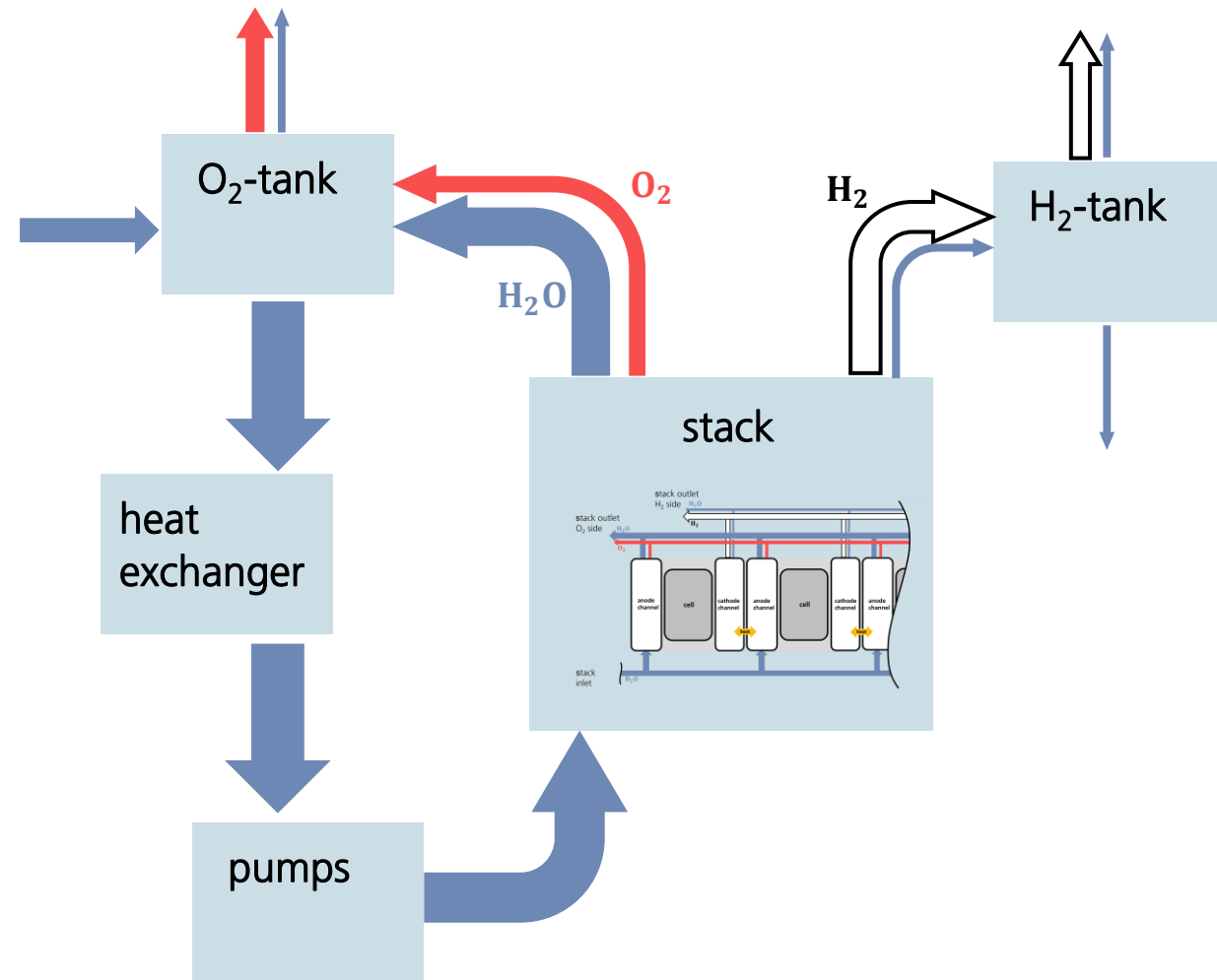
Additional components

Focus on anode water cycle

- > thermal behavior
- > anode side pressure

Relevant components

- O₂-tank
- Heat exchanger
- pumps
- pipes / hydraulic resistances



conclusion

BoP modelling approach was presented

- **Anode / cathode channels**
- **Stack model**
- **Additional components**

Advantages of BoP model

- **Dynamic behavior of the relevant components surrounding the cell**
- **Highly transient situations can be modelled:**
 - Shut down
 - Ramp up
 - Fault ride through
 - Etc.

Thank you for your attention!

Contact



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