Scale-up of organic redox flow battery

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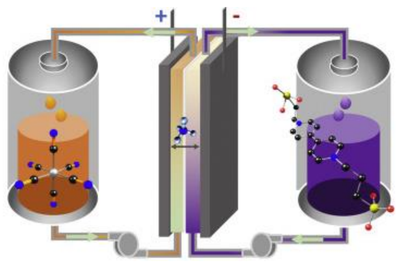
Introduction

Scale up of the battery was performer within the the HIGREEW project that aims to build an advanced redox flow battery based on water-soluble low-cost organic electrolyte.



$K_4Fe(CN)_6$ posilyte SPr_2V anolyte

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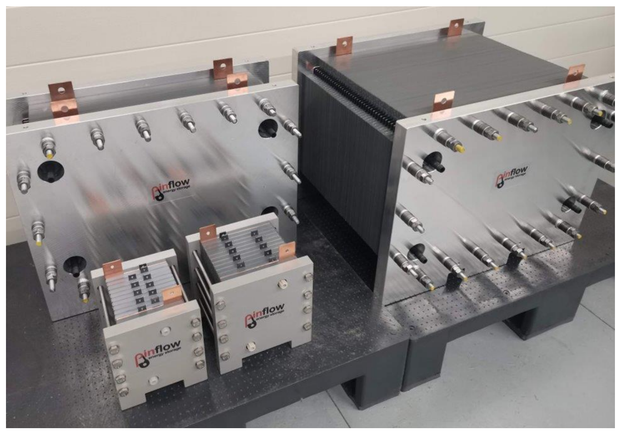
Scale-up issues

- Pressure losses
- Flow distribution
- Shunt current
- Current homogeneity
- Sealing concept



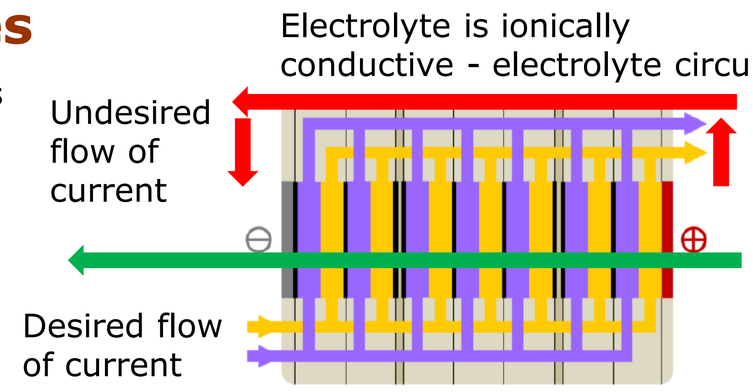
Shunt currents and pressure losses

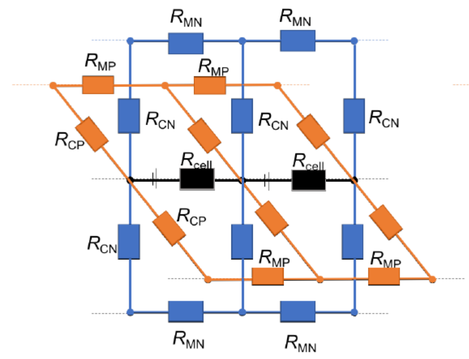
Analytical model of shunt current losses and pressure losses

- Optimization of sizes of channels and manifolds based on flow rate
- Optimization of size of active area

CFD model

- Optimization of preliminarily optimized design from analytical model
- Detailed model of flow channel
- Detailed model of flow distributor

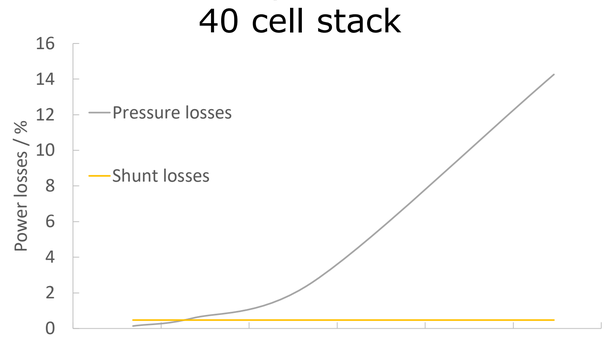




	Channel length (mm)	Power loss by shunt currents - 20 cell stack (%)	Power loss by shunt currents - 40 cell stack (%)
Organics	300	0.24	0.83
	200	0.35	1.14
	100	0.66	1.79
Vanadium	300	0.42	1.42
	200	0.60	1.94
	100	1.12	3.04

Shunt currents for organics based electrolyte significantly lower thanks to the lower cell voltage and conductivity of the electrolyte.

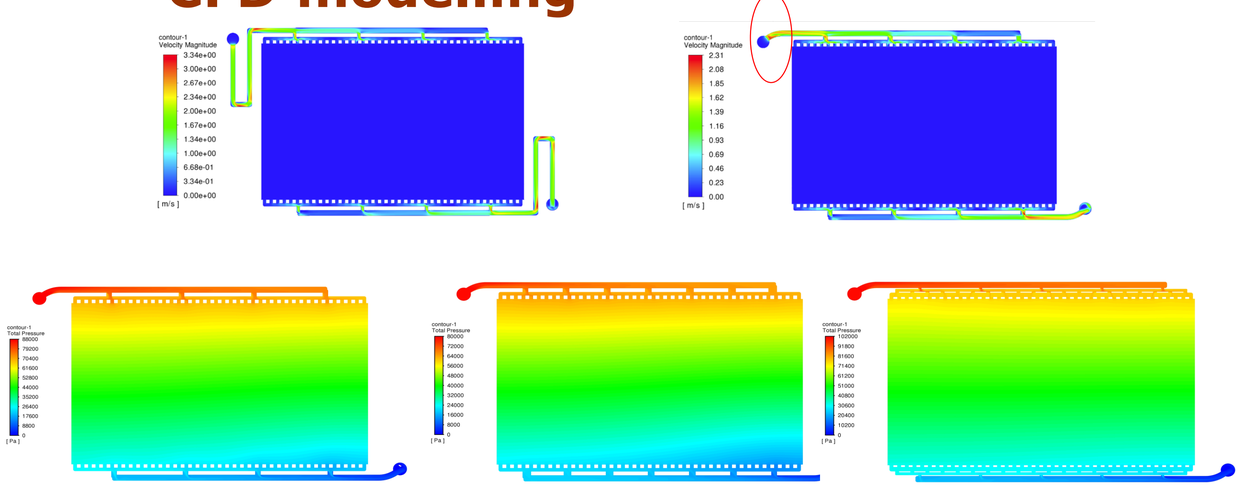
Analytical model – 40 cell stack



Summary

- Analytical model of shunt current losses and pressure losses and CFD model were developed
- Analytical model – determination of basic parameters of the stack
- CFD model – optimization from analytical model
- Electrochemical parameters are well transferable from laboratory cell to 20 cell stack

CFD modelling

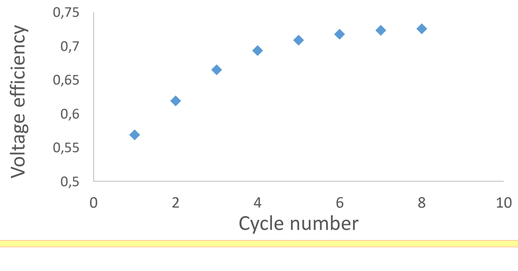


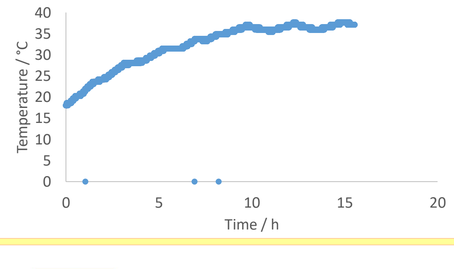
Electrochemical properties - comparison

1 and 5 cell setup

20 cell setup

	Resistance charging (Ohm cm²)	Resistance discharging (Ohm cm²)	Temperature
lab cell-20	3.05	3.15	20°C
1 cell-608	3.65	3.81	20°C
5 cell-608	3.41	3.62	20°C
20 cell-608	2.95	3.09	25°C





HIGREEW This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement no. 875613.