DesWEC
An investigation into wave-powered desalination

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Matching wave energy converter to reverse osmosis plant

Wave energy

- Variable flow of energy
  - Variable pressure
  - Variable flow

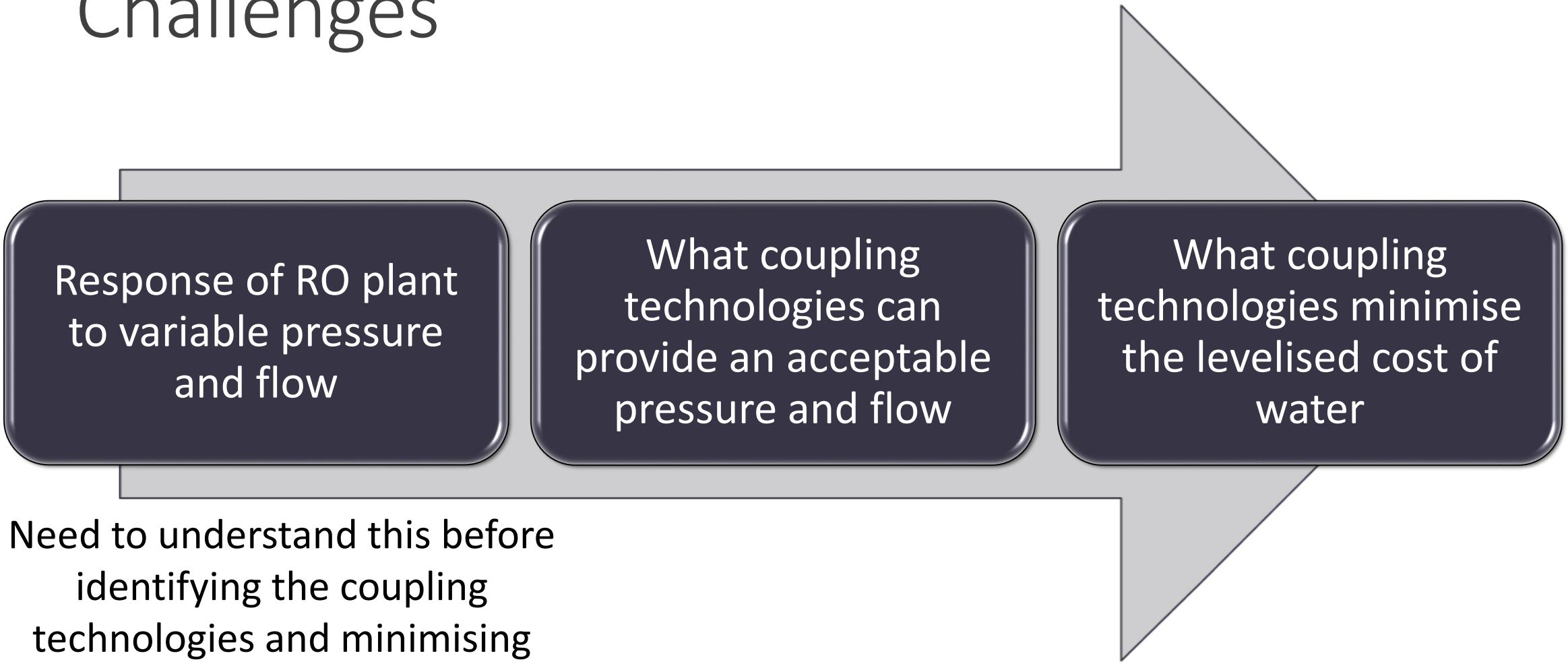
Coupling

- Accumulators / flywheels
- Intermediate energy vector (e.g. electricity)
- Energy recovery technology

Reverse osmosis

- Ideally constant pressure and flow
- Effect on
  - Specific energy consumption
  - Water quality
  - Membrane life

Challenges

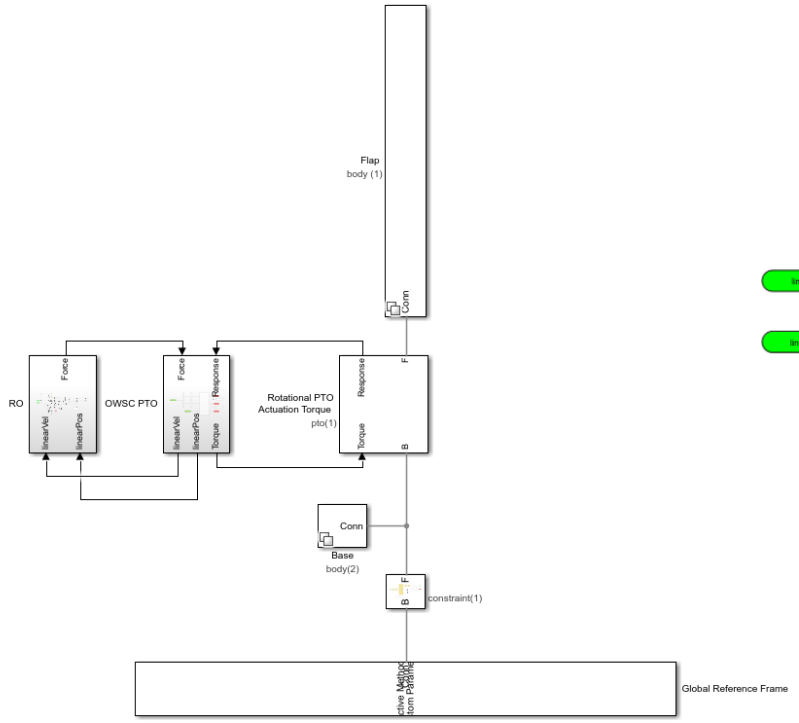


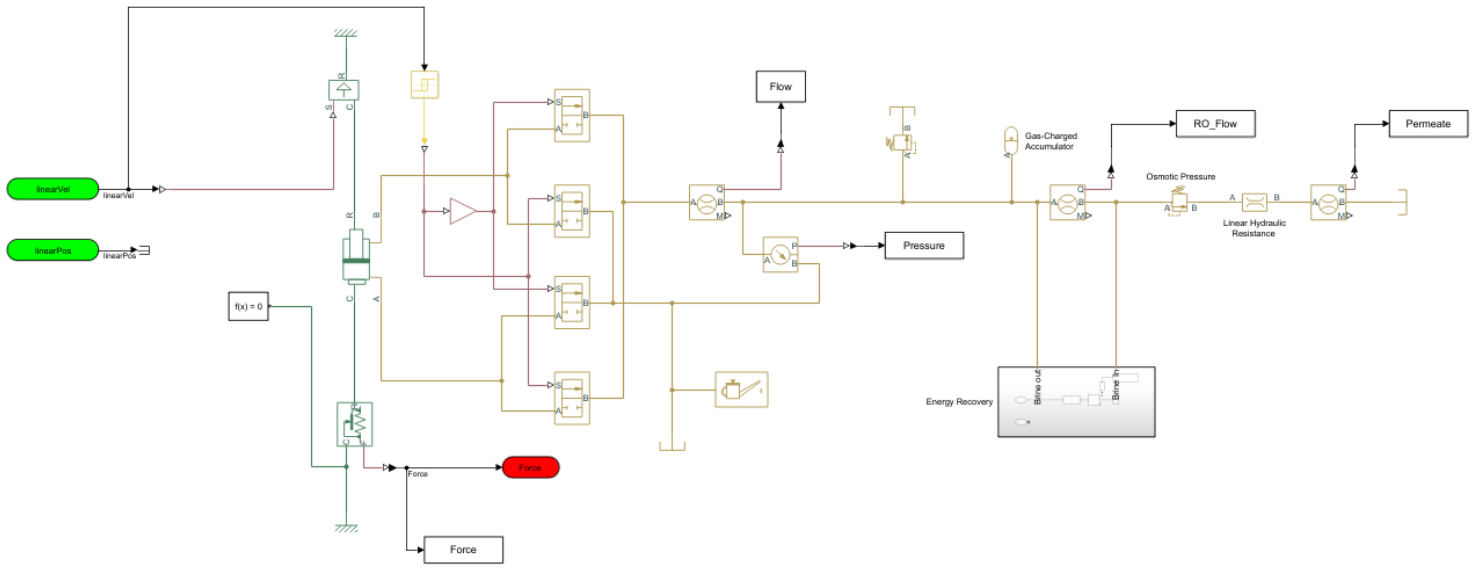
Need to understand this before identifying the coupling technologies and minimising LCoW

Focus of this research

Numerical modelling to estimate pressure and flow variations

WecSim / Simulink model of flap-type wave energy converter

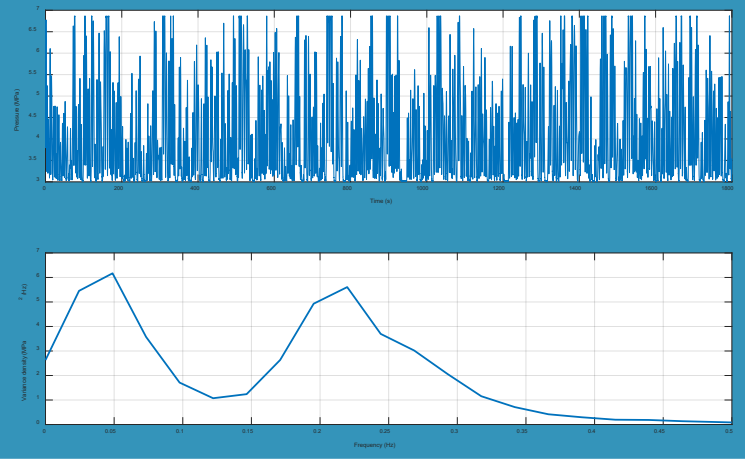




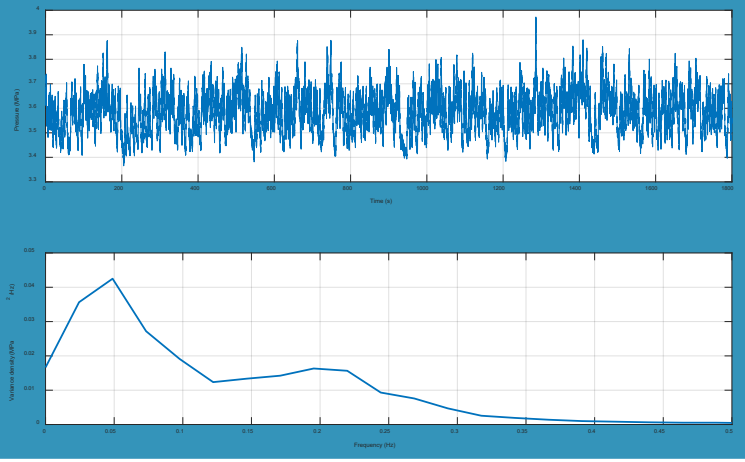
Simplified model of hydraulic circuit and RO membranes

Results

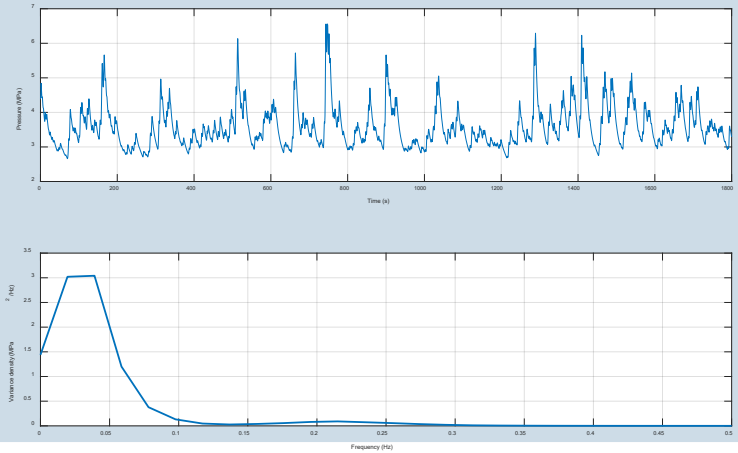
OWSC - Clark pump



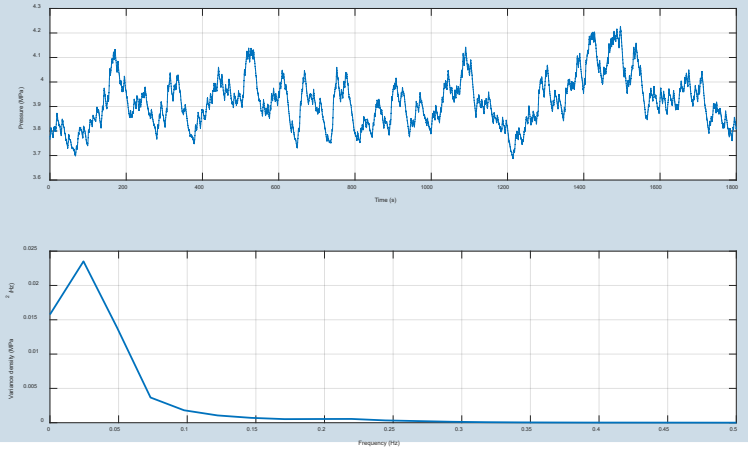
Buoy - Clark pump



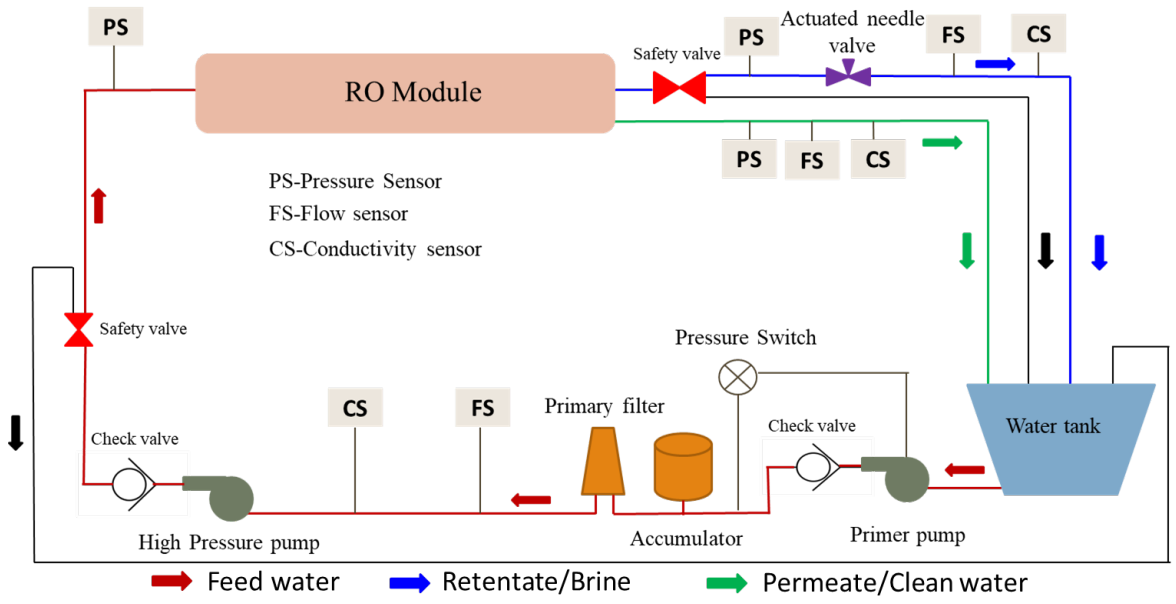
OWSC – Pressure exchanger / intensifier



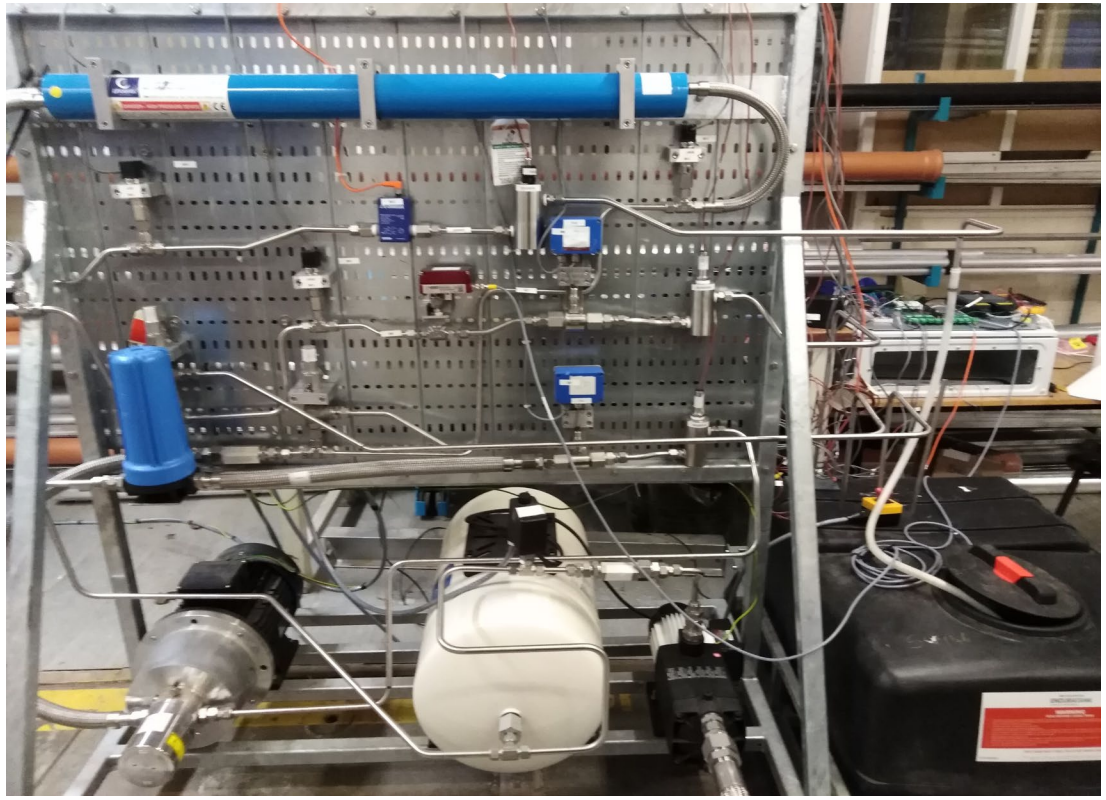
Buoy - Pressure exchanger/intensifier



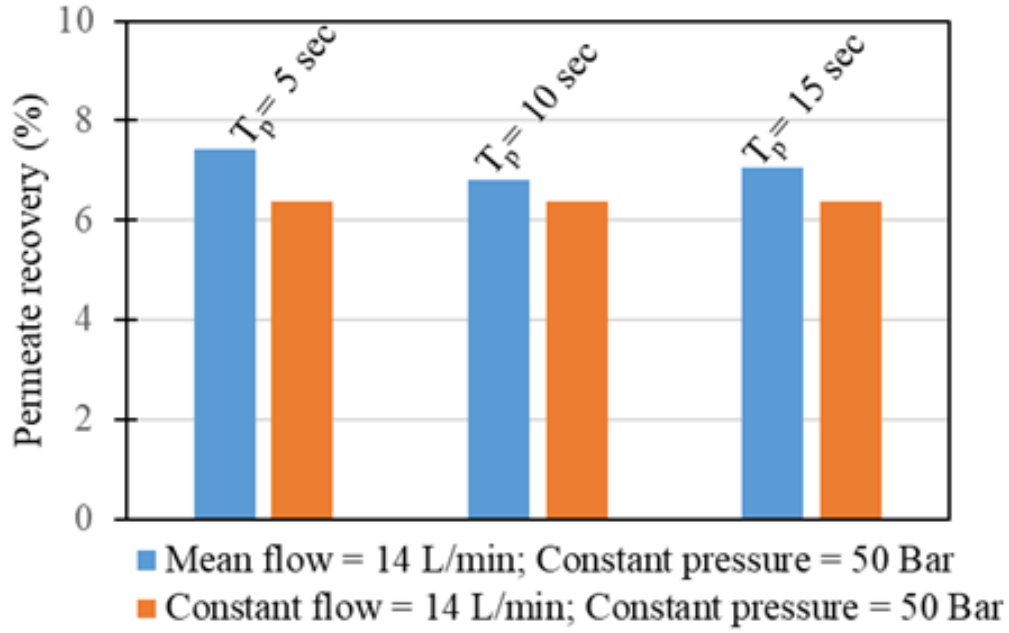
Experimental setup



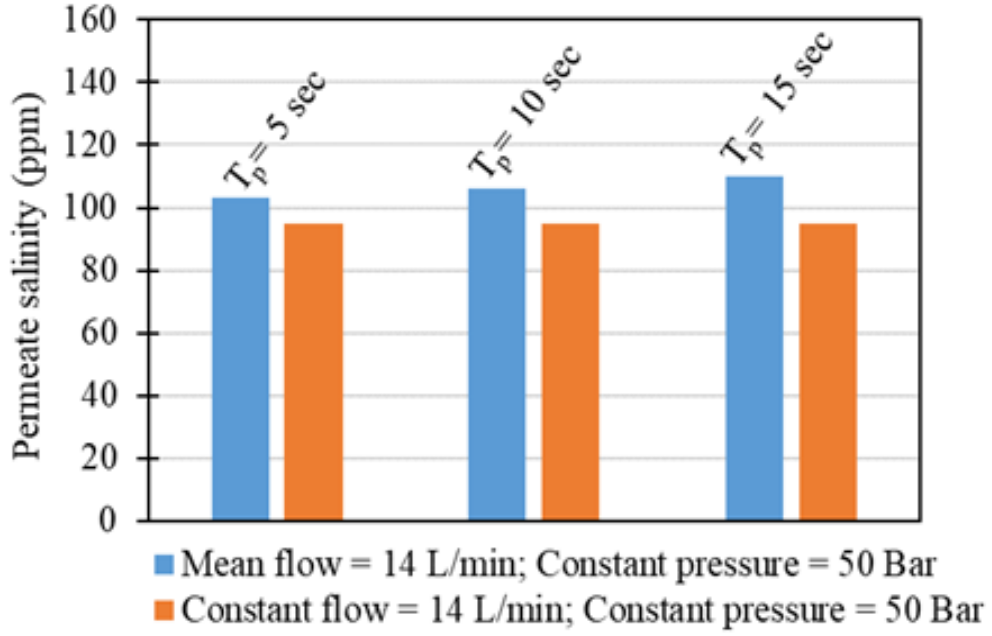
SW30-2540 DOW FilmTec RO membrane



Results – effect of variable flow

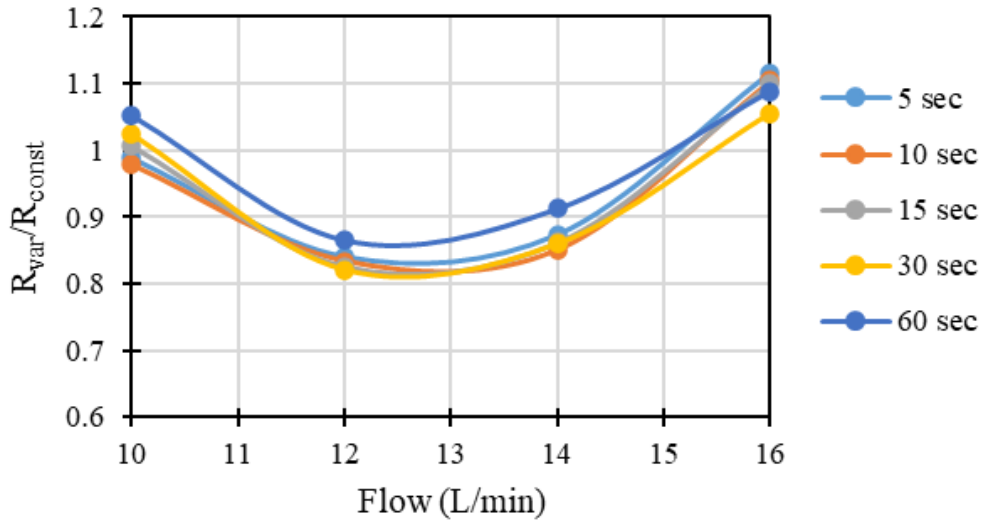


Comparison of permeate recovery for variable flow with respect to constant flow for different time periods

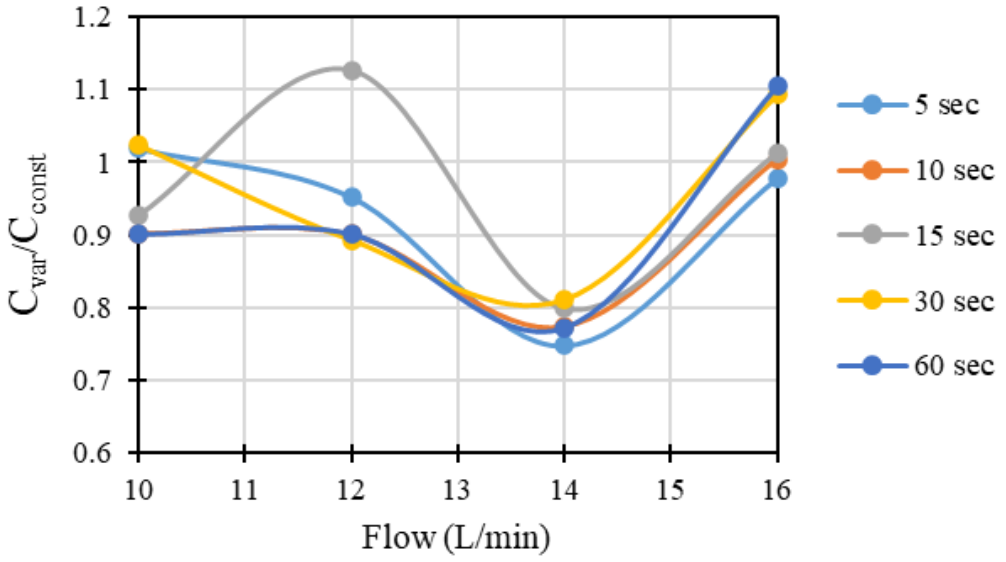


Comparison of permeate salinity for variable flow with respect to constant flow for different time periods

Results – effect of variable pressure



Ratio of permeate recovery in variable pressure relative to constant pressure



Ratio of permeate salinity in variable flow relative to constant flow

Conclusions

- The type of WEC does not significantly effect the design of desalination plant
- The type of energy recovery technology has a significant effect on the frequency of pressure and flow variations
- The pressure exchanger-intensifier provides a more consistent pressure and flow to the RO membranes when compared to a Clark Pump
- It is necessary to control the number of RO membranes connected to enable optimisation of the WEC damping
- Variable pressure and flow through the RO membranes result in an increase in the production in fresh water, accompanied by a reduction in water quality (salt content)

Follow on work

Further investigations into the impact of pressure and flow variations

Numerical and physical modelling with the inclusion of energy recovery

Research into the potential for coupling wave energy with batch desalination