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# Using heat-pump for simultaneous air conditioning and fresh water production by membrane distillation: performance prediction

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## Abstract

The objective of this project is the coupling of a refrigerating machine to a membrane distillation unit. This sea water desalination technique is based on the use of a hydrophobic membrane and the creation of a temperature gradient between a hot channel and a cold channel. The seawater is heated by the condenser of a refrigerating machine.

## Presentation of the study

Fig. 1 shows the design of a coupling approach of a MD unit and a refrigeration machine for simultaneous cooling and desalination.

**Principle:** this system allows the recovery of waste heat in the environment by refrigeration or air conditioning equipment to produce fresh water

**Mass transfer through the membrane:** It depends on the difference of vapor pressure between the feed water in the hot channel and the air gap and on the permeability B of the membrane

$$J_v = B \Delta P \quad (1) \quad B = \frac{\varepsilon M_w P D_{ia}}{RT_m(\delta_m \tau + \delta_g) |P_a| \ln a} \quad (2)$$

**Validation of the numerical model:** The theoretical model was developed and validated using experimental data obtained at the scale of an air gap membrane distillation pilot. The maximum difference between simulated and experimental results was 6% (Fig.2).

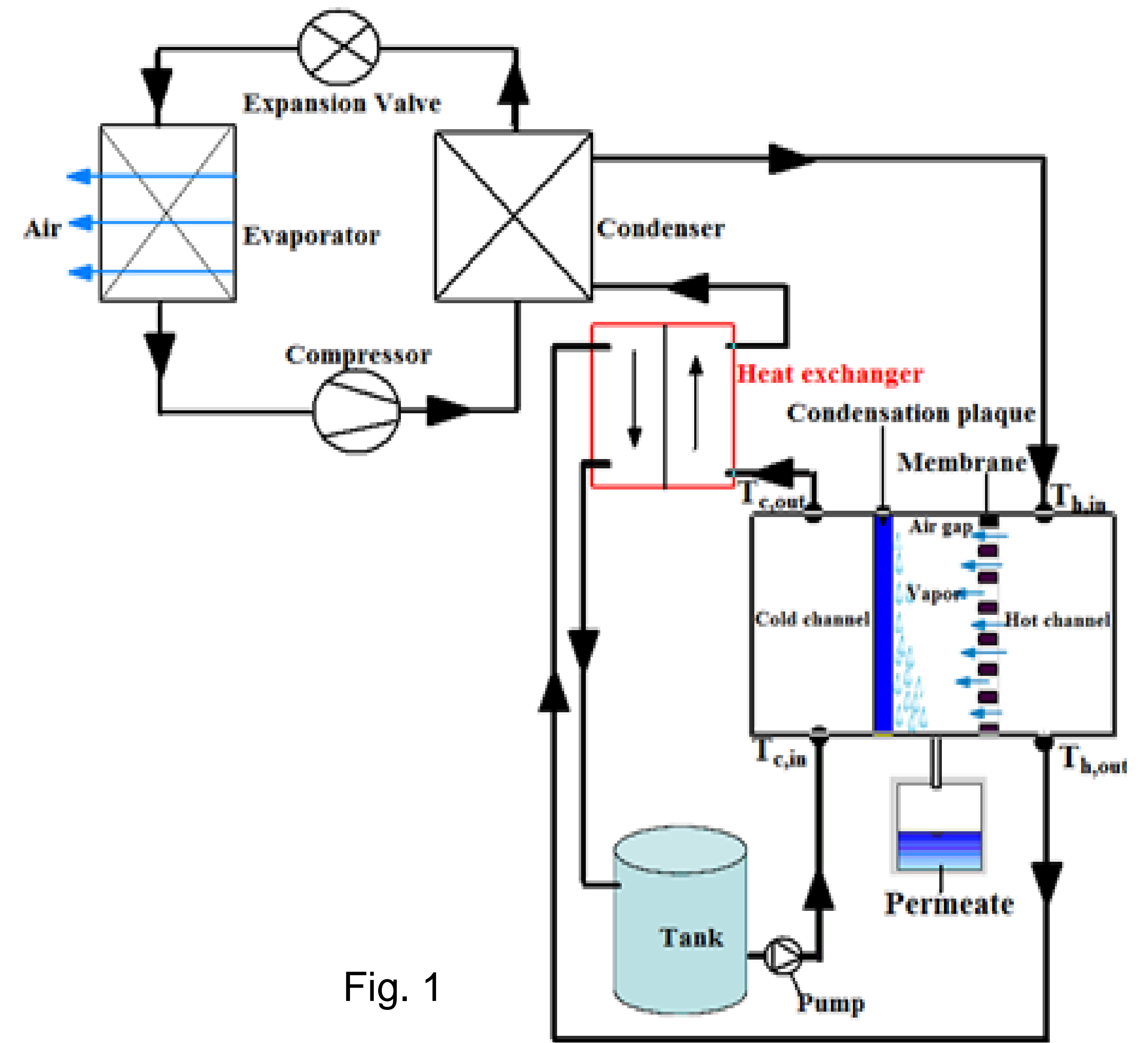
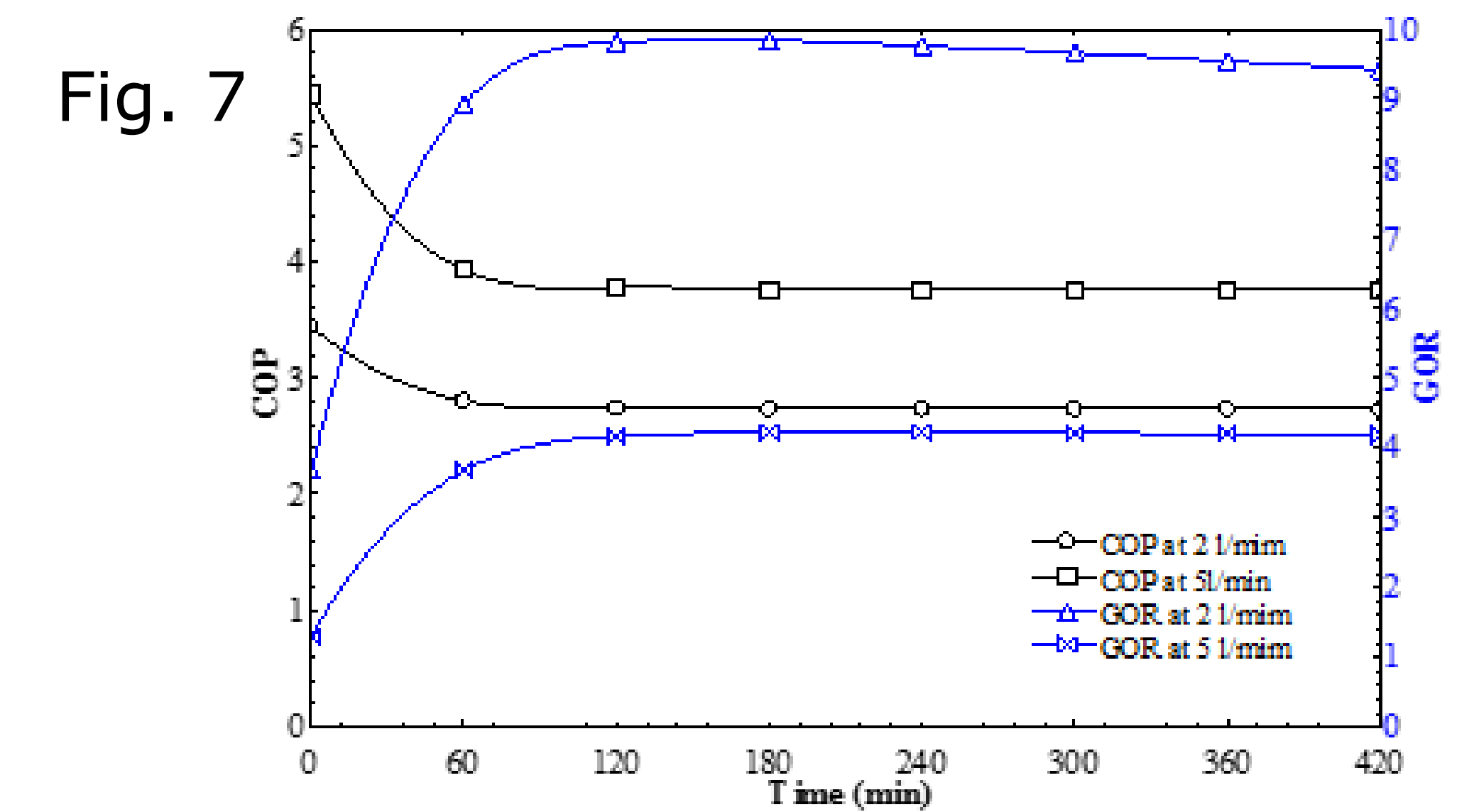
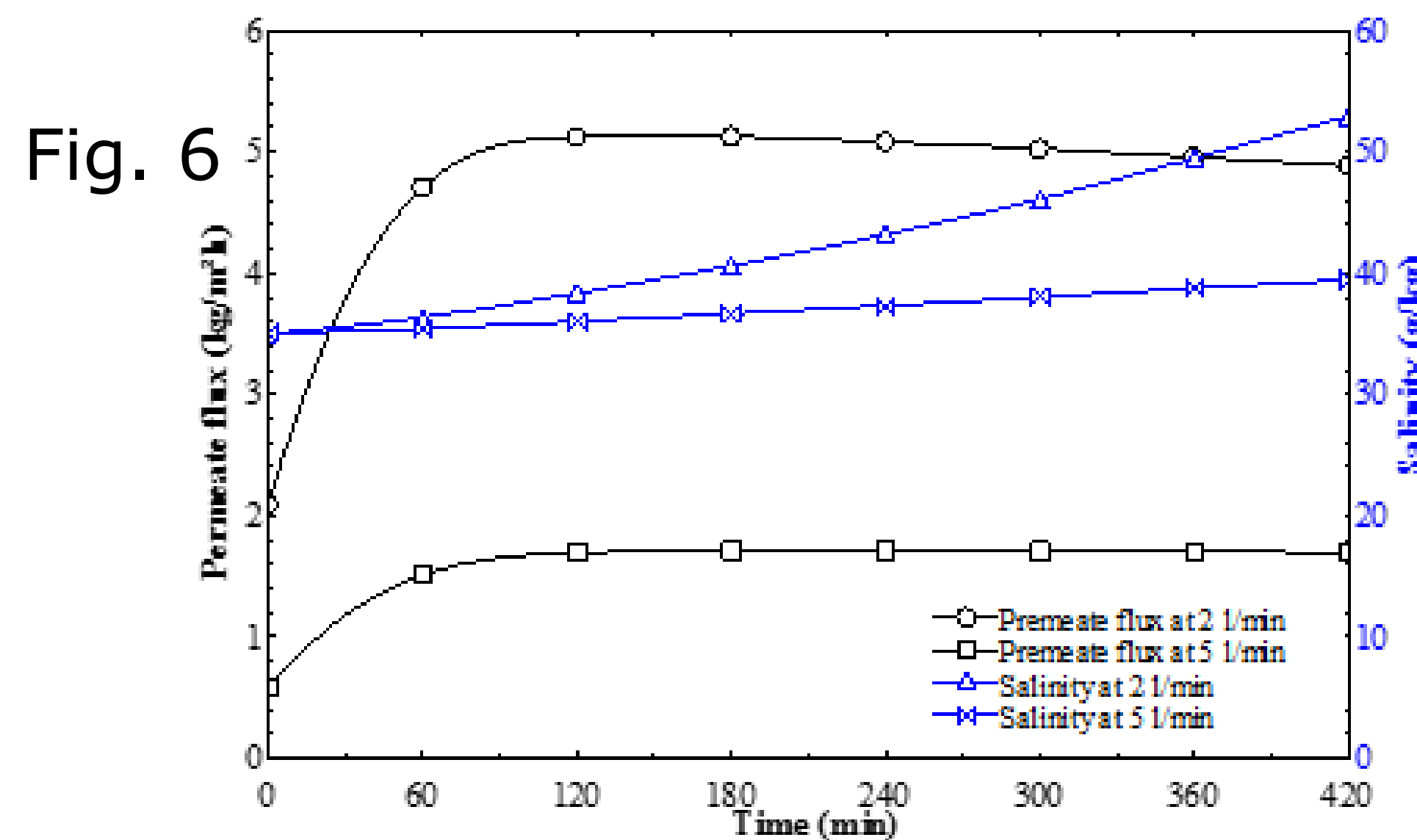
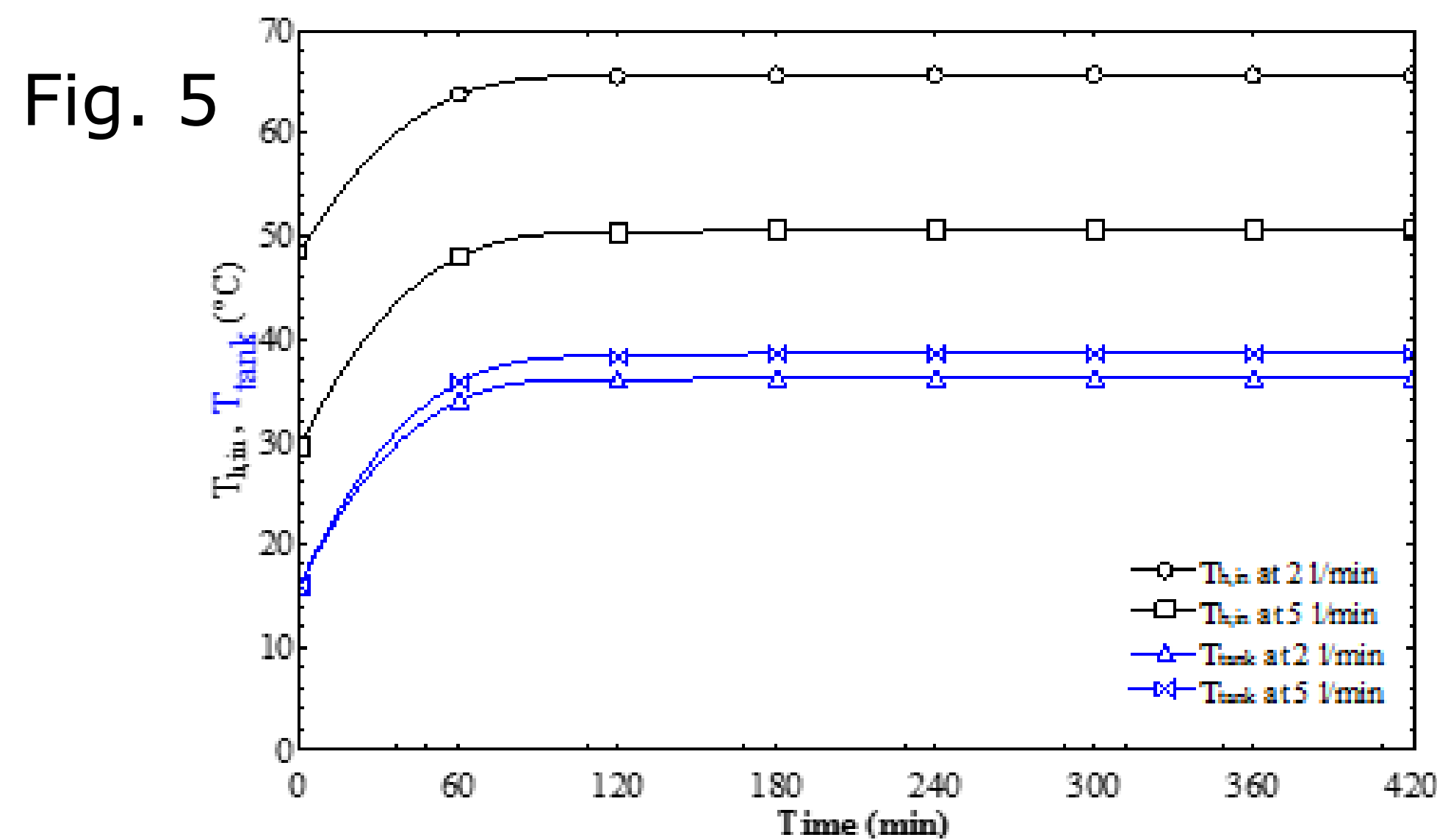
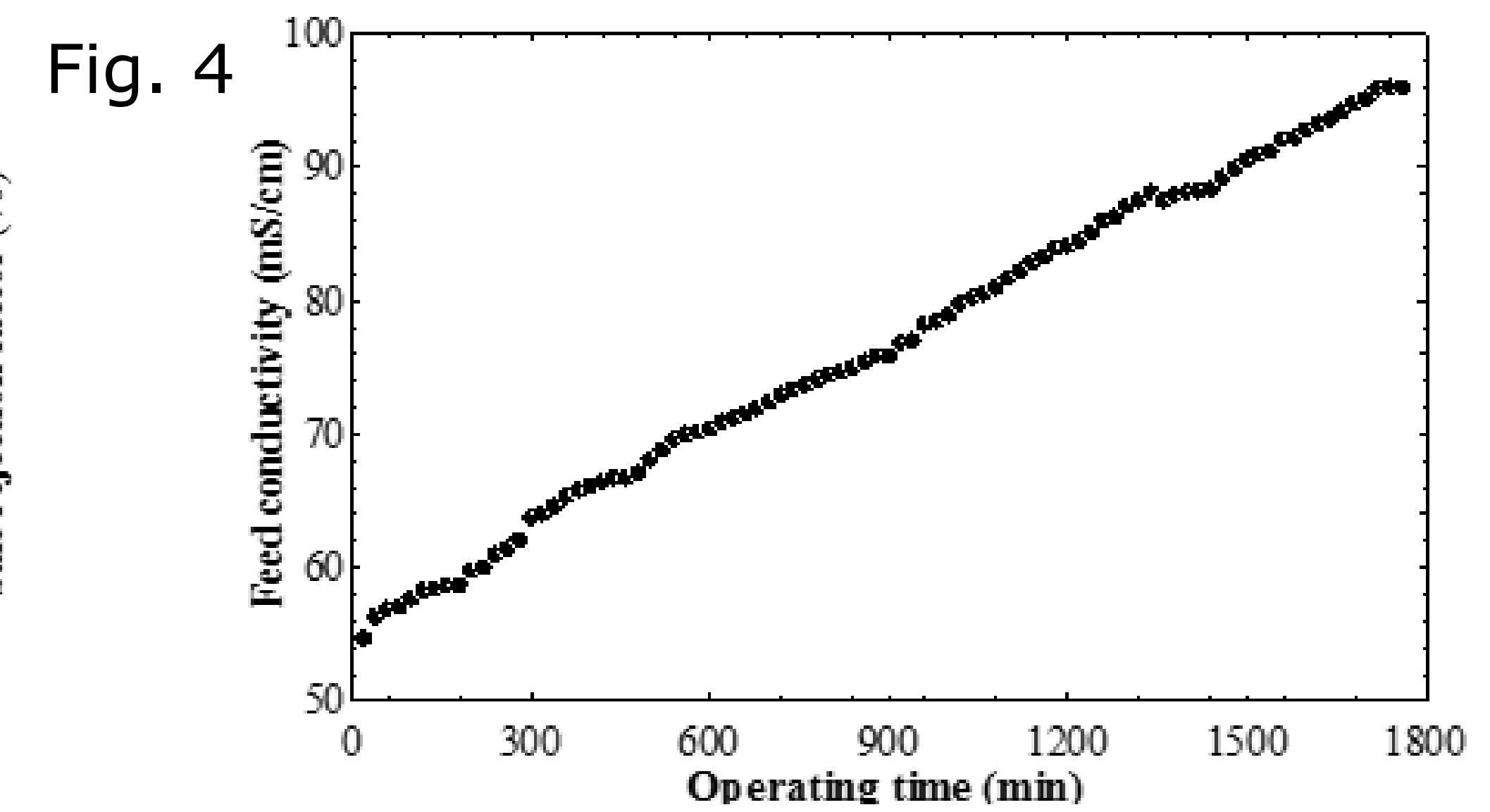
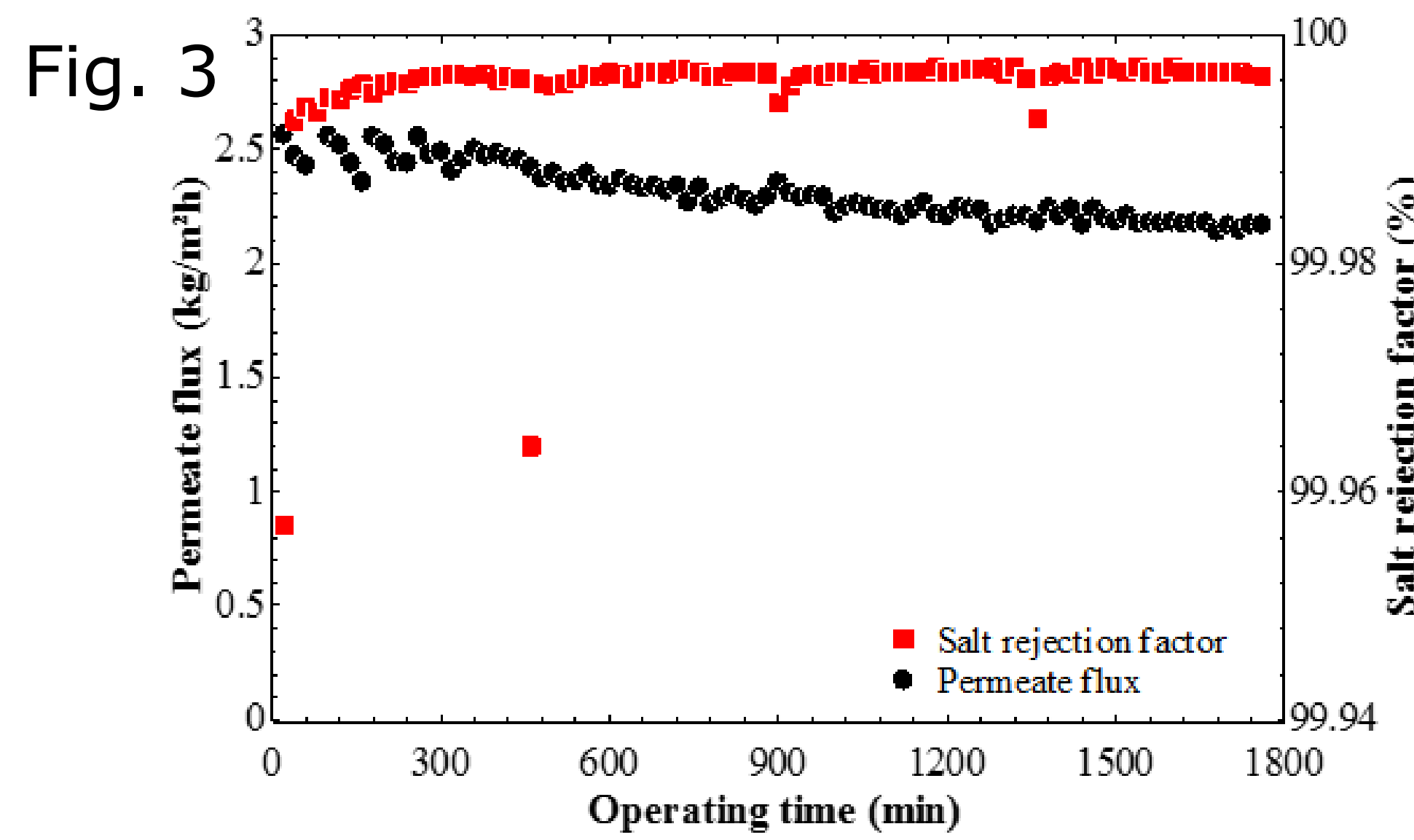
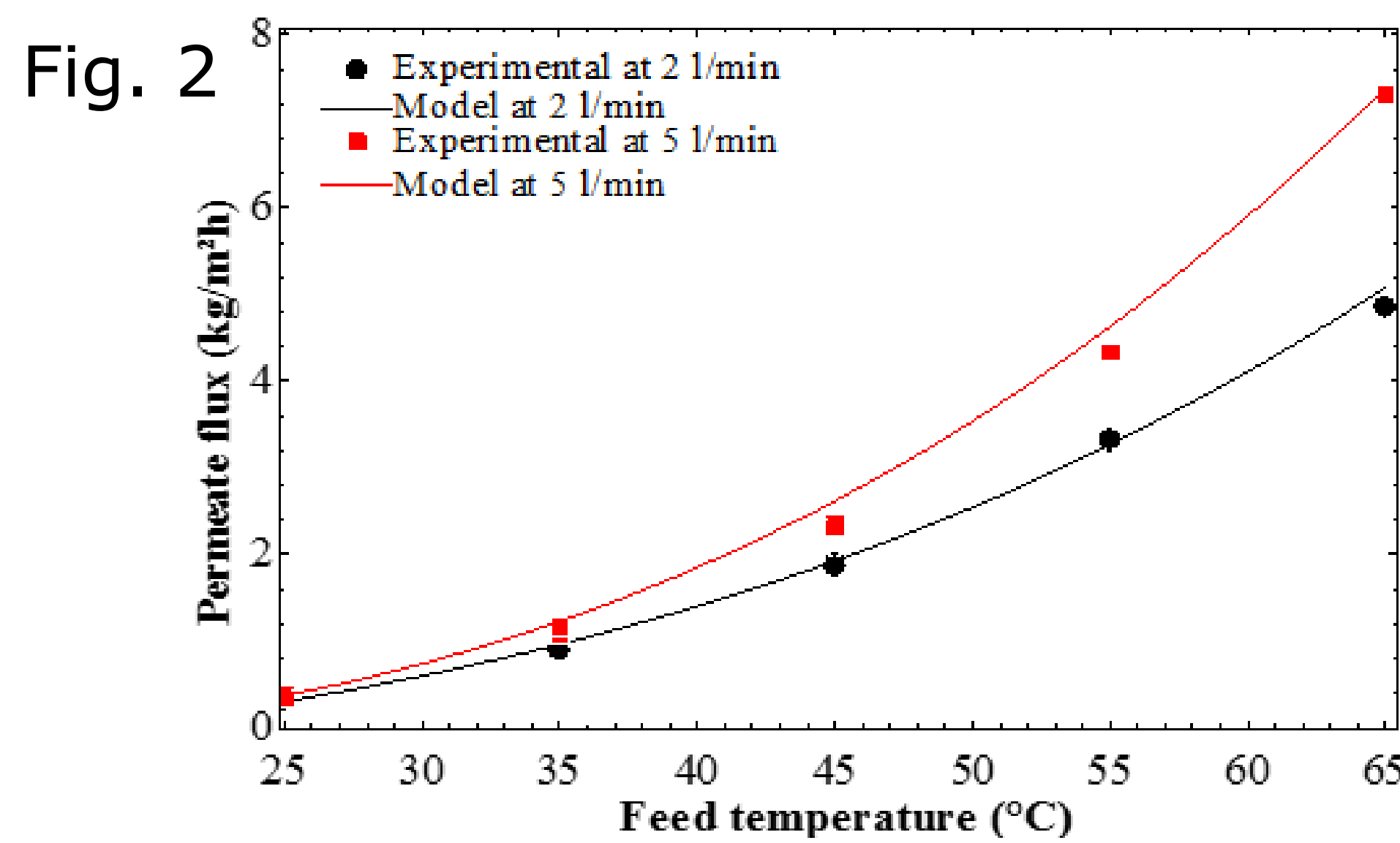


Fig. 1

## Results



## Conclusions

- Fig. 3 shows that the permeate flux of the AGMD slightly decreases with time while the salt rejection rate remains greater than 99.9%.
- Fig. 4 shows that salinity in the feed tank increases during the same test as in Fig. 3.
- A low flow rate increases the  $T_{h,in}$  while a high flow rate increases the  $T_{tank}$  (Fig. 5).
- The increase of the salt concentration has an impact on the permeate flux, which decreases despite constant values of  $T_{h,in}$  and  $T_{tank}$  (Fig. 6).
- GOR increases with a decrease in water flow rate and while the COP is decreasing (Fig. 7).

## Acknowledgements