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Flux as function of temperature

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Everybody agrees that flux increases as function of temperature. However, when it comes to turning this knowledge into a formula - allowing everybody to calculate what the flux is - things start to get difficult. Theory and reality seems not to match so well, maybe because the flux get influenced by physical limitations, which the theory does not take into account.

- In a university the flux is often measured in a flat cell, with absolutely no resistance to flow of permeate.
- In real life there is resistance to flow of permeate in the permeate carriers used in several element constructions, e.g. commercial spiral wound elements.

Four different ways to calculate the Flux Correction Factor

1. Based on theory, flux is described by the formula

$$(1)\ \text{Factor} = (1 + \text{fluxfactor})^{(°C - 25)}$$

where fluxfactor is a constant depending on the membrane type. For membranes of thin film polyamide, polysulfone and PVDF the factor is generally accepted to be 3,3% per °C and 2,7% per °C for CA membranes.

2. Another commonly used formula is

$$(2)\ \text{Factor} = 1 + \text{fluxfactor} * (°C - 25)$$

3. In commercial water design programs other approximations are used, e.g.

$$(3)\ \text{Factor} = \text{Fudge} * \exp(2919 * (1/298 - 1/(°C + 273)))$$

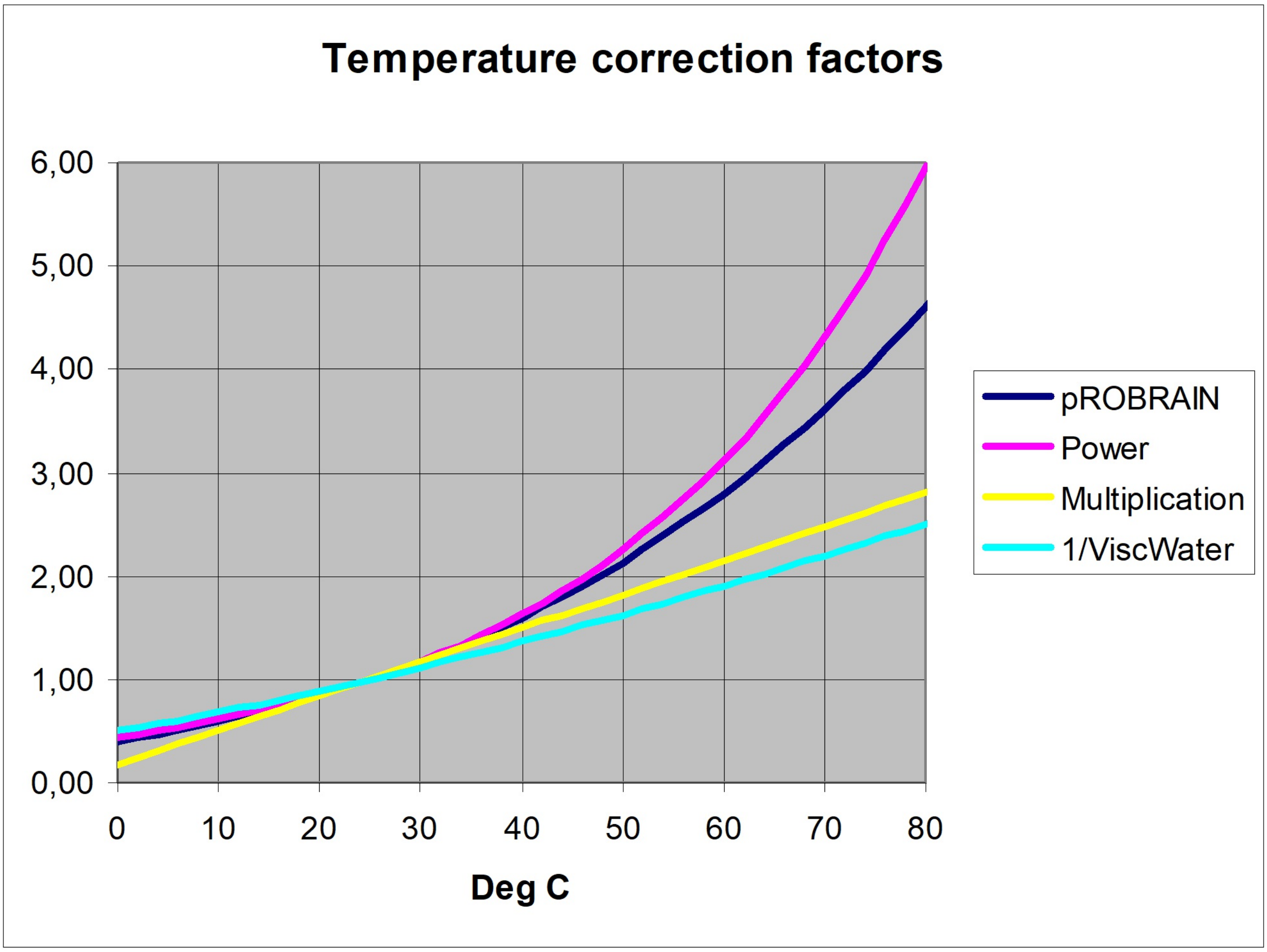
where Fudge is the inevitable extra correction factor used to finagle the data.

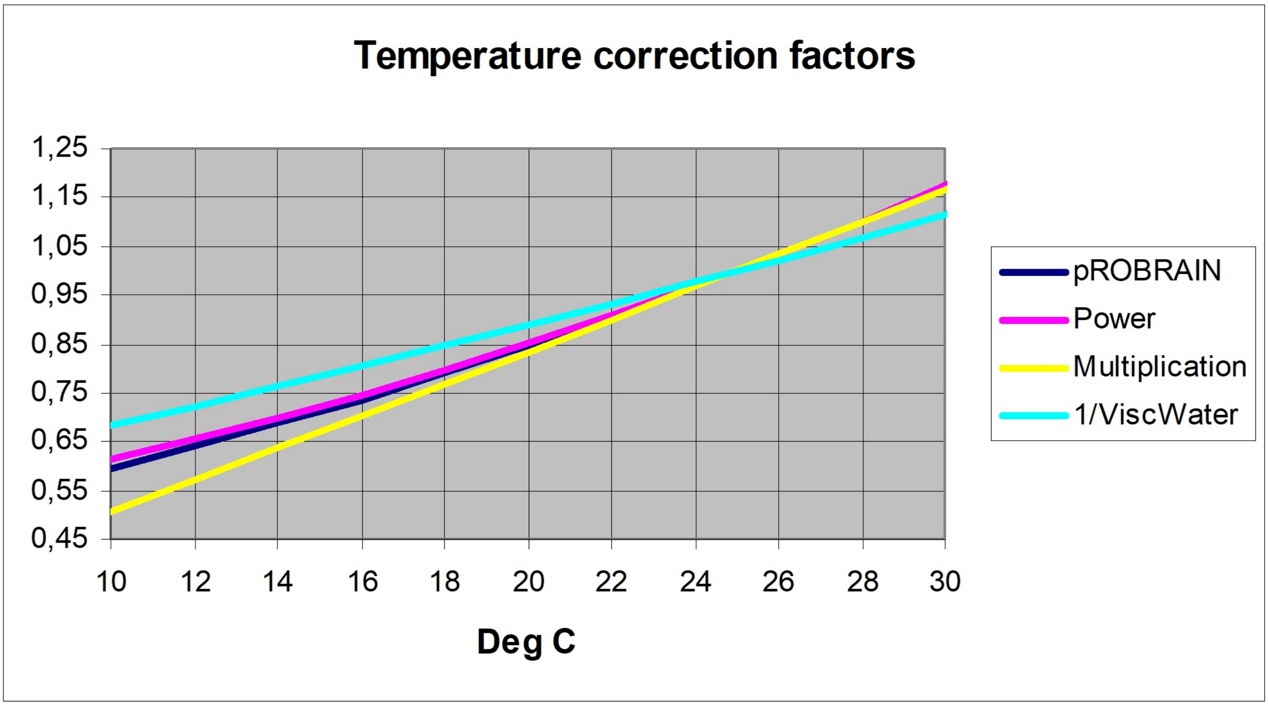
4. It is a rarely known fact that the reciprocal viscosity of water gives a very good approximation to flux observed in reality.

$$(4)\ \text{Factor} = 1 / (\text{Viscosity of water})$$

It is striking that no matter which of these methods is used there is little difference between them in the temperature range 10 - 35 °C, which is where the vast majority of the plants are operating. The real differences are seen at extreme temperatures, both high and low. There is good reason to suspect, that suppliers of high temperature membrane systems simply need to make a thorough investigation of the behavior of spiral wound elements at elevated temperature, in order to once and for all clarify how flux changes.

Until that happens the writer will use:
formula (1) in the temperature range 0 to 25 °C
formula (2) in the temperature range 25 - 90 °C.





Notice: pROPRAIN is the 1995-name for the desing program from Desal / Osmonics. Osmonics changed to GE and then to SUEZ and then to Veolia.