Exercise Series 13

Exercise 1: Module technology

a) What are the advantages and the drawbacks of a glass-glass laminate compared to a glass-backsheet laminate?

b) Is it ideal to have a perfectly airtight laminate (for instance glass-glass laminate and water-proof seals on the sides)?

c) What could we change or improve to speed up PV encapsulation processes?

d) What would be the properties of the "ideal" encapsulant?

e) What is the role of the frame in a module?

f) Modules found on the market for building integration are often criticized for being anaesthetic, what would you change to improve it?

g) Presently, modules have 20 years of warranty; if we want to push it over 30 years the modules reliability, on what aspects will need further developments?

Exercise 2: Polymer and water vapour

The diffusion of water vapour inside a polymer follow Fick's law for a semi infinite medium with an inexhaustible source of diffusive particles. Therefore the concentration of water vapour inside the polymer can be expressed as follow:

$$c(x,t) - c_i = (c_s - c_i)(1 - erf(\frac{x}{2\sqrt{Dt}}))$$

where x is the distance from the open edge, t is the time of vapour exposure, $c_{s(i)}$ is the saturation (initial) concentration.
If we take the following example: 85 °C, with a high relative humidity of 85 % the diffusion constant is around $D = 6.3 \times 10^{-6}\,\mathrm{cm^2\,s^{-1}}$, $c_s = 0.0055\,\mathrm{g\,cm^{-3}}$, $c_i = 0.0004\,\mathrm{g\,cm^{-3}}$ calculate the typical concentration at 1 cm from the front edge after 6 weeks (typical test for an encapsulant). How close is the module to reaching its saturation concentration?