

Migration Of MOSH/ MOAH Through Multi-layered Packaging Into Food



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Introduction:

- MOSH/ MOAH are suspected to be carcinogenic
- They are known to migrate through packaging into food [1,2]
- Experiments are very costly and time-demanding.

Computational Methods:

- One dimensional, because packaging is very thin compared to the food
- Packaging composite of several functional layers
- Fick'ian diffusion [2]
- Adsorbents commercially available
- MOSH/ MOAH mixture of components [1]

$$\frac{\partial c_i}{\partial t} = D_i \frac{\partial c_i}{\partial x^2} - k_{ads} \cdot (c_i - K_{ads,i} \cdot c_{ads,i})$$

$$\frac{\partial c_{ads,i}}{\partial t} = k_{ads} \cdot (c_i - K_{ads,i} \cdot c_{ads,i})$$

- Different affinity modelled by partition coefficient $K_{eq,i}$ with a very large interface mass transport coefficient $k_{mass} \gg 1$

$$J_{boundary} = k_{mass} \cdot (c_i^- - K_{eq,i} \cdot c_i^+)$$

- Mass transfer to surrounding
- Diffusion coefficients described by empirical correlations, including temperature-dependence
- Transport with module Transport of Diluted Species
- Many components and many different packaging solutions make building models manually error prone and very time consuming, therefore the model is created using the LiveLink to MATLAB®

Results:

- Model can describe migration of any number of components through any number of packaging material
- Adsorption layers, mass transfer to the surrounding and temperature changes can optionally be included

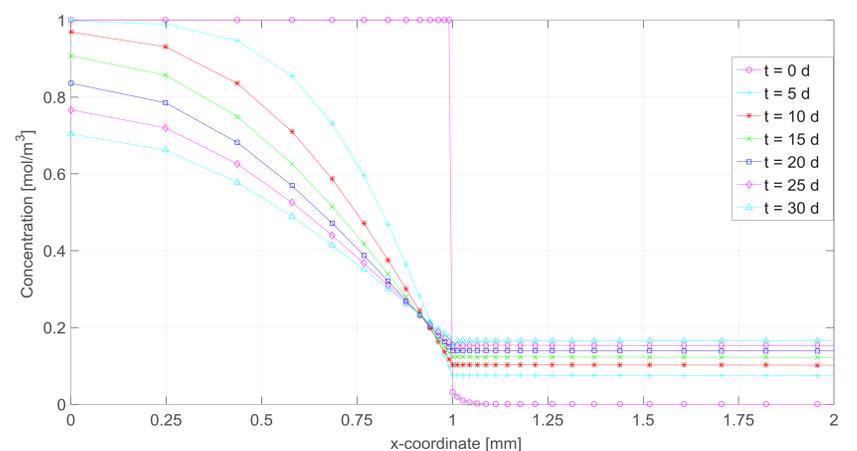


Figure 1. Concentration profiles in a one-layer packaging

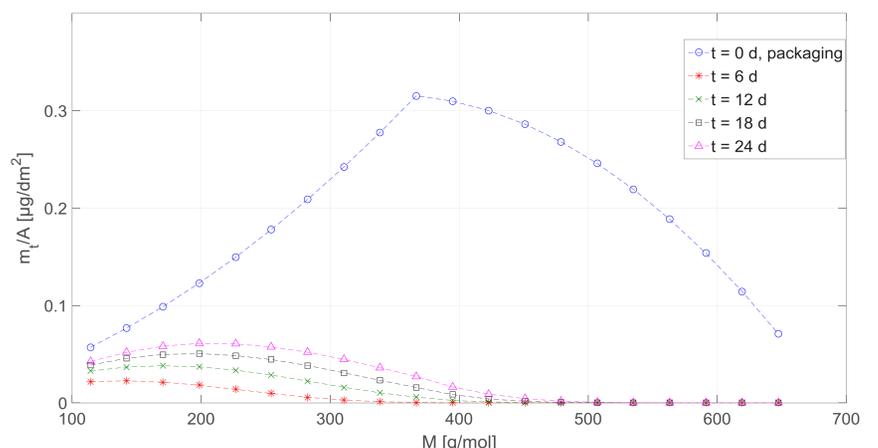


Figure 2. Amount of migrated substance as a function of its molar mass

Conclusions:

- Model can describe wide variety of packaging solutions
- Planned experiments will yield parameters
- Temperature effects can be considered
- Multi-scale approach will yield parameters of food

References:

1. Ewald, C. Modellierung des Einflusses von Faser- und Füllstoffeigenschaften auf Diffusionsvorgänge hydrophober organischer Stoffe im Papier, Fachgebiet Papierfabrikation und Mechanische Verfahrenstechnik, Technische Universität Darmstadt (2015)
2. Wang et al. Modelling of Migration from Printing Inks on Paper packaging, Packaging Technology and Science, 28, 357-366 (2015)