Migration of MOSH/MOAH Through Multi-Layered Packaging Into Food

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Abstract

Substances similar to Mineral Oil Saturated Hydrocarbons (MOSH) and Mineral Oil Aromatic Hydrocarbons (MOAH) have been proven to be present in recycling paper. MOSH/MOAH are suspected to be carcinogenic. Furthermore, MOSH/MOAH migrate through the packaging into food stuff [1]. This work aims at modelling, how much MOSH/MOAH migrates from the packaging into food to evaluate the exposure to toxic substances.
Compared to the dimensions of the food the packaging is very thin and one can, therefore, consider the problem to be one-dimensional [1]. The aim of the project is not to investigate one specific packaging, but to develop a tool that can be used for the simulation of a broad variety of packaging solution. Accordingly, instead of constructing the packaging consisting of several layers by hand, the LiveLink™ for MATLAB® is used to build a packaged food with an arbitrary number of layers.
Physics: The migration of MOSH/MOAH can be described by Fick'ian diffusion [2]. Therefore, the interface Transport of Diluted Species is used. Within the packaging can be adsorbents for MOSH/MOAH which are considered by a reaction term. Because MOSH/MOAH are groups of chemically similar substances with different molecular weights [1], the transport of several representative species is computed. The diffusion coefficients are computed by empirical correlations in MATLAB.
The packaged food is assumed to be symmetric around the center. The loss of MOSH/MOAH to the environment is currently neglected, but will be included in further work. The migrating substance can have a different affinity for the different layers [1], accordingly there can be a concentration jump at the boundary that is dealt with by using a concentration boundary condition for every layer. Initially, the migrant is only present in selected layers.
In Figure 1 the concentration is plotted for isothermally stored food wrapped with a single-layer packaging. One can see that for this specific contaminant and packaging solution, the diffusion resistance is in the packaging and that a significant fraction of the contaminant has migrated into the food.
In addition to this modelling work, experiments are planned to measure the migration. This will allow estimating the parameters. With these parameters the migration during storage of food can be described for a wide variety of packaging solution at all temperatures within the investigated range, instead of just the measured temperatures and packaging solutions. Further work will formulate a mechanistic model for migration in food which will allow the prediction of the diffusion coefficients of food based on the microstructure.

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Reference

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

Figures used in the abstract

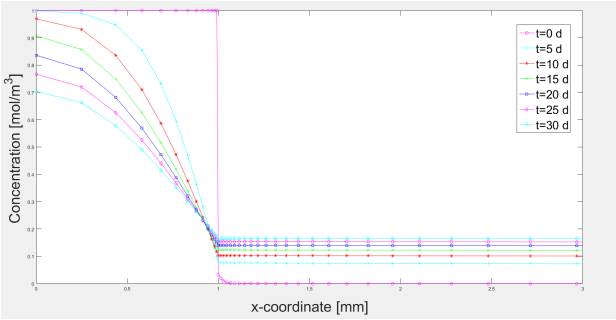

Figure 1: Concentration profiles after isothermal storage for a 1 mm thick single-layer packaging.