Nano in coffee capsules

In brief

- Certain nanomaterials in food packaging promise longer shelf life and freshness.
- Such materials, products, and related processes pose potential risks to the environment and health.
- “Safe by Design” (SbD) addresses safety issues during early stages of development.
- In future, SbD concepts must offer clear added value for users, and additionally specific research for testing and detection methods must be promoted.

What is it about?

Food contact materials are diverse and omnipresent, for instance in the form of dishes and cutlery, storage and packaging containers, food processing machines as well coffee capsules.

Nanotechnologies can improve the characteristics of materials and products. This is of particular interest for food packaging made of plastic as the shelf life of food can be increased, thereby ensuring freshness for longer and guaranteeing higher quality. Technical properties such as hardness, abrasion resistance or processability of materials can also be improved. However, there is currently a lot of uncertainty about the different risks nanomaterials pose as not enough is known about their possible release and impact on the environment and health. Moreover, there are currently no standardised test methods to collect this data.

In principle, the SbD concept allows companies to address safety-relevant questions at an early stage during the development of new materials and products. Nevertheless, the implementation of SbD at company level is, however, voluntary and can be put into practice in addition to measures resulting from existing mandatory EU chemicals legislation. In order to examine the applicability of these SbD concepts for Austrian small and medium-sized enterprises (SMEs), the SafeNanoKap project used the theoretical example of product development of nanomaterial-containing plastic coffee capsules.

Photo: ITA

When nanomaterials enter the body or the environment, risks remain largely unclear.

In the European Union (EU), nanomaterials are subject to a number of regulations to protect consumers. Nanomaterials authorised for application in food contact materials in the EU have undergone a safety assessment by the European Food Safety Authority (EFSA). Within this assessment, possible exposure routes of the nanomaterial to the food or drink are also investigated. So far, eleven nanomaterials have been approved in the EU for use in plastic food contact materials. One of these is nanoclay (montmorillonite clay), a so-called layered silicate consisting of fine plates arranged parallel to the material structure. This nanoclay can, in theory, improve the product properties of coffee capsules because even small amounts of this layered silicate improve the gas barrier properties. In turn, this can then improve the preservation of flavour.

Basic data

Project title:	SafeNanoKap
Project team:	Gazsó, A., Rose, G., Pavlicek, A., Gressler, S. in cooperation with BOKU ABF (lead) and Polymerwerkstatt GmbH
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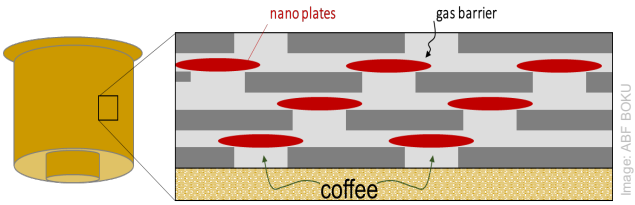
Key results

Integrating safety issues into the innovation process as early as possible as part of an SbD approach has many advantages. However, the practical implementation is currently very time-consuming and expensive, meaning that SMEs in particular may not feel encouraged to apply the SbD concept in its current version – especially since EU-approved nanomaterials have already been subject to a safety review and received precise specifications and restrictions for their use.

Some nanomaterials do not enter the food itself, but release ions (charged particles) which can transfer into or enter the food. This release is material-specific and must be considered during the review processes. As there are currently no standardised test procedures, the reviews are very time and labour intensive. In the case of processing nanoclay into a plastic, a quaternary ammonium compound ("QAC" – nitrogen with four organic bonds) is almost always used as a "mediator" between the hydrophilic clay and the hydrophobic plastic. QACs belong to the group of surfactants (as do detergents or soaps) and exhibit fat-soluble properties. A release of QAC-particles is therefore possible and must be taken into consideration, especially where packaging of fatty foods is concerned.



Nanoclay can be used to prolong the freshness and aroma of the coffee.

Once connected, the nanoclay and the quaternary ammonium compound can no longer be separated without special chemical processes. Whilst much is already known about the use phase, relatively little is known about release routes during waste and disposal phases. Plastics containing nanomaterials are therefore unregulated where their disposal into waste and the environment (where they are subject to recycling and weathering processes) is concerned. To date, there are no reliable detection methods for the release of nanoparticles in recycling plants, nor the potential increased exposure to employees. Similarly, little is known about how and for how long they persist in the environment. It is certain, however, that quaternary ammonium compounds can be detected in the environment, which are highly toxic to aquatic organisms, and are not easily biodegradable.

What to do?

Nanomaterials in food contact materials carry uncertainties and risks. For a concept of safety-based innovation, the development of testing and detection methods must be advanced as well as legal framework conditions adapted.

- More **manufacturer data on nanomaterials** are required so that manufacturers of products can address safety-relevant questions at an early stage. An SbD concept can be a structured template for this. In order to **make such a concept user-friendly**, the online information platforms must be arranged or designed more clearly, and offer added value through the application of the concept. This could be achieved by standardising the SbD concept.
- To ensure safety, intensive research is required for **specific testing and detection methods** targeting nanomaterials. This enables more efficient safety testing of nanomaterials, e.g. in food packaging.
- Knowledge gaps regarding the environmental fate of nanomaterials should be addressed through **specific research**. This could minimise the potential environmental and health effects of nanomaterials or nanoproducts.
- In order to be able to successfully implement an SbD concept in the future, **increased communication between research, industry and authorities is required**.

Further reading

Gazsó, A.; Pavlicek, A.; Rose, G. (2018) Endbericht SafeNanoKap Round Tables 18.10. & 22.11.2017. Report no. ITA 2018-02; ITA Wien epub.oeaw.ac.at/ita/ita-projektberichte/endbericht-safenanokap-round-tables.pdf

Contact

André Gazsó

Email: tamail@oeaw.ac.at

Phone: +43(1)51581-6582

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Main author: Anna Pavlicek, Co-authors: Gloria Rose, André Gazsó