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(German Chemical Industry Association)

Guidance for the Safe Recovery and Disposal of Wastes containing Nanomaterials

1. Introduction

Wastes containing nanomaterials can be generated in the production or use of nanomaterials. Such wastes occur e.g. in the production of substances, mixtures or products, in the processing and repair of products, or in the disposal of products at the end of their lifecycle.

2. Legal Framework

Where waste is concerned, the first priority is prevention, the second to fourth priority is recovery in different ways (preparation for re-use, recycling and other forms of recovery including, in particular, energy recovery), and the fifth priority is disposal. In these activities, numerous pieces of legislation must be observed; they protect both humans and the environment against negative effects. This applies, of course, equally for wastes containing nanomaterials.

In particular, provisions of the waste legislation include protection against hazardous substances in the respective wastes – with no specific examination of nanomaterials taking place under the waste legislation. Relevant requirements for the determination of hazardous properties of substances are laid down in the chemicals legislation. After the determination of hazardous properties of substances in studies prescribed under the chemicals legislation, possibly necessary protective measures in the handling of wastes or under the waste legislation follow quasi “automatically” on this basis.

Thus, the waste legislation includes several cross-references and cross-relations to the chemicals legislation. This holds true especially where decisions become necessary on whether waste is hazardous or not, and where aspects of occupational health and safety need to be considered in the handling of wastes.

Nevertheless, for good reason the chemicals legislation is not transferred one-to-one in the waste legislation. One reason is that chemicals legislation and waste legislation have different approaches on how to protect man and the environment. Regarding protection of human health, the waste legislation sets its focus on potential exposure at waste disposal and waste management. Waste is – contrary to substances, mixtures and products – not placed on the market but treated in waste treatment plants specifically licensed to fulfil the legal requirements for environment protection. The waste classification therefore serves in this case the purpose of human health

protection of workers who – contrary to consumers – always are equipped with adequate personal protection devices.

The hazardousness of wastes is therefore determined by applying the waste specific HP-criteria in Annex III to the *EU Waste Framework Directive (2008/98/EC)*. HP means "hazardous property". In turn, HP-criteria are laid down with the help of provisions under the chemicals legislation by resorting to the *EU CLP Regulation (1272/2008/EG).*

In order to bring the determination of hazardousness of wastes in a systematic form, the EU Commission established in Commission Decision 2000/532/EC the *European list of wastes*, which is based on the above-mentioned HP-criteria. In principle, these criteria are therefore derived from the classification provisions of the chemicals legislation. The German legislator transposed this list into national law with the *Verordnung über das Europäische Abfallverzeichnis (Ordinance on the European list of wastes).*

Wastes are, in fact, exempted, as a matter of principle, from the classification and labelling provisions of the *EU CLP Regulation*. As stated above, the waste classification is instead regulated by the European list of wastes in conjunction with Annex III to the *EU Waste Framework Directive*.

However, European and national provisions on occupational health and safety *(EU Chemical Agents Directive (98/24/EC), Gefahrstoffverordnung (German dangerous substances ordinance))* require adequate labelling in the handling of hazardous chemical agents at work. Relevant information about wastes is given in *TRGS 201 "Einstufung und Kennzeichnung bei Tätigkeiten mit Gefahrstoffen"* (classification and labelling when working with hazardous substances), mostly in chapter 4.6 of these technical rules.

For the monitoring of hazardous – and partly also non-hazardous – wastes, documentation requirements are additionally in place in Germany, in the form of the *Verordnung über die Nachweisführung bei der Entsorgung von Abfällen (Nachweisverordnung; Ordinance on documentation in the disposal of wastes / Documentation ordinance).* These German rules rank among the most comprehensive documentation requirements worldwide.

With the progressing implementation of the provisions of the *EU REACH Regulation (1907/2006/EC),* amounts of data available on substances are increasing successively. This is also helpful in the determination of hazardousness of wastes. Moreover, the REACH Regulation prescribes that registration dossiers must include at least some information on recovery and disposal. In the preparation of Chemical Safety Reports, the waste stage of substances needs to be considered, too (chapter R. 18 of the *ECHA Guidance on information requirements and chemical safety assessment*).

The REACH Regulation requires the compilation of safety data sheets for dangerous substances and mixtures according to the *EU CLP Regulation (1272/2008/EC).* Disposal considerations must be provided in chapter 13 of the safety data sheet. Relevant explanations are given, i.a., in the *ECHA Guidance on the compilation of safety data sheets.*

3. Conclusions from regulatory requirements

The outlined legal framework makes quite clear that CLP and REACH and further elements of the chemicals legislation have an essential role, both in the determination of hazardousness of wastes and in the handling of such wastes. This refers to impacts on the environment and on humans alike. The chemicals legislation evaluates substances according to their hazardous properties and in the light of exposure of humans and the environment. In the legal field, this approach is transferred to wastes (as described above).

Safety studies carried out to date show that in the handling of nanomaterials no basically differently structured risks need to be considered, as compared with the handling of other chemicals. If particle size influences the properties of substances and results in hazardous properties of a substance in nanoscale form, the concrete product needs to be classified and labelled accordingly, and relevant information on hazards and risk management measures needs to be provided in the safety data sheet.

4. Safe recovery or disposal of wastes containing nanomaterials

Wastes containing nanomaterials can be generated e.g. in the production of substances, mixtures or products, in the processing and repair of products, or in the disposal of products at the end of their lifecycle.

The recommendation of the EU Commission of 18 October 2011 defines as “nanomaterial” a natural, incidental or manufactured material containing particles, in an unbound state or as an aggregate or as an agglomerate and where, for 50 % or more of the particles in the number size distribution, one or more external dimensions is in the size range 1 nm-100 nm. Additionally, fullerenes, graphene flakes and single wall carbon nanotubes with one or more external dimensions below 1 nm should be considered as nanomaterials.

“Particle”, “agglomerate” and “aggregate” are defined as follows:

- “particle” means a minute piece of matter with defined physical boundaries,
- “agglomerate” means a collection of weakly bound particles or aggregates where the resulting external surface area is similar to the sum of the surface areas of the individual components,
- “aggregate” means a particle comprising of strongly bound or fused particles.

The measures described in the following part of this document are necessary for the safe recovery and/or disposal of wastes containing nanomaterials.

4.1 Waste recovery or disposal

The waste legislation applies where it is clear that waste cannot be prevented and where it is also clear that this is really about waste and not e.g. about a (by-)product.

The next step is to find out if safe recovery – be it in preparation for re-use, material or feedstock recycling, or other (esp. energy) recovery – is possible. If this is not the case, the waste needs to be disposed. Obviously, the hazardousness of waste must invariably be considered in all potential forms of disposal. However, hazardousness is not the decisive criterion in the decision whether to choose a recovery or a disposal method. For example, efficient incineration of hazardous wastes in modern incineration facilities with efficient energy utilization should usually be seen as recovery as it is the case e.g. if a hazardous waste mixture is fed into a refinery. The crucial point is compliance with all relevant regulatory provisions.

4.2 Gathering information about hazardous properties of substances regarding the waste status

In the preparation of the REACH registration dossiers, certain physico-chemical, toxicological and eco-toxicological information must be gathered and, i.a., the classification of the substance and risk management measures be derived. Additionally, disposal considerations and information on recycling must be given.

If a Chemical Safety Report (CSR) with exposure scenarios is required for a REACH registration, the CSR shall consider all relevant stages of the life cycle of the substance, including, where appropriate, the waste stage. In order to estimate the exposure and generate a risk characterisation the following aspects regarding waste disposal should be considered, where appropriate:

- Duration and frequency of emissions of the substance to the different environmental compartments and sewage treatment systems.
- Waste management measures to reduce or avoid exposure of humans and the environment to the substance during waste disposal and/or recycling.
- Exposure estimation covering the waste stage of the substance or for articles containing the concerned substance.

4.3 Communication along the supply chain

A Safety Data Sheet (SDS) needs to be compiled for dangerous substances and mixtures (and for PBT/vPvB substances and for substances on the candidate list for the REACH authorisation procedure).

Disposal considerations shall be provided in chapter 13 of the SDS. Further relevant specific information is given in the *ECHA Guidance on the compilation of safety data sheets*.

4.4 Determining the hazardousness of waste

The hazardousness of waste is determined on the following basis: HP-criteria in Annex III to the *EU Waste Framework Directive (2008/98/EC)* in conjunction with EU Commission Decision 2000/532/EC *(European list of wastes)* and the German *Abfallverzeichnisverordnung (Ordinance on the list of wastes*) and the "asterisk entries" in the Ordinance on the list of wastes, respectively.

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