nanoGRAVUR

# MATRIX TO PREDICT POSSIBLE ENVIRONMENTAL RISK OF NANOMATERIALS DURING USE PHASE


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## Introduction & objectives

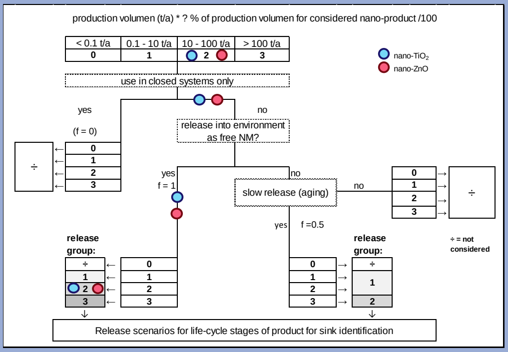
A risk matrix is a valuable instrument to prioritize nanomaterials (NMs) according to their potential adverse impacts on the environment while reducing testing effort. In the project NanoGRAVUR a matrix has been developed which is based on a combination of a decision tree, release scenarios, and grouping approaches for release, fate and environmental hazard. The approach and its applicability are stepwise demonstrated exemplarily for the prioritization of nano-ZnO and nano-$TiO_2$ in sunscreen products.

## Conclusions

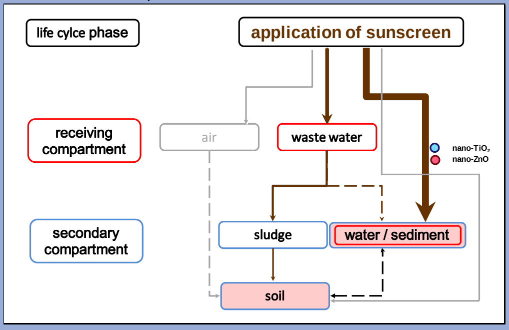
The presented approach conclusively results in a risk prioritization of NMs. Thus, the quality of the results is of selective nature.
A group comprises NMs with similar or different properties but with a similar risk. Due to the highly condensed form, no indication is given on those NM properties, which are responsible for the relative risk. This needs in-depth analyses.
The visualization of the results in form of a traffic light indicates whether and which further actions are needed.

## Example of the approach: aquatic risk prioritization of nano-ZnO and nano-$TiO_2$ in sunscreen products

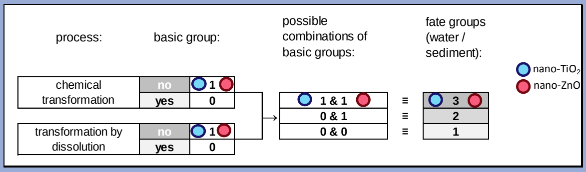
1. A decision tree and grouping of information is used for the **release grouping**. Data input is taken from literature and expert knowledge.



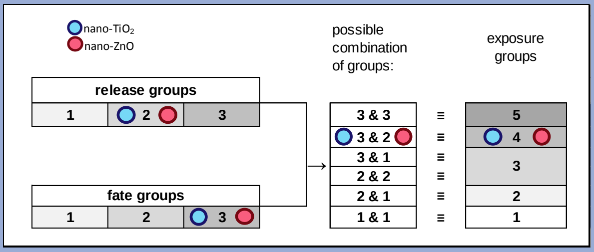

2. The **release scenario** for the application of sunscreen **identifies** water / sediment as main **sink**. Thus, fate and hazard grouping as well as the risk matrix are established for this compartment.



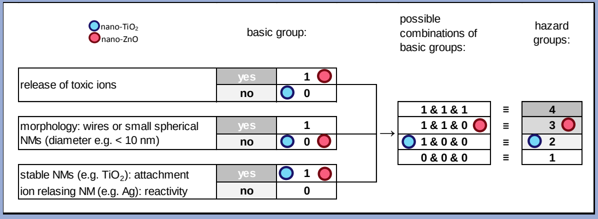

3. For aquatic **fate grouping** transformation (dissolution, chemical) processes are considered (see poster TH084).



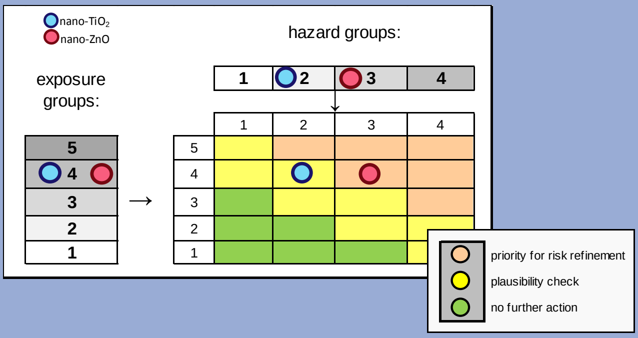

4. The combination of release and fate groups results in aquatic **exposure groups**.




5. Various NM properties lead to the aquatic **hazard groups** (see poster TH086).




6. The combination of exposure and hazard groups finally result in the aquatic **risk matrix**. The matrix triggers **further actions**.





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# Matrix to predict possible environmental risk of nanomaterials during use phase

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Grouping of engineered nanomaterials (ENMs) is a strategy in environmental risk assessment that should allow an adequate hazard assessment while reducing the testing effort rneeded for a material-by-material fate and effects testing.

We present a practicable matrix that allows to group of ENMs regarding their potential risk to the aquatic and terrestrial environment. This matrix are based on the combination of assumptions regarding release and fate as well as ecotoxicological effect. The assumptions on release are based on a decision tree which combines information on the production volume of the ENM, that portion which is relevant for the considered use, use in closed / open systems, and slow / fast release into the environment. The resulting so called “release bond” classes ENMs to ENMs with low release (release bond =1) to high release (release bond = 3). The release grouping is followed by a detailed description of release scenarios for the considered use. These scenarios allow the identification of the initial environmental compartment into which the ENM is emitted. Furthermore, possible sinks become obvious for which the fate and ecotoxicological effect grouping need to be performed.

Basically, surface water, sediment and soil are possible sinks in the environment. To simplify the fate grouping approach, surface water plus sediment are here supposed to be a monophase system. Thus, chemical transformation and dissolution are considered as relevant processes for the aquatic fate grouping. Transformation (chemical and dissolution) and transport (agglomeration and movement) are considered relevant processes for the terrestrial fate grouping. The so called “fate bond” classes ENMs to ENMs with low exposure potential (fate bond = 1) to high exposure potential (fate bond = 3). In a next step, release bond and fate bond are combined to a so called exposure bond (5 groups in total) and subsequently combined with the so called ecotox bond. The latter one is based on information about ecotoxicity of the bulk material, morphology of ENM, and the ion release potential. The combination results in a 5 x 5 risk matrix with 25 possible combinations of exposure and ecotox bonds. These are summarized to three risk groups low, medium and high. The applicability of the approach will be demonstrated by risk grouping of nano-ZnO and nano-$TiO_2$ used in sunscreen products.

Key words: release, fate, exotox bond