

# **Guidelines for preventing the environmental impact of manufactured nanomaterials (abstract)**

## **Expert committee on the environmental impact of manufactured nanomaterials**

**Under the auspices of the Ministry of the Environment, Japan**

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**(tentative translation as of June 2009)**

### **I. Introduction**

Nanotechnology offers potential benefits to human life in many fields. However, manufactured nanomaterials (MNs) need to be controlled in an environmentally sound manner in order to prevent human health and the environment from being affected by exposure to them.

Although available academic evidence on the hazard and exposure level of MNs on human health and the environment has been gradually increasing, not enough concrete documented evidence currently exists to be able to determine the level of control measures required to ensure the safety of the manufacture and manipulation of MSs.

In general, once chemicals have been released into the environment and their toxicity identified, it is extremely costly to remove the relevant chemicals from the environment and to enable the environment to recover from the effects. Damage to human health and the environment from chemical exposure can be observed even without waiting for sufficient scientific data documentation and information about the toxicity.

To avert such dismal outcomes, prevention of exposure to MNs is needed. This effort is also important for decreasing the burden imposed on responsible manufacturers after damage has occurred.

Manufacturers, both of MNs and of the products containing MNs, in addition to other interested parties that handle MNs, should perform proper controls of MNs relying on their expertise, in order to prevent the release of MNs into the environment.

### **II. Scope of these guidelines**

The purpose of these guidelines are to ensure that manufacturers prevent the effects of exposure to MNs in the environment on humans, plants and animals , by ensuring that

proper control measures are taken. These guidelines contain the following information to allow manufacturers to choose a proper control policy for environmental conservation:

- 1) Current available information concerning sound management of MNs
- 2) Basic concept of immediate countermeasures
- 3) Future challenges

Since physicochemical properties, the biological impacts, and other properties differ from one MN to another, it must be noted that features particular to one specific MN and its impact mechanism do not necessarily apply to another MN.

### **III. Countermeasures to be taken immediately as a control policy**

The basic aim of a control policy for preventing the exposure of humans, plants and animals to MNs is to identify the release route into the environment. Based on this, manufactures should build manufacturing equipment or facilities that do not release MNs, design products that separate MNs from other materials, and control MNs to prevent their release. If there is a possibility of MNs being released into the environment, a process to capture and remove them during the release route is required. If manufacturing equipment or facilities do not have measures in place to prevent the release of MNs into the environment, the use of substitute materials should be considered, unless the manufactures can fully assess the safety risk caused by the release of the MNs.

#### (1) MN manufacturing plants

At the MN manufacturing and processing plants, the types of MNs that the plants handle can be relatively easily identified, and centralized release control can be performed. At these plants, in order to prevent MNs from being released into the environment, the following action is appropriate:

- Check the MNs manufacturing process of manufacturing, packaging, and transporting and take relevant measures to prevent MNs from being released into the environment, for example, by changing the processes to a closed system.

When it is too difficult to take the above measures, to prevent the release of MNs into the environment, the following action is appropriate:

- Install a ventilation system to effectively prevent release to the outside from manufacturing equipment . A ventilation system installed for MNs must be equipped with a proper filter, adapted to the specific properties of MNs, to prevent MNs from being released into the environment. For instance, particulate MNs are more difficult to capture with a filter than fibrous MNs.

The use of a local ventilation system recommended by the Ministry of Health, Labour and Welfare is considered to be an effective measure to prevent the release of MNs. In addition, the filter must be replaced frequently and maintained in a good condition. The ministry recommends that for the local ventilation system, the particle diameter or flocculation of MNs, the capturing capacity of filters, etc. should be investigated to enable the selection of an appropriate filter that can capture the target MNs. If an investigation is not conducted, the ministry recommends that a HEPA filter or a filter with an equivalent performance be used.

- Treat wastewater and waste sludge containing MNs- in suitable facilities in the correct way according to their material property: incineration for sludge that may contain carbon-based MNs; and solidification for sludge that may contain inorganic MNs.
- Collect information on the efficiency of high-performance filters or wastewater treatment facilities used to remove MNs.

In many cases, MNs are likely to be released into the environment when waste containing MN is handled. Measures to prevent them from being diffused into the environment are particularly necessary when defective MNs or MNs used for research and development purposes with a high degree of purity are disposed of in large quantities. MN manufacturers should study and determine the proper MN disposal methods described below:

- Incinerate carbon-based MNs, or solidify inorganic MNs, according to the type of MNs in the waste disposal.  
Separate MNs themselves and waste to which MNs are adhered, including used filters, paper, and cloth for cleaning waste MNs, and MNs transport containers and bags, from other waste and keep them in airtight containers. Indicate the type of MN contained and the proper disposal method to ensure the correct waste disposal

procedure according to its properties. Dispose of the waste either at the company or deliver it to an industrial waste disposal service provider. When subcontracting the disposal to a waste disposal service provider, fill out a waste data sheet and instruct the provider on the disposal method according to the type of MN.

In each company, when disposing of waste containing MNs, take the proper disposal measures in accordance with Paragraph (3) according to the type of MN.

- To prevent MNs from being released into the environment, consult with experts about associated risk and countermeasures to be taken against waste difficult to dispose of i.e. glass filters that carbon-based MNs have adhered to or cloth that inorganic MNs have attached themselves to.

## (2) Manufacturers of MNs-containing products

In many cases, MNs-product manufacturers purchase MNs from nanomaterial manufacturers.

In the planning and design stages of products containing MNs, it is appropriate for the manufacturers of those products to consider the possibility of releasing MNs into the environment when using MNs-containing products and the need to dispose of MNs after the products have been discarded. It is also appropriate for manufacturers of products containing MNs to examine how to prevent exposure to MNs through the products and how to call user attention to MNs such as in the indication described below:

- In the planning and design stages of the manufacture of products using MNs, consider the possibility of releasing them in use (e.g. spray), during use (e.g. paint), after use (e.g. cosmetics), and during disposal.
- In short, study applications and design in order not to release MNs. If release is inevitable, examine the use of substitute materials. If the use is unavoidable, consult with an expert about the impact on human health and on the environment as well as on the environmental persistency, etc. before designing and selling the products. Also, consider informing users of the evaluation results.

## (3) Disposal of MNs and products containing MNs

If the proper disposal method of MNs contained in waste is specified or the waste disposal service provider is clearly notified, waste disposal including suitable intermediate treatment will be possible. For waste disposal, it is appropriate to take the

following measures, according to the type of MN, when incinerating carbon-based MNs or landfilling after solidifying inorganic MNs:

- For dispersible waste such as soot and dust, residue, and dry sludge anti-scattering measures could be taken such as keeping it moist, double packaging and using airtight containers, and handling the waste with as much care as possible not to scatter it.
- When crushing MNs-containing products, keep the waste moist to prevent MNs from flying in all directions. Avoid unnecessary crushing.

#### **IV. Future challenges**

The government and manufacturers who handle MNs should cooperate to address the following challenges:

- Collecting and updating information on MNs to secure their sound management
- Identifying the impact upon human health and the environment (test method)
- Developing monitoring methods
- Determining the environmental fate of MNs and the level of exposure
- Verifying the validity of current control measures and apply them to the management of MNs