NANEX WP2 – Exposure Scenarios Summary

Please note this ES was not developed as part of a full risk assessment process, and may not necessarily describe exposure conditions for which there are no risks to human health and the environment

Standard Exposure Scenario Format 1: For Uses Of Substances By Workers

Title:	Production of NanoAg during wet-chemistry process	**Date:**	24/05/2010
SubstanceType	Nano Ag	**Entered By:**	LEIA

Internal reference ID:	NanoAg 1

List of all use descriptors related to the life cycle stage and all the uses under it; include market sector (by PC) if relevant:

List of names of contributing exposure scenarios and corresponding PROCs/PCs

CES 1: Reaction process: Opening the reactor hatch
CES 2: Drying process: Opening the dryer door
CES 3: Grinding process: Opening the grinder hatch for packaging

CES 1: Name of contributing exposure

Reaction process: Opening the reactor hatch

Further specification

Bulky silver is synthesized by the liquid-phase reaction of Silver Nitrate (AgNO3) with Nitric Acid. A colloidal suspension of silver is produced by the reduction of AgNO3 in the presence of dispersing agent. Reaction mixing time is typically 24h.
After the reaction process, the resulting Ag nanoparticles are filtered and dried in a dryer to remove volatile organic materials and water.
Finally, silver nanoparticles (powder) are transferred to the grinding process.

Product characteristics

Colloidal suspension of silver

Amounts used

Production of approximately 3000 kg of sylver nanoparticles per month

Frequency and duration of use/exposure

Reactor hatch is opened for about 1 hour for the sampling of Ag nanoparticles

Human factors not influenced by risk management

Other given operational conditions affecting workers exposure

The reactor room is on the second floor of the industrial facility.
Temperature: 24.3 ºC
Relative air humidity: 55%

Technical conditions and measures at process level (source) to prevent release

Closed reactor.

Technical conditions and measures to control dispersion from source towards the worker

Vent hood installed approximately 1 m above the reactor.
All the windows in the facility are sealed to block circulation of the outside wind entering the facility.

Organisational measures to prevent /limit releases, dispersion and exposure

Conditions and measures related to personal protection, hygiene and health evaluation

Additional good practice advice (for environment) beyond the REACH CSA

Exposure Estimation

This step produces the highest release of nanoparticles (larger that the emission when handling dried nanoparticles).

EXPOSURE DATA:
- Number of particles with diameter of 100 nm increased after the hatch is opened: from 6,1e4 #/cm3 before opening the hatch to 1,2e5 #/cm3 after the hatch is opened (SMPS, normalized concentration).
- Total number concentration (after background subtraction) = 11,02e6 #/cm3 with a median particle diameter of 76.35 nm (SMPS)
- Collected samples showed that Ag nanoparticles were aerosolized into the work place; researchers explain that nanoparticles of 50-60 nm form agglomerates that will evolve to larger agglomerates depending upon particle mobility and concentration.

TECHNIQUES to characterize particles: SMPS (EPS 4410, CPC 4312); Soft X-ray charger 4530, HCT Co., Korea; sampling was carried out using an electrostatic precipitator (ESP; Nano Particle Collector 4650, HCT Co., Korea).

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CES 2: Name of contributing exposure

Drying process: Opening the dryer door

Further specification

After the reaction process, the resulting Ag nanoparticles are filtered and dried in a dryer to remove volatile organic materials and water.

Product characteristics

Dried Ag nanoparticles. Powder

Amounts used

Production of approximately 3000Kg of silver nanoparticles per month.

Frequency and duration of use/exposure

Human factors not influenced by risk management

Other given operational conditions affecting workers exposure

After the reaction process, Ag nanoparticles are filtered, dried and finally grinded. The outlet of the reactor is in the first floor of the industrial facility. The dryer and grinder are also in the first floor. The dryer room and the grinder room are connected with a narrow corridor. The distance between dryer and grinder is approximately 10 m.
Air conditions in the dryer room: Temperature= 25 ºC; RH= 58%

Technical conditions and measures at process level (source) to prevent release

Closed dryer.

Technical conditions and measures to control dispersion from source towards the worker

Air conditioner in the room
All the windows in the facility are sealed to block circulation of the outside wind entering the facility.

Organisational measures to prevent /limit releases, dispersion and exposure

Conditions and measures related to personal protection, hygiene and health evaluation

Additional good practice advice (for environment) beyond the REACH CSA

Exposure Estimation

This step produces the lowest release of nanoparticles.
EXPOSURE DATA:
- Number of particles in the range of 60-100 nm was doubled (SMPS); researchers explain that can be a momentary phenomenon by the temperature and pressure difference inside and outside of the dryer.
- Total number concentration (after background subtraction) = 1.34e6 #/cm3 (SMPS) with a median particle diameter of 63.78 nm.
- Collected samples showed irregular aggregates (researcher explain that aggregates could be explained by growth via oriented attachments)

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CES 3: Name of contributing exposure

Grinding process: Opening the grinder hatch for packaging

Further specification

After the drying process, silver nanoparticles (powder) are transferred to the grinding process and then packaged.

Product characteristics

Grinded Ag nanoparticles. Powder.

Amounts used

Production of approximately 3000 kg of silver nanoparticles per month.

Frequency and duration of use/exposure

Human factors not influenced by risk management

Particles deposited on the floor can be scattered by the movements of workers.

Other given operational conditions affecting workers exposure

After the reaction process, Ag nanoparticles are filtered, dried and finally grinded. The outlet of the reactor is in the first floor of the industrial facility. The dryer and grinder are also in the first floor. The dryer room and the grinder room are connected with a narrow corridor. The distance between dryer and grinder is approximately 10 m.
Air conditions in the dryer room: Temperature= 25.2 ºC; RH= 55%

Technical conditions and measures at process level (source) to prevent release

Closed grinder.

Technical conditions and measures to control dispersion from source towards the worker

Air conditioner in the room and vent hood near the grinder.
All the windows in the facility are sealed to block circulation of the outside wind entering the facility.

Organisational measures to prevent /limit releases, dispersion and exposure

Conditions and measures related to personal protection, hygiene and health evaluation

Additional good practice advice (for environment) beyond the REACH CSA

Exposure Estimation

EXPOSURE DATA:
- Small particles in the range 30-40 nm are released when the grinder hatch is opened; max at aprox 30-40 nm, 2e5 #/cm3 (SMPS, normalized number concentration)
- Total concentration (after background substation) = 2,45e6 #/cm3 with a median particle diameter of 34.61 nm.
- Collected samples showed aggregate particles with a rough surface.

NOTE: Before opening the grinder hatch (and with ventilation hood off) monitoring data showed an irregular increase in the number of particles because the particles deposited on the floor were scattered by the movements of workers. When the ventilation hood was turned on, concentration deceased. This may suggest that particles deposited on the floor could induce to secondary exposure to nanoparticles.

References

Ref Title: Characterization of exposure to sylver nanoparticles in a manufacturing facility
Author: Junsu Park, Byoung Kyu Kwak, Eunjoo Bae, Jeongjin Lee, Younghun Kim, Kyunghee Choi, Jonheop Yi
Journal: J Nanopart Res (2009) 11: 1705-1712
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