Case 2: Detaching / attaching of big-bags carbon black to a filling system

Description of the case

Study

Study 1 focuses on occupational exposure to nanoparticles and their health effects. The overall goal of the study is to delineate exposure and health effects of selected nano-sized particles relevant to the occupational environment. During the project different partners performed measurement series in different companies. Results from this case are collected at Company X in country Y in the period from 21 till 24 January 20xx. Among other activities, X produces toner for printers. Measurements were performed in the toner producing factory.

Description of the task

First, the empty bag with carbon black is removed from the filling system. To remove the big bag, the big bag is closed above the hose. Then the hose can be detached from the filling system and the bag can be raised with a winch and moved away. A new big-bag carbon black is collected from the stockroom and is put above the filling system using a winch. The operator attaches the big-bag to the inlet of an air-driven transport system by attaching the hose of the big bag to the filling system. After attaching the hose, the big bag is manually opened. Then the big bag is emptied.

The task is performed in an open-space part of the manufacturing hall. The task is performed once or twice a week and takes approximately 5 minutes. The activity took place at January 21 at 17.11h to 17.18h. No other source were specified during the performance of the task.

Handled nanomaterial

Carbon black. Powder.

Precautions and personal protective equipment used

Employees are not allowed to eat, drink, smoke or apply cosmetics in the work area. Hand care products are available for the employees. A salve, which should be applied before working, is available to simplify cleaning of the hands after working. Another salve is available to moisturize a dry skin.

Warning signs are displayed for different dangers, like the wearing of hearing protection. Next to warning sings ‘werkplekkaarten’ are available in the different areas of the factory. The floor-manager is in charge of the maintenance and purchase of PPE and RPE. The in-use RPE is stored in a closed closet in the office (not stored in the factory).

All operators, wear leather disposable gloves which are replaced when dirty. Most operators (who work with carbon black big-bags or fumed silica) replace their gloves a couple of times during 1 shift when the gloves are dirty. In-use gloves are stored in a closed closet in the office (not stored in the factory).

Reusable cotton (woven) coveralls are worn by the operators which covers the whole body except the hands, head/neck and feet. Separate storage facilities are provided for work clothing and home clothing. Coveralls are cleaned after every shift at a professional laundry. Washing facilities (showers) are available on the factory. In-use coveralls are stored in a closed closet in the factory.

Safety boots are worn by all employees in the factory. Earplugs are used by all employees in the factory.

Location, ventilation and conditions

Air temperature and relative humidity were recorded during every measured task through the datalogger Kistock KT100 (KIMO) and Velocicalc 8386 a-m-gb RH-sonde (TSI, Shoreview USA). Air velocity and direction were recorded in the vicinity of the operator/ location of loading through an air velocity device (Testo). The exact locations of the measurements were indicated on the situation map below.

The initial loading of big bags takes place in a part of the factory at the ground floor that is separated from the factory by a half-length wall. It is assumed that the ventilation rate is the same in the factory and the initial loading. In the factory natural ventilation takes place through open doors in the walls. By these doors the factory is connected to other rooms like the storage and the packaging. The main part of the ventilation air flow comes in through two doors to the storage and leaves the factory through the other doors and holes. In figure 1 a floor plan is given from the ground floor factory.

To estimate the ventilation of the factory the air flow through the doors to the storage is determined by measuring the air velocity in that doors. The air velocity in the other open doors was very low. Therefore it is assumed that the ventilation rate is determined by the air flow from the storage.

The calculated ventilation rate of the ground floor factory is about 6 ACH at a measured airflow through the storage doors of 34.000 m³/h. The volume of machines and such like is not taken into account. The air velocity at the measurement position was very low: < 0.08 m/s. De direction was upwards mainly.

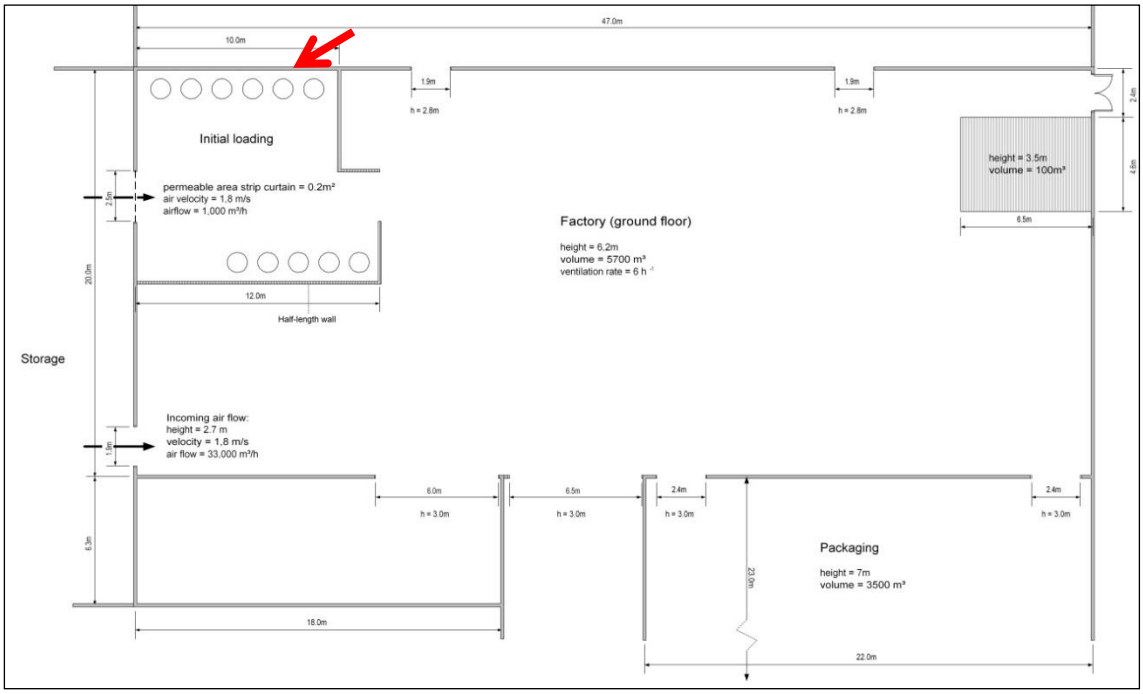


Figure 1. Floor plan of the ground floor factory.

Air temperature in °C and relative humidity in % where:

T or %RH	*Apparatus*	*Location*	*Average*	*Maximum*	*Minimum*
T	Velocicalc	Between inlet of Carbon Black 1 and Carbon Black 2 on a height of ca. 1.50 m	-	20.1 ºC	20.8 ºC
%RH	Velocicalc	Between inlet of Carbon Black 1 and Carbon Black 2 on a height of ca. 1.50 m	-	45.7 %	41.7 %

Used measurement devices

The parameters mass-, and number concentration, and surface area were measured directly (online measurement). For off-line characterization of the particles by using Transmission electron microscopy (TEM), air samples were collected by use of a portable pumps. All measurement devices were used by qualified personnel. Instruments were place within 1 meter of the loading point.

SMPS (Scanning Mobility Particle Sizer) was used to measure number-based particle mobility size distributions in the range of approx 14 to 661 nm. The SMPS exists of three parts: an electrostatic

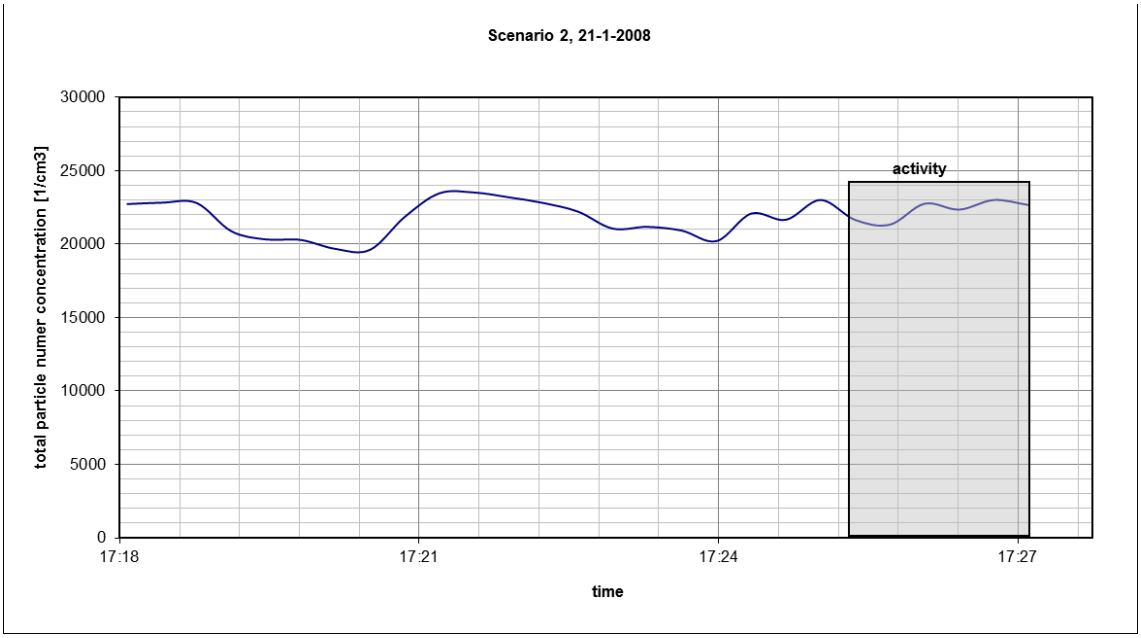
classifier (TSI, model 3080, serial number 3238) with a differential mobility analyzer (DMA) to separate particles on base of (mobility) size range and a CPC (TSI model 3025, low flow) to count the particles in each size range. The SMPS had a scan time of 2.5 minutes therefore its use in very short processes is limited. The default settings are given in report D2.1 (Mark et al, 2007) and the corresponding instrument SOP. The flow rate was 3 l/min, the sampling volume was 300 ml/min.

UCPC (TSI model 3786, serial number 70519009) was used to count nanoparticles with a particle size range from 2.5 to 3000 nm using an optical particle detector. Because the kind and size of nanoparticles that were measured is not yet known, we used the digital signal that was scaled automatically by the software program. The flow rate was 300 ml/min and the scan time was 20 seconds.

Personal air samples (PAS) are taken using a sampling device consisting of an open-faced filter holder including a 25 mm gold coated polycarbonate on which a TEM grid was placed. A backing filter, i.e. a 5 µm pore size mixed esters of cellulose, was used. The pump was a 2 litre/minute diaphragm pump (GSA SG4000EX). The flow rate of the sampling assembly (pump plus filter) was measured using a calibrated flow meter at the start and end of the sampling period. Due to the small pore size of the filter, a relatively high pressure drop of the pumps was experienced. However, the recommended flow rate of 0.4 l/min was achieved. The samples that are collected on TEM grids through the precipitator were analyzed by Transmission Electron Microscopy (Health and Safety Laboratory, UK). Analysis include X-ray analysis on individual particle and X-ray mapping; analysis of transmitted or scanned images for size and agglomeration of collected particles.

Measurement results

Raw data



Results samples

Very few large carbon agglomerates/aggregates were noted on the sample grid. On the TEM-grids mostly carbon agglomerates/aggregates were found and a few nanoparticles (Ti, Si and Fe).