# Dustiness testing of engineered nanomaterials based on $ZrO_2$ by vortex shaker method

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Keywords: nanomaterials, nano-objects, dustiness, vortex shaker.

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Information about dustiness of engineered nanomaterials is very important during the design and the realize of many industrial processes. This information is also very essential for evaluation, controlling and minimize exposure workers to nano-objects. Dustiness determined with gravimetric method is not appropriate to the evaluation of workers exposure since parameters which characterized of nano-objects emission are mainly number concentration and size distribution.

The aim of the investigation was to determined number concentrations of nano-objects emitted when generated nanomaterials with vortex shaker method (Witschger, et al., 2011). This results can reflected of dustiness of nanomaterials. Investigations were done for 3 engineered nanomaterials based on zirconium oxide: pure zirconium oxide ($ZrO_2$) and stabilized by calcium ($ZrO_2$+8%CaO) or yttria ($ZrO_2$+8%$Y_2O_3$). Those nanomaterials are available from NanoAmor. Test-stand showing equipment for aerosol generation (vortex genius 3) and getting of respirable fraction of nano-objects (cyclone of GK 2.69) is presented on Figure 1.

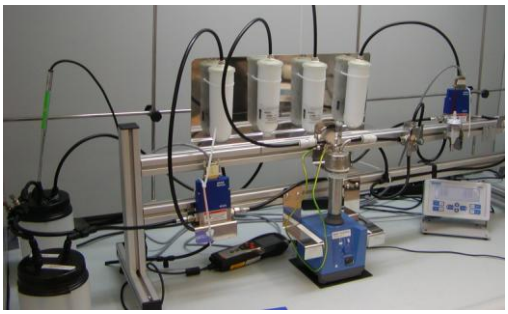

Figure 1. Test-stand for generation of resbirable fraction of nano-objects from nanomaterials (vortex shaker method).

Total number concentrations of particles with diameter 0.01-8.14μm were measured with Electrical Low Pressure Impactor ELPI+ with flowrate 9.91$dm^3$/min. Results of investigation are shown on Figure 2. Received data indicated that from investigated nanomaterials pure zirconium oxide ($ZrO_2$) was characterized highest emission of nano-objects, with possibility of staying them by the longer time in the air. For the time up to 1000s from starting of $ZrO_2$ generation total concentrations of particles varied between 5700-8500#/$cm^3$ and after 3000-3500s were ca. 2000-3000#/$cm^3$. Another tendency of changes concentrations during generations were observed for zirconium oxide stabilized by calcium ($ZrO_2$+8%CaO) or yttria ($ZrO_2$+8%$Y_2O_3$). For them pikes of concentrations were visible ca. 150s after starting nanomaterials generations, ca. 4700#/$cm^3$ for $ZrO_2$+8%CaO and ca. 5800#/$cm^3$ for $ZrO_2$+8%$Y_2O_3$. About 700s after starting generations of $ZrO_2$+8%CaO or $ZrO_2$+8%$Y_2O_3$ concentrations achieved ca. 500#/$cm^3$ for $ZrO_2$+8%CaO and ca. 2100#/$cm^3$ for $ZrO_2$+8%$Y_2O_3$.

It can be concluded that zirconium oxide stabilized by calcium ($ZrO_2$+8%CaO) or yttria ($ZrO_2$+8%$Y_2O_3$) are less dusty than pure zirconium oxide ($ZrO_2$).

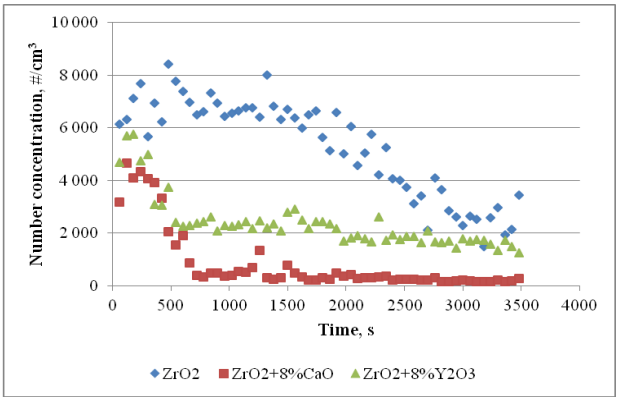


Figure 2. Total number concentration of particles 0.01-8.14μm obtained during generation of nanomaterials ($ZrO_2$, $ZrO_2$+8%CaO, $ZrO_2$+8%$Y_2O_3$) with vortex shaker method.

Currently are carried out standardization works (CEN) in the field of "Workplace atmospheres - Measurement of dustiness of bulk nanomaterials". One from the developed methods is vortex shaker method. Participants of the project: INRS (leader), CIOP-PIB, HSL, IGF, NRCWE and TNO.

This study was prepared on the basis of the results of project 04.A.18 carried out within of the NP "Safety and working conditions improvement", funded in the years 2011-2013 by the Ministry of Labour and Social Policy. Main co-ordinator CIOP-PIB.

Witschger, O et al. (2011) *DUSTINANO: A PEROSH Initiative Towards a Harmonized Approach for Evaluating the Dustiness of Nanopowders.* On Fifth International Symposium on Nanotechnology – Occupational and Environmental Health, August 9-12, 2011 Boston, MA, USA.