Generation of Mn oxides nanoparticles

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The nano scale objects are created within a wide range of anthropogenic processes including welding procedures. Welding produces high amounts of fumes containing manganese oxides nanoparticles (MnONPs). Several recent epidemiologic studies describe occupational exposure ranges of approximately 0.01–5 mg/m^3 Mn in fumes. An accumulation of Mn in lung, liver, and olfactory bulb after acute inhalation exposures is confirmed, but data emerge from animal studies ongoing days maximally two weeks.

Due to an absence of suitable instrumentation for the inhalation and production of MnONPs, there are no studies to concern of long lasting inhalation experiments (months) with chronic concentration of MnONPs.

An inhalation chamber for the whole body exposure studies of small animals to nanoparticles under strictly controlled experimental conditions was constructed recently (Večeřa *et al*, 2012). The inhalation chamber allows long-term inhalation experiments with up to four discrete groups of small animals. The inhalation chamber was tested for leakage of nanoparticles by means of manganese oxides nanoparticles (MnONPs).

Manganese oxides nanoparticles (MnONPs) were synthesized continuously in a vertical hot wall tube flow reactor using thermal decomposition of metal organic precursor manganese(II)acetylacetonate at temperature 850°C in the presence of 30 vol. % of oxygen. The vapors of manganese(II)acetylacetonate were generated from solid form in front of the reactor in saturator at temperature 140-170°C and after that released vapours were transported by nitrogen (flow rate 0.5 l/min) into the reactor. The total flow rate of nitrogen/oxygen mixture throught the flow reactor was 2 l/min. At the outlet of the reactor, MnONPs transported in nitrogen/oxygen mixture were mixed with air (1 l/min). The concentration (1-3×10^7 particles/cm^3) as well as the size (7-50 nm) of produced nanoparticles (Mn_xO_y) was stable for at least a few weeks.

The concentration and size of generated nanoparticles were measured by SMPS (TSI, model 3936L72).

To establish chemical composition, the generated nanoparticles were sampled on cellulose nitrate membrane filters (Millipore, porosity 1.2 µm), the filters were digested in acids in microwave device and content of Mn in extracts was analysed using an AAS (AAnalyst 600 Perkin-Elmer). Content of Mn in NPs collected on cellulose filters was in the range 67-79%, which indicates that generated nanoparticles are composed of mixture of two Mn oxides, Mn_2O_3 (i.e., 69.6% Mn) and MnO (i.e., 77.4% Mn).

For morphology study, the nanoparticles were sampled on cellulose nitrate membrane filters, silver membrane filters and/or deposited onto cupreous TEM grids by electrostatic collection using a Nanometer aerosol sampler (TSI, model 3089) and analysed by a scanning emission microscopy and a transmission emission microscopy.

We suppose that MnONPs are produced as single nanoparticles, however, we identified on filters also larger aggregates. The primary generated MnONPs have shape of sphere with diameter in the range several nm – tens nm.

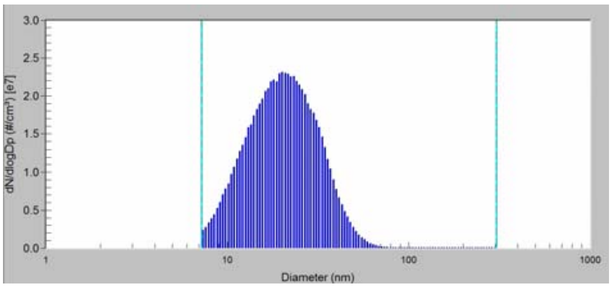

Figure 1. Size distribution of generated Manganese oxides nanoparticles

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Večeřa Z., Mikuška P. (2012), *Sborník 13. konference České aerosolové společnosti*, Třeboň, Česká Republika, 25.-26.10.2012, str. 43-46.