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Analysis of ROS generated by PM_{10} sampled at a rural and urban location in North Rhine Westphalia

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The formation of reactive oxygen species (ROS) and subsequent induction of oxidative stress in cells are nowadays considered to be the dominant factors responsible for the pulmonary toxicity of PM_{10} (Donaldson et al., 2004). Especially, a compound- and particle upon load-dependent hydroxyl-radical generation via Fenton-type reactions has been demonstrated. Electron Spin Resonance spectroscopy is a sophisticated technique for detecting ROS, predominantly hydroxyl-radicals, in cell free systems. In the present study a simplified filter preparation method was tested and used to point out potential differences between the hydroxyl-radical-generation potential of sampled air at a rural versus an urban location.

Measurements of PM_{10}- and PM_1-elicited ROS-activity on quartz fibre filters are carried out for more than one year (February 2008-March 2009) at a rural (Eifel, mountainous area) and an urban location (Styrum, Ruhr area), respectively (c.f. Quass et al., 2009, abstract T113A03). Samples are taken every other day on preheated quartz fibre filters (Munktell MK 360). For verifying the ROS-activity a simplified method is tested. Instead of preparing a particle suspension from the PM loaded filters by sonication, as usually described in literature (Shi et al., 2003), the filters are put directly into the reaction mixture containing H_2O_2 and the spin trap compound (DMPO), followed by the common preparation steps. This cost and time saving procedure is possible if no subsequent toxicity assessment is planned.

Tab. 1 method comparison exemplary for one selected loaded PM_1 quartz fibre filter from the rural location (a.u. = arbitrary unit); coefficient of variance (3 replications) <5%

technique	sonication t[min.]	ESR-signal a.u.
Shi et al., 2003	5	1049
	10	2274
	15	2094
this study	--	5565

First measurements confirm the applicability of the quartz fibre filters and the modified method for detecting the ROS-activity of PM loaded filters, shown in Tab. 1. No significant filter blank signals are detectable (not shown) and in comparison to the commonly applied method using particle suspensions the reactivity approximately doubles (see table 1).

The differences between the hydroxyl-radical generation at rural and urban locations are shown in Fig. 1.

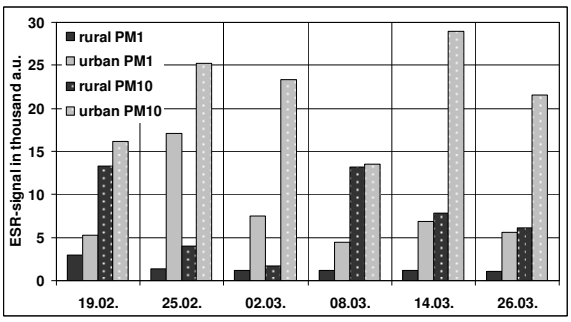

Fig. 1 hydroxyl-radical generation of PM_{10} and PM_1 loaded filters from a rural (black) and urban (grey) location (a.u. = arbitrary unit).

For both particle size-fractions a higher activity of samples collected at the urban site is apparent (ratio± SD rural/urban: PM_1 24± 17%; PM_{10} 43± 37%). Compared to PM_{10} samples, PM_1 reactivity is always less (ratio± SD PM_1/PM_{10}: rural 28± 22%; urban 36± 16%). This indicates a pronounced influence of the coarse particle fraction. For both sample types no correlation between ROS-activity and mass concentration was found. The variability of the values could probably be caused by differences in compounds and chemistry mixture and will be investigated by additional chemistry and mass measurements. In the end, based on the whole one-year dataset analysis, we will elucidate on the determination of location-dependent particulate ROS-activity as a marker for health risk.

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