Evaluation of the mutagenicity of PM10 and PM2.5 collected in an industrial and urban area of Antwerp

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AIRNET
A Thematic Network on Air Pollution and Health

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Introduction and Aim

Epidemiological studies over the last decades suggest rather consistently that inhalable particulate matter may be responsible for increased rates of lung cancer.
Limited research has been performed to measure the toxicity of particles in Flanders. Particle monitoring is restricted to measurement of PM10 concentrations and sporadical chemical analyses.
The aim of this study is to investigate the toxic activities associated with coarse (PM10) and fine (PM2.5) particles, collected in the industrial environment of the harbour (Petrol Quay) and the city center of Antwerp, Borgerhout.
Human alveolar epithelial cells (A549) are used for this purpose. Cytotoxicity is evaluated with the Alamar Blue assay, mutagenicity with the micronucleus test.

PM10 and PM2.5 samples

Samples were collected by the department of Environmental Measurements (Vito).
Sampling periods were not simultaneous for both locations.

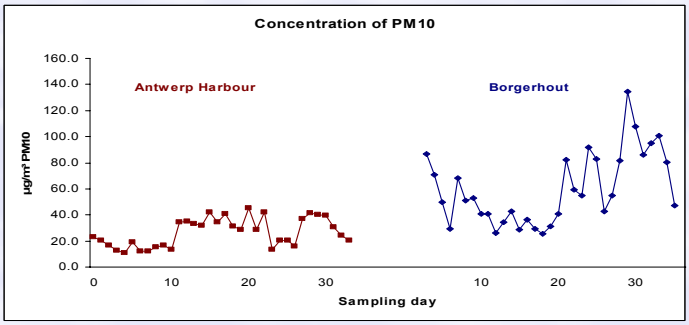
Average PM10 concentration is twice as high in the city as compared to the harbour.
The percentage of fine particles (PM2.5), contributing to the total amount of coarse particles (PM10) counts 54% in the urban location and 82% in the industrial location.


Eberline sampler


Borgerhout Antwerp: urban


Harbour Antwerp: industrial

Location	Average PM_{10} concentration	Average $PM_{2.5}$ concentration	Sampling Period
Borgerhout	57 µg/m³	31 µg/m³	12/02/03 – 31/03/03
Antwerp Harbour	28 µg/m³	23 µg/m³	20/12/02 – 31/01/03

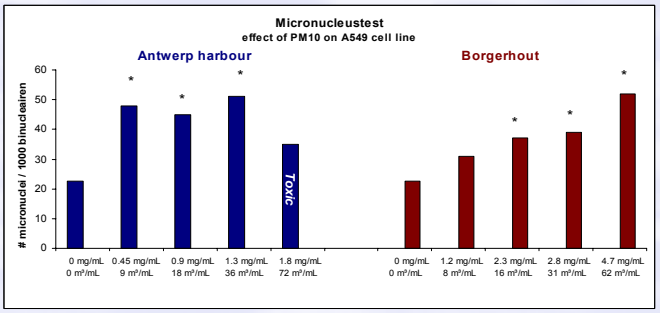


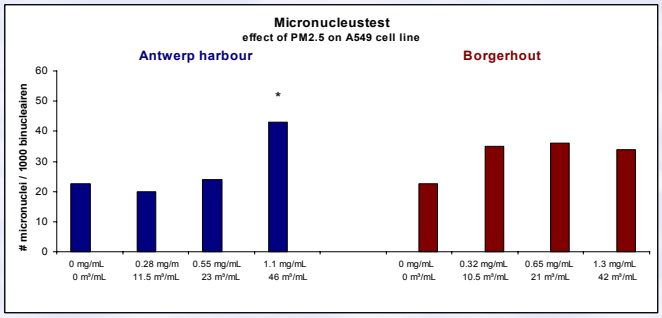
Methods

Particles were suspended in bidistilled sterile water supplemented with 0.1% tween-80. Particle mass is gravimetrically assessed by weighing the filters before and after sampling.
Human alveolar epithelial cells (A549) were exposed for 48 hours to the particles to examine *in vitro* the toxicological potential of both PM10 and PM2.5.
Cytotoxicity was assesed using the AlamarBlue assay.
Mutagenicity was assessed using the cytokinesis-block micronucleus assay on binucleated cells *(Fenech et al., Mut Res, 147:29-36 (1985), with modifications)* .

Results

Particles from both areas and both size-fractions showed no significant cytotoxicity (results not on poster).
PM10 and PM2.5 originating from both areas were able to cause mutagenic effects. The micronucleus frequency in binucleated cells was significantly increased.
Although the m³ equivalents added to the cells are comparable, the mass of particles (mg/mL), reflecting the concentration (µg/m³), is two-fold higher in the urban area. Particles from the industrial area are more potent than the urban particles to evoke a mutagenic response.
PM10 is more mutagenic compared to PM2.5 for both locations.





*: Significant difference between the marked sample and the 0% dose, assessed with Statistical Tables from Kastenbaum et al., *Mut Res, 9 (1970) 549-552.*

Conclusion

Routine concentration measurements of PM10 and PM2.5 are insufficient to predict the genotoxic potential.
The increase in micronucleated cell frequencies in this study is related to both location and particle size.
This research needs to be confirmed by more environmental measurements and precise determination of particle mass, number and composition.

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