



Diffusion Tube Measurements of Outdoor Air Pollution in Malta with Special Focus on the Exposure of Children

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1. Introduction

Air pollution is a substantial problem as it negatively affects human health and causes damage to the natural and built environment. In the European Union a long-term strategy to reduce air pollution has been established, and member countries are committed to monitor a variety of outdoor air pollutants. However, samples are taken in relatively open spaces according to the regulations. Within this study, it was attempted to measure energy-related outdoor air pollution in areas that combine heavy road traffic with a large number of pedestrians, and to measure pollutants at low heights relevant to young children walking or being transported in prams.

2. Measurements

Two relevant pollutants, benzene and NO₂, have been measured using diffusion tubes of the radial type. The tubes were protected in shelters that allow for sufficient air flow but avoid direct exposure to rain. For measurements at low heights special protective equipment has been devised (Figure 1).



Figure 1: Left: Protective shelter used at the usual measuring height of ca. 3 meters. Right: Shelter with special protection for measurements at ca. 0.6 meters

Measurements have been conducted in Sliema at locations on Tower Road, the Strand and Manwell Dimech Street as indicated in Figure 2. As reference points, measurements were also conducted on Manoel Island and at the automated MEPA station in Msida.



Figure 2: Measurement sites in Sliema

3. Results

Figures 3 and 4 present the concentration levels of benzene and NO₂ at different test sites during a week in October 2011. The attribute "low" in the legend refers to a measuring height of ca. 0.6 meters, the attribute "high" to a height of ca. 3 meters. "The Strand II (High)" and "The Strand II (Low)" refers to distinct measurements at the same site for a direct comparison.

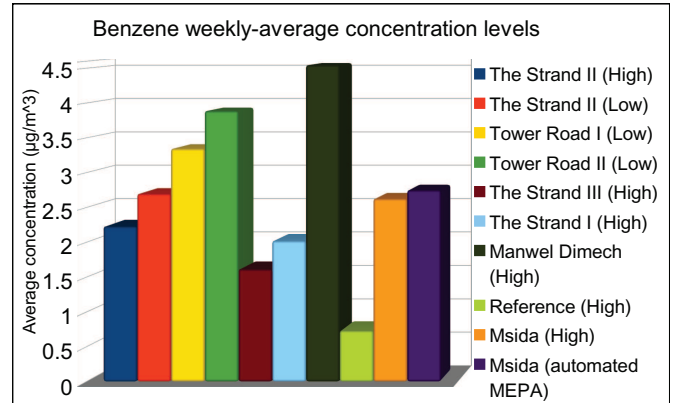


Figure 3: Benzene Results

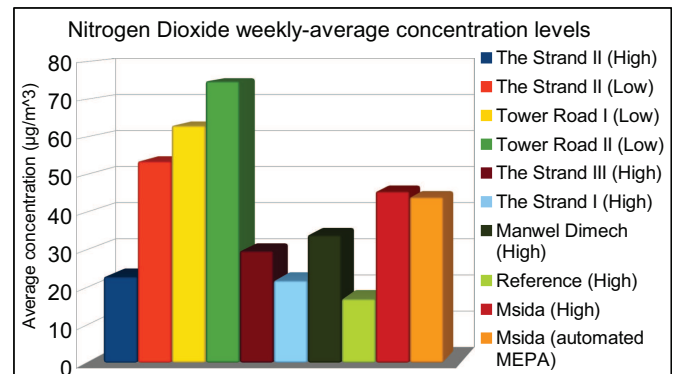


Figure 4: NO₂ Results

4. Conclusions

- Air pollution at heights at which young children are exposed is indeed significantly higher compared to the usual measuring height. Benzene concentrations at lower heights were found to be at least 20% higher compared to measurements further up. NO₂ concentrations can easily be more than twice as high when measurements are taken at lower heights.
- Steep, narrow roads with road traffic moving upward (Tower Road entered from the Strand) are more polluted further up the hill in terms of both benzene and NO₂.
- Coastal roads (the Strand) are less polluted in terms of both benzene and NO₂ than narrow inland roads.
- Benzene concentrations at a three-meter site in Manwel Dimech Street exceed those at 0.6-meter sites on Tower Road (and at the three-meter site at the relatively open space at the Msida roundabout), while the opposite is the case for NO₂.
- Air pollution background levels measured at Manoel Island are small compared to the test sites with regard to benzene, but substantial with regard to NO₂.

To translate weekly time-averaged diffusion tube measurements at various sites into values that can be compared to European air quality legislation, a simulation based on the pollutant concentration variations measured at the automated Msida MEPA station in 2011 has been carried out. According to this simulation,

- Benzene concentration levels comply with European air quality legislation while NO₂ levels at the test sites do not meet the legally required standard (Table 1).

POLLUTANT	PLACE								
	The Strand II (High)	The Strand II (Low)	Tower Road I (Low)	Tower Road II (Low)	The Strand III (High)	The Strand I (High)	Manwel Dimech (High)	Reference (High)	Msida (High)
Benzene	YES	YES	YES	YES	YES	YES	YES	YES	YES
NO ₂	NO	NO	NO	NO	NO	NO	NO	YES	NO

Table 1: Simulated level of compliance with European air quality legislation