Introduction

The chemical/biological composition of particulate matter (PM) in aerosols can be complex and varies spatially – between continental and marine environments [1]. One source of PM that contributes to air pollution is that derived from ship emissions. Seagoing ships are not subject to the stringent air quality legislation which is applied to land-based transport. Ships make significant contributions to the pollution inventories of SO\textsubscript{2}, CO\textsubscript{2}, NO\textsubscript{X}, organic compounds, and PM (especially PM\textsubscript{2.5} – fine particulates). The average sulfur content of marine heavy fuel oil (“bunker fuel”) used in European waters is 27,000 ppm and it is estimated that by 2010 emissions from ships will equal three-quarters of the EU total for sulfur [2].

Sampling Campaign Cork Harbour – 2007 & 2008

Monitoring Sites & In-Port Shipping Facilities

Sampling Equipment

Chemical Analysis

- Total Metals by ICP- OES (Perkin & Elmer Optima 2000 series UV/VIS detector)
- Extraction by microwave acid digestion (HNO\textsubscript{3}, H\textsubscript{2}O\textsubscript{2})
- Soluble Inorganic Ions - IC (Dionex ICS 2000)
- Aqueous extraction (shaking & sonication)
- Total mass loading of ambient PM \(2.5\mu\text{m}\) by gravimetric analysis.


Fine particulate ions are formed as secondary particles, often originating as primary emissions or as primary airborne particles from combustion sources. Sulphate particles (SO\textsubscript{4}\textsuperscript{2-}) are found in highest concentration at Tivoli Docks during the winter (Fig. 4).

The ammonium to sulphate ratio is an index to identify the degree of neutralisation of acid sulfate in aerosols. Ammonium rich particles (\(2 \geq 2\text{[NH}_4\text{]}/\text{[SO}_4\text{]} \geq 1.5\)) are mostly dominant in air at Tivoli Docks because of the high concentration of ammonia in the exhaust gases from these ships.

The correlation between Nickel and Vanadium is stronger at Tivoli Docks compared with Mid-Harbour (Fig. 5b). This could indicate the existence of one dominant source of these trace metal particles, such as combustion of oil.

Future Work

A short field campaign has been undertaken at Tivoli Docks using an ATOMS (Aerosol Time-Of-Flight Mass Spectrometer TSI 3800). Sea-salt particles have readily collected, characterised by Na, Mg, Ca and Cl content (Fig. 8).

The ATOMS will allow for the identification of different particle size range and information on the composition of single particles.

References

[2] “Air pollution from ships“ (European Environmental Bureau, Swedish NGO Secretariat on Acid Rain) 2004