Real time detection and characterization of bioaerosols from environmental sources

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Keywords: Bioaerosols, Fluorescence, Emissions, Waste management
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There have been increasing concerns about exposure to bioaerosols, particularly, from growing industrial processes such as compost and intensive livestock / poultry facilities. However, the current knowledge on their exposure and resultant public health impact is inconclusive due to lack of dose response relationship and limitations of conventional methods (poor time resolution, labour intensive) for the detection and characterisation of ambient bioaerosols. Among emerging techniques, laser induced fluorescence has shown promise in exploring bioaerosol properties with high time and size resolution (Pan et al. 2015). Nonetheless, broad emission bands in the existing commercially available fluorescence based detectors limits their capability in molecular determination of fluorescence origin and thus classification/discrimination of bioaerosols. The present investigation, part of a lager project focusing on detection and characterisation of inflammatory agents associated with bioaerosol emitted from biowaste and intensive agriculture, aims to demonstrate the potential of a fluorescence based bioaerosol sensor unit with highly resolved fluorescence intensity measurements to detect and characterize bioaerosols in real time.

The composting site had the highest concentration of particles in all the categories (Table 1). The lowest concentrations were found at the sewage treatment works. For the fluorescent particles, whilst the minimum levels were relatively comparable at three sites there was considerable variation in maximum concentrations depicting source/activity specific nature of emissions.

Table 1. Number concentration of particles at different sites (NT= Total Particles, NE= Excited Particles, Fluorescent Particles)

	Number concentration (#/cm^3)		
Environmental scenario	NT (Range)	NE (Range)	NF (Range)
Open Windrow Composting	0.53 - 3.05	0.43 - 2.06	0.10 - 0.92
Sewage Treatment Works	0.52 - 1.11	0.35 - 0.58	0.07 - 0.15
Urban Background	0.69 - 2.18	0.60 - 1.24	0.14 - 0.45

Figure 1 shows impact of various activities and wind direction on emissions at a composting site.

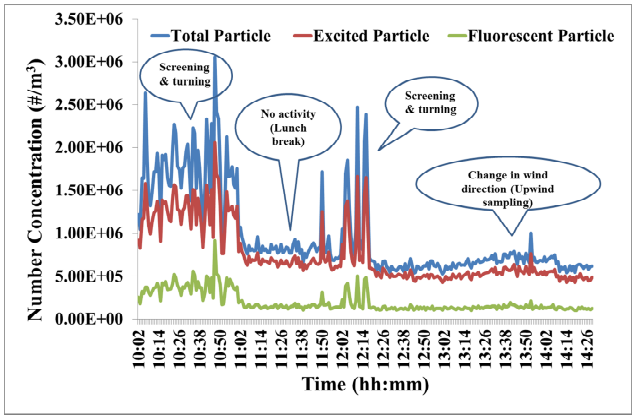

Figure 1. Representative number size concentration of particles in different categories at a composting site

There were distinct differences in emission peaks at composting and background site (Figure 2) demonstrating the possibility of classifying bioaerosols.

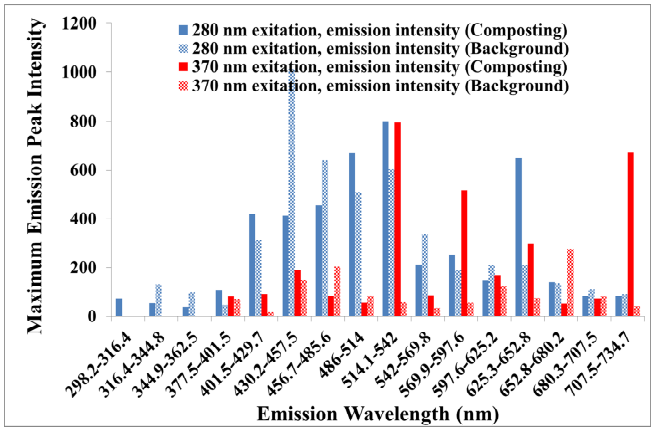

Figure 2. Comparison of fluorescence intensity between composting and background site across 16 wavelength band

The findings offers evidence that that fluorescence based real time measurement of bioaerosols can significantly contribute to advancing the existing state of knowledge on bioaerosol detection and emission characteristics from different environmental sources.

This work was supported by the UK Natural Environment Research Council [NE/M01163/1].

Pan, Y. L. (2015). *J. Quant. Spectrosc. Radiat. Transf.* **150**, 12-35.