Development and validation of a novel experimental system to investigate particulate matter emitted from a steelworks

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Work place exposure to particulate matter (PM) can be a potential health risk, especially if it is able to penetrate into the respiratory system (Petavratzi *et al*, 2005). Both the shape and size of PM determines how far it can penetrate into the respiratory tract and the rate of particulate removal following deposition. To help further the understanding of the sources and formation of PM and allow efficient abatement, full characterisation must be completed.

PM suspended within the atmosphere may also be known as dust. Dustiness is defined as the likelihood of a material to emit dust during handling (Hjemsted and Schneider, 1996). One method currently used to test the dustiness of a material, and referred to in the British and European standard BS EN 15051, is the rotating drum sampler (RDS). The RDS was originally developed by Warren Springs Laboratories to simulate the general handling of powder materials. It is commonly used to measure the dustiness index of a sample as well as collecting size fractionated particulate matter (PM) into three health related size fractions; inhalable, thoracic and respirable, defined by BS EN 481. Unlike other methods the rotating drum is capable of sampling moist, dry, coarse and fine samples. By testing raw and recycled materials from an integrated steel works using the RDS, dustiness may be quantified and control measures put in place to prevent PM entering the atmosphere.

This work simultaneously couples an Aspect morphology analyser (Biral, UK) and an electrical low pressure impactor (ELPI, Dekati, Finland) to a RDS, as shown in Figure 1. It follows on from previous research completed by Jackson (2009), who coupled a RDS with an ELPI to obtain real time data and chemical information for resuspended particulates

This unique set up allows determination of real time morphological information for particles ranging from 0.5 µm to 20 µm and mass size distributions ranging from 30 nm to 20 µm. The Aspect morphology analyser works by measuring irregularities in the light scattered by single particles passing through a laser beam within the measurement chamber. The ELPI is based on inertial impaction of aerosol particles combined with particle charging and electrical detection. It is capable of determining particle size distributions and concentration in real-time whilst also collecting size fractionated PM onto substrates for subsequent gravimetric and chemical analyses.

One current source of PM within the iron and steel making industry is the handling and stockpiling of raw materials. During this work eleven granular samples originating from stockyards and processes based at an integrated steelworks have been tested, including a selection of iron ores, recycled materials and fluxes such as limestone.

Simultaneous coupling of both the Aspect and the ELPI instruments to the RDS has been successfully completed and morphological data of PM has been obtained. Size distribution profiles have been acquired from both the Aspect and the ELPI allowing comparisons to be made between each instrument.

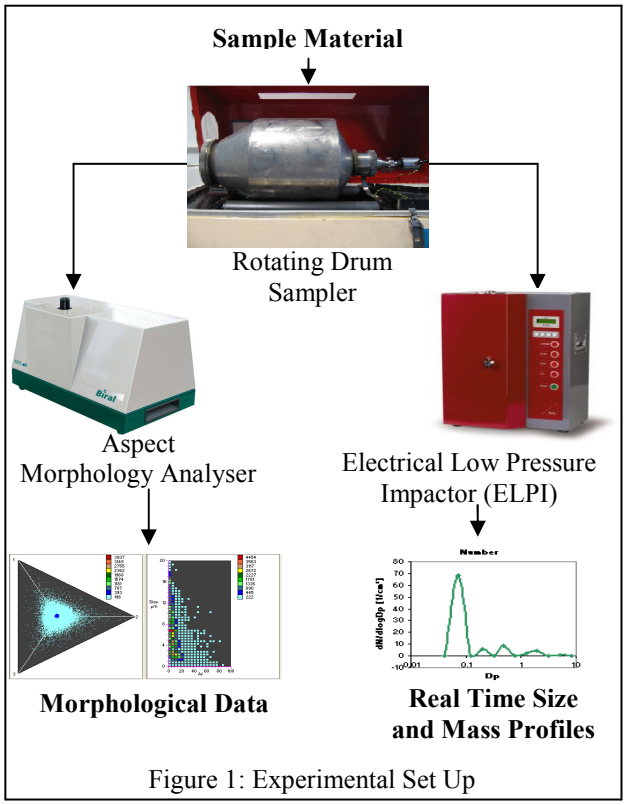

Figure 1: Experimental Set Up

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