Coarse and fine particulate emissions from drilling activity

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Building-related activities such as drilling, cutting and mixing of concrete have the potential to generate coarse (PM_{10}, i.e. those below ≤10 µm) and fine ($PM_{2.5}$, i.e. those below ≤2.5 µm) particle dust. However, there are still limited numbers of studies currently available which can provide a good account of the release of particulate matter (PM) from a variety of building activities (Kumar *et al.*, 2012c). This gap indicates a need to understand the emission characteristics of various construction activities. One such activity, which is carried out in abundance at construction sites, is 'drilling'. Past work indicate that the drilling process can also generate both the coarse and fine particles that can become available for inhalation by the site workers (Balout et al., 2007).

The aim of this work is to investigate the release of coarse and fine particle dust during the concrete drilling and estimate the emission factors (EF) of PM_{10}, $PM_{2.5}$ and PM_1 dust. The knowledge of the PM concentrations is important for the exposure assessment of the people working on sites and investigating dispersion into the surrounding built environment. The key results of such a work could help establishing the EFs of various building activities, such as drilling of concrete slabs in this particular case, besides providing useful inputs to the environmental regulations and development of guidelines for construction industry.

A GRIMM portable aerosol spectrometer (model 1.109; Peters *et al.*, 2006) was used to measure PM_{10}, $PM_{2.5}$ and PM_1 concentrations during the drilling of concrete slab. The measurements were taken close to the source (i.e. 1 m). Nimbus handheld drill was used for drilling purpose. The drill was hallow from inside, and contained the external and internal diameters as 0.091 and 0.083 m, respectively.

Table 1 presents the summary of results obtained. Figure 1 shows the concentrations of PM_{10}, $PM_{2.5}$ and PM_1 during the drilling activity as well as before and after the drilling (representing background concentrations). Figure 1 shows a clear increase in PM concentrations during the drilling compared with pre– and post– background concentrations. The peak values during the drilling were noted as 7.62×10^4 µg/m^3, 6.78×10^3 µg/m^3 and 6.15×10^2 µg/m^3 for PM_{10}, $PM_{2.5}$ and PM_1, respectively. These were ~1650, 450 and 110 times over the background concentrations of PM_{10}, $PM_{2.5}$ and PM_1, respectively. Largest differences between the PM_{10} concentrations clearly indicate that the drilling activity produced majority of particles in coarse size range, followed by the fine particles (i.e. $PM_{2.5}$ and PM_1). The emission factors (EF) were derived using the measured concentrations. These were estimated to be in the range of 0.002 to 0.057 µg/s for the different types of PM dust (see Table 1). The results presented here are preliminary, based on a short experimental campaign. Detailed experiments are planned to substantiate these findings and develop EFs for various other building activities. Availability of such EFs can greatly help in the development of emission inventories from construction sites.

Table 1. Summary of PM concentrations and the EFs.

	Background (µg/m^3)	During activity (µg/m^3)	EF (µg/s)
PM_{10} (Av±SD)	46.3±50.3	20399±20357	0.057
$PM_{2.5}$ (Av±SD)	13.8± 4.2	923±1636	0.025
PM_1 (Av±SD)	5.56± 0.77	105±131	0.002

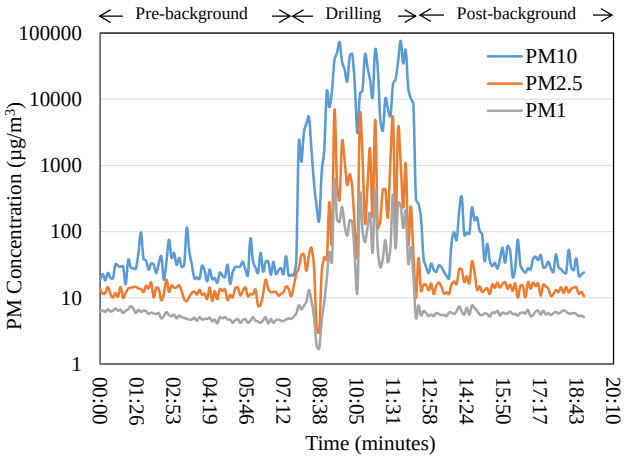

Figure 1. PM_{10}, $PM_{2.5}$ and PM_1 concentrations over time.

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