

PM₁₀ AND PM₁ DOWNSLOPE THE COAL STRIP MINE: DIURNAL A SEASONAL VARIATION

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Abstract: Concentrations of PM₁₀ and PM₁ downslope the coal strip mine were measured by portable laser nefelometers – DT's in line arrangement during one winter and two summer campaigns. There were no significant seasonal or inter-DT differences measured for PM₁. Similarly, inter-DT differences were negligible for PM₁₀ in winter. But in summer, significantly higher PM₁₀ concentrations were recorded up to 60 m of elevation from the coal seam, while the depth of the strip mine was about 130 meters. To conclude, mining activity mainly produced aerosol of coarse mode (> 1 μm of aerodynamic diameter). Field measurements are in accord with resuspension chamber experiments conducted in our laboratory.

Keywords: opencast mine, air pollution, dust, DustTrak

INTRODUCTION

Coal strip mining was recognized as a distinct source of atmospheric aerosol. There were PM₁₀ concentrations in the range 103 – 426 μg.m⁻³ in mine area while 41 – 172 μg.m⁻³ in residential area nearby in India (Chaulya 2004a,b). In Turkey, PM₁₀ concentration reached 300 μg.m⁻³ in mine area (Onder et al. 2009). To apportion sources of aerosol in the mine and nearby environments, Fugitive Dust Model – FDM was developed (Trivedy et al. 2009). The FDT application estimated coal mining activities to have low/moderate impact on air quality more than 500 meters far-away from the strip mine.

The aim of presented work was to determine particle size, and concentration dynamic of aerosol produced by mining activity

EXPERIMENTAL

A set of seven laser nefelometers DustTrak – DT, (model 8520,TSI), with omni-directional sampling inlets at height about 1.7 m above the ground, was positioned in a line-arrangement downslope the strip-mine. The first DT

measured nearby block of extracted coal while the last DT recorded PM values at the strip mine edge. Five minute integrates of PM_{10} or PM_1 were measured for two days in winter 2009 and in summer 2009 and 2010. Data on wind speed/direction, temperature and humidity were taken from our station positioned in distance of 2.2 km from the last DT.

Resuspension experiments with samples from the strip mine were conducted in the resuspension chamber of the Institute for Environmental studies described in details elsewhere (Civiš 2010). 1 – 2 kg samples were sampled in the North Bohemian lignite strip-mine Nastup from different parts of the mine such as the mine roads, coal dump, mining locations, flue ash dump, gypsum dump, and the soil used for covering flue ash and gypsum dumps. The aim was to find which parts of the mine contribute most to aerosol particle emission.

RESULTS

During the summer campaign 2009, diurnal pattern of PM_{10} significantly vary with the altitude (fig. 1) while PM_1 values did not exhibit such a pattern (fig. 2). Similar PM variability in the strip mine was recorded during the summer campaign 2010.

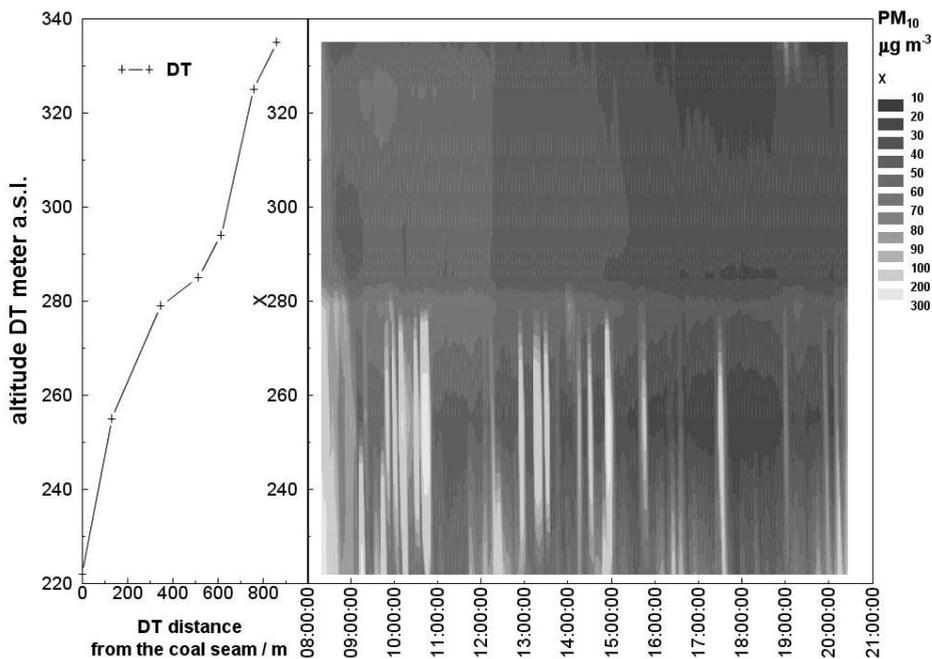


Fig. 1: Diurnal PM_{10} variation measured by DustTrak's in a line arrangement downslope the coal strip mine Nastup, North Bohemia. 18. 8. 2009

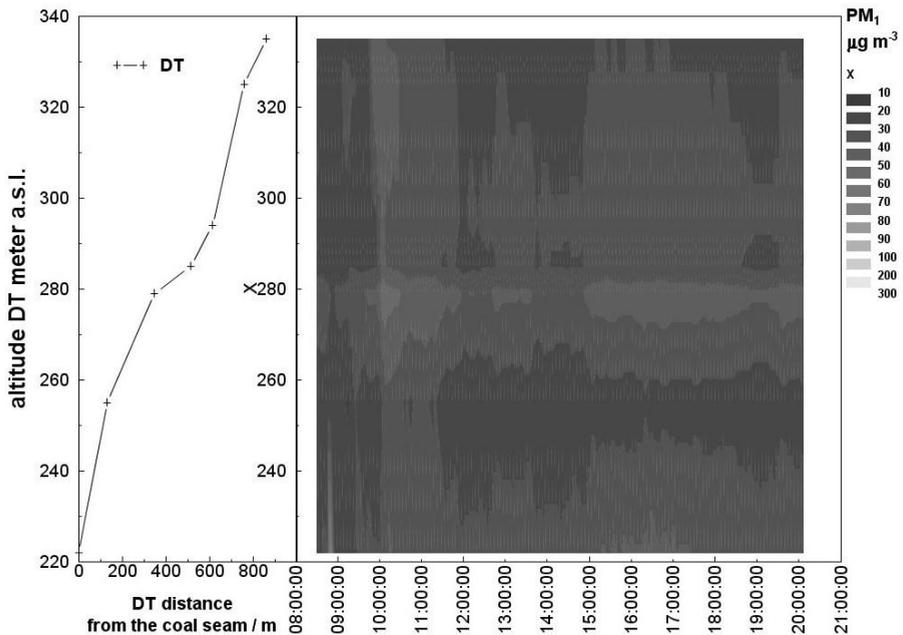


Fig. 2: Diurnal PM₁ variation measured by DustTrak's in a line arrangement downslope the coal strip mine Nastup, North Bohemia. 19. 8. 2009

Particle size distribution of aerosol, formed by dispersion of samples from the strip mine in resuspension chamber, is dominated by coarse mode particles. As an example, mass or number particle size distribution of homogenized coal sampled from the strip mine is depicted in fig. 3.

DISCUSSION

Our measurements are in accord with prediction by the FDM (Trivedy et al. 2009).

CONCLUSION

According to our measurements, mining activity produce coarse (> 1 µm in aerodynamic diameter) aerosol particles which are then restrictedly dispersed.

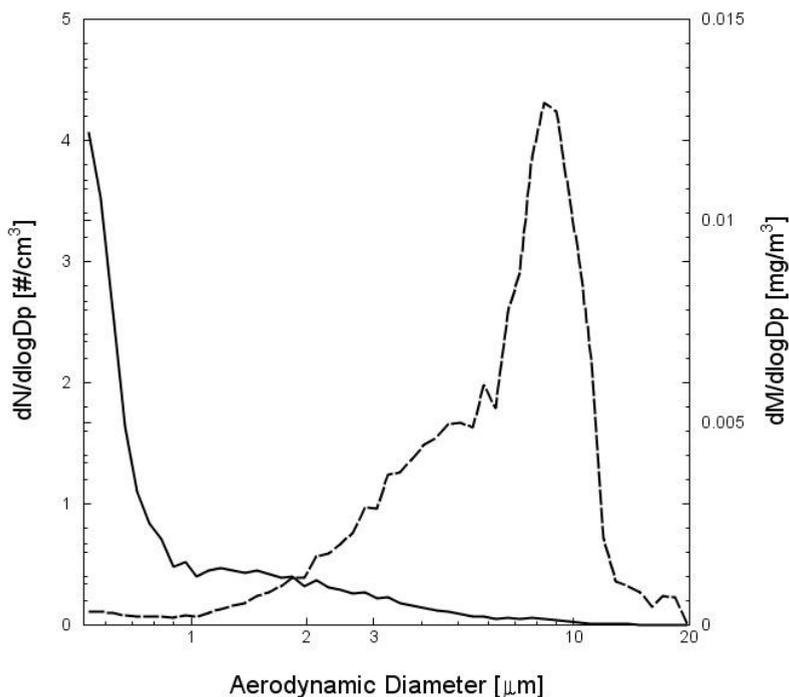


Fig. 3: Resuspension of homogenized lignite: continuous line – number size distribution, dashed line – mass size distribution

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