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Characterization of Magnetic Particles in Road Dust from Philadelphia, USA

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Road dust acts as both a sink and a source of heavy metals in urban settings [1]. After deposition, particles may be resuspended into the atmosphere or transported to local bodies of water via stormwater runoff, making them potentially harmful to human and ecosystem health [2]. The environmental availability of metals bound to road dust particles largely depends on their geochemical speciation. Metals frequently adsorb onto the surface of iron (hydr)oxide minerals by electrostatic or chemical interactions. Consequently, the concentration of iron (hydr)oxide minerals in road dust strongly correlates to metal loadings. Studies show ferrimagnetic mineral concentrations can be used as environmental proxies for assessing heavy metal pollution [3]. This research aims to characterize the fine magnetic fraction of road dust sampled from various sites across Philadelphia, PA using several standard mineralogical, chemical, and morphological analysis techniques, then compare these results to those of the bulk road dust. Results of X-ray diffraction analysis revealed that the mineralogy of the bulk road dust largely reflects that of the local geologic formation, the Wissahickon Schist, consisting of quartz, dolomite, plagioclase and potassium feldspars, and micas. The magnetic fraction consists of Fe-bearing minerals such as magnetite and hematite, with notable concentrations of dolomite. Scanning electron microscopy revealed the presence of crystalline and amorphous particles in both the bulk and magnetic dust. A substantial number of spherical fly ash particles and mineral-encrusted tire wear particles were observed in the magnetic dust, indicating the presence of both lithogenic and anthropogenic particles. Energy-dispersive X-ray spectroscopy shows substantially more Fe-bearing particles in the magnetic dust, as well as higher concentrations of Mg, Al, Ti, and Co, as revealed by X-ray fluorescence and inductively coupled plasma optical emission spectroscopy. By investigating the physicochemical properties of both magnetic and bulk road dust, this study provides the information necessary for predicting the fate and mobility of potentially toxic metals in urban environments.

[1] Teran et al. (2020), *Journal of Hazardous Materials*, 384, 120963

[2] Hedberg et al. (2019), *Environmental Science & Technology*, 53, 4030-4044.

[3] Yang et al. (2012), *Environmental Earth Sciences*, 66, 409-420