Table 4-9. Studies of 6PPD and 6PPD-q concentrations in indoor and nonroad settled dust

Location	Information	Concentration (ng/g)	Lab Instrumentation	Detection Limit
Guangzhou, China (Liang et al. 2022)	In August 2020, researchers collected one sample each from 45 different e-waste recycling workshops within a larger e-waste recycling complex. The samples were analyzed for a range of antioxidants and transformation products, including 6PPD and 6PPD-q.	The concentrations of 6PPD and 6PPD-q in e-waste dust were found to be [median (range)]: 6PPD: 113 (13.8–1,020) 6PPD-q: 375 (87.1–2,850)	LC-MS/MS	MDL (ng/g): 6PPD: 0.96 6PPD-q: 1.8
Beijing, China (Liu et al. 2019)	In March 2016, researchers collected dust samples from 30 different rubber playgrounds and from living rooms in 30 different homes in Beijing and analyzed them for three PPD, including 6PPD.	The concentrations of 6PPD in playground dust and indoor dust were found to be [geometric mean (range)]: Playground dust: 6PPD: 30.4 (<MQL–685) Indoor dust: 6PPD: 16.4 (<MQL–180)	ASE & UHPLC	Not available*
Guangzhou, China (Y.-J. Zhang et al. 2022)	From April–August 2021, researchers collected dust samples from different indoor environments and analyzed them for 6PPD-q, including air conditioner filters in college male (n=16) and female (n=16) dormitories and residential houses (n=18), as well as settled dust in residential bedrooms (n=16), buses (n=17), and shopping malls (n=20). As part of this study, researchers also measured indoor air concentrations of 6PPD-q concentrations in eight size-segregated particles (0.43−10 µm) at four waste recycling plants (n=160) in September and December 2020. At the same time settled-dust samples (n=24) were collected from the plants and analyzed for 6PPD-q.	The concentrations of 6PPD-q in indoor dust were found to be [mean ± SD (range)]: Air conditioner filters: Male dormitories: 4.76 ± 2.81 (1.95–13.4) Female dormitories: 6.78 ± 2.98 (2.85–12.6) Residential houses: 11.4 ± 8.11 (0.62–31.7) Settled dust: Residential bedrooms: 10.7 ± 7.58 (0.97–26.1) Buses: 43.0 ± 12.9 (19.7–71.4) Shopping malls: 23.5 ± 23.4 (3.92–106) The reported concentrations of 6PPD-q in indoor air were [median (range)]: 0.43–0.65 µm size: 2.75 (ND–9.52) 0.65–1.1 µm size: 2.07 (ND–12.2) 1.1–2.1 µm size: 1.17 (ND–6.81) 2.1–3.3 µm size: 2.22 (0.17–13.1) 3.3–4.7 µm size: 4.1 (0.89–18.9) 4.7–5.8 µm size: 4.66 (1.46–17.0) 5.8–9.0 µm size: 9.43 (2.37–39.2) 9.0–10.0 µm size: 16.65 (3.12–36.0) Overall: 3.73 (ND–39.2)	LC-MS/MS	LOD: 0.03 ng/g
Guangzhou, China (Huang et al. 2021)	In 2020, researchers collected 20 road-dust samples, 10 parking-lot samples, 11 vehicle-dust samples, and 18 house-dust samples in homes located in an e-waste dismantling area in South China. These samples were analyzed for a range of p-phenylenediamines, including 6PPD and 6PPD-q. Both compounds were detected in 100% of the road-dust, parking-lot–dust, and vehicle-dust samples. For house dust, 6PPD and 6PPD-q were detected in 56% and 33% of the samples, respectively.	The concentrations of 6PPD and 6PPD-q in vehicle and house dust were found to be [median (range)]: 6PPD: Vehicle dust: 19.3 (5.0–41.9) House dust: 0.3 (<LOQ–6.1) 6PPD-q: Vehicle dust: 80.9 (17.9–146) House dust: <LOQ (<LOQ–0.4)	HPLC-MS/MS	LOD (ng/g): 6PPD: 0.11 6PPD-q: Value not reported, but estimated based on the calibration curve and LOD of 6PPD

Table 4-9. Studies of 6PPD and 6PPD-q concentrations in indoor and nonroad settled dust

Location	Information	Concentration (ng/g)	Lab Instrumentation	Detection Limit
United States and Canada (Wu, Venier, and Hites 2020)	In 2016, researchers collected 21 e-waste dust samples in an e-waste dismantling facility located in Ontario, Canada. Residential samples were collected in Ontario, Canada in 2015 (n=20) and in Indiana, United States, in 2013 (n=12). In 2013, 10 sediment samples were collected in the Chicago Sanitary and Ship Canal. From 2018 to 2019, 20 air samples were collected in Chicago. Samples were tested for various antioxidants and ultraviolet filters, including 6PPD. 6PPD was detected in 100% of the e-waste dust samples, and in 70%–75% of all other sampled media.	The concentrations of 6PPD were found to be [median (range)]: E-waste dust: 15.4 (7.31–37.7) House dust (Canada): 0.083 (<MDL–6.65) House dust (United States): 1.84 (<MDL–23.7)	LC-MS/MS	MDL: Air: 0.02 pg/m^3 Dust and sediment: 0.06 ng/g
Hangzhou, China (Zhu et al. 2024)	During July and August 2022, indoor dust samples were collected from residential apartments (n=97) in Hangzhou, China, and analyzed for various PPD and PPD-q. 6PPD and 6PPDQ were detected in 100% of the indoor dust samples collected.	The concentrations of 6PPD and 6PPD-q in indoor dust were found to be [median (range)]: 6PPD: 10 (0.48–135) 6PPD-q: 9.5 (0.33–82)	HPLC-MS/MS	LOD: PPDs: 0.051–0.39 ng/g PPDQs: 0.081–0.27 ng/g
Guiyu Town and Haojiang, China (Z. Zhang et al. 2024)	From 2019 to 2021, researchers collected 91 house indoor dust and 52 kindergarten indoor dust samples from Guiyu Town and Haojiang municipalities in China. Samples were collected with brushes treated with n-hexane and sealed in aluminum foil and analyzed for 6PPD-q. 6PPD was not analyzed for.	The concentrations of 6PPD-q in house dust and kindergarten dust in Guiyu Town were found to be [median]: House dust: 3.2 ng/g Kindergarten dust: 7.5 ng/g The concentrations of 6PPD-q in house dust and kindergarten dust in Haojiang were found to be [median]: House dust: 1.4 ng/g Kindergarten dust: 1.3 ng/g	HPLC-MS/MS	IDL (ng/mL): 0.055 IQL (ng/mL): 0.061

Notes: µm=micrometer, ASE=accelerated solvent extraction, HPLC-MS/MS=high–performance liquid chromatography–tandem mass spectrometry, IDL=instrument detection limit, IQL=instrument quantification limit, LC-MS/MS=liquid chromatography / tandem mass spectrometry, LOD=limit of detection, LOQ=limit of quantitation, MDL=method detection limit, MQL=method quantification limit, ND=nondetect, ng/g=nanogram per gram, ng/mL=nanogram per milliliter, pg/m^3=picograms per cubic meter, PPD=para-phenylenediamines, PPD-q=para-phenylenediamines-quinones, SD=standard deviation, UHPLC=ultra-high–performance liquid chromatography

*This information may be available in the supplemental information section, but we were unable to obtain access.

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