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Airborne particulate matter and diesel engine exhaust on infrastructure construction sites in the Copenhagen metropolitan area

Patrick L. Ferree, Merve Polat, Jakob K. Nøjgaard, Keld A. Jensen

The National Research Centre for the Working Environment, Lersø Parkallé 105, Copenhagen DK-2100, Denmark
kaj@nfa.dk

Diesel engine exhaust (DEE) is a known carcinogen but many industries continue to deploy diesel-powered machines, albeit with improved filtration systems and regulatory standards. The goal of this study is to evaluate workplace exposure to DEE on outdoor construction sites. To that end, we carried out a series of online and offline measurements at four sites in the Copenhagen metropolitan area. We used quartz-fiber filters to measure elemental carbon (EC), a standard proxy for DEE exposure; scanning mobility particle sizers and optical particle sizers to measure particle number concentrations, mass concentrations, and particle size distributions; and micro-aethalometers to collect time-course data on black carbon (BC) concentration. We sampled at near-field and far-field positions, as well as from the breathing zones of workers and machine operators. We report that the average EC concentration ranged from < 0.3 to 6.4 $\mu g/m^3$. EC exposure was highest for ground workers (3.4 ± 0.8 μg EC $/m^3$), followed by drilling-rig operators (2.8 ± 0.5 μg EC $/m^3$). Non-drilling-rig machine operators (1.4 ± 1.3 μg EC $/m^3$) did not differ significantly from background (1.0 ± 0.3 μg EC $/m^3$). Construction sites with active drilling rigs had higher average particle number concentrations (22,000, 70,000, and 20,000 $/cm^3$) than sites without (5,000 $/cm^3$). Overall, although DEE exposures were below current occupational exposure limits (10 $\mu g/m^3$ in Denmark; 50 $\mu g/m^3$ in the European Union), they generally exceeded the 1:1000 cancer risk (0.45 μg EC $/m^3$).