



Stormwater Quality Assessment of Urban and Rural Road: A Comparative Analysis of Runoff and Dust Sampling Methods

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Road dust significantly impacts stormwater quality from roads, acting as a temporary pollutant sink that varies between urban and rural environments. Urban roads, with high traffic and impervious surfaces, accumulate finer particles with higher concentrations of metals and hydrocarbons. This study investigates pollutant profiles from urban and rural road runoff and dust samples in Galle, Sri Lanka. It evaluates the applicability of using tap water as an alternative testing medium through artificial rainfall simulation. Four sites representing diverse pollution levels were selected: two low-traffic rural sites and two high-traffic urban sites adjacent to a busy bus terminal. Using a developed experimental laboratory apparatus, rainfall events were simulated under controlled conditions. Runoff samples were collected using both natural rainwater and tap water. Dust samples were manually collected from road surfaces adjacent to runoff sampling locations. Key water quality parameters assessed included pH, EC, turbidity, TSS, TDS, VSS, COD, oil and grease, BOD₅, and heavy metals (Pb, Cu). Runoff samples were analyzed directly, while dust samples were mixed with water using a magnetic stirrer for 48 hours before analysis. Results indicate significant pollution differences, with urban areas showing high levels of TSS (59.4–78.9 mg/L), COD (478–603 mg/L), oil and grease (144–198 mg/L), and Pb (2.9–3.3 mg/L), all surpassing aquatic life standards. Rural areas showed TSS (52–65 mg/L), COD (56–122 mg/L), oil and grease (2–4 mg/L), and Pb (0.1–0.15 mg/L), with only COD and TSS exceeding standards. Sieve analysis confirmed that 85% of collected particles were smaller than 1.622 mm and 2.261 mm in low and high traffic conditions, respectively. Correlation analysis revealed that urban road runoff was the major pollution source ($R^2 > 0.8673$), while rural road dust was the primary contributor ($R^2 > 0.9791$). Stormwater runoff provided the most realistic pollution assessment, tap water runoff proved suitable for controlled experimental evaluations, and dust sampling supported understanding of particle-associated pollutant accumulation, necessitating targeted stormwater management strategies for varying traffic conditions.

Keywords: Stormwater quality, Rural roads, Road dust, Road runoff, Urban roads