Characterization and sources apportionment of overflow pollution in urban separate stormwater systems inappropriately connected with sewage

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**Abstract:** In recent years, combined sewer overflow (CSO) has been identified as a significant contributor to the deterioration of the urban water environment. It is thought that remolding it to a separate sewer system is a thorough and effective method of controlling the CSO in the appropriate area. However, according to current research, the separate stormwater sewer systems will also have overflow pollution due to functional defects, damaged or inappropriately connected with sewage, which has serious consequences for the separate system's operational efficiencies and the urban water environment. The event mean concentration, first flush effect, source apportionment, and correlation analysis of variables in overflow pollution generated in three residential catchments in Nanning, China, were investigated in this study. The results showed that the event mean concentration values in drainage outlets inappropriately connected with sewage were 2 to 4 times higher than those in stormwater outlets, especially for NH3-N, TN, and TP. Meanwhile, more than 80% of overflow events at outlets inappropriately connected with sewage had a weak first flush or even a weak dilution effect, with peak pollutant concentrations occurring 40 to 60 minutes after the overflow began. Besides, the discharge pollution load was primarily derived from the inside of the sewer. When the rainfall was heavy, the contribution rate of sewer sediment erosion exceeded 60%, which was much higher than the contribution rate of rainfall runoff and sewage. The variability in event mean COD and TSS concentrations was primarily attributed to the antecedent dry period and rainfall intensity. The COD concentration increased from 140.7 to 277.1 mg/L with the increase of antecedent dry period from 3 to 10 days. This study could help guide the implementation of targeted measures to treat overflow pollution in urban residential catchments, as well as the development of strategies to mitigate the effects on receiving water bodies.

**Keywords:** Overflow pollution; Separate sewer system; Inappropriate connection; First flush effect; Source apportionment