

Occurrence of the pollutant first flush phenomenon on the example of the stormwater sewer system in Kielce – case study

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ABSTRACT

This paper attempts to describe the occurrence of the pollutant first flush phenomenon in the stormwater sewer system in two urban catchments located in different parts of the city of Kielce. The research covered measurements of concentration variations of the total suspended solids (TSS) during runoff events caused by precipitation of varied nature and events resulting from snowmelt. The flow rates and precipitation values recorded were used for the analyses. Based on the calculations, pollutographs were plotted to illustrate the characteristics of the first flush phenomenon in the catchments in question. Nine events from the period of 2009–2010 and five events from 2018 were selected for the analysis. In the first case, the maximum flow rates and durations of the event ranged as follows: 0.037–0.312 m³ s⁻¹ and 120–540 min, in the second: 0.209–4.530 m³ s⁻¹ and 150–1,000 min. They were caused by precipitation depth of 3.6–20 mm. The greatest TSS concentration recorded for the rainfall events was 10,621 mg dm⁻³, and for snowmelts – 7,432 mg dm⁻³. An analysis of the occurrence of the pollutant first flush, in relation to the mass of TSS in individual events, showed significant differences in the course of the process. The first flush phenomenon does not occur in smaller catchment areas, and those with a greater degree of land sealing. The first 30%, 25%, and 20% of the runoff volume (%V) carried up to 47%, 40%, and 34% of the TSS mass (%M). In the larger catchment, having six times greater area and a slightly lower degree of land sealing, the first flush phenomenon occurs virtually for every event (depending on the criterion %M/%V adopted). The initial 30%, 25%, and 20% of the cumulated runoff volume carried respectively: from 53% to 75%, from 47% to 69%, and from 39% to 60% of the TSS mass.

Keywords: Stormwater; First flush phenomenon; Total suspended solids; Urban catchment

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