

Relationship between selected pollution indicators of stormwater from urban catchments

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ABSTRACT

The article presents the results of studies on stormwater quality in two urban catchments located in Kielce, differing in the area and land use. Precipitation water samples were taken in stormwater drainage during runoff events in order to determine concentrations of the following heavy metals (HM): Cd, Cu, Cr, Ni, Pb, Zn, Co, Mn, Fe, as well as the concentration of total suspended solids (TSS) and total organic carbon (TOC). Completed analyses proved that maximum TSS and TOC concentrations were higher in the Jesionowa stormwater treatment plant (SWTP) catchment (10,621 and 71.6 mg dm⁻³, respectively) compared to the Witosa SWTP catchment (627 and 21.9 mg dm⁻³, respectively). The analysis of the values of mean concentrations of HMs (the ANOVA test) shows that a substantially higher mean value of Cu concentration (0.133 mg dm⁻³) was found only for the Jesionowa SWTP. For the sake of comparison, in stormwater flowing from the catchment of the Witosa SWTP, this value was 0.029 mg dm⁻³. The lack of statistically significant differences between the mean values of the indices of concern may reveal similarities between factors that determine deposition processes and pollutant wash-out in the catchments examined. The modified contamination index (mC_d), calculated in the study, allows a statement that for both catchments, stormwater is very highly contaminated with respect to HMs. That is confirmed by the enrichment factors, that attribute the category extremely severe enrichment or severe enrichment for C_d (Witosa/Jesionowa), severe enrichment for Zn (Witosa) and moderately severe enrichment for Pb, Ni and Cr (both facilities). The principal component analysis was applied to assess the correlation between the analyzed pollution indices. For the Jesionowa catchment, the occurrence of strong positive relationships was found between Ni, Co, Mn, Cu and Zn. As regards the other catchment, a single strongly correlated group of HMs (Cu, Pb, Zn, Co, Mn, Fe) and TSS ($r = 0.65-0.94$) was observed. That may indicate a major TSS role in the transport of the pollutants examined, whereas the rate of their wash-out depends on the hydrological conditions prevailing in the catchment (precipitation intensity).

Keywords: Stormwater; Heavy metals; Total suspended solids; Principal component analysis; Urban catchment

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