

Quality Characteristics of Road Runoff in Coastal Zones: A Case Study in A25 Highway, Portugal

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Abstract : Road runoff is a linear source of diffuse pollution that can cause significant environmental impacts. During rainfall events, pollutants from both stationary and mobile sources, which have accumulated on the road surface, are dragged through the superficial runoff. Road runoff in coastal zones may present high levels of salinity and chlorides due to the proximity of the sea and transported marine aerosols. Appearing to be correlated to this process, organic matter concentration may also be significant. This study assesses this phenomenon with the purpose of identifying the relationships between monitored water quality parameters and intrinsic site variables. To achieve this objective, an extensive monitoring program was conducted on a Portuguese coastal highway. The study included thirty rainfall events, in different weather, traffic and salt deposition conditions in a three years period. The evaluations of various water quality parameters were carried out in over 200 samples. In addition, the meteorological, hydrological and traffic parameters were continuously measured. The salt deposition rates (SDR) were determined by means of a wet candle device, which is an innovative feature of the monitoring program. The SDR, variable throughout the year, appears to show a high correlation with wind speed and direction, but mostly with wave propagation, so that it is lower in the summer, in spite of the favorable wind direction in the case study. The distance to the sea, topography, ground obstacles and the platform altitude seems to be also relevant. It was confirmed the high salinity in the runoff, increasing the concentration of the water quality parameters analyzed, with significant amounts of seawater features. In order to estimate the correlations and patterns of different water quality parameters and variables related to weather, road section and salt deposition, the study included exploratory data analysis using different techniques (e.g. Pearson correlation coefficients, Cluster Analysis and Principal Component Analysis), confirming some specific features of the investigated road runoff. Significant correlations among pollutants were observed. Organic matter was highlighted as very dependent of salinity. Indeed, data analysis showed that some important water quality parameters could be divided into two major clusters based on their correlations to salinity (including organic matter associated parameters) and total suspended solids (including some heavy metals). Furthermore, the concentrations of the most relevant pollutants seemed to be very dependent on some meteorological variables, particularly the duration of the antecedent dry period prior to each rainfall event and the average wind speed. Based on the results of a monitoring case study, in a coastal zone, it was proven that SDR, associated with the hydrological characteristics of road runoff, can contribute for a better knowledge of the runoff characteristics, and help to estimate the specific nature of the runoff and related water quality parameters.

Keywords : coastal zones, monitoring, road runoff pollution, salt deposition

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