Remobilizationof particle-bound contaminants from re-suspended sediments and their impact on aquatic organisms

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Introduction: It is widely accepted that sediments are sinks for a variety of anthropogenic contaminants, but can be re-suspended following, e.g., dredging or flood events and, thus, act as a secondary source of contamination for aquatic organisms. Since flood events increase in frequency and magnitude, they are regarded as a major cause of concern regarding the resuspensionof legacy sediment layers. In order to understand transport of contaminated sedimentsand the impact on aquatic organisms,an interdisciplinary research group was established. Hydraulic engineers and ecotoxicologists combined their expertise and methodologies to set up integrated, hydrotoxic experiments.Ina successful feasibility studyknowledge on conducting hydro-toxic experiments was acquired. The present study aims to investigate the conditions under whichcontaminants may become bioavailable from re-suspended sediments during erosion.

Methods: The interdisciplinary approach combines various methodologies in one test stand. Amodified annular flume(fig. 1) is used to simultaneously re-suspend contaminated sediments and expose aquatic organisms. Earlier results of the joint research showed that the annular flume is suitable to conduct hydro-toxic experiments [1], [2], [3].

Fig. 1: Annular flume at the Institute of Hydraulic Engineering and Water Resources Management, Aachen, Germany.

The instrumentation of the annular flume was extended tocontinuously record a wide range of physico-chemical parameters during the entire test of several days. The transport behavior of the suspended load is monitored by continuous measurement of turbidity at two locations over the entire height of the water depth. In addition, water samples are taken at those two points for chemical and sedimentological analysis.Furthermore, effect biomarkers will be analyzed to assess the impact of toxic substances (PAH, heavy metals) on organisms during remobilization.

Results: The detailed and extensive data sets from measurement and observation of the cohesive sediment will help to characterize and define its transport behavior (critical bed shear stress, erosion rate). Furthermore, precise recordings of thephysic-chemical parameters (pH value, oxygen concentration, redox potential etc.)will allow a detailed description of test conditions in the annular flume. The analysis of suspended particulate matter (SPM) and watersamples will provide information on SPM concentration and grain size distribution as well as on contaminant concentration in re-suspended sediment.

Discussion: The acquired knowledge about contaminated sediment transport and about the impact on aquatic organisms will help to develop new advices for an integrated and sustainable sediment management.Moreover, the results will help to define thresholds of contaminant concentrations in river systems, basins and harbors.

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