

A methodology to determine riverine loads and coastal deposition processes of polluted sediments in the Drammen Harbour, Southern Norway

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Introduction: In line with the implementation of the EC Water Framework Directive, river and coastal management plans are being developed all over Europe. In this context there is a need to find appropriate methods to measure the interaction between land and coastal sediment processes, particularly in terms of the transport and deposition patterns of particle associated pollutants.

The harbour of the city of Drammen is situated in the innermost part of the Drammensfjord at the south coast of Norway. The fjord basin is restricted from the outer Oslofjord by a sill of 10 m depth, and is dominated by an estuarine circulation with a mean freshwater discharge of about 340 m³/s from the river Drammen. Past and present pollution has ranked Drammen harbour among Norway's most polluted harbours; with consume restrictions on cod liver. The sediments in the harbour are polluted mainly by TBT, PAH, PCB and metals (with decreasing importance). In order to consider the appropriate remedial actions in a future management plan, it was of vital importance to estimate where these pollutants are deriving from. The main sources were believed to be the river Drammen, the smaller river Lierelva (mean water discharge of about 4.5 m³/s), overflow of the sewage system, urban areas, and seepage from polluted landfills.

Methods: A two year program was designed to measure the contaminant discharges from the sources, and the deposition patterns in the harbour. The methodology included sampling of large amounts of river water from the two main tributaries to the fjord, in order to analyse for pollutants; whereas sediment rating curves were used to estimate total sediment loads. Contributions from urban areas and the sewage system was estimated through digital maps, GIS, and using template values developed from years' experiences on pollution rates from sewage systems and urban areas in Norway. Sediment traps were placed in the harbour in order to investigate present sedimentation patterns; and sediment cores (dated by ²¹⁰Pb) were collected in order to gain information on past sedimentation processes.

Results and discussions: Results indicate that sedimentation rates have increased during the latter years in some parts of the harbour. A budget of particle associated contaminants was established, showing that the influx of metals from land sources was higher than the sedimentation of metals in the inner part of the fjord. The pattern did, however, vary according to the different metals. Thus, for Pb, 90% of the material from land sources settled in the inner part of the fjord, whereas for Cu, only 20% settled; the rest is believed to be deposited further out in the fjord.

The influx of PAH equalled the sedimentation in the harbour whereas the sedimentation of TBT was higher than the measured influx. This suggests that there must have been sources of TBT that were not accounted for in the measuring program. These discrepancies may be explained by discharges from a shipyard in the harbour.

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