Quality dredging and policy:
Environmental risk assessment for heavy metals

Chiel Lauwerijssen - Jaap Steketee

Quality dredging has been under extra attention after the EU Water Framework Directive to reduce transport of contaminants and nutrients from sediments to surface waters. Only the freely dissolved and not-tightly bound, bioavailable, fraction of contaminants and nutrients may have a negative impact of environmental quality. Therefore, we assess remediation techniques that diminish sediment resuspension illustrated with two case studies.

TAKE HOME MESSAGE

- Avoiding sediment resuspension significantly improves water quality
- Water quality improvement without removing all sediments
- Sequential extraction methods provide more insight in transport behaviour of contaminants

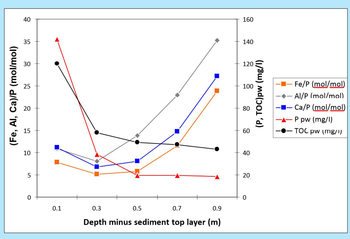
WAY FOREWARD

- Combining sample techniques and chemical analysis empowers risk characterization
- Helicopter view of goals and procedures to define a remediation strategy

Mercury contamination ‘De Poel’ (Wormer)

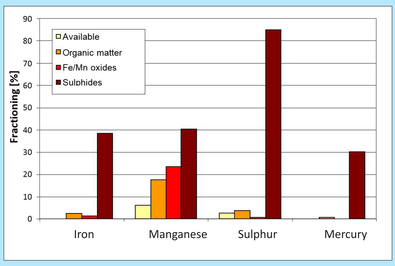
As a result of industrial activities in the 17th and 18th century heavy metals (copper, lead and mercury) have accumulated in the sediment of Wormer- and Jisperveld. In this case high levels of mercury might pose risk for humans after fish consumption and threat water quality. Sediment cores were taken and each layer has been examined thoroughly. A chemical characterization was made by sequential extraction methods to examine the mobility of mercury and phosphorus.

- Pore water concentrations of mercury are considered low; highest concentrations are present in the sediment top layer (0-20 cm)
- None or limited mobilization of soluble mercury as a result of resuspension and ripening of sediment
- Sequential extraction shows only 1% of mercury is free available for biota
- Mercury is primarily bound to sulphides, which is considered a stable mineral with very low solubility
- The mobility of copper and zinc increases tremendously as a result of ripening



Molar ratios of macro-elements (Fe, Al, Ca)/P in sediment and phosphorus concentrations (µmol/l) and TOC (mg C/l) in sediment pore water over depth.

- Phosphorus mobility is highest in sediment top layer (0-20cm)
- Phosphorus availability is most determined by calcium
- Addition of calcium may reduce the amount of available phosphorus



Results sequential extraction: average values for fractioning per element, % of total concentrations (n=5)

Conclusions

- High mercury concentrations in deeper layers poses no risk and mobility is low
- Sediment removal will not significantly improve water quality and benefits do not outweigh the costs
- Control measures should focus on preventing sediment resuspension and transport throughout the water system

Waterway ‘De Vaart’ (Zaandam)

High metal concentrations and increased levels of (polycyclic aromatic) hydrocarbons in Waterway ‘De Vaart’ were identified with water quality problems. In combination with geotechnical location inspections, sediment cores were taken to characterize the internal layered structure and the extent of the contamination. The environmental risk assessment indicated that remediation was needed to ensure water quality to ensure water quality standards. Tauw developed a customized recovery action-plan for the executive proceedings with Computer Aided Designs (CAD) to remove as much contaminated sediment as possible and and protect shores against erosion. Additional capping improves water clarity and has a positive effect on the development of macrophytes and increases biodiversity and shore quality.

FACTSHEET

Time period	January - June 2017
Remediated volume	11.000 m^3
Area capped by a thin sand layer	2,5 ha
Thickness sand layer	0,3 m

Chiel Lauwerijssen
E: chiel.lauwerijssen@tauw.com
T: +31 61 17 33 31 7