Stability of Contaminated Sediments
a multidisciplinary research program

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Introduction: In Norway serious contamination of marine sediments has been found in fjords and coastal areas. This has resulted in restrictions on the consumption of fish and fishery products in many fjords. The Ministry of the Environment has identified the abatement of contaminated coastal, fjord and harbour sediments as a top priority for the coming years.
However, as a result of the general depth of Norwegian fjord systems, there is a limited need for maintenance dredging. Large-scale remediation will therefore be initiated based on environmental requirements only. Compared to natural processes, remediation and construction works will often exert extreme changes in physical/chemical conditions. These stresses might result in a deterioration of the present day situation over a defined period of time.
To be able to assess the efficiency of sediment remediation options, a proper understanding of the physical and chemical stability of the contaminants is required. This will allow a prediction of contaminant mobilization and migration under various environmental stresses as well as support decisions on remediation priorities.

Research methodology: The main research focus of the program is on the integration of knowledge on the physical and chemical interactions in contaminated sediments, with the objective to i) quantify the principal parameters determining the physical and chemical stability of contaminants in the sediment matrix, ii) determine the contaminant migration resulting from engineering operations in contaminated sediments, like dredging, backfilling and construction works, iii) establish design criteria for containment methods with a long term intrinsic stability and required safety, iv) develop tools to evaluate efficiency of remediation methods.
Chemical and physical stability research forms the theoretical basis for the programme principally through the use of laboratory scale tests and pilot studies with subsequent validation at established field sites.

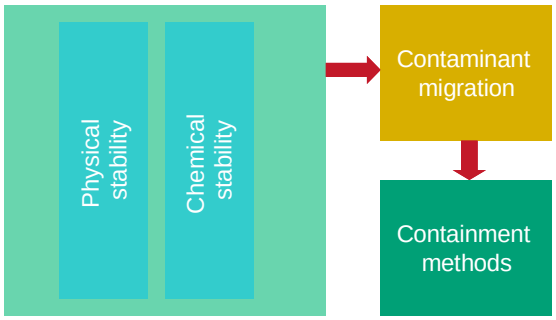

Fig. 1: Structure of the research program.

Research program:
The sediments at the water-sediment interface are often very soft and have a very “fluffy” nature. It is therefore difficult to determine a clear border where suspended solids become a sediment. Physical stability is studied using innovative methods to determine sedimentation and consolidation rates as well as very low shear strength both under laboratory and field conditions.
High contaminant loads have resulted in increased levels of organic matter in near shore sediments giving anoxic conditions. The organic matter in the sediments effectively sorbs organic contaminants while the anoxic conditions stabilise heavy metals in sulphide complexes. Predictive tools for contaminant release are critical to quantify migration of contaminants. Laboratory and field methods have been developed to quantify these processes.
Remediation of contaminated sediments can be based on removal, and storage in a “Confined Aquatic Disposal” (CAD), or near shore “Confined disposal facilities (CDF) or on shore. Containment can also be achieved by in-situ capping. Long term containment stability is studied using different cover constructions and natural consolidation conditions both in lab and field. In addition the chemical interaction between capping material and sediment is studied.
Pilot study demonstration sites have been established at Oslo Harbour, Bispevika/Bjørvika and in the harbour of Trondheim, focusing on physical and chemical containment.