Use of tracer particles - a new technique to monitor and quantify transport of contaminated sediments

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Introduction: A major challenge with sediments is to measure and describe how they spread in estuaries and coastal areas. In many cases, the sediments are contaminated and the spreading pattern of the sediment particles will give information about how and where the contamination is spread. It is difficult to tag sediment particles in a way that they can be traced directly. An indirect method using fluorescent tracer particles with the same properties as the local sediment, has been more successful. This paper shows two examples of how tracer particles can be used to monitor and quantify transport of contaminated sediments.

Methods: Tracer particles for monitoring and quantifying transport of contaminated sediments are added at the source of spreading. They are placed at the appointed place of release either in soluble bags, in frozen state or pumped as slurry to avoid any spreading (cross-contamination). In Norway two studies with tracer particles studies have been performed recently. One study in Trondheim to monitor and quantify spreading of contaminants from a nearshore CDF (Confined Disposal Facility) and one study in Sandefjord assessing the spread of contaminated seabed sediments from two areas.

The Trondheim study

Tracer particles were added in a CDF with 80 000 m^3 capacity in 2005 and 2007 in the Trondheim harbour. In 2005 blue tracer particles were added (see Fig. 1) and in 2007, violet, orange and yellow tracer particles were added. The reason for adding three different tracer colours in 2007, was to make it possible to study from which part of the CDF particles were spread to the sea and the sediments.

Fig. 1: A 5 µm fluorescent tracer particle at ×20 magnification in sediment.

The Sandefjord study

In the inner Sandefjord fjord there are two locations with contaminated sediments which have potential for spreading to a nearby beach and the fjord in general. To be able to find out if this was the case, a blue tracer was placed in the sediments in the first location and a red tracer was placed in the second location. Sediment samples were taken at different time steps after the release of the tracer particles in and around the release areas and in and around the beach area. At the same time the tidal variations and currents were registered.

Results: Both in Trondheim and Sandefjord it was possible to count and register tracer particles in the sediments. In Trondheim, the amount of tracer particles found was low, indicating that the amount of contaminants leaking from the CDF was low. In Sandefjord, low amounts of tracer particles were registered in the sediments at the beach area. This indicated that small amounts of contaminants were spread from the two locations to the beach area.

Discussion: Tracer particle study is a promising technology to monitor and quantify the spreading of contaminants. The method needs however a large amount of sediment samples which have to be analysed for tracer particles to be able to give good results. Methods to quantify the spreading of contaminants with tracer particles need to be further refined.

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