Use of sediment quality guidelines in ecological risk assessment of dredged materials: recent developments and perspectives

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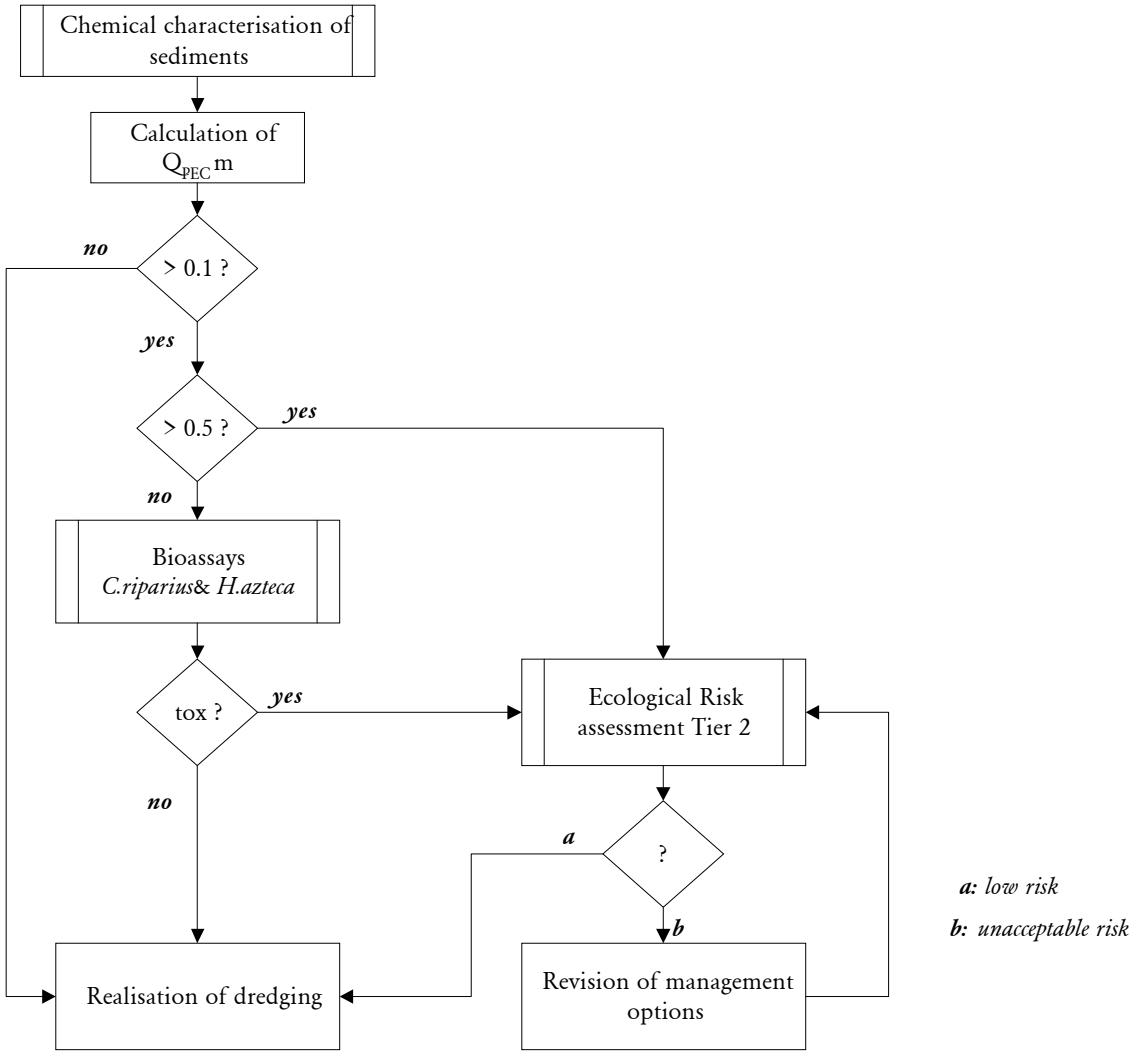
In several countries, ecological risk or hazard assessment for dredged materials relies upon a tiered process, with tier 1 being often based on a chemical characterisation of the sediments. At that stage, risk may be characterised by comparison of chemicals concentrations to hazard thresholds like sediment quality guidelines (SQG) or sediment effect concentrations (SEC). Methodologies allowing to determine SQGs or SECs are therefore critical and should be reviewed carefully, as underlying concepts and assumptions may greatly differ.

Three main approaches may be distinguished: the first focuses on geochemistry, the second relies upon a distribution model among sediment, water and living organisms, and the third on toxicity incidence among large datasets. These approaches may be criticised on theoretical aspects, and have practical limitations. Recently, consensus guidelines were proposed in North America, along with an aggregation method allowing to assess the risk of sediments contaminated by several chemicals. These consensus SECs were not obtained by a methodological improvement, but their relevance appears rather good, as the overall risk score is correlated to the toxicity incidence in independent datasets.

A two tiers approach, such as that recently proposed in France for assessing the ecological risk of freshwater dredged materials (Figure 1), will be presented and tested on various sediment datasets. The first tier is based on a chemical characterisation; results are then compared to "probable effect concentrations", and aggregated as mentioned above. If the score value is below a given threshold, dredged sediments may be disposed of without any further assessment; conversely, if the score value is above a second threshold, a tier 2 assessment should be done. For those samples having scores between the two thresholds, sediment toxicity tests will allow to decide whether tier 2 is justified or not.

Figure 1. First tier flow diagram and connections to tier 2, as proposed in France for dredged materials



Several issues have now to be discussed, and examined in further studies: it seems interesting to use the same bioassays in both tiers, as it will help to enlarge the existing database, and thus gather information on concentration-effects relationships or allow to determine new SECs. However, the relevance of at least the lowest threshold appears questionable, on theoretical and practical issues. For instance it remains a significant percentage of toxic samples below this threshold (type I error). Conversely most of sediments in some areas like French Northern canals have risk scores above this limit, meaning that theoretically many of them should be tested with sediment toxicity bioassays. Moreover, in this French area 61% of the sediments have risk scores above the second threshold, and therefore should enter tier 2 directly, or be disposed of in appropriate facilities. As it seems unrealistic in practice, a refined prioritisation tier might be necessary.

Obviously, any significant improvement of tier 1 assessments are linked to the availability of a database associating effect and chemical data; these desired improvements might be obtained more rapidly if these data were pooled at a European level.