Flushing of Sediments from Reservoirs: an Analytical Protocol for Preliminary Assessment of Sediment Toxicity.

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Introduction: Reservoir desiltation is often necessary to maintain or recover storage capacity. For technical and economic issues, accumulated sediment is frequently removed by flushing [1], but concerns may arise over the ecological effects on the riverine ecosystem receiving the removed sediments [2]. Direct effects on aquatic organisms can be primarily due to physical-mechanical impact [2], but in some cases chemical compounds accumulated in the sediments may induce toxic effects. Accordingly, a proper ecotoxicological and physical-chemical characterization of sediments is essential to evaluate the toxic potential of sediments released downstream. To ensure environmental sustainability of flushing operations, a preliminary analytical protocol (PrAP) comprising criteria and methods for sampling and analysis of sediments was defined and is here presented.

Methods: The PrAP has been developed through several operational steps:
- evaluation of case studies: reservoirs with high silting degree and characterized by different degree and types of anthropic pressures deriving from the catchment;
- comparison of several analytical methods, taken from Italian laws and from national and international best practices;
- definition of sampling design and protocols;
- definition of adequate "standard" sets of analysis for the characterization of sediments;
- definition of a monitoring plan in the downstream river before and after flushing operations, in order to determine physical-chemical and ecotoxicological effects of sediment deposition downstream;
- evaluation of proper ecotoxicological tests to determine sediment toxicity and selection of appropriate concentration values, taken by scientific papers [3] and by national legislation, to be considered as threshold values for trace elements and organic compounds;
- development of a method for cross-interpretation of analytical results deriving from chemical and ecotoxicological analyses, in order to provide a practical and efficient tool ensuring a sustainable management of the flushing activities.

Results and discussion: Contents of the PrAP and its trial in some Italian reservoirs will be presented. Preliminary results show that the definition of proper threshold concentrations of contaminants is rather difficult, because background values of trace elements may be naturally high, biasing the interpretation of chemical data; moreover, threshold values are defined as total concentration of contaminants, but bioavailability is often not correlated and may be altered during flushing.
Other concerns are:
- the sampling design should integrate chemical and ecotoxicological analysis with a proper timing, in order to allow reliable results with the minimum effort;
- monitoring protocols defined by law are often not adequate to correctly manage this kind of operations and to determine the ecological effects; nonetheless they need to be integrated within the PrAP.
The efficiency and the representativeness of the protocol are discussed, as well as the potential in predicting the effects in the downstream river. The PrAP allows determining the synergic effect of different pollutants; it also permits to use analytical results for decision making. At this purpose, the combined ecotoxicological and physical-chemical approach is necessary for managing flushing operations at regional scale and for different types of reservoirs.

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