Appropriate Use of Numeric Chemical Water Quality Criteria

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Increasing attention is being given to the cost-effectiveness of chemical contaminant control programs designed to control water column and sediment toxicity to aquatic life and excessive bioaccumulation of contaminants in aquatic life. Corresponding attention is being given to the appropriateness of using US EPA criteria and state standards based on these criteria as independently applicable regulatory tools in designated beneficial use protection - enhancement. The worst-case or near worst-case nature of these criteria and standards, which largely ignores the aqueous environmental chemistry of contaminants in assessing potential toxicity or bioaccumulation, tends to make them highly overly protective. The US EPA has adopted the Independent Applicability Policy in which chemical specific values are assumed to be independently applicable to regulating water quality even though biological effects based criteria and standards, such as toxicity testing and actual measurements of bioaccumulation evaluated on a site specific basis, show that the chemical specific values significantly over estimate what actually occurs in a waterbody.

The Problem

While the US EPA has correctly recommended use of dissolved metals rather than total recoverable metals (US EPA, 1993), it has not yet addressed problems of over regulation for other heavy metals and for a wide variety of nonmetallic contaminants. These are still being regulated based on total contaminant concentrations rather than toxic - available forms. The US EPA's (1994) recent revision of guidance governing the development of site specific water quality criteria - standards through water effects ratio adjustments does not address the most important reason why many contaminants in point and nonpoint sources become highly over regulated. This problem arises from the fact that many particulate forms of contaminants do not equilibrate with dissolved - available forms, while available forms of contaminants are used in the testing procedure and applied to unavailable forms.

Recognition of problems with chemical specific criteria - standards is not new. The National Academies of Science and Engineering Committees (NAS/NAE, 1973) concluded that heavy metals could not be reliably regulated without significant waste of public and private funds based on chemical specific measurements. Those committees recommended that toxicity testing be used to evaluate toxic - available forms of metals. While the US EPA adopted this approach in its Red Book of water quality criteria in 1976, unfortunately, in the early 1980s they abandoned the technically valid approach and adopted a technically invalid approach (Lee and Jones-Lee, 1994a).

Over Regulation of Copper in San Francisco Bay

One of the best examples of gross over regulation is copper in San Francisco Bay. Total recoverable and dissolved copper concentrations in San Francisco Bay frequently exceed the US EPA national water quality criterion for copper and the site specific water quality objective for copper developed by the San Francisco Regional Water Quality Control Board based on and with concurrence of the US EPA guidance. If the criteria are adequately protective, exceedances of copper concentrations in Bay waters should be causing toxicity to aquatic life. However, comprehensive toxicity testing conducted in 1993 by independent laboratories using the same aquatic organisms and organism forms that were used to establish the original water quality criterion for copper found no evidence for toxicity (Thompson *et al.*, 1994). However, because of the US EPA's Independent Applicability Policy, the point and nonpoint source dischargers, including the agencies responsible for stormwater runoff quality management, have been forced into an arbitrarily developed wasteload allocation and TMDLs which is projected to ultimately result in expenditures for copper control expected to exceed one billion US dollars.

However, the expenditure of these funds will not enable San Francisco Bay waters to achieve the copper national criterion or the site specific objective for total or dissolved copper. This is because any exceedance of the criterion for more than one hour once in three years is judged to be a water quality violation and, even if all copper inputs to the Bay from external sources were terminated, the copper derived from wind induced stirring of sediments into the water column would cause water quality violations under current Agency policy.

Under Regulation of Diazinon

In the US, massive amounts of money are being spent to address a few regulated chemicals out of the 65,000 largely unregulated chemicals and the 1,000 new chemicals that are produced each year. However, some obvious problems are not being adequately addressed. Recently reported studies have demonstrated that diazinon is a significant cause of water column toxicity to aquatic life in the Sacramento-San Joaquin River Delta in California. However, according to representatives of the State Water Resources Control Board, this chemical cannot be regulated since the state has not developed a chemical specific water quality criterion for it.

Appropriate Use of Chemical Specific Water Quality Criteria

The authors have maintained for many years that chemical specific water quality criteria and standards based on these criteria should be used as indicators of *potential* water quality problems, not as independently applicable values that must be achieved at the edge of mixing zones for point and nonpoint sources as is being done today (Lee, 1973; Lee and Jones, 1979, 1981, 1983; Lee *et al.*, 1982). If an exceedance of a chemical-specific criteria - standard occurs, then those responsible should be provided the opportunity to conduct appropriate studies to determine whether this exceedance truly reflects a designated use impairment.

For example, if the chemical of concern is mercury and a publicly-owned treatment works (POTW) finds that it has excessive mercury in its discharge compared to the allowed chemical specific criterion, the POTW should be able to determine if this "excessive" mercury is leading

to excessive mercury in edible aquatic organisms downstream of the discharge. If there are no problems, then there should be no need to control the mercury discharge from the POTW beyond current controls.

A similar situation should occur for copper in point and nonpoint source discharges to San Francisco Bay. If, as has been found, there is no water column toxicity associated with copper, then there should be no need for the POTWs, industrial dischargers and stormwater dischargers to reduce the copper input to San Francisco Bay from the current levels. There may be some who attempt to argue that while there may be no toxicity due to copper in the water column, there could be toxicity problems in the benthos associated with the sediments. However, the water quality criterion - standard is designed to address water column issues. Sediment quality benthos issues should be addressed through appropriate evaluation of whether copper in the sediment is in fact available - toxic to aquatic life (Lee and Jones-Lee, 1993). This cannot be done by chemical specific water column-based water quality criteria - standards for aquatic life.

Conclusion

It is the authors' position that, rather than throwing money at a non-issue such as an exceedance of an overly protective national or site specific water quality criterion - standard, it is far more appropriate to use the limited funds available to address the control of contaminants that are causing real, readily discernible significant adverse impacts on designated beneficial uses of waterbodies. Where administrative exceedances of chemical specific criteria occur, then those responsible for the exceedances need to provide sufficient funding to enable credible studies to be conducted to ascertain whether these exceedances are of significance in adversely impacting the designated beneficial uses of the waterbody.

Abandonment of the US EPA's Independent Applicability policy for chemical specific criteria and the adoption of an approach in which the exceedance of chemical specific criteria and standards in a discharge - runoff is used as a trigger to allow site specific evaluation of potential adverse impacts of the discharge would result in a much more technically valid and cost-effective approach for regulating chemical contaminants in waters.

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