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Editorial

ESTABLISHING EFFLUENT DISCHARGE LIMITS — HAVE WE GOT IT RIGHT?

Traditionally, the permitted quantity of effluent discharge has been controlled by specifying limits on variables such as the biochemical oxygen demand (BOD), chemical oxygen demand (COD), suspended solids, and pH. These variables are essential to characterizing an effluent, but they are grossly insufficient for assessing the impact of a discharge on the health of an ecosystem. One such system is the consortium of microorganisms that degrade the waste in activated sludge biological treatment of wastewater. Because the activated sludge process is a workhorse technology for treating most of the world's treated wastewater, setting of discharge limits should consider all those effluent characteristics that affect the efficacy of the biological treatment. One relevant characteristic that is virtually ignored at the moment is the effluent's toxicity.

Toxicity is the ability of a pollutant to adversely affect a biological system. Admittedly, toxicity is difficult to assess. Unlike BOD, COD and pH, it is difficult to ascribe a single quantitative value to toxicity of a chemical. Biological systems are diverse and different species respond differently to different pollutants. Often, the toxic response of a measurement system is not a simple linear function of the concentration of a given toxic chemical. In addition, toxic chemicals in mixtures interact synergistically or antagonistically, to enhance or suppress toxicity relative to pure compounds. Notwithstanding these difficulties, establishing discharge limits based on effluent toxicity is critical to the well-being of aquatic ecosystems and the efficacy of the biological wastewater treatment processes. Presence of toxic substances in an effluent can inhibit the biodegradation of normally degradable pollutants and therefore the real environmental impact of a toxic compound is far greater than would be indicated by its COD value.

How should we assess toxicity? There are no absolute values for toxicity and toxicity of a compound depends on the measurement system used. Because toxicity is a biological response and diverse lifeforms inhabit aquatic environments, an adequate assessment of toxicity necessarily requires a battery of assays that measure the response of a carefully selected group of biotic species representing the various trophic levels. Not all toxicity assays are equally sensitive or relevant to assessing discharges to natural waters.

Toxicity assessment can be an expensive and lengthy process. Considering this, techniques are needed for predicting the toxicity of organic chemicals from molecular structure. Some progress has already been made in this area and quantitative structure activity relationship (QSAR) models are being evaluated for predicting toxicity of untested pure chemicals towards certain fish species. Toxicological data on pure compounds are useful in certain applications but may not be satisfactory for setting discharge limits. This is because most effluents contain a mixture of chemicals and discharged chemicals do mix in the receiving environment. Because of synergistic and antagonistic toxicity effects, toxicity of mixtures is difficult to relate to toxicities of pure compounds even when using a given toxicity assay. Perhaps, therefore, the toxicity of whole effluent should be the basis for setting discharge guidelines for a particular effluent. Significant advances notwithstanding, much work is required in establishing methods for comprehensively assessing toxicity and environmental impact of mixed pollutants. However, inaction is not an option and the knowledge already available is sufficient to inform reasonable decisions on limiting discharges.

In addition to toxicity and the various existing physical measures of pollution load, at leas two other indices should be considered for comprehensively assessing environmental impact of chemicals. These indices are the environmental persistence and the ability to bioaccumulate. A consideration of persistence and bioaccumulation is important because persistent chemicals that seem innocuous in low dosages can quickly build up to concentrations that are severely damaging at some trophic level.

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