

Fiproles as a proxy for ecological risk assessment of mixture of fipronil and its degradates in effluent-dominated surface waters

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ABSTRACT

Environmental risk assessment of complex chemical mixtures has increasingly been prioritized as a management goal, especially in the regulatory sector. Although fipronil and its three degradates (- sulfone, -sulfide and -desulfinyl) have been frequently quantified in waterways, little information is available about the likelihood and magnitude of ecological risk posed by these chemical mixtures – collectively known as fiproles in surface water. In the present study, a probabilistic risk assessment of mixtures of fipronil and its three degradates was conducted for three effluent-dominated southern California rivers: Los Angeles River (LAR), San Gabriel River (SGR) and Santa Clara River (SCR), California, USA. The assessments, which used fiproles as an integrated proxy, were based on three levels of toxicity endpoints: median lethal concentration (LC50), half-maximal effective concentration (EC50), and lowest observed effect concentration (LOEC), to gain comprehensive assessment information. Probabilistic approaches based on species sensitivity distribution (SSD) and exposure concentration distribution (ECD) were developed with the log- logistic model by pooling the toxicity and occurrence data, respectively. The 5th percentile hazardous concentrations (HC5s) were calculated to be at low parts per billion levels, enabling these values to be used to estimate the chemical-specific benchmarks for components that lack ecotoxicity data. The single substance potentially affected fraction (ssPAF) of fiproles revealed risk levels for the three rivers in descending order: LAR ≥ SGR > SCR. The overall risk probability estimated from the joint probability curve (JPC) by Monte Carlo simulation was $1.13 \pm 0.20\%$ (LC50), $9.31 \pm 1.46\%$ (EC50), and $6.58 \pm 1.43\%$ (LOEC) for the three rivers collectively. These results derived from the fiproles indicates that fipronil and its degradates pose risks to the aquatic organisms in the surface water of the three rivers. The present study provides a methodology for the use of a proxy in the risk assessment of chemical mixtures.

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