

1C.O-Tu-2

Ecological Risk Assessment of PFOS Contamination in Surface Waters From Sulfluramid-Treated Watersheds in Brazil

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Abstract

The use of sulfluramid as an insecticide in Brazil poses environmental risks as it may convert into the persistent and toxic perfluorooctanesulfonic acid (PFOS), a chemical listed in Annex B of the Stockholm Convention that can accumulate in the environment and threaten human and wildlife populations. This study evaluated the ecological risk associated with the presence of PFOS in surface waters of watersheds with intensive use of sulfluramid ant bait. To assess the exposure levels, surface water samples were sampled monthly for a year (October 2020 to September 2021) from eight watersheds containing planted forests using ant baits. A stainless-steel collector was used for the sampling, and the samples were stored in polypropylene bottles, refrigerated, and sent to the laboratory within 48 hours. Water samples were concentrated by solid phase extraction (SPE) and subsequent analysis by UPLC-ESI-QqQ-MS/MS. To assess the impact of PFOS in surface waters, the risk quotient (RQ) approach was employed. RQs were calculated by dividing the measured environmental concentrations (MECs) by the Annual Average Environmental Quality Standard (AA-EQS) proposed by the European Union for PFOS (0.65 ng L⁻¹). For samples with PFOS concentration above the limit of detection (LOD) but below the limit of quantification (LOQ), the concentration was estimated using the equation $(LOQ + LOD)/2$. PFOS was detected in 85.3% of surface water samples, with the highest concentration observed in October 2020 and the lowest concentrations found between March 2021 to July 2021. The PF1 sampling point had the highest average concentration of PFOS at 8.2 ng L⁻¹. The PF6 point had the lowest mean concentration at 1.5 ng L⁻¹. In all the samples where PFOS was detected, risks to the preservation of aquatic life were observed. The samples collected in PF6 had the same RQ value (2.3) because the concentrations of PFOS were between LOD and LOQ. The highest RQs obtained were 77.8 (PF1), 20.5 (PF8), 19.2 (PF4), 18.9 (PF5), 18.5 (PF3), and 7.7 (PF2 and PF7). All the highest RQs were found in the samples collected in October 2020, except for sites PF6 (sample not analyzed in this campaign) and PF8 (highest RQ obtained in the sample collected in February 2021). All the lowest RQs found had a value of 2.3 because the concentrations of PFOS were between the LOD and the LOQ, except for the sampling site PF1, which had the lowest RQ of 3.4.