

Nonylphenol Ethoxylate Degradation in Detergents During Shelf Time, a New Exposure Pathway, and a Perspective on Their Substitution

Luis Armando Bernal-Jácome

Centro de Investigación y Estudios de Posgrado Edificio P. Facultad de Ingeniería, Zona Universitaria, Dr. Manuel Nava, San Luis Potosí, S.L.P, México

Juan Manuel Izar-Landeta

Instituto Tecnológico Superior de Rioverde, Carretera Rioverde-San Ciro Km 4.5, Rioverde, San Luis Potosí, México

Rogelio Flores-Ramírez

CONACYT Research Fellow, Coordinación Para La Innovación y Aplicación de La Ciencia y La Tecnología (CIACYT), Avenida Sierra Leona, Colonia Lomas Segunda Sección, San Luis Potosí, SLP, México

Luis Fernando González-Salazar

Centro de Investigación Aplicada en Ambiente y Salud, Avenida Sierra Leona, Colonia Lomas Segunda

Karla Ximena Vargas-Berrones

Instituto Tecnológico Superior de Rioverde, Carretera Rioverde-San Ciro Km 4.5, Rioverde, San Luis Potosí, México

Abstract:

Detergents are highly produced pollutants with environmental problems like foam generation and toxic effects in biota. Non-ylphenol ethoxylates (NPEs) are efficient, economical, and versatile surfactants, used in detergents for more than 40 years due to their detergency capacity. In the environment, NPE biodegrades into the metabolite nonylphenol (NP), classified as an endocrine disruptor. The identification and quantification of 4-NP in a designed detergent and 30 commercially available detergents were performed to prove the degradation of NPE into 4-NP during storage time. This investigation introduces the first evidence of NPE degradation during storage in commercially available detergents, demonstrating a novel exposure pathway in humans that has not been explored before, representing potential human health risks. Therefore, simple, easy, low-cost, and available approaches to remove and substitute NP is paramount. Alkyl polyglucoside (APG) was assessed as a substitute, and the feasibility of this substitution was proven according to physical and chemical properties, cleaning performance, and antimicrobial properties. NPE substitution in detergents is demonstrated as a viable strategy to minimize exposure risks in humans and the environment.

Keywords:

Nonylphenol ethoxylate · 4-nonylphenol · Endocrine disruptor · Dermal exposure · Alkyl polyglucoside · Sustainable detergent.