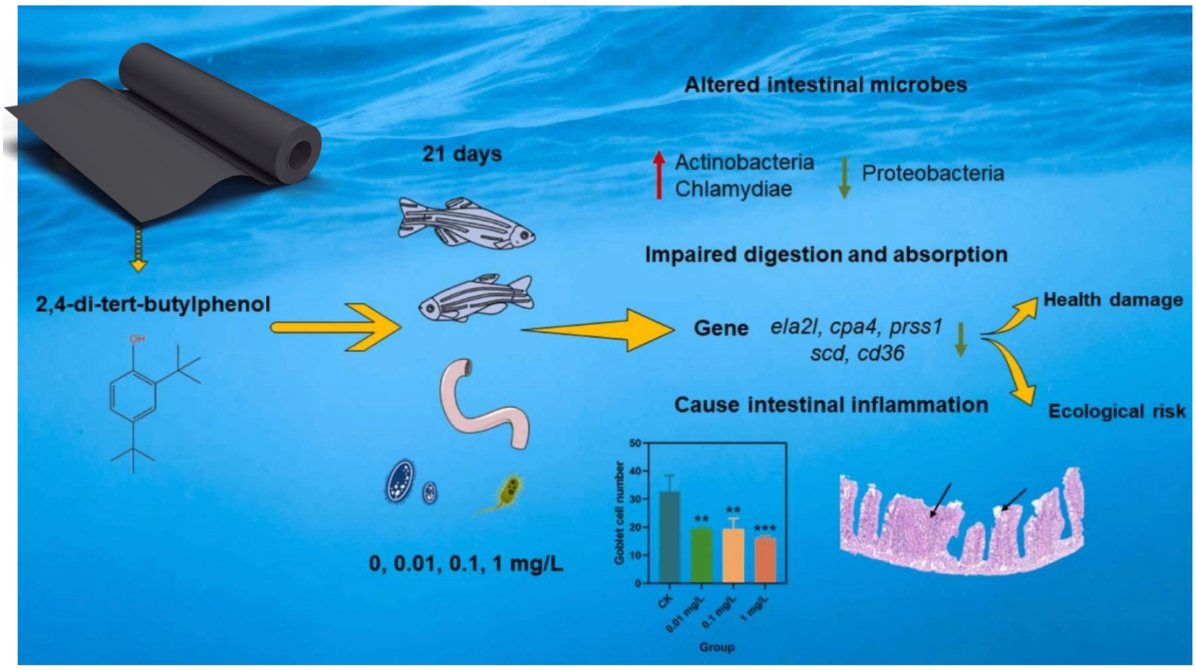
# Toxic “Arvin #4 Compound” Found in PE and PP Geomembranes Poses Threat to Fish

## Degradation By-products from a Common Phosphite Antioxidant in Geomembranes Threaten Fish

*By GNA Editor*

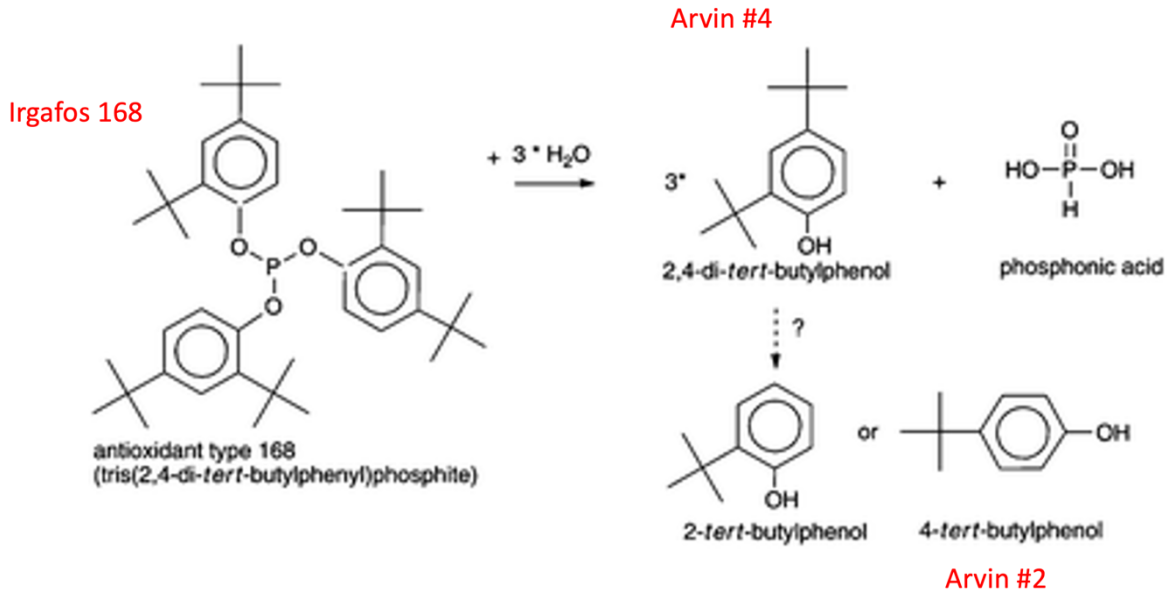



## Introduction

Geomembranes—plastic liners used to prevent seepage in landfills, dams, and water reservoirs—are meant to protect the environment. But recent research reveals a disturbing irony: these same materials may be quietly poisoning aquatic life.

At the centre of this concern is a chemical additive by-product known as 2,4-di-tert-butylphenol (2,4-DTBP) (Arvin #4), formed during the degradation of tris(2,4-di-tert-butylphenyl) phosphite—commonly known as Irgafos 168, a widely used secondary antioxidant in polyethylene (PE) and polypropylene (PP) geomembranes. When exposed to heat, UV radiation, or moisture, Irgafos 168 hydrolyzes into 2,4-DTBP—a compound now known to have genotoxic, cytotoxic, and potentially carcinogenic properties, especially in aquatic environments.

The reaction scheme below shows the Arvin substances formed from Irgafos 168 which is commonly used in all HDPE and PP geomembranes.




**From Liner to Lethal: How Plastics Poison the Water**

Recent studies have revealed that 2,4-DTBP can leach into water bodies at concentrations reaching 300 µg/L in surface water. This is not a trace presence—it is a toxic dose capable of harming aquatic ecosystems and the organisms that rely on them.

In zebrafish, a widely used indicator species for environmental toxicity, exposure to 2,4-DTBP triggered a cascade of biological dysfunction:

- Severe dysbiosis of intestinal microbiota, undermining immune and metabolic regulation.
- Inflammation and tissue disruption in the intestinal lining.
- Compromised digestive and nutrient absorption functions.

These findings were published in a 2024 peer-reviewed study titled *"Effects of the Plastic Additive By-product 2,4-di-tert-butylphenol on Intestinal Microbiota of Zebrafish"* (ScienceDirect Link).

**From Fish to Fetuses: A Threat to Humans**

The danger isn't confined to fish.

Another 2023 study demonstrates that 2,4-DTBP impairs osteogenic differentiation—the process by which stem cells become bone-forming

osteoblasts. Alarmingly, this chemical has been detected in human breast milk, cord blood, and placental tissue, suggesting in utero and neonatal exposure in humans.

As reported in *Toxicology and Applied Pharmacology*, developmental exposure to 2,4-DTBP could potentially affect skeletal formation and long-term bone health in children. (Study Link)

**Regulatory Red Flags**

The European Chemicals Agency (ECHA) has flagged 2,4-DTBP under its Community Rolling Action Plan (CoRAP) due to:

- Potential classification as a CMR substance (carcinogen, mutagen, reproductive toxin)
- Possible endocrine-disrupting effects
- High environmental persistence and bioaccumulation

Despite these red flags, its use in geomembranes—materials often deployed in environmentally sensitive water catchments, fish hatcheries, and irrigation dams—continues largely unchecked.

**The Silent Spill: A Regulatory Vacuum**

Manufacturers of geomembranes rarely disclose the exact composition of their stabilizer systems, and no requirement currently exists to test for 2,4-DTBP leaching in field-deployed liners. This regulatory blind spot allows potentially toxic materials to be used in close contact with drinking water supplies and aquatic habitats in aquaculture.

**A Call to Action**

We urgently need:

- Reformulation of geomembrane stabilizers using safer alternatives such as Vitamin E (α-tocopherol)—already used in biomedical PE implants.
- Transparency from manufacturers regarding additive systems.
- Mandatory testing for by-product leaching under UV and oxidative stress.
- Immediate regulatory oversight for products deployed in aquatic environments especially fish hatchling and rearing ponds.

## References and Further Reading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