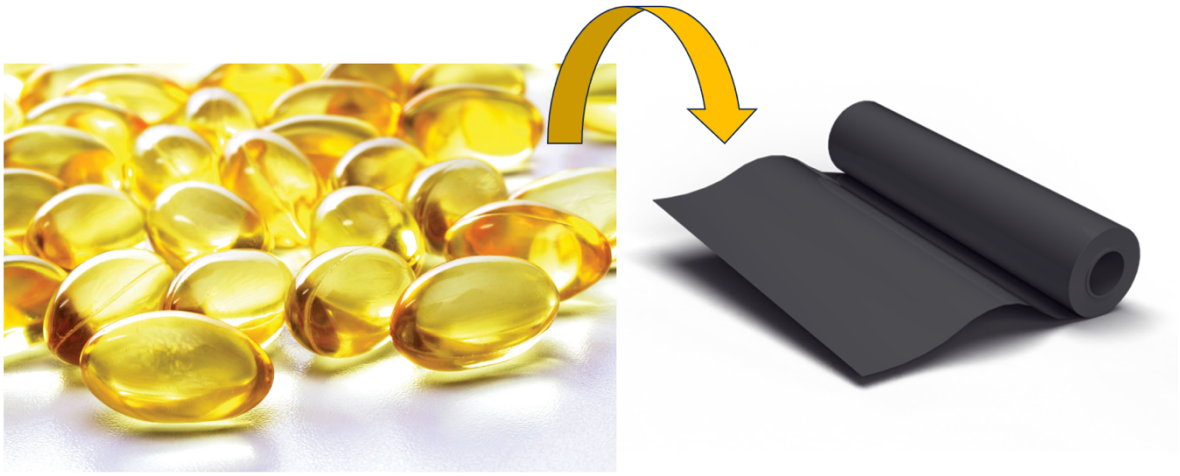
The Future of Safe Geomembranes: The Geomembrane Industry Needs to Take Its Vitamins

By GNA Editor



In the world of engineered barriers, geomembranes have long been the silent workhorses—trusted to protect water supplies, secure landfills, and line critical environmental containment systems. But emerging research reveals that these very liners may be quietly releasing toxic degradation compounds, now known in the scientific community as **Arvin substances** [https://cloud.excelplas.com/s/xRmK0AUVqb7wL7J#pdfviewer], named after Danish scientist Erik Arvin, who first identified these concerning by-products.

These degradation compounds, generated from the breakdown of traditional antioxidant additives used during processing and long-term service life, are not just chemical curiosities—they are cytotoxic, genotoxic, and potentially carcinogenic. Their presence raises red flags for drinking water safety, regulatory compliance, and ecosystem health, particularly in potable water reservoirs, fish hatcheries, and environmentally sensitive catchments where water quality cannot be compromised.

The Hidden Risk Inside Geomembranes

The culprits behind these toxic by-products are widely used phenolic antioxidants (like Irganox® 1010) and phosphite stabilizers (such as Irgafos® 168). These compounds, while effective in stabilizing polyethylene during manufacturing and long-term heat ageing, are prone to degradation—especially

under prolonged UV exposure, heat, and mechanical stress—leading to the release of harmful leachables into water bodies.

This isn't just theoretical. The medical industry learned this hard lesson decades ago. In hip replacement devices, polyethylene acetabular cups stabilized with conventional phenolic antioxidants were found to cause inflammatory responses due to similar breakdown products. The solution? A transition to Vitamin E (alpha-tocopherol) stabilization, with excellent biocompatibility and proven long-term safety.

If It's Good Enough for Your Hip, Why Not Your Geomembrane?

Vitamin E stabilization has been standard practice in medical-grade polyethylene for over 20 years. Now, this same technology is fully available to the geomembrane industry. BASF—the same company that produces Irganox® 1010 and Irgafos® 168—also offers Irganox® E 201, a commercial-grade Vitamin E antioxidant.

Key Advantages of Vitamin E (Irganox® E 201):

- Effective at 0.01% loading, offering equivalent melt flow control as 0.05% of Irganox® 1010
- Non-toxic, non-phenolic, and suitable for food contact and potable water applications
- Supported by decades of successful use in the medical device sector
- Positive consumer perception associated with the Vitamin E label

This approach is not hypothetical—it is ready for deployment today.

Beyond Vitamin E: The Vitamin C Option and Sulphur-Based Synergists

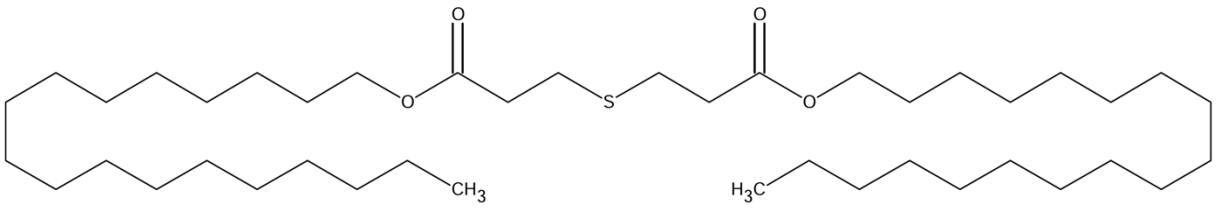
Another promising option is Ascorbyl Palmitate, a fat-soluble derivative of Vitamin C. It serves as an effective antioxidant for PE and PP systems where food safety and toxicity concerns are paramount.

For the phosphite replacement side, sulphur based antioxidant such as those found in garlic are highly effective. For example, Distearyl Thiodipropionate (DSTDP) offers a sulphur-based, phenol-free solution. Unlike phosphite stabilizers such as Irgafos 168 which degrades to toxic products, DSTDP degrades into:

- Stearic acid (a fatty acid found naturally in the human body)
- Thiodipropionic acid, and

- Mild sulphur-containing compounds similar to those found in garlic—not toxic phosphates or phenols.

The chemical structure of DSTDP is shown below and note the absence of harmful aromatic (i.e. benzene) rings.



DSTDP is commercially available as:

- Irganox™ PS802 (BASF)
- Cyanox™ TDP (Cytec)
- Lowinox STDP (Chemtura)

The Call to Action: Transitioning Toward Safe Stabilization

The evidence is clear: the future of safe geomembranes depends on moving beyond legacy phenolic and phosphite stabilizers. If the industry wishes to silence the growing concerns around toxic antioxidant degradation products, the solution is not a distant dream—it is a choice we can make today.

Switching to food-safe, vitamin-based antioxidants like Vitamin E and Vitamin C derivatives—along with sulphur-based synergists like DSTDP—offers a scientifically sound, commercially available pathway to safer geomembranes. It aligns with consumer expectations, environmental responsibility, and regulatory demands.

The question is no longer can the industry do this?

It is why haven’t we done this already?

It’s time the geomembrane industry took its vitamins.

References and Further Reading

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