



GaiaSoil Safety & Quality FAQ

GaiaSoil™ is an ultra-lightweight engineered soil primarily composed of recycled expanded or extruded polystyrene (Styrofoam). We created GaiaSoil to convert a pernicious waste product into something that regenerates cities, rather than polluting the environment.

Is styrofoam recyclable?

Yes, but it's complicated. Over 2.3 million tons of styrofoam enters landfills each year, and less than 1% of it is recycled, according to Rick Perez, founder of Avangard Innovative, a large scale waste and recycling optimization company. Because styrofoam is so lightweight, that's as much volume as 62 Empire State Buildings. Challenges with recycling styrofoam have to do with its bulkiness, sorting challenges, and end-market options. When styrofoam does get recycled, it is typically melted down and densified into blocks that are reprocessed into other products, such as picture frames. As a result most styrofoam ends up in the waste stream, either in landfill or polluting our waterways. In either case it's there for a long time.

GaiaSoil is the only way to repurpose styrofoam at scale and turn it into something that regenerates the environment, instead of harming it.

Does GaiaSoil generate microplastics?

No. In recent years, there has been extensive research into the presence of microplastics within the environment. Microplastics are generated in two ways: UV degradation of plastic material and physical erosion forces¹. When styrofoam enters the waste stream, it often ends up in waterways where it floats on top of surface waters and gets exposed to UV radiation from sunlight. As it travels alongside other waste materials, physical erosion takes place as well. These microplastic particles do enter water bodies.

In GaiaSoil, **both microplastic-generating mechanisms are absent**. GaiaSoil is not exposed to UV radiation because it is used as a soil medium on green roofs and other green infrastructure. As a result, GaiaSoil is buried under a dense layer of compost and vegetation. GaiaSoil does not move or get disturbed after it is installed and planted, so physical degradation does not occur either. Finally, GaiaSoil rooftops are self-contained, so there is typically no outflow of water except during the heaviest rainfall events. By installing a GaiaSoil green roof, you are actually intercepting styrofoam before it has a chance to enter the waste stream, and reducing the amount of microplastics that end up in the environment.

Do GaiaSoil particles break down into styrene?

No. While styrofoam is considered chemically inert and stable, under certain very specific conditions, styrofoam can break down into styrene precursor, a colorless oily liquid that can be harmful to human health. Those conditions are not found in GaiaSoil.

First, let's talk about what causes styrofoam to break down into styrene:

- Organic Solvents (such as acetone), chlorinated solvents, and aromatic hydrocarbon solvents
- Very high temperatures (430° C or higher) via pyrolysis



Neither of the above breakdown mechanisms are present in GaiaSoil. In fact, styrene is rapidly biodegradable under both aerobic and anaerobic soil and aquifer environments due to the presence of styrene-catabolic activities in many microorganisms^{2,3}. In simple terms, this means that in the off chance you spill a bottle of nail polish remover unto your GaiaSoil green roof, or your barbeque grill tips over unto the roof, the beneficial microbes naturally present in the GaiaSoil will break down the small amount of styrene produced in a matter of days.

Can plants take up microplastics/styrene?

Absolutely not. Plants can only take up substances that are dissolved in water. For example, when you apply solid fertilizer to plants, it requires the presence of water to release the nitrogen, phosphorus and potassium ions found in the fertilizer.

Microplastics are solid plastic particles below 5 mm in diameter. Because they are always solid and not soluble, plants cannot uptake microplastics. Styrene is a liquid; however it is a hydrocarbon that is not soluble in water. At worst, if you are growing root vegetables in GaiaSoil, there is a chance that some larger, easily visible styrofoam particles will cling to the vegetable as you pull it out - simply shake the particles off and you're good to go.

What happens to GaiaSoil after the service life of the roof?

It gets reused again! Leaf Island's green roofs carry a 30-year warranty. Well, that's actually the warranty of the polyurea spray-on waterproof membrane under the roof. The GaiaSoil and plants growing on top of it will last far longer - remember, styrofoam is stable except under very specific conditions not present in GaiaSoil. So what happens if in 35 years, the membrane breaks down and it's no longer waterproof? If the membrane can't be repaired as a spot fix, then the roof has to come off and the membrane needs to be reapplied.

Removing a GaiaSoil green roof is actually much easier than it sounds, and does not require disposal of the GaiaSoil. After several growing seasons, the plant roots become so developed that they actually make the entire GaiaSoil layer function as one continuous root network. In order to remove the roof, all you need to do is cut the green roof into sections and lift them away, much like scooping brownies off a baking sheet. At this point, the membrane may be reapplied before placing the planted GaiaSoil sections back into place, or we may just buy them from you so they can be moved to another location. Mature, pre-planted green roof sections are very valuable and we wouldn't mind having them.

References

1. **Potential Toxicity of Polystyrene Microplastic Particles**, Hwang, J., et.al, 2020
2. **Microbial Metabolism and Biotransformations of Styrene**, Warhurst, A.M. & Fewson, C.A, 1994. Department of Biochemistry, University of Glasgow
3. **Microbial Styrene Degradation: From Basics to Biotechnology**, Tischler, D. & Kaschabek, S. Environmental Science and Engineering book series