Problems with Polystyrene Foam Products and Foodware

Polystyrene foam is extruded, blown or expanded polystyrene (EPS) pellets which are expanded 40 to 50 times into beads. It is often used for packaging, such as loose-fill packaging "peanuts," or polystyrene blocks, and foodware.

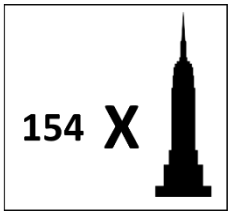
Polystyrene foam is a contaminant at our recycling facilities and paper mills

- **Most local governments do not collect polystyrene foam at** curbside because of significant problems of foam products and pieces contaminating the other materials in the sorting process at the material recovery facilities (MRFs).[1]
- **In recent study, 1 out of 3 paper mills** expressed explicit concerns about polystyrene foam. Contamination by polystyrene foam leads to a decrease in bale yields.[2]

Foam causes litter in communities and harms our wildlife

- **Polystyrene foam easily blows around** and breaks up, scattering tiny pieces.
- Polystyrene foam **may persist in the environment for centuries until it fully breaks down**, depending on environmental conditions and level of exposure.[3]
- **Foam is one of the most common items found in beach cleanups** Per Surfrider's 2019 beach cleanup report, foam fragments are the third most-common item found littering beaches.[4]
- **Physical impacts on wildlife.** Polystyrene foam is one of the most commonly found plastic items on beaches and inland waters,[5] often breaks down into smaller pieces and is easily ingested by wildlife. As Douglas McCauley, a marine biology professor at the University of California, has said: "Oftentimes, we find polystyrene foam lodged in the intestines that causes blockages that can be lethal. If you think about how we worry about a mild blockage from eating the wrong thing, imagine eating a ball of Styrofoam. That's what some of these animals are doing."[6]

- **Polystyrene foam is found in gut contents of marine wildlife**, both invertebrates and vertebrates.[7]
- **Leachate from polystyrene foam** has been found to be toxic to aquatic invertebrates.[8]
- **Exposure to polystyrene microplastics** have been found to reduce reproduction in oysters.[9]
- **It doesn't matter to wildlife or the environment** if that foam cup or container littering the beach or in the ocean includes post-consumer recycled content.



Polystyrene foam products are a large volume at our landfills

Polystyrene foam products take up volume. Because polystyrene foam is so lightweight, it appears to be a small load to the landfill by weight but it more than makes up for that in volume. For example, in Washington State, 3,559 tons were disposed in 2017,[10] which is about 162 million cubic meters[11] and equates to ~154 Empire State Buildings in volume per year.

Banning polystyrene foam foodware is popular with voters

The public widely supports a Styrofoam ban. A new survey of bipartisan voters in Washington state, Colorado, Florida and Maine found that 76% want to see more legislation to reduce plastic pollution. Nearly 60% of people surveyed say they support a statewide ban on foam takeout containers, while just 26% say they oppose it.[12]

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[1] Commissioner Kathryn Garcia. 2017. Determination on Recyclability of Food-Service Foam. NYC Department of Sanitation. (www.paperenterprisesusa.com/assets/File/Foam%20Ban%20Information.pdf)
[2] Davis et al., 2019. ASTRX Review of Material Flow at MRFs and Reprocessors. ASTRX Applying Systems Thinking to Recycling, Sustainable Packaging Coalition, and The Recycling Partnership. (https://astrx.org/wp-content/uploads/2019/06/ASTRX-Review-of-Material-Flow-at-MRFs-and-Reprocessors.pdf)
[3] Ward et al. 2019. Sunlight Converts Polystyrene to Carbon Dioxide and Dissolved Organic Carbon. American Chemical Society. (https://pubs.acs.org/doi/10.1021/acs.estlett.9b00532)
[4] Jennifer Hart. 2020. Surfrider's 2019 Beach Cleanup Report. Surfrider Foundation. (www.surfrider.org/coastal-blog/entry/surfriders-2019-beach-cleanup-report)
[5] Belhouari et al., 2017. *International Coastal Cleanup Report.* Ocean Conservancy. (https://oceanconservancy.org/blog/2017/06/05/results-international-coastal-cleanup/)
[6] *Why New York banned polystyrene foam.* 2015. BBC News. (www.bbc.com/news/magazine-33334994)
[7] Boerger et al., 2010. Plastic ingestion by planktivorous fishes in the North Pacific Central Gyre. Marine Pollution Bulletin. (www.sciencedirect.com/science/article/abs/pii/S002532610003814). Schuyler et al., 2014. Global analysis of anthropogenic debris ingestion by sea turtles. Conservation Biology. (https://conbio.onlinelibrary.wiley.com/doi/10.1111/cobi.12126). Jang et al., 2016. Widespread detection of a brominated flame retardant, hexabromocyclododecane, in expanded polystyrene marine debris and microplastics from South Korea and the Asia-Pacific coastal region. Environmental Pollution. (www.sciencedirect.com/science/article/abs/pii/S0269749117316494?via%3Dihub)
[8] Taysen et al., 2018. Leachate from Expanded Polystyrene Cups in Toxic Aquatic Invertebrates. Frontiers in Marine Science. (https://www.frontiersin.org/articles/10.3389/fmars.2018.00071/full)
[9] Sussarellu et al., 2016. Oyster reproduction is affected by exposure to polystyrene microplastics. PNAS. (https://www.pnas.org/content/113/9/2430)
[10] State of Washington Department of Ecology. 2016. Waste Characterization Study. (https://apps.ecology.wa.gov/publications/documents/1607032.pdf)
[11] The densities of molded polystyrenes and reference information (www.aqua-calc.com/phpbb/viewtopic.php?t=282)
[12] Brett Nadrich. 2021. New Survey Shows Broad Public Support for Reducing Plastic Pollution, Improving Recycling, and Holding Manufacturers Responsible. Break Free from Plastic. (www.breakfreefromplastic.org/2021/01/26/new-survey-shows-broad-public-support-for-reducing-plastic-pollution/)

Styrene can cause cancer

- **California** recognized styrene as a carcinogen in 2016.[13]
- **National Toxicology Program** (NTP) listed styrene in 2011 as "reasonably anticipated to be a human carcinogen".[14]
- **National Academy of Sciences** independently reviewed the 2011 NTP report. Their resulting 2014 report found "compelling evidence exists to support a listing of styrene as, at a minimum, 'reasonably anticipated to be a human carcinogen'."[15]
- **International Agency for Research on Cancer** (IARC), which is part of the World Health Organization, listed both styrene and styrene-6,8-oxide (CAS 96-09-3) as "probably carcinogenic to humans" in 2018.[16]

Toxic chemicals in polystyrene foam can migrate into food

- **Residual styrene monomer is present in low levels in polystyrene foam foodware and can leach into food products.** While styrene does occur naturally in some fruits and vegetables,[17] many toxic organic chemicals occur in nature[18] and this does not justify deliberately increasing our exposure through foodware products.
- **The *European Food Safety Authority*** recently concluded in a 2020 assessment on the safety of styrene for use in plastic food contact materials that a concern for genotoxicity from oral exposure "cannot be excluded."[19]
- **Benzene** is also used to make polystyrene foam and can also migrate into food at low levels. Benzene is a known carcinogen.[20]
- **Polycyclic aromatic hydrocarbons (PAHs)** are found in polystyrene foam and can migrate into food. Some PAHs are known or probable carcinogens.[21]

IARC says safety of styrene in food packaging is not assured

"Taking the human exposure data into account, the Panel concluded that a systematic review of genotoxicity and mechanistic data, comparative toxicokinetics and analysis of species differences is required for assessing the safety of styrene for its use in food contact material."

Styrene production and polystyrene manufacturing can impact worker health

- **Occupational studies have found increased risks for cancers** such as leukemia and lymphoma, and genetic damage in the white blood cells of workers exposed to styrene. There is also some evidence for increased risk of cancer in the pancreas or esophagus.[22]
- **Worker exposure to styrene** has been linked to heart disease, vision changes, hearing impairment, and symptoms of neurotoxicity.[23]
- **The Centers for Disease Control and Prevention** has found that "Workers exposed to large amounts of styrene can develop irritation of the eyes and breathing passages. With long-term and large exposures, workers using styrene have had injury to their nervous systems."[24]
- **Expanded polystyrene is a derived from benzene, a known carcinogen** according to the International Agency for Research on Cancer (IARC), the National Toxicology Program (NTP), and the Environmental Protection Agency.[25]
- **Highly flammable pentane** is often used as the "blowing agent" to expand styrene pellets into foam beads. Health effects due to pentane inhalation include dizziness, passing out, lung irritation (and potentially pulmonary edema), and nervous system damage. Chronic exposure to pentanes may cause chemical pneumonitis, pulmonary oedema or peripheral neuropathy.[26]

Burning polystyrene is both toxic and common

- **Incinerating polystyrene for energy (850-900˚C) can release emissions** containing more than 90 different compounds, including polycyclic aromatic hydrocarbons (PAHs), which may cause birth defects.[27]
- **Polystyrene can produce polycyclic aromatic hydrocarbons** (PAHs), as well as carcinogenic styrene monomers and deadly carbon monoxide when burned at lower temperatures typical of a campfire or a household fireplace.[28]
- **Polystyrene foam should not be burned,** but in Washington some people burn their trash, even though it is prohibited.

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[13] California Office of Environmental Health Hazard Assessment. 2016. (https://oehha.ca.gov/proposition-65/chemicals/styrene)
[14] National Toxicology Program. 2016. The Report on Carcinogens. U.S. Department of Health and Human Services. (https://ntp.niehs.nih.gov/ntp/roc/content/profiles/styrene.pdf)
[15] Committee to Review the Styrene Assessment in the National Toxicology Program 12th Report on Carcinogens; Board on Environmental Studies and Toxicology; Division on Earth and Life Studies; National Research Council. 2014. Review of the Styrene Assessment in the National Toxicology Program 12th Report on Carcinogens: Workshop Summary. National Academies Press (US). (https://pubmed.ncbi.nlm.nih.gov/25232634/)
[16] IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. 2019. Styrene, Styrene-7,8-Oxide, and Quinoline. International Agency for Research on Cancer, World Health Organization. (https://publications.iarc.fr/582)
[17] Tang W, H. I. 2000. Estimation of human exposure to styrene and ethylbenzene. Toxicology, 39-50 (https://pubmed.ncbi.nlm.nih.gov/10781869/)
[18] Dolan et al., 2010. Naturally Occurring Food Toxins. *Toxins* 2010. (www.ncbi.nlm.nih.gov/pmc/articles/PMC3153292)
[19] EFSA Panel on Food Contact Materials et al., 2020. Assessment of the impact of IARC Monograph Vol. 121 on the safety of the substance styrene (FCM No 193) for its use in plastic food contact materials. European Food Safety Authority Journal. (https://www.efsa.europa.eu/en/efsajournal/pub/6247)
[20] Jickells et al., 2009. Headspace analysis of benzene in food contact materials and its migration into foods from plastics cookware. Food Additives & Contaminants, 7:2. (www.tandfonline.com/doi/abs/10.1080/02652039009373884)
[21] Li et al., 2017. PAHs in polystyrene food contact materials: An unintended consequence. Science of The Total Environment. (www.sciencedirect.com/science/article/abs/pii/S0048969717319812)
[22] National Institute of Environmental Health Sciences. 2018. Styrene. (www.niehs.nih.gov/health/topics/agents/styrene/index.cfm#:~:text=Human%20Studies%3A%20The%20limited%20evidence,of%20workers%20exposed%20to%20styrene.)
[23] Capella et al., 2019. Ethylbenzene and styrene exposure in the United States based on urinary mandelic acid and phenylglyoxylic acid: NHANES 2005–2006 and 2011–2012. Environmental Research. (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6382531/)
[24] Centers for Disease Control and Prevention. 2017. Styrene. (https://www.cdc.gov/biomonitoring/Styrene_FactSheet.html)
[25] American Cancer Society. 2016. Benzene and Cancer Risk. (www.cancer.org/cancer/cancer-causes/benzene.html#:~:text=IARC%20classifies%20benzene%20as%20%E2%80%9Ccarcinogenic,%2C%20and%20non%2DHodgkin%20lymphoma)
[26] Chemwatch. 2008. Pentane. (https://datasheets.scbt.com/sc-250672.pdf)
[27] Hawley-Fedder et al., 1984. Products obtained during combustion of polymers under simulated incinerator conditions : II. Polystyrene. Journal of Chromatography A. (www.sciencedirect.com/science/article/abs/pii/S002196730190737X?via%3Dihub)
[28] Elomaa and Saharinen. 1991. Polycyclic aromatic hydrocarbons (PAHs) in soot produced by combustion of polystyrene, polypropylene, and wood. Journal of Applied Polymer Science. (https://onlinelibrary.wiley.com/doi/abs/10.1002/app.1991.070421020)