

BREAKING DOWN OCEAN POLYSTYRENE

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THE PROBLEM

Polystyrene is a type of plastic that is often foamed (expanded or extruded) to create rigid, lightweight materials. Foamed polystyrene¹ is among the most commonly recorded components of marine litter², frequently found broken up along shorelines and floating at sea.

Cheap to produce, easy to mould, impact resistant, waterproof, a good insulator, and buoyant, foamed polystyrene is extremely versatile and useful in a range of applications such as packaging and insulation³. These properties also mean it is frequently used in and near the ocean for fish boxes, buoys, floats, pontoons, vessel insulation, and support blocks for boats³.

Unfortunately, these properties also make it vulnerable to a variety of potential problems when used in coastal or marine settings. Foamed polystyrene is easily fragmented and carried off by wind and waves, it becomes brittle when exposed to UV rays in sunlight, and is burrowed into by marine invertebrates that can cause it to break apart. Buoys can be lost at sea, fish boxes blown away, and polystyrene pontoons are vulnerable to being broken up or lost during bad weather, as happened in 2018 at Holyhead, Wales (see box on p.2)⁴.

As well as this accidental loss, foamed polystyrene may also be intentionally discarded at sea or on the coast. For example, damaged buoys and fishing nets with foamed polystyrene floats may be thrown off boats, and unwanted fish boxes, boat support blocks or bodyboards abandoned on the shoreline.

Once in the ocean, foamed polystyrene can rapidly fragment into microplastic pollution that persists for decades, if not centuries, presenting a risk to marine life. When ingested, foamed polystyrene can cause a range of problems such as digestive obstructions, a false sense of fullness that can lead to starvation, and reduced fertility.

Already inherently toxic, it is often treated with additional chemicals like flame retardants, and adsorbs pollutants from the sea around it, increasing the chemical threat it poses to wildlife the longer it is adrift.

Given the risk of direct pollution from the use of foamed polystyrene in the marine environment, Fauna & Flora International undertook initial scoping to explore how foamed polystyrene is used in marine contexts (with a focus on the UK), how and why it becomes pollution, and what further actions could be taken to tackle this threat to ocean life.



MARINE USES OF POLYSTYRENE

In the UK, the highest turnover of foamed polystyrene for marine uses appears to be for fish boxes. These are mainly used for transport and storage of fish and shellfish, while high density polyethylene (HDPE) containers are more commonly used on board vessels in Europe. Foamed polystyrene fish boxes are widely used around the world, as the example from Hong Kong shows (see box on p.3).

Foamed polystyrene is also commonly used for pontoons, buoys, and floats. In the UK, pontoons and large buoys are increasingly covered in hard plastic, but smaller uncovered foamed polystyrene buoys and net floats are still used in fishing and aquaculture. Uncovered buoys and floats are commonly used in other regions of the world, and in certain locations are known to contribute significantly to marine pollution:

- **Chile:** At-sea surveys showed a high degree of foamed polystyrene pollution in the north, where the majority of Chile's mussel and salmon aquaculture operations are based⁵.
- **Japan:** Foamed polystyrene accounted for 99.5% of marine litter found along the shores of Hiroshima bay, with stranded floats and buoys recorded at 58 different sites⁶.
- **South Korea:** A 2015 study identified commercial fisheries and aquaculture as the main source of marine litter nationwide, with uncovered foamed polystyrene buoys the most abundant type of beach litter recorded⁷.
- **Vietnam:** A survey in Cat Ba Archipelago found that approximately 54,582 foamed polystyrene floats are in use by floating aquaculture farms at any one time⁸.

DISPOSAL OF POLYSTYRENE

Data suggest that a large proportion of waste foamed polystyrene in Europe is incinerated, as it releases a lot of energy when burned. Although 54% of foamed polystyrene packaging is reportedly recycled in the UK⁹, this figure will include chemical recycling (a catch-all term that is sometimes used to include plastic converted to fuel or energy), and data on the recycling of other foamed polystyrene products – including those used in coastal and marine settings – could not be found. One estimate puts the percentage of fish boxes in Europe that end up in landfill at 45-50%, though there are reports of a significant proportion of fish boxes in some countries (e.g. the Netherlands) being recycled. Further information on these figures and how they are determined would be useful.

Among the barriers to recycling are foamed polystyrene's bulky nature and frequent contamination during use in marine settings (e.g. with fish residues and fluids, or as a result of biofouling by algae and sea life).

Additionally, waste reception facilities at some ports and harbours are limited and there may be a charge for their use, which may encourage the illegal dumping of waste at sea or littering on the coast. There is little incentive not to do this, as foamed polystyrene is relatively cheap, meaning items are not always valued and can be regarded as disposable. The relative cost also makes it hard for marine users to justify investing in reusable or more durable alternatives.

HOLYHEAD MARINA

In March 2018, Holyhead marina in Wales was devastated by the effects of Storm Emma, which left nearby beaches choked with 30 tonnes of foamed polystyrene debris from broken up pontoons.

Following an extensive clean-up operation, plans have been drawn up to build a permanent sea wall to defend the new marina from future storms (expected to increase in frequency with the changing climate), and thus reduce the loss of debris from the marina to the coast and open ocean.



INITIATIVES TO ADDRESS POLYSTYRENE POLLUTION FROM MARINE SOURCES

The intergovernmental Baltic Marine Environment Protection Commission (HELCOM) and the OceanWise initiative in the North Atlantic are both exploring the issue of marine foamed polystyrene pollution and potential solutions.

Alternatives to foamed polystyrene are being trialled for some applications, particularly for fish boxes. For example, reusable polypropylene bins are being trialled by an aquaculture business in Scotland, and laminated cardboard fish boxes are available or being explored by several producers. Recyclability, reusability, potential to pollute and thermal efficiency remain important factors to bear in mind when considering such alternatives.

Though the release of any kind of plastic waste into the sea from maritime sources is prohibited under the International Maritime Organisation's MARPOL Convention, these rules are difficult to enforce due to fisheries and maritime activities being dispersed across vast seascapes.

In certain locations, there are local laws preventing the use of exposed foamed polystyrene for pontoons or buoys, such as in a city in Texas, USA, where ordinances prohibit any kind of foamed polystyrene to be used on or near the San Marcos River, and hard plastic coverings are required on all buoys and pontoons. No such regulation appears to exist in the UK.

Credit: Ting Cheng/Flickr



OYSTER FARMING IN TAIWAN

Oyster farms in Taiwan traditionally use thousands of foamed polystyrene rafts and buoys, which are regularly discarded at sea or damaged and swept away in rough weather, and are among the most pervasive types of pollution recorded there.

To combat this problem, the Taiwanese government has banned oyster aquaculture during the typhoon season, prohibited the use of uncovered buoys, and established a deposit return scheme with financial incentives to return damaged buoys to collection points. Though fishers are concerned about the viability and cost of alternatives, it is hoped these legislative steps will prove effective¹⁰.

FISH BOXES IN HONG KONG

In Hong Kong, foamed plastic is estimated to make up around 21% of marine refuse¹¹. Broken up and damaged fish boxes are a common component of marine litter, and are regularly found washed up on beaches throughout the territory's islands, particularly after typhoons.

Though the government has yet to take any legislative action, Hong Kong's main fishing port, Aberdeen harbour, has trialled alternative fish box materials, and has installed a compressor machine in the fish market to shred and compress used polystyrene foam to be sent for recycling as part of a pilot scheme¹².



Credit: Amkahnin Sharp



CONCLUSIONS & RECOMMENDATIONS

From this initial research, it is clear that marine use of foamed polystyrene in aquaculture, fisheries, marinas and the leisure industry presents a considerable pollution risk. Building on this work, we propose the following recommendations for action:

- Promote the use of appropriate durable, weather-resistant materials for floats, buoys and pontoons, including protective coverings.
- Improve the care of marine items made from or containing foamed polystyrene to protect them from wear, storm damage and accidental loss, for example through guidelines or training for users.
- Provide affordable recycling/disposal facilities at ports and harbours to encourage responsible disposal of foamed polystyrene items used at or near the sea.
- Explore and evaluate the use of alternative, less environmentally damaging, materials for fish boxes; a full life-cycle analysis, including potential to pollute, is needed for any alternatives proposed.
- Increase the reuse and end-of-life recycling of fish boxes (made of foamed polystyrene or alternative materials), for example through Deposit Return or Extended Producer Responsibility schemes, if appropriate.
- Increase awareness and share information amongst users and other stakeholders about the impacts of foamed polystyrene pollution, measures to reduce it and relevant regulations, to encourage engagement in addressing the problem and support for solutions.
- Include information on ocean plastic pollution in existing free environmental safety courses for fishers.
- Develop a widespread foamed polystyrene recycling industry to encourage more responsible disposal.
- Evaluate the full life-cycle cost of foamed polystyrene use to increase awareness of the damage it presents when in the environment, and to ensure this is better built into future costings and decision making.
- Research the possibility of incorporating efforts to detect and tackle discarding of foamed polystyrene at sea into initiatives to address other ocean threats (e.g. illegal fishing).
- Advocate for the development of clear, time-bound next steps towards practical trials and implementation of the potential interventions identified by intergovernmental and multi-stakeholder processes on foamed polystyrene, such as the HELCOM and OceanWise initiatives.

For further information and additional context, see our [full report](#), or contact:

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