

2021 M/V *X-Press Pearl* maritime accident:

Recommendations to prepare for and respond to marine spills of plastic cargo



Figure 1. Unlike previous nurdle spills, which only spilled unaltered white nurdles, the M/V *X-Press Pearl* fire created, at least, four additional forms of plastic: orange nurdles, gray nurdles, burnt plastic, and combustion remnants.

Fire and oil turned a simple spill into a complex, unprecedented crisis

On May 20, 2021, the cargo ship M/V *X-Press Pearl* caught fire while anchored off the coast of Sri Lanka, near the capital city of Colombo. The ship was carrying 1486 containers, of which 1214 held an assortment of raw materials, hazardous chemicals, and finished products. Included among the cargo were 69 containers of polyethylene plastic preproduction pellets or “nurdles” and 72 containers of lubricating oil. During the fire, an oil sheen was observed near the ship, which was determined to be heavy fuel oil. Nurdles were seen bobbing within the sheen.

Within five days of the fire, white nurdles reached the Sri Lankan shore, along with irregularly shaped, different-colored pieces of burnt plastic both smaller and larger than the white nurdles (Fig. 1). Current estimates suggest ~1680 metric tons of nurdles were spilled, along with burnt plastic pieces making this the largest plastic spill on record.

The decision by responders to preemptively treat any recovered material as hazardous was prudent. From subsequent chemical analyses, the levels of concerning chemicals associated with the spilled plastic warrants more detailed efforts. **An in-depth study is needed to determine the threat of the already collected waste and remaining debris to marine and human health.**

Freely available reports and publications on the spill:

United Nations Environment Programme. [X-Press Pearl Maritime Disaster Sri Lanka. 2021.](#)

de Vos, A., Aluwihare, L., DiBenedetto, M. H., Ward, C. P., Youngs, S., Michel, A. P. M., Colson, B. C., Mazzotta, M. G., Walsh, A. N., Nelson, R. K., Reddy, C. M., James, B. D. [The M/V X-Press Pearl Nurdle Spill: Contamination of Burnt Plastic and Unburnt Nurdles along Sri Lanka's Beaches.](#) ACS Environmental Au. 2022, 2, 2, 128–135.

Rubasinghe, C., Brosché, S., Withanage, H., Pathragoda, D., Karlsson, T. [X-Press Pearl, a 'new kind of oil spill' consisting of a toxic mix of plastics and invisible chemicals.](#) International Pollutants Elimination Network (IPEN). 2022.

Sewwandi, M., Hettithanthri, O., Egodage, S. M., Amarathunga, A. A. D., Vithanage, M. [Unprecedented marine microplastic contamination from the X-Press Pearl container vessel disaster.](#) Science of the Total Environment. 2022, 828, 154374.

Prepared by:

Asha de Vos (Oceanswell), Bryan James, Michael Mazzotta, Anna Michel, Christopher Reddy, Anna Walsh, Collin Ward, Mark Hahn, and Sarah Youngs (Woods Hole Oceanographic Institution), Lihini Aluwihare (Scripps Institution of Oceanography), and Gopal Bera, Terry Wade, and Anthony Knapp (Texas A&M University, Geochemical and Environmental Research Group).

Supported by the following funders of Woods Hole Oceanographic Institution:

WHOI Marine Microplastics Catalyst Program, WHOI Marine Microplastics Innovation Accelerator Program, March Limited, The Seaver Institute, Gerstner Philanthropies, Wallace Research Foundation, Richard Saltonstall Charitable Foundation, the Harrison Foundation, the Richard Grand Foundation, and others.

Contact: Asha de Vos, asha@oceanswell.org and Christopher Reddy, creddy@whoi.edu

Disclaimer: Please note that these data are preliminary or provisional and are subject to revision. They are being provided to meet the need for timely best science, and therefore, they are provided without guarantee or warranty (express or implied). These data have not necessarily received validation, quality assurance, quality control, or approval by WHOI or a WHOI staff member, and are provided on the condition that WHOI shall not be held liable for any damages resulting from any use of the data. This document and data were created to inform officials and responders directly involved in the M/V *X-Press Pearl* disaster, and neither the document nor the underlying data may be publicly released without prior express written permission.

Samples collected by team member, Dr. Asha de Vos from the Sri Lankan marine conservation research and education organization [Oceanswell](#) on May 25, 2021, have provided an opportunity for physical and chemical inspection and recommendations for further study and consideration (**Table 1**).

Table 1. Differences between previous nurdle spills and the M/V X-Press Pearl spill, implications of those differences, and recommendations for managing them.

Considerations	Nurdle spills from the past decade ¹	Sri Lanka spill (M/V X-Press Pearl)	Implications for Sri Lanka	Recommendations for Sri Lanka
Type of Plastic	Polyethylene (PE) or polypropylene (PP)	PE and other plastics	These types of plastic can persist in the environment for years to decades.	Stow containers below deck and reinforce the packaging used for nurdles to prevent future spills.
Physical Properties				
Color	White	White, Orange, Gray, Black	Heat from the M/V X-Press Pearl fire altered the color of plastic, resulting in orange nurdles. Burning resulted in colors ranging from gray to black. These changes may affect visual properties key to monitoring and clean-up and may also encourage ingestion by wildlife.	Produce a full accounting of the nurdle cargo carried by the M/V X-Press Pearl. Establish a consistent set of protocols for monitoring, sample collection, proper chains-of-custody, storage, nomenclature, and archiving.
Shape	Regular (unaltered)	Irregular	Melting and/or burning of the plastics changed their shape, which is known to affect how individual pieces move in the ocean. Shape may also affect monitoring, clean-up, short- and long- term fate, and both the rate and extent of natural breakdown.	
Size	Uniform (~3 mm)	Variable (<mm to >cm)	Smaller plastic pieces can go undetected and may pose greater risk to humans and wildlife if left in the environment. The brittleness of the burnt plastic may facilitate its fragmentation.	
Chemicals of Concern				
Combustion		PAHs ²	The spilled plastic accumulated elevated levels of chemicals of concern for human health and the environment (e.g., total PAH content ranged from 2600 ng/g for white nurdles, to 150000 ng/g for combustion remnants). The concentration of PAHs in the nurdles and burnt plastic make them some of the most PAH-contaminated plastic found in the ocean.	Establish a monitoring program to evaluate these chemicals of concern and those yet identified that are associated with the spilled plastic. Develop physical, chemical, and biological methods to identify the extent of changes occurring after an event, and the potential impacts to humans, wildlife and the environment.
Oil		PAHs ²		
Synthetic		BPA ³ UV-stabilizers ⁴		
Metals ⁵		Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, Sb, Sn, Ti, V, Zn		
Waste Designation	Solid municipal waste or recyclable	Hazardous waste	The plastic recovered in Sri Lanka was rightly treated as hazardous waste from the start. Because of this, special protocols for the handling, transport, and disposal of the material were employed. For context, the volume of material spilled and cleaned from beaches is equivalent to at least 1/3 of the organic solid hazardous waste generated by Sri Lankan heavy industry annually.	Reevaluate the hazardous waste designation for the spilled plastic in accordance with Sri Lankan regulations and international standards (e.g., Basel Convention) for hazardous waste determination. As per the Basel Convention, is it too hazardous to recycle? Is it too hazardous to be transported out of the country? Develop protocols for citizens and authorities to safely handle and dispose of the material cleaned from beaches. Utilize best practices for mitigating secondary plastic pollution during handling, transport and disposal of collected material.

¹Previous container related nurdle spills include the Hong Kong spill of 150 tons (2012), the South African spills of 47 tons (2017) and 175 tons (2020), the North Sea spill of 13 tons (2020), and the New Orleans, Louisiana spill of 25 tons (2020).

²PAHs or **polycyclic aromatic hydrocarbons** are a class of organic molecules typically found in petroleum and smoke that are known **carcinogens**.

³BPA or bisphenol A is a component of many epoxy resins. 349 containers onboard the M/V X-Press Pearl were listed to contain epoxy resin. BPA is acutely **toxic to aquatic organisms** and is an **endocrine disruptor**.

⁴UV stabilizers are common additives used in plastic to prevent degradation by sunlight and have been shown to **bioaccumulate in marine organisms**.

⁵Heavy metals (e.g., lead) can exert **negative impacts on human health** and **associate with plastic in the environment**.