FACT SHEET - JUNE 23, 2021

WOODS HOLE OCEANOGRAPHIC INSTITUTION

2021 M/V X-PRESS PEARL nurdle spill

Beached nurdles span a continuum of physical and chemical properties

Fig. 1: Samples collected on May 25, 2021, by Dr. Asha de Vos at Pamunungama Beach, Sri Lanka. (Photo: Dr. Asha de Vos, Oceanswell).

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. News reports indicated that the cargo on board included 78 metric tons of nurdles, the pre-production plastic material used to manufacture a wide range of end products. The event released upwards of ~25 million spherical pieces of plastic. Additional reports suggest that the type of plastic washing up on beaches is both **polyethylene** and **polypropylene**. The **ship's manifest** the cargo included polyethylene (32 containers), polypropylene (2 containers), polyvinyl chloride film (1 container), polycarbonate (2 containers), polyester yarn (1 container), synthetic polybutadiene rubber (2 containers), expandable polymeric beads (1 container), synthetic resins (8 containers), and epoxy resins (349 containers).

Within five days, translucent and apparently pristine nurdles reached the Sri Lankan shore along with irregularly shaped, dark pieces both smaller and larger than the pristine nurdles (Fig. 1). Presumably, these altered pieces resulted from melting and burning of the pristine nurdles or other plastic items released during the ship fire. While nurdle spills have **occurred in the past**, the burnt plastic adds an unknown challenge for clean-up and damage assessment of this spill, one that demands greater analysis of the material spilled into the ocean and currently washing ashore. Samples collected by Dr. Asha de Vos from the Sri Lankan marine conservation research and education organization **Oceanswell** on May 25, 2021, provided an opportunity for a preliminary physical and chemical inspection and recommendations for further study and consideration.

Additional information on the M/V *X-Press Pearl* incident is **available here**.

Key takeaways from preliminary analyses of nurdles collected from Pamunugama Beach on May 25, 2021.

1. All of the nurdles tested floated in seawater (density less than ~1 g/cm^3).
2. At least two different types of pristine nurdles were released, as verified by differences in density, appearance, and chemical features, but all were approximately the same size, ~4 mm (Fig. 2, left). These nurdles broadly fit into two categories: those with densities of ~0.93 g/cm^3 and those with greater density, but less than ~1 g/cm^3 (Fig. 3). While density is often used to identify different types of plastics, the effects of burning and/or melting or other factors related to this event may affect this approach. Nevertheless, the density of low-density polyethylene, high-density polyethylene, and polypropylene typically range from 0.85 to 0.92, 0.89 to 0.93, and 0.94 to 0.97 g/cm^3, respectively. Other plastics reported on the manifest, such as polyvinyl chloride film and polycarbonate, have densities known to be greater than 1 g/cm^3.
3. Under a microscope (10x magnification), pristine nurdles vary in shape, with many appearing to have undergone partial melting.
4. The burnt plastic samples seem to have originated from the two different types of pristine plastics (Fig.3).

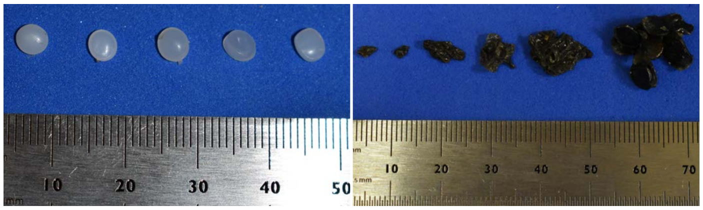

Fig. 2: Comparison of pristine (possibly partially melted) nurdles (left) and burnt nurdles (right). (Photos: Dr. Michael Mazzotta, WHOI)

Why does this matter?

COLOR	Burning of the plastics darkened their color. This may affect visual recognition for monitoring and clean-up and also encourage ingestion by wildlife. Field images suggest the change in color camouflages the burnt plastic among seaweed, posing further challenges to clean up efforts.
SHAPE	Melting and/or burning of the plastics changed their shape, which is known to affect how different pieces move in the ocean (e.g., spheres and disks move differently in fluids). Shape may also affect monitoring, clean-up, short- and long- term fate, and both the rate and extent of natural breakdown.
SIZE	Burning of the plastics resulted in pieces that are smaller and larger than the raw nurdles (Fig. 2, right). Typically smaller plastics can go undetected and may pose greater risk to humans and wildlife.

This recent review addresses how these factors affect the behavior and impacts of plastics in the ocean.

Recommendations

1. Establish a consistent set of protocols for monitoring, sample collection, proper chains-of-custody, storage, nomenclature, and archiving.
2. Develop physical, chemical, and biological methods to identify the plastic type, extent of changes occurring during and after the event, and the potential impacts to wildlife and humans. Specifically, the burning of plastics can create a wide range of products including known carcinogens such as benzo[*a*]pyrene.
3. Analyze additional field samples to determine whether results of this preliminary study are more widespread.
4. Determine whether the diverse types of materials found (variations in density, appearance, and chemical features) demand a modification of the ongoing clean-up and potential impacts to wildlife and human health.
5. Account for the cargo initially on the M/V *X-Press Pearl* with the amount remaining, lost to burning, found and removed from the beaches.
6. Take advantage of a recently published paper as a baseline for plastics released to the ocean from Sri Lanka.
7. If necessary, conduct laboratory studies to recreate the processes that led to the diversity of density, appearance, and chemical features observed in samples.
8. Create a working group of local, national, and international experts to provide advice on ongoing clean-up and remediation efforts and to create opportunities for scientific exchange.

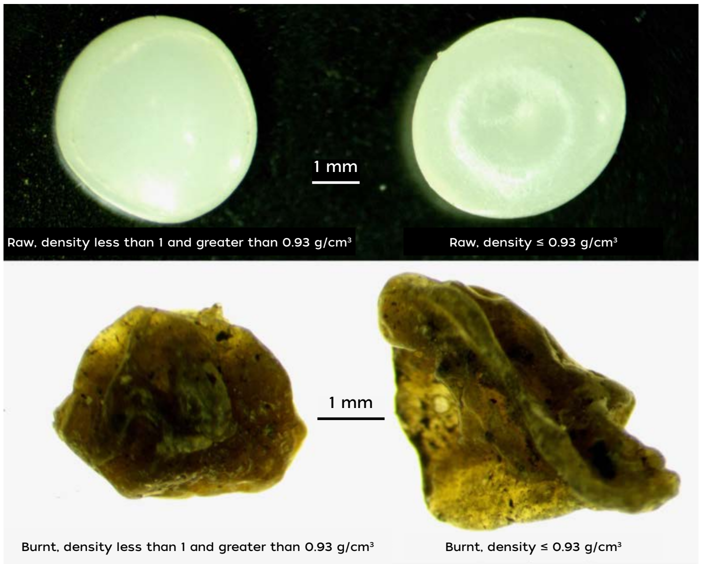

Fig. 3: Example pieces of collected plastic separating into four broad categories based on appearance and density. Top panel (left) pristine nurdle with density greater than ~0.93 and less than ~1g/cm³. Top panel (right) pristine nurdle with density ~0.93 g/cm³. Lower panel (left) burnt nurdle with density greater than ~0.93 and less than ~1g/cm³. Lower panel (right) burnt nurdle with density ~0.93 g/cm³. (Photos: Sarah Youngs, WHOI)

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