Paint – a key source of microplastics to the environment: *An introduction to the fate, effects, and mitigation strategies*

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Introduction

It is estimated 12.7 million metric tons (MT) of plastic enter the environment as microplastics every year, the main sources being paint, tyres, pellets, textiles and personal care products. There are also substantial additional quantities from the fragmentation of larger items of plastic that have already entered the environment as debris. This document focuses on paint, which is estimated to be one of the largest sources of microplastics to the environment, accounting for annual releases of around 4.68 MT [1].

On average, paint contains 37% polymers, such as polyacrylic and poly(meth(acrylates)), epoxy resins and polyurethanes, which are dissolved in organic solvents to produce oil-based paints or are dispersed in water as hydrophobic particles (approximately 1000 nm in size) to produce aqueous paints[2]. In addition to polymers, a variety of additives may be incorporated to facilitate application and other requirements; including colour additives, binders, antifouling agents, anti-corrosion materials, algaecides, bactericides and other chemicals to improve adhesion, reduce biofouling, and to strengthen the paint after drying [3].

Release of paint to the environment occurs during application, wear and as a consequence of maintenance/removal (Figure 1). For example, droplets are released during painting, especially if the paint is applied as a spray [4]. Flakes or dust are released from the degradation of paint on buildings, ships [5] and fixed structures such as piers and oil rigs, offshore/onshore wind installations or during scraping/blast cleaning of old paint from boats or buildings [6,7]. Washing of brushes and rollers can also introduce microplastics into wastewater, while some of these may be captured in wastewater treatment, others will be released with treated discharges. In addition, microplastics captured may be spread onto farmland in locations where biosolids are applied as a nutrient enrichment media [8]. Paint particles can also enter the aquatic environment directly via road runoff, e.g. from road markings.

Impacts

Paint additives can include toxic substances. For example, antifouling paint is intentionally manufactured to prohibit the growth of organisms, and antifouling paint particles can leach metals and biocides into surrounding sediments [9], while organotin compounds can harm gastropods[10] and human health [11]. Organotins have been linked to endocrine disruption causing the feminisation of gastropods (termed imposex) [12]. Following the regulation of organotin compounds in antifouling paints by UN Member states, a decrease in the prevalence of imposex in gastropods was noted [13,14].

Potential interventions

Paints and associated microplastics are lost at all stages of their life cycle: from production to disposal. Regulatory efforts should be guided by the release mechanisms and fate processes of microplastics resulting from paint leakage.

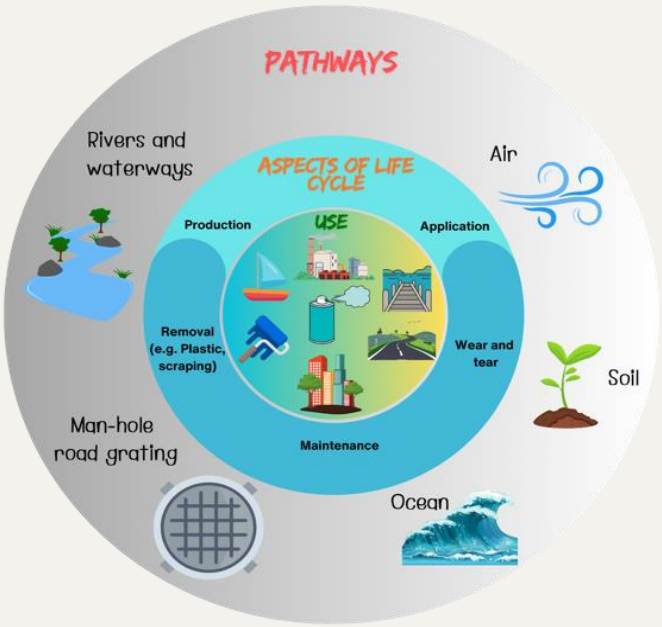

Figure 1. Schematic illustrating the sources of paint microplastic emission, modes of generation throughout their life cycle, along with environments which can receive and disperse paint microplastics.

Regulatory interventions, similar to those implemented by the International Anti-fouling Systems (ASF) Convention in 2008 prohibiting the use of organotin compounds in antifouling paints [15], could be considered.
The EU proposed the development of guidelines to minimise the release of microplastics from paint (applications related to painting), internationally harmonised guidelines, and labelling on sustainability requirements, including microplastic release [16]. Further interventions include:

- Innovation to improve the wear resistance of paint.
- Improving the method of application to minimise releases.
- Using methods to minimise the escape of dust during the removal; e.g. using mechanical or vacuum collection and collecting paint particles that fall to the ground;
- Reducing the amount of paint used; use of equipment that ensures the optimum amount of paint is applied which limits overapplication.
- Preventing the washing of brushes and rollers in the sink. Instead, collect the washed paint and dispose of it in an environmentally friendly manner.

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