



## Short Communication

## Time to kick the butt of the most common litter item in the world: Ban cigarette filters



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## HIGHLIGHTS

- Cigarette filters are the most abundant litter item found in the environment globally.
- Cigarette filters offer no human health benefits yet are a major source of plastic (cellulose acetate) pollution.
- Cigarette filters contain contaminants adding to planetary burden of chemicals and pose ecological risks.
- Cigarette filters should be considered hazardous waste.
- Cellulose acetate cigarette filters should be banned.

## GRAPHICAL ABSTRACT



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## ABSTRACT

Cigarette filters offer no public health benefits, are single-use plastics (cellulose acetate) and are routinely littered. Filters account for a significant proportion of plastic litter worldwide, requiring considerable public funds to remove, and are a source of microplastics. Used cigarette filters can leech toxic chemicals and pose an ecological risk to both terrestrial and aquatic ecosystems. Bottom-up measures, such as focusing on consumer behaviour, are ineffective and we need to impose top-down solutions (i.e., bans) if we are to reduce the prevalence of this number one litter item. Banning filters offers numerous ecological, socioeconomic, and public health benefits.

### 1. The rise of single-use plastic cigarette filters

The rise of single-use plastic cigarette filters began in the 1950s. As the health hazards associated with smoking became better understood, the tobacco industry developed filters to make what they called “safer” cigarettes (Harris, 2011). Filter use rose rapidly from just 1 % of the global cigarette

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market in 1950 to >90 % by the 2000's. Filters are, however, problematic, for example, filters splintered, causing smokers to inhale plastic fibers (Harris, 2011; Song et al., 2017). Indeed, subsequent research has confirmed that filters never made smoking safer, but instead imposed additional health hazards (Harris, 2011; Song et al., 2017; Evans-Reeves et al., 2022). Despite these issues, the majority (>90 %) of cigarettes today are sold with a single-use plastic filter composed of a collection of cellulose acetate fibers and various additives.

## 2. Most common litter item and a source of microplastic pollution

Over the last three decades, used cigarette filters (a.k.a. “butts”) rank among the top litter items collected through urban and coastal clean-ups with an estimated 4.5 trillion entering the environment each year. Observational studies report at least 65 % of smokers litter used cigarette filters exceeding the littering rate of other single-use items (Schultz et al., 2013; Webler and Jakubowski, 2022). This is likely due to a misconception that cigarette butts are made from a material other than plastic and are biodegradable (Webler and Jakubowski, 2022). Used filters, however, may take over a decade to decompose (Joly and Coulis, 2018) and are a major contributor of microplastic contamination (Belzagui et al., 2021). Each cigarette filter contains approximately 15,000 microplastic fibers and can shed these at a rate of around 100 microplastic fibers per day into water (Belzagui et al., 2021). Globally, considering all the littered cigarette butts, this amounts to an estimated 0.3 million tons of microfibers released per year, similar to estimated microfiber emissions from domestic laundry (0.28 million tons) (Belzagui et al., 2021). There is now ample evidence that microplastics pose a threat to ecosystems (UNEP, 2021) and, unsurprisingly, microfibers from cigarette filters can also have toxic effects on organisms (Belzagui et al., 2021; Nitschke et al., 2022).

## 3. A toxic chemical threat to ecosystems

Even unsmoked cellulose acetate filters can be toxic to some invertebrates and plants (Green et al., 2022), but after smoking cigarette filters pose an increased chemical threat to organisms. Cigarettes contain over 7000 toxic chemicals and some of these are readily leached into aquatic habitats (Green et al., 2014; Akhbarizadeh et al., 2021). Leachate from a single butt can contaminate 1000 L water with concentrations of nicotine above the EU predicted no effect concentration of only  $2.4 \times 10^{-3}$  mg L<sup>-1</sup>, thus qualifying as hazardous waste according to EU thresholds (Green et al., 2014). Since 2006, over 35 studies have examined the toxicity of cigarette butts in biota from aquatic and terrestrial habitats and a range of lethal and sublethal impacts have been documented (Green et al., 2022). Despite gaps in knowledge, there is evidence that cigarette butts can be lethal for a range of aquatic organisms, including microorganisms (Micevska et al., 2006), invertebrates (Green et al., 2020), and fish (Slaughter et al., 2011). They can also alter key biological processes such as growth (Parker and Rayburn, 2017), reproduction (Lima et al., 2021) and feeding rates (Green et al., 2021) and even alter the structure and composition of microbial communities in marine sediment (Quéméneur et al., 2020). On land, littered cigarette butts can contaminate crops with nicotine, and reduce growth and alter productivity of common plants (Green et al., 2019).

## 4. Economic and societal costs of littered cigarette filters

According to the World Health Organization, cleaning up smoking-related litter, including butts incurs significant annual costs to taxpayers, estimated at ~\$2.6 billion for China, >\$760 million for India, >\$200 million for Brazil, >\$230 million for Germany. The real costs are likely even higher due to lost revenue in terms of declining visitors of very polluted areas or potentially due to lowered ecosystem services. Recent policy development has seen the implementation of the extended producer responsibility (EPR) in European nations such as Denmark. This measure is intended to make the industry pay for the pollution, as a way of enforcing the polluter pay principle (Diggle and Walker, 2020). However, while this measure has

some merit it is far from sufficient to prevent the pollution. This measure addresses the pollution from an end-of-life perspective, even though it is well established that measures before products turn into waste are more efficient. This is indeed the idea behind the “waste hierarchy”, which is meant to guide measures in a preferred order (European Union, 2008). According to the waste hierarchy, preventing production of waste is the most favorable option.

## 5. Necessary action and conclusion

We stand at a crossroads where the quantity of plastics and other “novel entities” exceeds planetary boundaries and threatens the stability of Earth systems. Cigarette filters are a “low-hanging fruit”, a hazardous, expendable product with no significant benefit to society. Efforts to change smokers' littering behaviour, clean up or recycle used filters are costly and ineffective. Cigarette filters are a marketing tool, not a protective health device (Harris, 2011; Song et al., 2017), that pose both health and ecological concerns; thus, restricting them benefits both public and environmental health. Restrictions on filters have been proposed before, but the necessity for policy intervention is now more urgent than ever. If society relies on soft measures such as the current suggested implementation of EPR, where producers should pay for clean-up activities, it is unlikely that any substantial changes can be achieved. Loizidou et al. (2018) demonstrated that cigarette butts are often left after beach clean-up activities due to their small size, illustrating the insufficiency of this measure for mitigation. We therefore propose an outright ban on cigarette filters, a relatively minor institutional change that would reduce pollution and minimize an all-too-common form of single-use plastic debris containing multiple toxic chemicals. Banning plastic filters would facilitate the transition towards more sustainable consumption, and as such, aligns with the principles of Earth stewardship as well as the broad international mandate to develop a UN Treaty to end plastic pollution.

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## CRediT authorship contribution statement

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## Data availability

No data was used for the research described in the article.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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