

# Distribution of Coastal Cigarette Butts

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Litter on beaches is one of the most difficult problems in coastal management and every year, much efforts and public money are invested to try to alleviate and solve the problem. Cigarette butts (CB) are among the most widespread abandoned personal items in the world. In Spain, they are found on all types of beaches, where they are discarded by beach users; however, rivers and streams can also deposit CB on shores.

Keywords: beach ; cleaning efforts ; marine litter ; plastic pollution ; smokers ; tobacco product waste

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## 1. Introduction

Litter is typically observed on almost all beaches and oceans around the world since it is able to reach most isolated areas of the planet, such as deep environments <sup>[1]</sup>, e.g., the Mariana Trench <sup>[2]</sup>, or extremely remote sites such as Antarctica <sup>[3]</sup> <sup>[4]</sup>. Coastal systems receive litter from land-based sources (e.g., through rivers and sewerage systems) and from sea-based sources (e.g., fishing boats and infrastructures at sea) <sup>[5]</sup>. The presence of litter is also the result of intentional actions, e.g., when it is abandoned directly onto the beach by users such as beachgoers and fishers, among others <sup>[6]</sup>. Marine litter and associated contaminants have accumulated and transferred to biota in coastal areas, the open sea and the water column over several decades <sup>[7]</sup>.

Within beach litter, cigarette butts (CB) constitute one of the most abundant items. The presence of this type of personal waste has been very well documented in different beaches around the world <sup>[8]</sup><sup>[9]</sup><sup>[10]</sup><sup>[11]</sup><sup>[12]</sup><sup>[13]</sup>, including Spain <sup>[14]</sup><sup>[15]</sup><sup>[16]</sup>. Their presence on the coast can be used as an indicator of beach management efficiency <sup>[17]</sup>, environmental consciousness <sup>[18]</sup> and beach pollution linked to beachgoers <sup>[19]</sup>. In addition, the presence of CB has an aesthetic impact on beaches that can affect the “Sun, Sea and Sand” (3S) tourism <sup>[20]</sup>. Smoking is an activity that produces waste that comprises a large number of different materials: for example, from only one packet of cigarettes, various types of items are dumped on the beach: at least, 20 cigarettes filters made of cellulose acetate and tobacco, a cardboard cigarette packet, two pieces of inner foil packaging and, finally, two pieces of outer plastic packaging made of polypropylene (PP), all of which are very commonly found on beaches in Southern Spain <sup>[21]</sup>.

Cigarette butts contain four main components: a filter, burned and unburned tobacco, ashes and paper. There are over 5000 compounds present in cigarettes, among these, at least 150 (of which 44 are found in large amounts) are considered to be highly toxic <sup>[22]</sup>. When burned, many of the chemicals present in cigarettes produce new compounds <sup>[23]</sup> <sup>[24]</sup>. These compounds can contaminate the soil after leaching by rainwater and are superficially transported to aquatic environments where they can be detected <sup>[22]</sup>.

Toxicity due to the presence of CB in aquatic environments has been demonstrated by numerous investigations including different marine species from unicellular organisms such as foraminifera <sup>[25]</sup> to larger ones such as invertebrates and fish <sup>[26]</sup>. Environmental groups have expressed concerns for marine creatures that ingest littered filters <sup>[27]</sup>. A laboratory study by Micevska et al. (2006) found that CB were found to be acutely toxic to a freshwater cladoceran organism and a marine bacterium and that the main cause of toxicity was attributed to nicotine and ethylphenol in their leachates <sup>[28]</sup>. Filter fibres are treated with titanium dioxide and packed using triacetin (glycerol triacetate). Most cigarette filters are surrounded by two layers of paper and/or rayon wrapping, which contain chemicals, such as glues to hold the paper together, and alkali metal salts of organic acids in order to maintain burning while the cigarette is being smoked <sup>[22]</sup>. Slaughter et al. (2011) showed that the toxicity of cigarette butt leachate increased from unsmoked cigarette filters (no tobacco) to smoked cigarette filters (no tobacco) to smoked CB (smoked filter + tobacco) <sup>[22]</sup>. They confirmed the toxicity of CB to fish and some other representative marine organisms such as daphnids and marine bacteria. Moreover, other studies have also shown that heavy metals and chemicals in cigarette butt leachate may be acutely toxic to marine species <sup>[29]</sup>.

The occurrence of different metals in cigarettes is mainly attributed to the cultivation and growth of tobacco [30]. Insecticide, herbicides and pesticide application may also introduce metals to the tobacco leaf [31]. Further introduction of metals may occur during cigarette manufacture [32][33] or during the application of brightening agents on the wrapping paper [34]. The response of biota to the metals is extremely different according to the tolerance of each specie to the amount and type of metals present [35]. Furthermore, pesticides, which potentially remain in unsmoked cigarettes, may contribute to the toxicity of cigarette leachate. Ethylphenol is commonly used in the tobacco industry as a tobacco flavouring agent and is present in cigarette smoke [36]. Ethylphenol is bioaccumulated in aquatic organisms. Chemical additives are often introduced to make tobacco products more attractive to consumers. For example, sugars and humectants make smoke milder and easier to inhale, humectants can prolong shelf life, ammonia may enhance the delivery of nicotine and menthol and eugenol effectively numb the throat [37]. Approximately 600 additives were in use by major American cigarette companies in 1994 [38].

Cigarettes discarded onto beaches can be ingested by children, domestic animals and wildlife, causing severe health risks [39]. Nicotine in tobacco products is rapidly absorbed by oral and intestinal mucosa and nicotine-related symptoms develop rapidly (<4 hours) after ingestion. Symptoms include nausea, vomiting, salivation, convulsions, bradycardia with hypotension, cardiac arrhythmias and respiratory depression [40]. Reports of accidental ingestion of butts are not uncommon among children, especially those <6 years old [41]. In young children, 1–2 mg may be toxic, causing nausea and vomiting in low doses, and more extensive neurological symptoms with higher doses [42]. CB ingestion in wildlife (for example, marine turtles or sea birds) is rare but CB ingestion in pets is frequent. In dogs, this ingestion can cause excessive salivation, excitement, tremors, vomiting, lack of coordination and weakness (signs have been reported at doses as low as 1 mg/kg) [43]. The quantification of filters in coastal environments as well as the role of aging on filter toxicity merits further research. Enhanced public awareness about the toxicity of discarded CB in marine and coastal areas may help to decrease their environmental hazards. Research concerning the impacts of smoked cigarette filters on marine life is crucial for consolidating a remedial policy [44].

## 2. Conclusions

Each beach is unique and their management is the responsibility of local municipalities and administrations. It is advisable to manage each beach in the most appropriate way, taking into consideration the determinant factors (e.g., tourism seasonality, beach typology, accessibility, type of sediment, etc.) that most influence the abundance of beach litter. Almost all studies conducted on beach litter have shown that the dominant material is plastic, with CB often being the most common item. In addition, their abundance is often underestimated because CB are often buried in coastal sediments or rapidly washed away by waves and currents. According to this, beach clean-ups should be carried out with special attention at the beach landward limit (usually coinciding with a seawall, a promenade, dunes, etc.) on both tidal and micro-tidal beaches. On tidal coasts (e.g., the Cádiz coast), special attention should be devoted to the high tide line. Proper cleaning operations according to the characteristics of a beach are essential to reduce the number of CB items, but are not enough to solve the problem. Authorities have to emphasise anti-pollution campaigns to educate the general public and, particularly, beachgoers.

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