



Center for Tobacco
and the Environment

SDSU

New Study Shows Cigarette Butt Waste Is a Significant Source of Chemical Pollution in Waterways

Cigarette butts are the most commonly littered item worldwide, but their harmful impact does not end once they are thrown away. When cigarette filters are discarded into streets, beaches, and waterways, chemicals can leach from the filters and enter the environment, contributing to water pollution. As these chemicals enter water supplies, they have the potential to affect and aquatic ecosystems and water quality.

A recent study published in *American Chemical Society Environmental Science & Technology Water* provides a new insight into how cigarette filters contribute to aquatic pollution.

The study was conducted by a team of researchers at San Diego State University. The project was originally conceived by Dr. Eunha Hoh, Professor of Environmental Health at the School of Public Health, and was led by master's student Sarah Poletti under the supervision of Dr. Natalie Mladenov, Professor and William E. Leonhard, Jr. Chair in the Department of Civil, Construction, and Environmental Engineering. Dr. Mladenov is also the Director of the Water Innovation and Reuse Lab, where her research focuses on understanding the fate, transport, and treatment of pollutants in natural and engineered water systems.

The study found that cellulose acetate plastic, the filter material, contributed relatively little to the chemical pollutants caused by the filter. Instead, chemical residues from smoking and from substances added during filter production played a much larger role in what was released into water. plastics and are released into aquatic ecosystems.

The goal of this study was to better understand what types and amounts of pollutants are released from cigarette filters when they come into contact with water. Although previous research has shown that cigarette butts can leach chemicals into aquatic environments, most studies have examined whole cigarette butts containing tobacco, paper, and filters together. As a result, it has been difficult to determine which parts of the cigarette butt contribute most to the pollution.

To address this gap, researchers focused exclusively on cigarette filters. They compared three different sources: cellulose acetate filter material alone, unused cigarette filters, and smoked cigarette filters, to determine how much each contributed to the release of pollutants into water. This approach allowed the researchers to distinguish pollution originating from the filter material itself, additives during manufacturing, and chemical residues that accumulate in the filter during smoking.

To learn more about the study, we invited Dr. Mladenov to sit down with us for an interview.

What made this study different, Dr. Mladenov explained, was that researchers not only isolated the different filter components but also tracked what was released over time. To the research team's knowledge, no previous study has monitored how pollutants leach from cigarette filters over time or used fluorescence spectroscopy to characterize the compounds released from filters.

Researchers analyzed what was released from cigarette filters over time by measuring dissolved organic carbon and nitrogen, two indicators of chemical pollution. They also used fluorescence spectroscopy, a rapid analytical technique that allowed researchers to track how quickly organic compounds leached from the filters while providing a fluorescence "fingerprint" of the compounds released into water.

The researchers found that many carbon-containing compounds were released almost immediately after the filters came into contact with water, while nitrogen continued to leach over time. Smoked cigarette filters release significantly more organic carbon and nitrogen compared with unused filters and cellulose acetate material alone, suggesting that residues left behind during smoking continue to be released after discarded filters come into contact with water.

One of the study's most surprising findings was that cellulose acetate itself contributed relatively little to the pollutants measured. Instead, additives used during filter manufacturing, along with chemical residues from smoking, appeared to play a much larger role in what was released into water.

"The material itself, cellulose acetate, didn't leach much at all." It doesn't produce much organic carbon. It really is the filter, once it becomes a filter with the binding agents and adhesives and everything, that is leaching out a lot of organic carbon," Dr. Mladenov explained.

The researchers also wanted to understand what happens to these compounds after they enter the environment. Because discarded butts are often exposed to sunlight before reaching streams, rivers, or other waterways, the team investigated how sunlight affected the chemicals released from the filters.

"We exposed the leachates to sunlight because when compounds are traveling downstream or in a waterway like a creek or river, they will be exposed to sunlight," Dr. Mladenov said. "Sunlight usually degrades or transforms compounds, and this is what we found, that the exposure to sunlight did have an impact, not so much in unsmoked filters, but more in smoked filters."

Although sunlight reduced the fluorescence signal of many compounds, researchers found little change in the amount of organic carbon present. This suggests that the chemicals were not disappearing but instead transforming into different compounds. More research is needed to understand what these transformation products are and whether they pose different environmental risks.

These findings add to growing evidence that cigarette butt waste is an environmental pollution issue, not simply a litter problem. When discarded into the environment, cigarette filters can become an immediate source of chemical pollution when they enter waterways.

"I do hope that it gets on people's radar that cigarette butts should not be littered in the environment, that they are [an immediate] source of water pollution," Dr. Mladenov said. "By

the time that they are already littered, it is going to be too late, and a lot of these pollutants will have leaked into the environment – pollutants that wouldn't be there otherwise.”

Dr. Mladenov hopes these findings encourage greater awareness about tobacco product waste and support efforts to reduce cigarette litter. Preventing cigarette butts from entering the environment could help reduce a preventable source of pollution before these chemicals have the opportunity to reach aquatic ecosystems.

“Ultimately, I hope that these findings become another reason to limit tobacco products, and that will benefit the youth especially. I hope this maybe puts an end to the improper disposal of cigarettes, so it doesn't transfer into pollution in aquatic environments.”

You can read Dr. Mladenov's article published in *ACS ES&T Water* [here](#).