

A SYSTEMATIC CRITICAL REVIEW CONCERNING THE PRESENCE OF PFAS IN WASTE AND RELATED IMPLICATIONS ON THE CURRENT AND PROPOSED EUROPEAN REGULATORY FRAMEWORK

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Since the early 2000s, Per- and polyfluoroalkyl substances (PFAS) have attracted much attention due to the emergence in the public dominion of their hazards, ubiquitous occurrence, and persistence. This is due to their widespread use in modern society, from personal care products and cosmetics to water and stain repellent textiles, from food-contact materials to medical supplies. Nowadays, a multitude of compounds can be listed within the PFAS definitions (N≈14.735), but only a limited set of them (PFOS, PFOA, PFHxS, C9-C14 PFCAs) is regulated by EU laws (N≈679) (USEPA, 2022, Gaines et al., 2023) and even less can currently be detected by target analysis (N≈40).

In addition to their presence in products and articles, regulations focused on the fate of PFASs also in the waste sector. This is crucial to control the impacts related with the entire material life cycle, including disposal, recycling, and use as secondary raw materials. In fact, PFASs can be difficult to remove completely from waste and can then be transferred to recycled materials.

Figure 2 shows a comprehensive overview of the most relevant regulations in the waste field where existing and proposed limits for PFASs could influence current and future waste management practices.

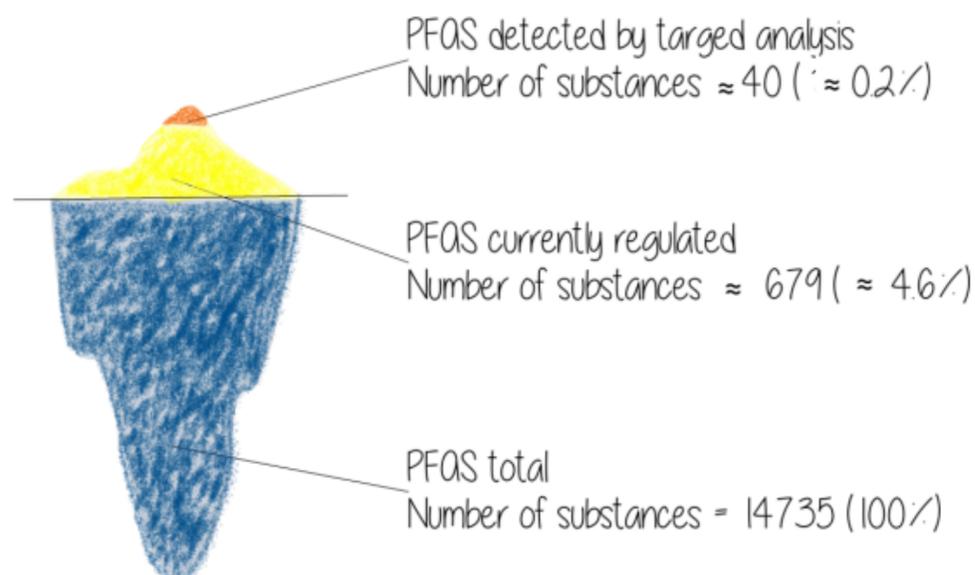


Figure 1

The "iceberg" knowledge of PFAS from a regulation perspective.

In this context, the knowledge needed to develop even more efficient practices in waste management and to support future regulatory updates toward the establishment of a sustainable circular economy is still scarce. To tackle this issue, a study was commissioned by FEAD to the Environmental Engineering Research Team of the University of Padova to present for clarity the highest number of scientific proofs of the presence of PFASs in relevant waste streams, namely plastic, textile, metal, and paper waste, selected for their importance for waste management and recycling sector. Then, a critical review of the scientific literature was conducted according to PRISMA methodology (Gurevitch et al., 2018, PRISMA, 2023) to shed light on the concentration ranges in the selected four waste material categories selected, as monitored and reported in available peer-reviewed scientific articles. The collected datasets were then compared to the ultimately and more conservative proposed limit of 25 ng/g, indicating the maximum content of any PFAS compound in products and waste, measurable by the available analytical methods.

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In summary, almost 5000 single concentration values were retrieved from the consulted manuscripts. Most of them focused on paper and textile waste, where measurements were reported from disposable food contact materials and upholstery, respectively. A minor fraction of the dataset was dedicated to plastic and metal waste, including PFASs content on single-use plastic packaging, End-Life Vehicles components and household appliances and automotive shredder residues. Within the limits of the critical review and concerning only the selected waste streams, just a very small number of cases exceeded the considered limit. The percentage of exceedances ranged from almost 1% (in paper and cardboard waste) to 8% (in textiles and leather waste).

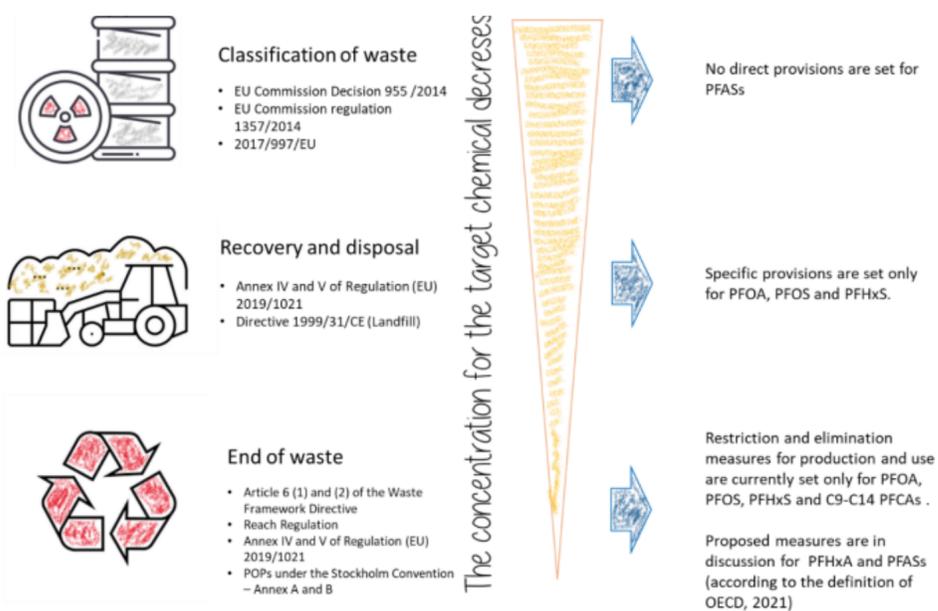


Figure 2

Graphical representation of the most relevant regulation applications in the waste field where PFASs can be interested

These outcomes could help to understand the impacts of proposed updates of the pertinent legal framework and, in parallel, provide scientific-sound bases for new reliable regulation proposals, able to consider current limitations (e.g., in analytical methods) and guide future research developments. Regarding the analytical methods, a pragmatic solution was suggested. This solution combines "not targeted" and "targeted" methodologies in a stepwise procedure, building upon the OECD definition of PFASs.

The full work has been submitted to a scientific Journal to be published as open access. Once the paper will be published a link will be available on the official webpage of FEAD. The study was conducted by the Environmental Engineering Research Team of the University of Padova and supported by FEAD, the European Waste Management Association.

ESSENTIAL BIBLIOGRAPHY

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