Test &
Innovation
Lab

Chemical risk assessment in recycled wool

Natural Fiber Connect – Prato Meeting

18 / 09 / 24

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Textile Exchange – CID PRSL

Introduction to new standard for textile recycled materials

Introduction on recycled materials

The use of recycled textile materials is an important approach to improve the sustainability and circularity of textile materials, reducing the human impact on the consumption of virgin raw materials

The desire to use these noble textile materials is pushing numerous bodies and associations to promote quality standards, guidelines and protocols aimed at the recovery, use and correct management of recycled textile materials.

Among these examples we can mention the important commitment promoted by and the recent introduction of the “Materials Matter Standard Pilot V1.0” promoted by Textile Exchange and the PRSL dedicated to recycled materials developed by Consorzio Italiano Detox (CID) in 2022.

Textile Exchange - Materials Matter Standard Pilot V1.0

The document created by Textile Exchange opens an important focus at **point 5.2.15** - ***Pellet, flake, filament, or fibrous form recycled outputs are tested for restricted substances prior to further processing, and records of test results are maintained:***

1) Testing is required for Textile Exchange data collection, improved understanding of restricted chemicals' potential impact on recycling, and knowledge building on recycled materials.

Create a dialogue with textile industries that have been dealing with recycled raw materials for years to evaluate the historical trend of contamination of chemical contaminants in recycled materials

2) Test parameters, limit values, test methods, sampling requirements, frequency, etc., shall be conducted using a risk-based approach.

The creation of a sampling plan and the parameters to be monitored must be subject to further studies to identify the correct sampling approach.

3) Recycled wool fibers can follow the Italian Detox Consortium (CID) document that provides parameter and limit values for testing

CID - Restricted Substances List (RSL) for natural fibers textile products made with recycled materials

CID CONSORZIO ITALIANO IMPLEMENTAZIONE DETOX

Gestione della sostenibilità delle imprese della filiera del sistema moda

RSL (RESTRICTED SUBSTANCES LIST) NEI PRODOTTI TESSILI IN FIBRE TESSILI RICICLATE (LANA, COTONE E SETA)

https://consorziodetox.it/wp-content/uploads/2022/02/RSL-_Natural-recicled-fibres-textile-WEB-IT.pdf

CID - Restricted Substances List (RSL) for natural fibers textile products made with recycled materials

Chemical contaminant	Countries with regulations in force	Limits of actual regulation	Limit PRSL	Incidence of positivity in recycled wool materials
Aromatic amines from azo dyes	China (GB/T 18401), UE (Reach Regulation), Arabian Gulf (SASO Regulation), Korea (KC Mark)	20 mg/kg (China) / 30 mg/kg (other regulation)	20 mg/kg	Medium risk
Heavy metals (extractable) - Cd, As, Pb, Cr VI	UE (Reach Regulation)	1 mg/kg	1 mg/kg	Low risk
Heavy metals (extractable) – Cr	No regulation – Private PRSL	No limits	5 mg/kg	Medium risk
Ethoxylated alkylphenols (APEOs)	UE (Reach Regulation)	100 mg/kg (derogation for 100% recycled materials and not washable in water)	250 mg/kg	High risk
Chlorophenols	Korea (KC Mark), UE (POP Regulation)	0,05 mg/kg	0,5 mg/kg	Low risk
Formaldehyde	China (GB/T 18401), UE (Reach Regulation), Arabian Gulf (SASO Regulation), Korea (KC Mark)	75 mg/kg	75 mg/kg	Low risk
Per- and Polyfluoroalkyl Substances (PFAS)	UE (Reach Regulation), Arabian Gulf (SASO Regulation), Korea (KC Mark)	Multiple (1 µg/m² / 25 µg/kg / 1000 µg/kg)	Multiple (1 µg/m² / 25 µg/kg / 1000 µg/kg)	Low risk
Total organic fluorine	US Federeal regulation	No intentional additions / 100 mg/kg	---	Medium risk
Dyes (forbiddend and diperse)	UE (Reach Regulation), Arabian Gulf (SASO Regulation), Korea (KC Mark)	5 mg/kg for specific dyes	50 mg/kg	Low risk

Change of contaminations

Chemical contamination trends over the last 10 years.

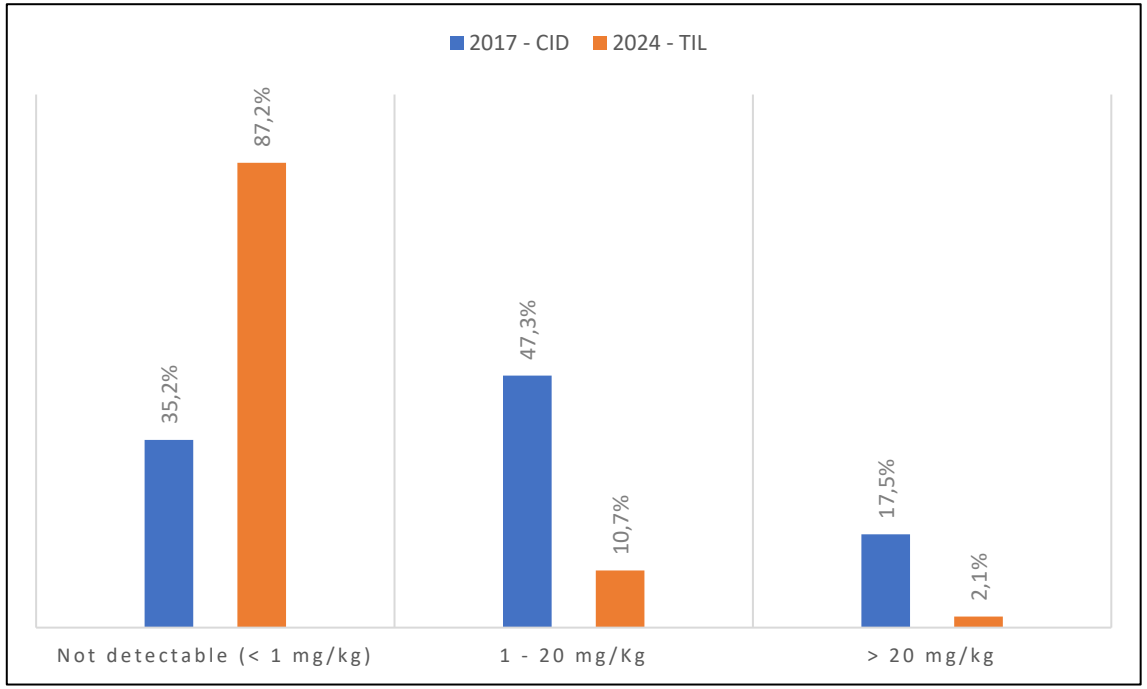
Change of contaminations

Chemical contamination trends over the last 10 years

Aromatic amines from azo dyes

Some azo dyes can release aromatic amines following the degradation of the dye molecule: the aromatic amines obtained from this process are classified as human carcinogens.

The use of azo dyes containing banned aromatic amines is constantly decreasing over the years thanks to the synthesis of new generations of dyes and production processes, thus ensuring the safety of the final consumer and workers.



2017: 108 test

2024: 1525 test

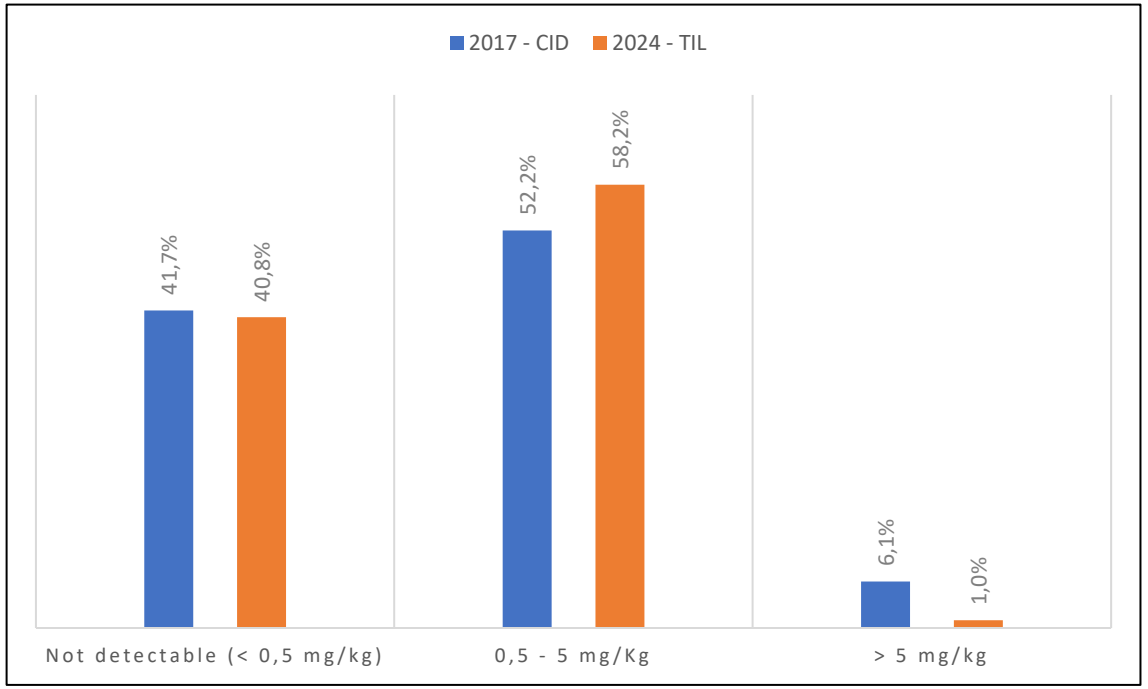
Change of contaminations

Chemical contamination trends over the last 10 years

Heavy metals (extractable) - Chromium

The heavy metals monitored and restricted by regulations are distinguished between toxic/carcinogenic metals and irritant/allergenic metals for skin contact.

Among the most present metals is chromium (verified as total chromium): Chromium compounds can be used as dyes for wool, silk, and polyamide (pre-metallized dyes especially dark shades); dyeing additives; dye fixing agents; colorfastness aftertreatments.



2017: 108 test

2024: 507 test

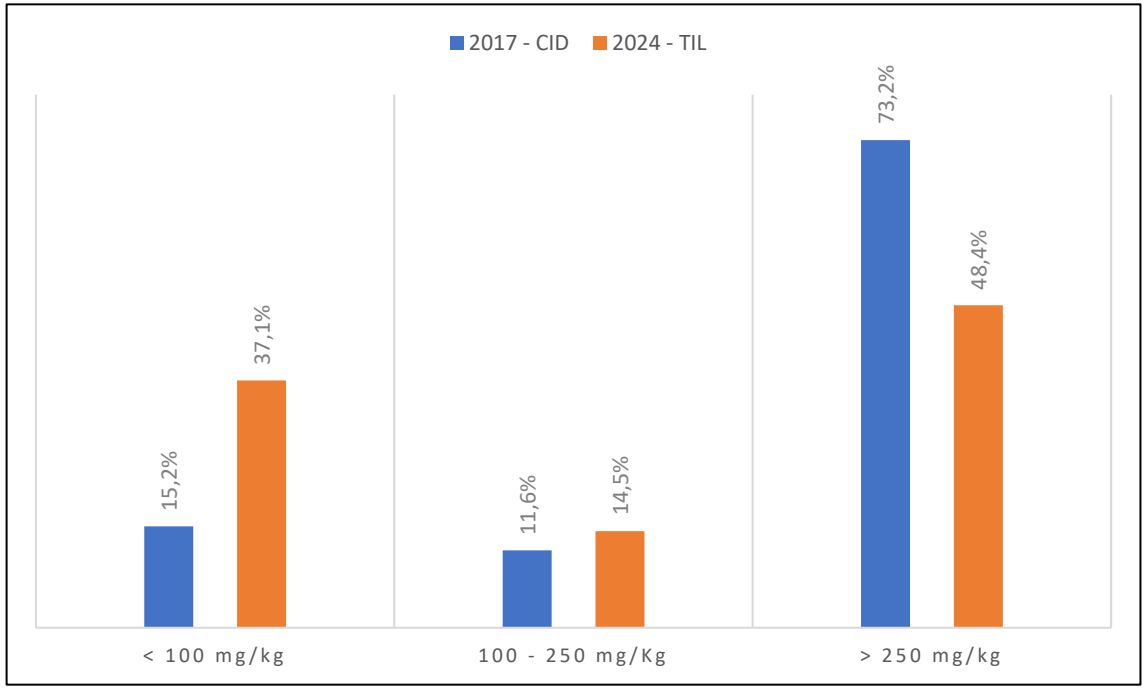
Change of contaminations

Chemical contamination trends over the last 10 years

Ethoxylated alkylphenols (APEOs)

APEOs can be used as or found in detergents, scouring agents, spinning oils, wetting agents, softeners, emulsifying/dispersing agents for dyes and prints, impregnating agents, de-gumming for silk production, dyes and pigment preparations, polyester padding and down/feather fillings. Biodegradation of APEOs into APs is the main source of APs in the environment.

APs are used as intermediaries in the manufacture of APEOs and antioxidants used to protect or stabilize polymers.



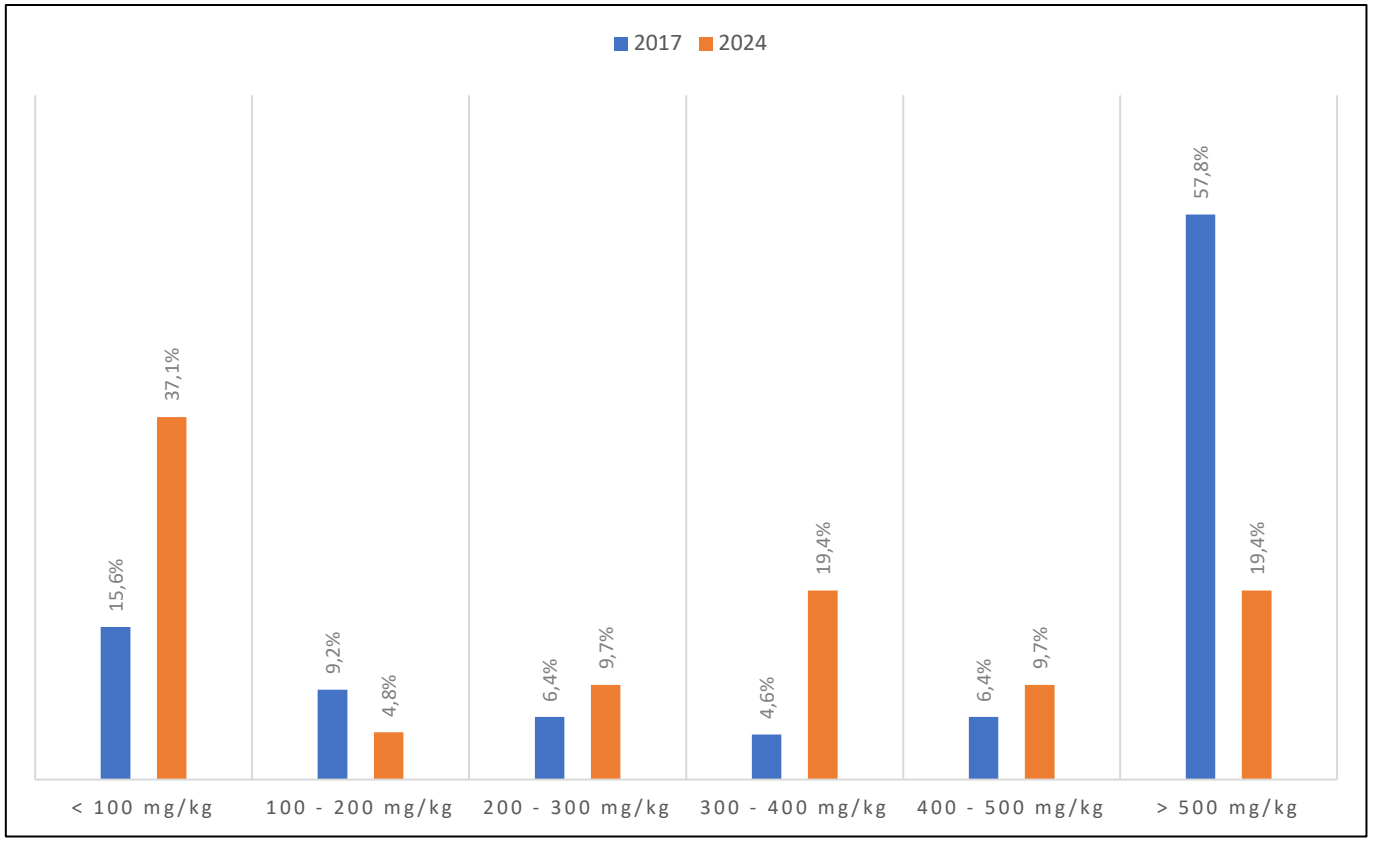
2017: 108 test

2024: 1577 test

Change of contaminations

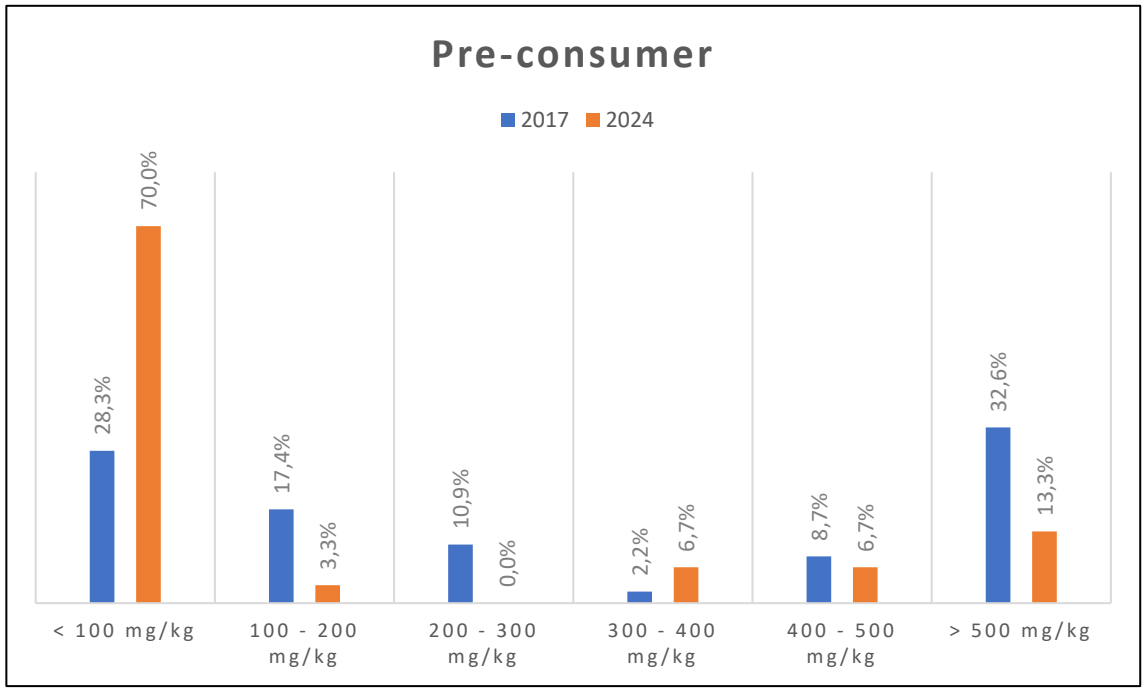
Chemical contamination trends over the last 10 years

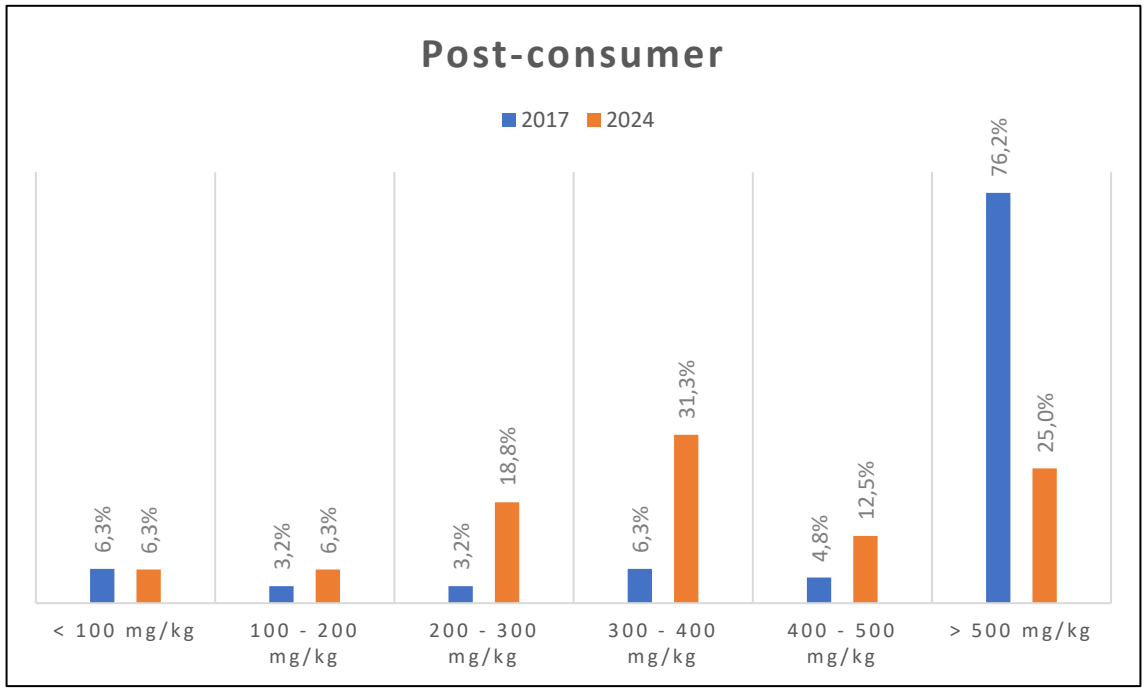
Ethoxylated alkylphenols (APEOs)



Chemical contamination trends over the last 10 years

Ethoxylated alkylphenols (APEOs)





Future challenge

PFAS: the new challenge for textiles.

What are PFASs?

OECD (2021) – PFAS Definition

"Per- and polyfluoroalkyl substances (PFASs) defined as: Any substance that contains at least one fully fluorinated methyl (CF3-) or methylene (-CF2-) carbon atom (without any H/Cl/Br/I attached to it)"

In consideration of the above, at present the substances covered by this definition have moved from around 4,700 (OECD original definition) to around 10,000.

Future challenge

PFAS: the new challenge for textiles

Target analysis

Many regulations in force (e.g. Regulation reached) are based on the testing of individual chemicals, for which there are individual restriction values.

The chemical approach of the laboratories is based on the search for a panel of chemicals that can be traced back to the precursors or impurities of chemical formulations.

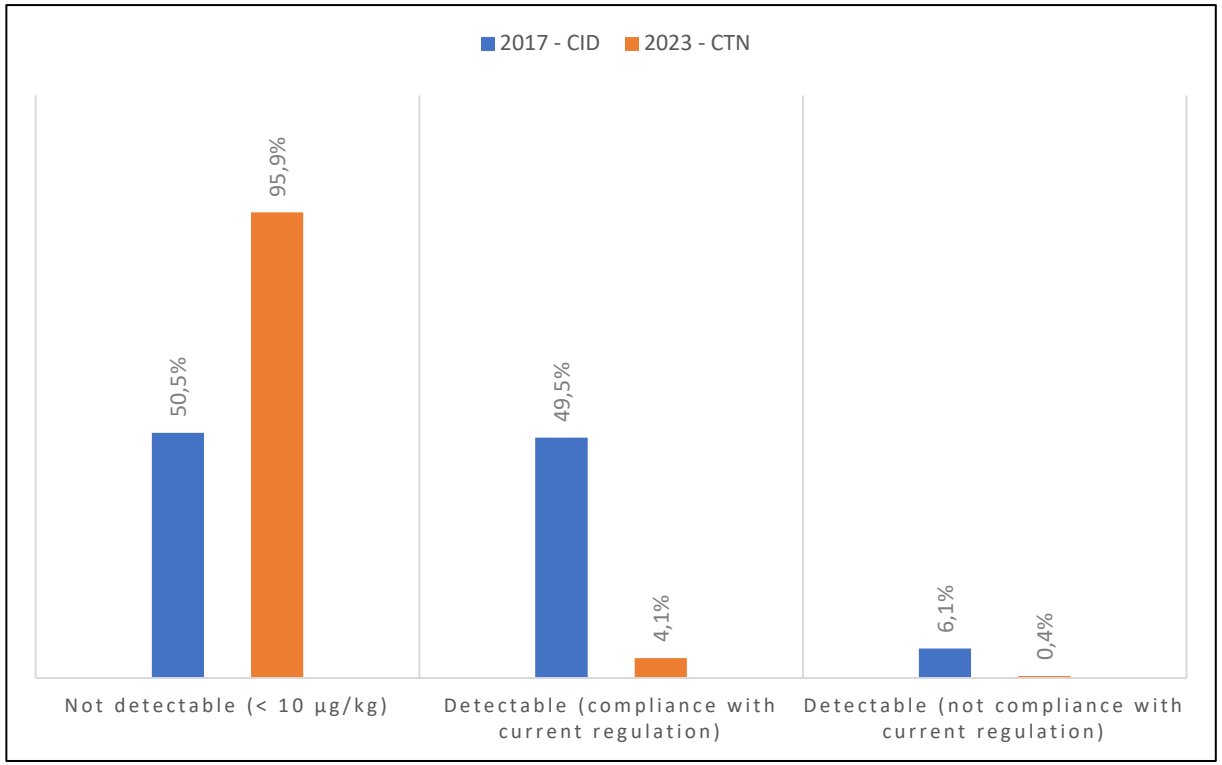
Non-specific approach

To compensate for the difficulties in identifying all the new generation PFAS, numerous research methods have been developed that allow the conversion of the new PFAS into "traditional" compounds (e.g. TOP assay) or non-specific research methods (e.g. Total Organic Fluorine) and numerous regulations are adapting to these research and quantification technologies.

Future challenge

PFAS: the new challenge for textiles

PFAS quantification by target analysis



2017 - CID: 108 test

2024 - CTN: 93 test

PFAS limits

1 µg/m2 PFOS (EU Regulation 757/2010)

25 µg/kg PFOA (EU Regulation 2017/1000)

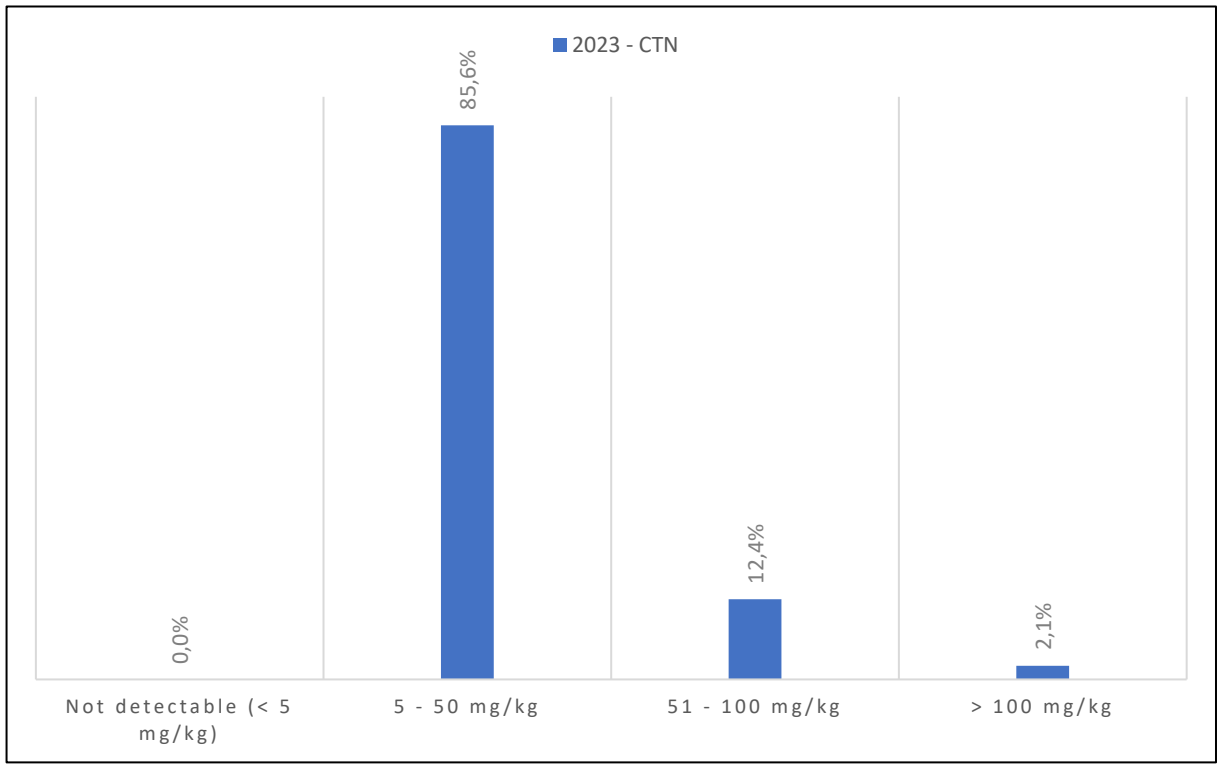
25 µg/kg PFCA C9-C14 and 260 µg/kg PFCA C9-C14 related substances (EU Regulation 2021/1297)

25 µg/kg PFHxS and 1000 µg/kg PFHxS related substances (EU Regulation 2023/1608)

Future challenge

PFAS: the new challenge for textiles

PFAS quantification by non-specific analysis (Total Organic Fluorine – TOF)



TOF Limits

< 50 mg/kg compliance with all actual and future proposal of regulation

> 50 mg/kg not compliance with possibile future Reach regulation and 2027 California limit

> 100 mg/kg not compliance with 2025 California limit

2017 - CID: N.A. test

2023 - CTN: 93 test - https://www.ecotextile.com/2023100231235/dyes-chemicals-news/research-demonstrates-pfas-levels-in-recycled-textiles.html

PFAS: impacts on the environment

Contamination of drinking water by PFAS

Contamination of wastewater by PFAS

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Thank you.

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