

PFAS v predmetih splošne rabe

Viviana Golja



- Kje se nahajajo
 - Materiali v stiku z živili (embalaža in posoda)
 - Kozmetika
 - Tekstil
 - Igrače in izdelki za otroke
 - Čistila
 - Barve, premazi in laki
 - Toaletni papir
 - Smučarski voski, kolesarska olja, elektronika, gradbeništvo
 - Pesticidi
- Zmanjšanje izpostavljenosti
- Projekt PARC



Slika s spletne strani <https://www.ecowatch.com/pfas-forever-chemicals-explainer.html>

PFAS – materiali v stiku z živali



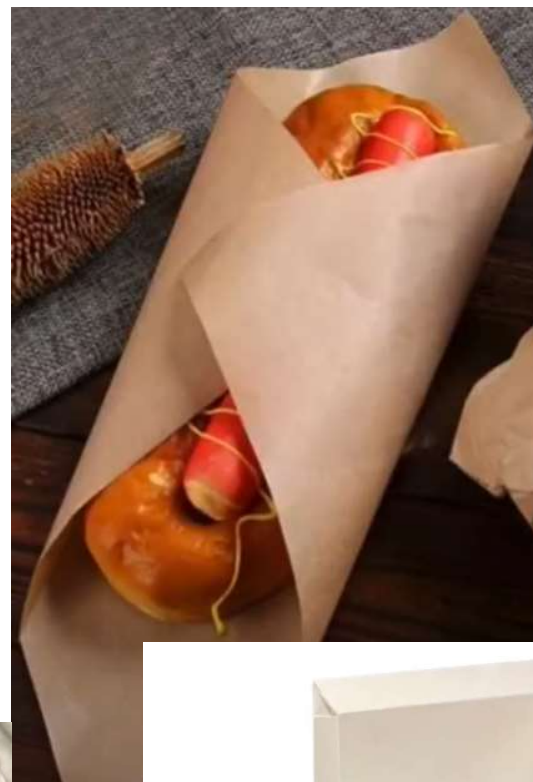
Slika: Freepick

- za izdelavo materialov in površin, ki odbijajo vodo, umazanijo in maščobo
- papir za peko, pekači za kolačke ali ponve z oznako proti prijemanju verjetno vsebujejo PFAS

Embalaža

Lahko so prisotni v:

- ovojnem papirju za sendviče
- papirnatih vrečkah in podlagah za pekovske izdelke in slaščice
- krožnikih in škatlah za enkratno uporabo

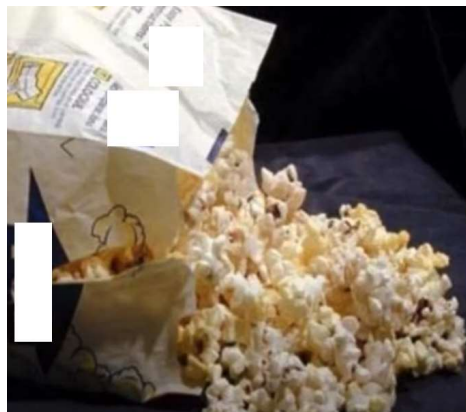


Slike: <https://pfas.chemsec.org/>

Embalaža

Lahko so prisotni v:

- nekaterih izdelkih iz bambusa
- embalaži za pokovko



Slike: <https://pfas.chemsec.org/>



Iz članka Dueñas-Mas, M. J., Ballesteros-Gómez, A., & de Boer, J. (2023) Determination of several PFAS groups in food packaging material from fast-food restaurants in France- pregled objavljenih rezultatov
<https://doi.org/10.1016/j.chemosphere.2023.139734>

Table S1. Reported presence of PFAS in food packaging material: target compounds, concentration range (ng·g⁻¹), detection (LOD) and quantification (LOQ) limits (ng·g⁻¹), packaging material and contained food, with sample preparation method.

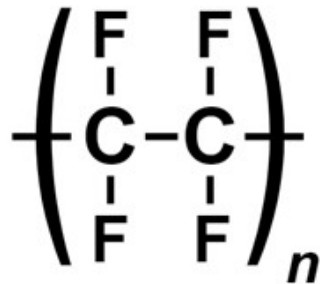
^a Analytes	PFAS concentration (Σ, ng·g ⁻¹)	PAP concentration (Σ, ng·g ⁻¹)	^b Contained food (type of material)	LOD (ng·g ⁻¹)	LOQ (ng·g ⁻¹)	Sample preparation	Ref.
PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFNA, PFDA, PFUnDA, PFDoDA, PFTrDA, PFTeA, PFHxDA, PFODA, PFBS, PFPeS, PFHxS, PFHpS, PFOS, PFNS, PFDS, PFOSA, N-MeFOSA, N-EtFOSA, HFPO-DAM 9Cl-PF3ONS, 11Cl-PF3OUDS, FTS (4:2, 6:2, 8:2, 10:2), mPAP (6:2, 8:2), diPAP (6:2/6:2, 8:2/8:2)	< LOQ – 14 < LOD < LOD	< LOQ – 290 < LOD < LOD	13 Oil-beading compostable 15 Oil-beading takeaway paper 14 Oil-spreading or oil-soaking paper/board	-	1700 (PFAS) 26.000-260.000 (PAPs)	LLE Solvent: MeOH: Ethyl acetate clean-up: SPE evaporation/reconstitution steps: yes	(Straková et al., 2021)
PFBS, PFPeA, PFHxA, PFHpA, PFOA, PFNA, PFDA, PFHxS, PFOS, PFOSA, mPAP (6:2, 8:2), diPAP (6:2/6:2, 8:2/8:2)	< LOD < LOD < LOD < LOD < LOD < LOD < LOD < LOD < LOD 2.1 115.7 3282	< LOD 2.1 7 < LOD 2.2 11 < LOD < LOD < LOD < LOD < LOD < LOD	2 cardboards 1 baking paper 1 muffin cup 1 plate (cardboard) 1 cup (cardboard) 1 burger wrapper 2 boxes 2 French fries wrappers 2 Burger clam bags 1 bag 2 pizza boxes 2 Spanish popcorn bags 1 Chinese popcorn bag 1 pet food bag (paper)	1.3 – 3.5 (PFAS) 0.8 - 2.8 (PAPs)	-	FUSLE Solvent: ACN: water (9:1) extraction time: 5 min clean-up: SPE evaporation/reconstitution steps: yes	(Zabaleta et al., 2020)

PFOA PFOS	< LOD – 28.6 < LOD	-	7 popcorn bags (paper) 3 lunch snacks (paper)	0.63 - 1.53 (PFAS)	2.11 – 5.11 (PFAS)	FUSLE Solvent: ethanol extraction time: 30s clean-up: filtration evaporation/reconstitution steps: yes	(Monge Brenes et al., 2019)
PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFNA, PFDA, PFUnDA, PFDoDA, PFTTrDA, PFTeA, PFBS, PFHxS, PFOS, PFDS, PFOSA, mPAP (6:2, 8:2), diPAP (6:2/6:2, 8:2/8:2)	< LOD – 10.3 < LOD – 0.746 < LOD – 0.8 < LOD – 0.021 < LOD - 1.3 < LOD < LOD < LOD < LOD < LOD < LOD	< LOD < LOD < LOD < LOD < LOD < LOD < LOD < LOD < LOD < LOD	11 plates (different materials) 5 cupcake cups 5 food bags (paper) 3 hot drink cups 3 popcorn beakers 2 candy bags (paper) 2 baking paper 1 coffee filter 1 pizza tray 1 French fries tray 1 snack beaker (cardboard)	0.006 – 0.06 (PFAS) 0.006 (PAPs)	-	PLE Solvent: ethanol and ethanol:water extraction time: 1 h clean-up: filtration evaporation/reconstitution steps: no	(Granby and Tesdal Haland, 2018)
PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFNA, PFDA, PFUnDA, PFDoDA, PFTTrDA, PFTeA, PFBS, PFHxS, PFOS, PFOSA, PFHxPA, mPAP (6:2, 8:2), diPAP (6:2/6:2, 8:2/8:2, 10:2/10:2), triPAP (6:2/6:2/6:2)	< LOD – 466	< LOD - 112	33 popcorn bags (cardboard)	1.3 – 3.5 (PFAS) 0.8 – 2.8 (PAPs)	-	FUSLE Solvent: methanol extraction time: 2.5 min clean-up: filtration and SPE evaporation/reconstitution steps: yes	(Zabaleta et al., 2017)
PFBS, PFHxS, PFOS, PFDS, PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFNA, PFDA, PFUnDA, PFDoDA, PFOSA, N- EtFOSA, N-MeFOSA, mPAP (6:2, 8:2), diPAP (6:2/6:2, 8:2/8:2)	< LOD – 306.44	< LOD - 478	Burger wrapper (paper) French fries box (paper) pizza box (paper) sandwich box (paper) non-stick baking cup popcorn bag soup cup	0.004 - 0.03 (PFAS) 4.5 - 119 (PAPs)	-	PLE Solvent: diluted acetic acid and methanolic ammonium hydroxide extraction time: 90 min clean-up: SPE evaporation/reconstitution steps: yes	(Shoeib et al., 2016)

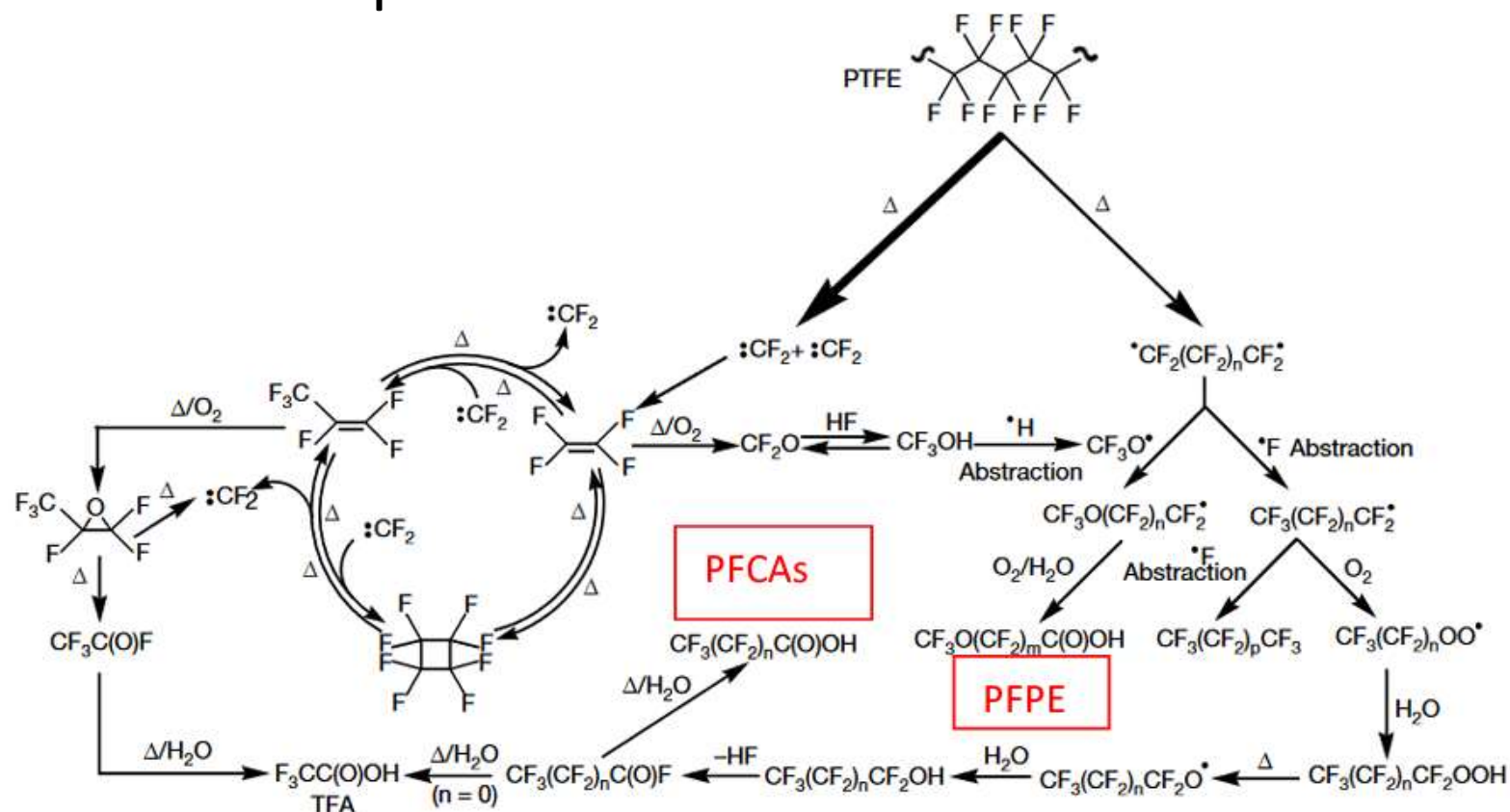
Premazi: PTFE



Zaradi non-stick lastnosti PFAS so idealni za premaze kuhinjske posode. Ena najbolj znanih uporab PFAS so teflonski premazi na ponvah. Polimer PTFE je zelo velika molekula in **ne prehaja skozi črevesno membrano**. Migranti z MW <1000 Da potencialno lahko ogroža zdravje ljudi. Običajno se domneva, da snovi z molekulsko maso nad 1000 Da (ali 1500 Da za **fluoropolimere**) ne morejo absorbirati iz prebavil in posledično niso toksikološko pomembne, razen če je znano, da se v prebavilih razgradijo do snovi z manjšo molekulsko maso.



Termični razpad PTFE



K O Z M E T I K A



Slika s spletne strani NIJZ kozmetovigilanca

PM 9/21: PFAS v kozmetiki



Založnik: **Švedska agencija za kemikalije**

Format datoteke: **PDF**

Oblika strani: **A4**

Število strani: **113**

Leto izdaje: **2021**

jezik: **angleščina**

IVL Švedski inštitut za okoljske raziskave in Univerza v Stockholmu sta izvedla to študijo o PFAS v kozmetičnih izdelkih v imenu Inšpektorata za kemikalije. Študija je del pripravljalnega dela inšpektorata za kemikalije s široko omejitvijo PFAS v uredbi REACH.

Table 12: PFAS containing products and product versions by product categories and share of PFAS containing products/versions in % (i.e. products with PFAS INCI names on ingredient lists); data in the table sorted by PFAS share from high to low; classification and product categories based on the CosmEthics database, entire database information included (product and product versions, EU/EEA and non-EU/EEA).

Main product category (CosmEthics)	Total number of products and product versions	Total number of cosmetic products and product versions containing PFAS	Share of cosmetic products and product versions containing PFAS (%)
Make up	26 899	1102	4.1
Facial care	23 059	285	1.2
Male grooming	4394	52	1.2
Hair care	22 135	145	0.65
Hands and Nails	7869	26	0.33
Bath and Body Products	25 089	38	0.15
Tanning	2717	7	0.25
Mouth	2081	2	0.09
Baby and Children's Products	2610	1	0.03
Fragrances	3455	0	0
Foot care	931	0	0

- V katerih kozmetičnih izdelkih se PFAS nahajajo

PFAS INCI names	CAS No	EC/List no	Fluorinated carbons
PTFE	9002-84-0	618-337-2	fluoropolyme
C9-15 fluoroalcohol phosphate	223239-92-7	N/A	C9-C15
Perfluorodecalin	306-94-5	206-192-4	C10/fully F
Perfluorooctyl triethoxysilane	51851-37-7	257-473-3	C6
Perfluorononyl dimethicone	N/A	N/A	C9
Polyperfluoromethylisopropyl ether	69991-67-9	615-044-1	C4
Hydrofluorocarbon 152a	75-37-6	200-866-1	C1
Octafluoropentyl methacrylate	355-93-1	206-596-0	C4
Acetyl trifluoromethylphenyl valylglycine	379685-96-8	609-497-4	C1
Methyl perfluorobutyl ether	163702-07-6	N/A	C4
Polyperfluoroethoxymethoxy difluoroethyl PEG phosphate	N/A	N/A	C1+C2
Ammonium C6-16 perfluoroalkylethyl phosphate	65530-72-5 / 65530-71-4 / 65530-70-3	685-094-7 / 809-881-3 / 809-882-9	C6-C16

Izveček iz tabele 13
švedskega
dokumenta

PFAS INCI names	CAS No	EC/List no	Fluorinated carbons
Methyl perfluoroisobutyl ether	163702-08-7	605-340-9	C4
Trifluoropropyldimethyl/trimethylsiloxysilicate	N/A	N/A	C1
Polyperfluoroisopropyl ether	25038-02-2	626-882-2	C3
Trifluoromethyl C1-4 alkyl dimethicone	N/A	N/A	C1
PEG-8 trifluoropropyl dimethicone copolymer	N/A	N/A	C1
HC yellow no. 13	10442-83-8	443-760-2	C1
Polysilicone-7	146632-08-8	N/A	C8
Polysilicone-10	N/A	N/A	Unclear

Kateri PFAS so prisotni v kozmetiki - izvleček iz tabele 13 švedskega dokumenta

Polysilicone 7: Poly(oxydimethylsilanediyl), .alpha.-butyl-.omega.-3-hydroxypropyl-, 2-methyl-2-propenoate, polymer with 2-methylpropyl 2-methyl-2-propenoate and 2-(N-heptadecafluorooctyl-N-methylamino)ethyl 2-methyl-2-propenoate.

Tekstil

- Nepremočljiva oblačila in obutev
- Dežniki
- Nepremočljive vzmetnice
- Oblazinjeno pohištvo
- Talne obloge
- Odeje, prti, prtički
- Vrvi, jadra

KEMI
Swedish Chemicals Agency

PFASs in chemical products and textiles

PM 21/22



Igrače in izdelki za otroke

- Nepremočljiva in proti madežem obstojna otroška oblačila, dežniki, nepremočljive vzmetnice
- Igrače
- Paziti:
 - Embalaža za hitro hrano
 - Otroci se plazijo po tleh:
 - Premazi za tla, talne obloge!

ENVIRONMENTAL
Science & Technology

pubs.acs.org/est



Article

How Well Do Product Labels Indicate the Presence of PFAS in Consumer Items Used by Children and Adolescents?

Kathryn M. Rodgers, Christopher H. Swartz, James Occhialini, Philip Bassignani, Michelle McCurdy, and Laurel A. Schaidler*

Cite This: *Environ. Sci. Technol.* 2022, 56, 6294–6304

Read Online

Čistila

PFAS so lahko prisotni v:

- čistilih za steklo in trde površine
- sredstvih za obdelavo tkanin, oblazinjenega pohištva in preprog
- voskih in loščilih za tla, pohištvo, avtomobile in čolne
- sredstvih za izpiranje posode
- čistilih in osvežilnih zraka na osnovi aerosola



Graf. abstrakt iz spodnjega članka



Atmospheric Environment
Volume 258, 1 January 2022, 118845



Per- and polyfluoroalkyl substances (PFASs) in airborne particulate matter (PM_{2.0}) emitted during floor waxing: A pilot study

Jiani Zhou^a, Karsten Boumann^a, Naomi Chang^a, Glenn Morrison^a, Wanda Bodnar^a, Zhenfa Zhang^a, Joanna M. Atkin^b, Jason D. Surratt^{a,b}, Barbara J. Turain^a

Barve, premazi in laki

- Barve (zunanje)
- Premazi (za zunanje gradbene materiale, elektroniko, kable)
- Laki za les, beton in kamen (notranji prostori)

Per- and Polyfluoroalkyl Substances
and Alternatives in Coatings, Paints
and Varnishes (CPVs)

Report on the Commercial Availability
and Current Uses

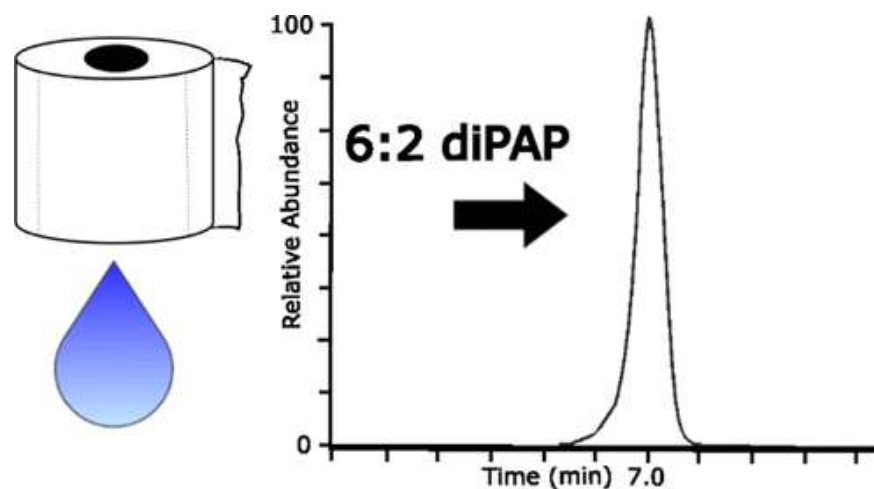


Series on Risk Management
No. 70

Toaletni papir



Davydenko Yulii/ Shutterstock.com



•Per- and Polyfluoroalkyl Substances in Toilet Paper and the Impact on Wastewater Systems
Jake T. Thompson, Boting Chen, John A. Bowden, and Timothy G. Townsend
Environmental Science & Technology Letters **2023** 10 (3), 234-239
DOI: 10.1021/acs.estlett.3c00094

Smučarski voski in kolesarska olja

- PFAS se uporabljajo tudi za zmanjšanje trenja ali za mazanje. Tipične uporabe so smučarski voski in kolesarska olja.



Avtor: Tiia Monto – lastno delo; licenca: CC BY-SA 4.0; URL: <https://commons.wikimedia.org/w/index.php?curid=57165416>



Slika s spletne strani: <https://www.kupibarve.si/nega-in-zascita/nega-zascita-vzdrzevanje-kolesa>

Elektronika

- Elektronska industrija je trenutno eden največjih uporabnikov PFAS, saj porabi več kot 4400 ton na leto v EU. Te kemikalije se uporabljajo v različnih aplikacijah v industriji, zaradi česar je za podjetja zahtevna naloga razumeti, kako se PFAS uporabljajo v njihovih izdelkih in procesih.
- <https://chemsec.org/reports/check-your-tech-a-guide-to-pfas-in-electronics/>



Slika iz zgoraj navedenega poročila

Elektronika

Category of use	Function performed	Product(s)	PFAS identified	Contained in the product?	Actively used?	Alternatives available?	Alternatives Identified
Electrical Devices	Structure/low dielectric constant/insulation	Printed Circuit Boards (PCB)/ Printed Wiring Board (PWB)	6:2 FTSA (27619-97-2) Perfluorooctane sulfonamid (754-91-6) PFOS (1763-23-1) PFBA (375-22-4) PTFE (9002-84-0) ethene,1,1,2,2-tetrafluoro-, polymer with 1,1'oxybis[ethene] (102646-47-9)	Yes ^{1,2}	Confirmed ³	Yes	FR-4 epoxy, Polyimide laminates, liquid crystal polymer, polyester, polyethylene naphthalate (PEN), bismaleimide triazine (BT), cyanate ester, ceramics ⁴
Electrical Devices	Final Coating/protection/waterproofing	Printed Circuit Boards (PCB)/ Printed Wiring Board (PWB)	6:2 FTSA (27619-97-2) Perfluorooctane sulfonamid (754-91-6) PFOS (1763-23-1) PFBA (375-22-4) PTFE (9002-84-0) ethene,1,1,2,2-tetrafluoro-,	Yes ⁵	Confirmed ⁶	Yes	Acrylic Resin, Epoxy, Urethane resin, silicone resin ⁷
Electrical Devices	Liquid impregnates	Capacitors	Aliphatic perfluoroalkane (355-42-0) Perfluoromethylcycloalkane (1805-22-7, 255-02-2) Perfluoro-1,3-dimethylcycloalkane	Yes ¹	Unconfirmed	Yes	Mineral oils, vegetable oils, silicone oils, and biodegradable synthetic oils. ⁸

Gradbeništvo

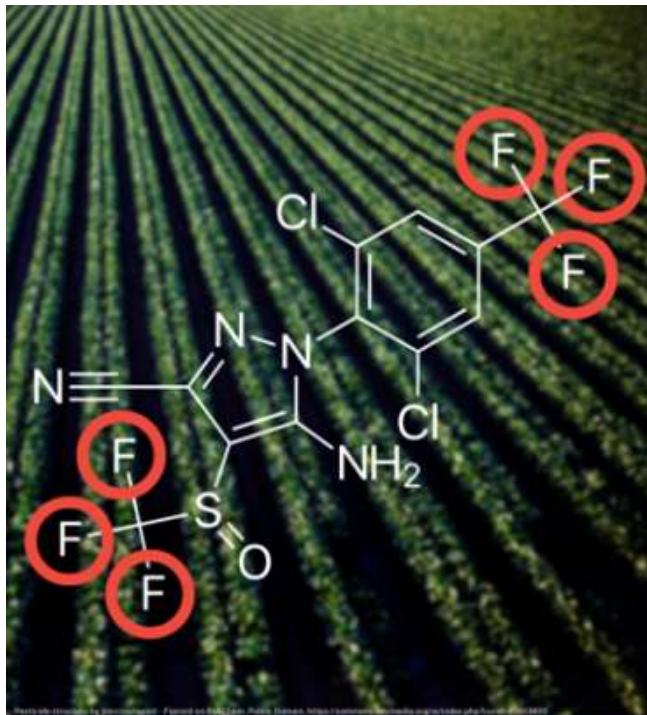
- <https://greensciencepolicy.org/docs/pfas-building-materials-2021.pdf>

- Strešne kritine
- Talne obloge
- Tesnilne mase in lepila
- Steklo
- Tkanine
- Žice in kabli
- Trakovi
- Izdelki iz lesa
- Solarni paneli
- Umetne trate
- Sistemi za potresno blaženje



Pesticidi

- inertne sestavine (detergenti)
- avtorizirane aktivne substance



**THE
PROBLEM
WITH PFAS
IN
PESTICIDES**

Zmanjšanje izpostavljenosti PFAS iz predmetov splošne rabe

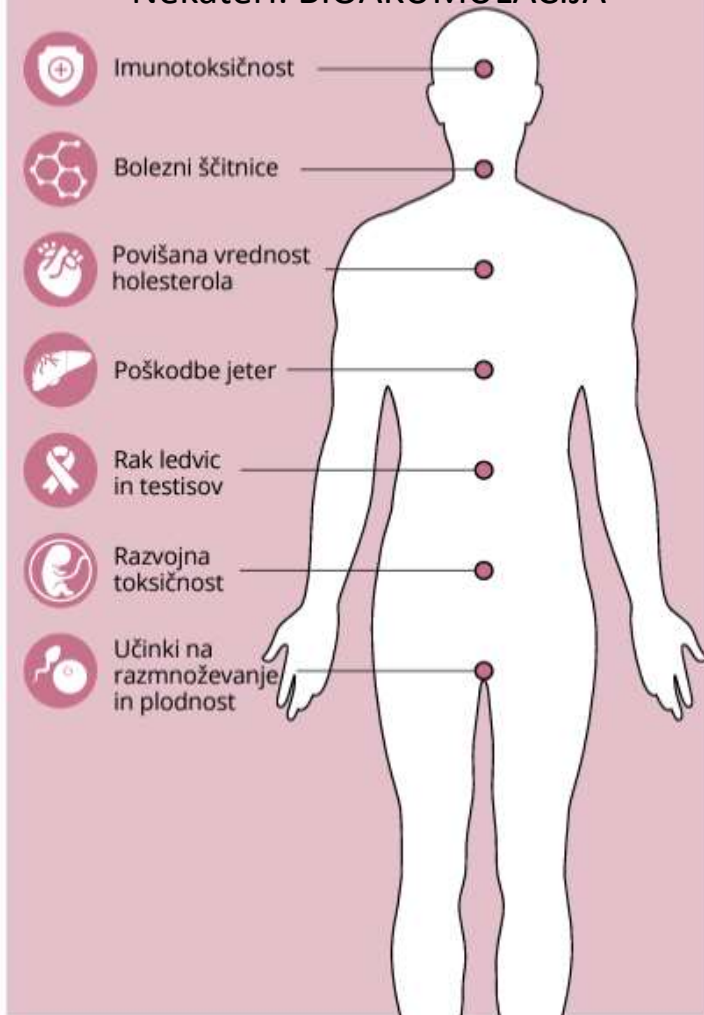
IZPOSTAVLJENOST



Osnova slikk: spletna stran NIJZ PFAS

Kako lahko PFAS vplivajo na vaše zdravje?

Nekateri: BIOAKUMULACIJA



Zmanjšanje izpostavljenosti PFAS iz predmetov splošne rabe

Možnosti:

- Izogibamo se hitri hrani, pakirani v karton, kot so npr. nekatere škatle za pico, vrečke za krompirček...
- Namesto posode s prevleko proti prijemanju se raje odločimo za posodo iz nerjavečega jekla, litega železa, keramike, stekla
- Pri kozmetiki izbiramo izdelke, ki ne navajajo PFAS na seznamu sestavin
- Izogibamo se nenujni uporabi sprejev za impregnacijo, npr. pri oblačilih in obutvi
- Pri nakupu izdelkov, ki lahko vsebujejo PFAS, zahtevamo izdelke brez PFAS (naj izdelki ne vsebujejo nobene PFAS spojine in ne samo PFOS in PFOA)
- Na spletu preverimo, ali določen izdelek vsebuje PFAS ali ne



WHAT WE DO

Partnership for the Assessment of Risks from Chemicals aims to develop next-generation chemical risk assessment to protect human health and the environment. It supports the European Union's Chemicals Strategy for Sustainability and the European Green Deal's "Zero pollution" ambition with new data, knowledge, methods and tools, expertise and networks.

- PFAS sodijo med prioritetne kemikalije v sklopu projekta, skupaj z bisfenoli, zaviralci gorenja, ftalati, pesticidi, kovinami, mikotoksini, kemikalijami, ki povzročajo motnje v delovanju žlez z notranjim izločanjem in mešanicami kemikalij
- Sklop 6 2 obravnava razvoj inovativnih metod, orodij in konceptov in izvedbo celovitih ocen tveganja in vpliva na zdravje na podlagi notranje in zunanje izpostavljenosti ljudi, izpostavljenih posameznim kemikalijam in mešanicam iz več virov in poti za različna življenjska okolja (vključno z delovnim mestom)

Hvala za pozornost!