

HAZARDOUS COMPOUNDS RELEASED FROM TEXTILES

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WHY STUDY THIS?

Chemicals are used in production of cloths

- Process chemicals 19 substances
- Functional chemicals 44 substances
- Unwanted chemicals 51 substances



AIM

Examine the extent to which laundering
of five types of clothing contributes
to the presence of toxic pollutants
in sludge and effluent water from a
representative sample of treatment plants
in Sweden.



THE CLOTHS



	T-shirts	Jeans	Fleece sweaters	Weatherproof jackets	Working pants
No	8	3	7	3	2
Colors	Orange, red, blue, green, black and yellow	Dark blue	Blue, green, purple, red, white, black and pink	Blue, red and pink/purple	Black, gray
Weight (kg)	1.3	1.9	2.4	1.5	1.7



EXPERIMENTAL

- Detergent (Via Color, Unilever), 20 mL
- Washing mashine – Miele Softronic (front loading, Model W 3251)
- The washing instructions for the clothing were followed
- The cloths was washed 2 times, without drying in between



EXPERIMENTAL



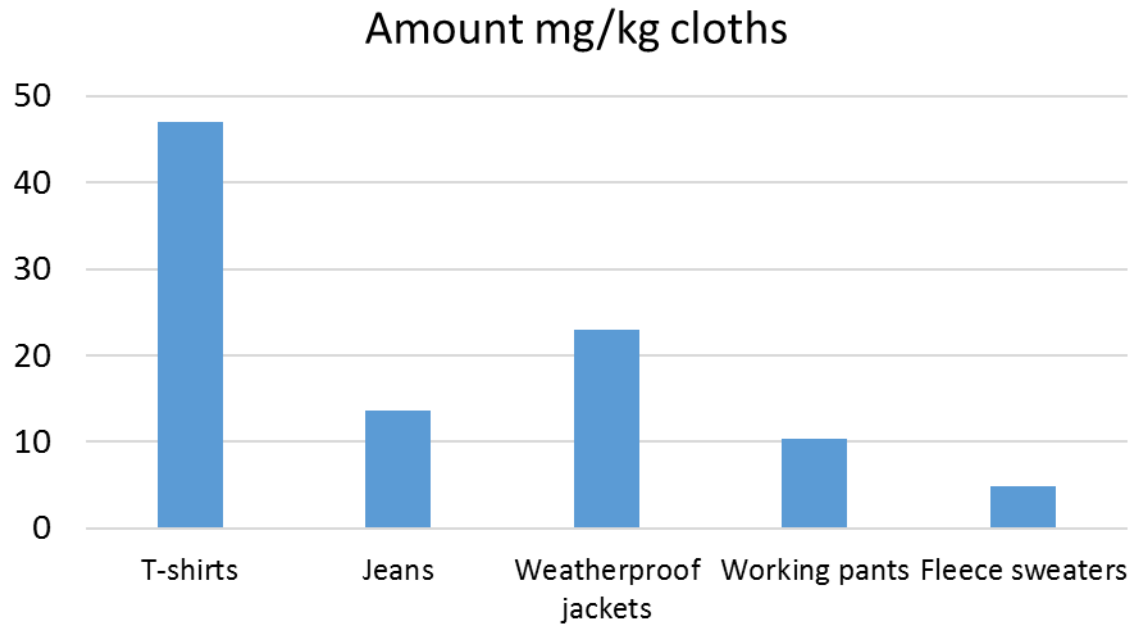
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EXPERIMENTAL

- Water volume:
 - Varied between 42 and 100 L
- 3 subsamples of 2 L each
 - Department of Chemistry Umeå University
 - IVL - Swedish Environmental Research Institute
 - ACES - Department of Environmental Science and Analytical Chemistry at Stockholm University



RESULTS

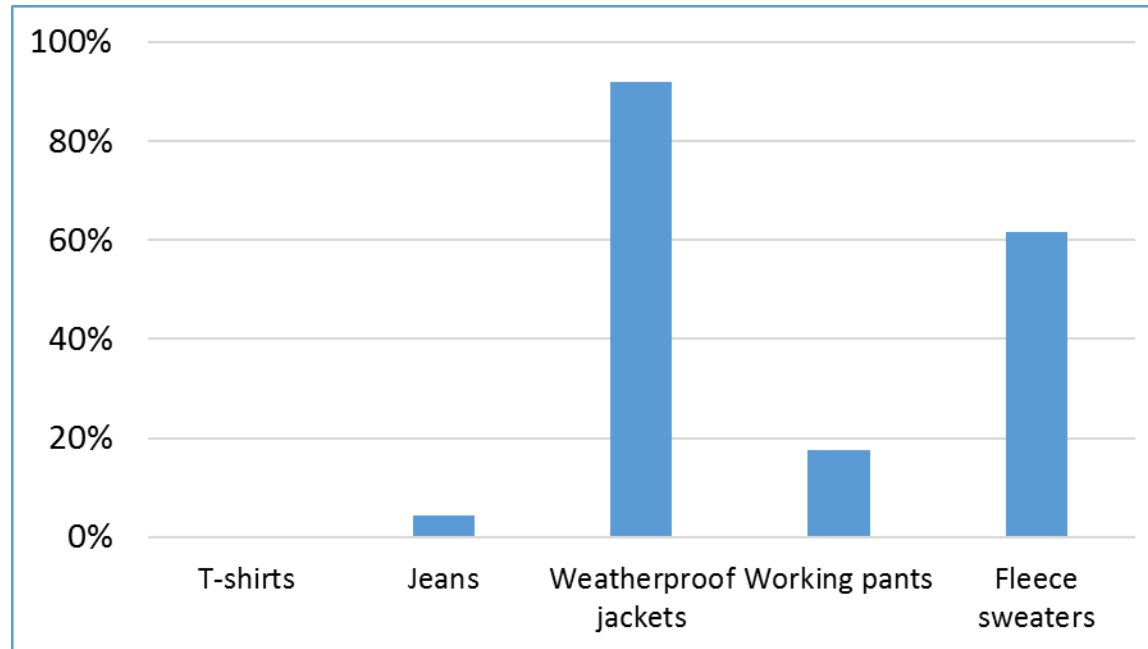


In total 62 substances was detected of
114 targeted substances



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PROCESS CHEMICALS

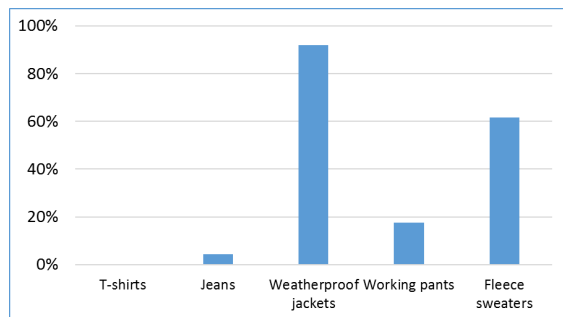


Process chemicals contributing to the total amount of chemicals released from the cloths

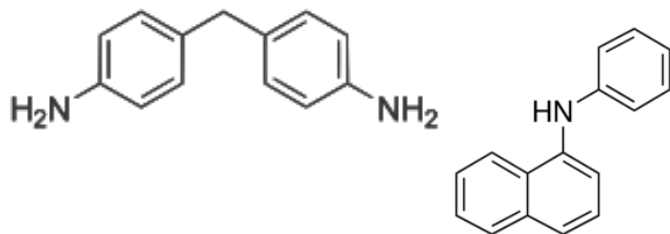
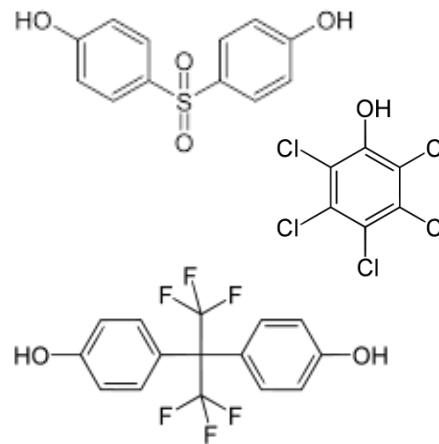


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PROCESS CHEMICALS



Phenolic compounds:
BPS, PCP and bisphenol AF



Arylamines:
DADPM and
IPPD

Process chemicals contributing to the total amount
of chemicals released from the cloths



PROCESS CHEMICALS

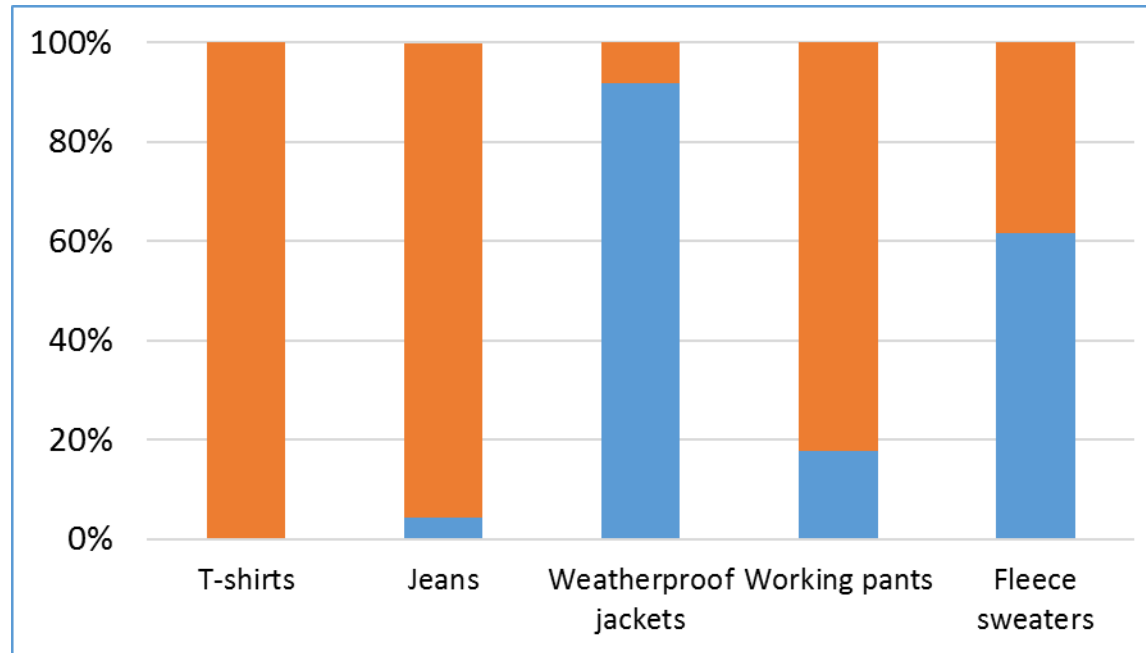
Compound	T-shirts	Jeans	Weatherproof jackets	Working pants	Fleece sweaters
PCP	2.9	27	220	n.a.	1000
BPS	<31	150	21000	1800	2900
Bisphenol AF	2.5	2.4	1.5	0.99	1.7
IPPD	9.8	<4.8	<3.7	<2.5	<4.2
DADPM	33	420	140	17	92

µg/kg cloths



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PROCESS AND FUNCTIONAL CHEMICALS

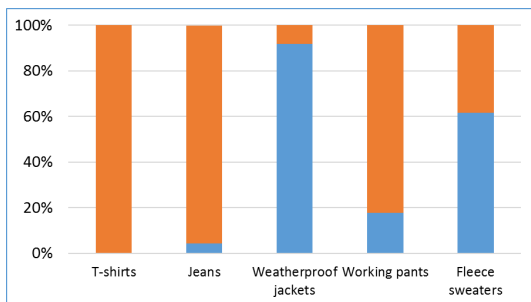


Adding functional chemicals contributing to the total amount of chemicals released from the cloths

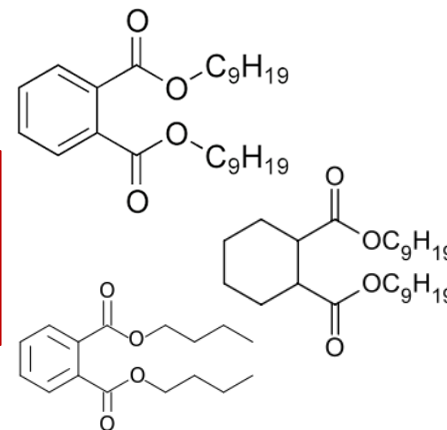


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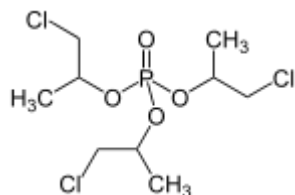
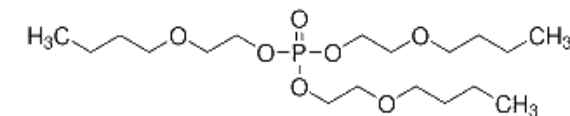
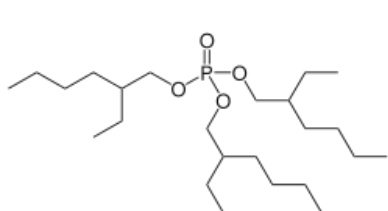
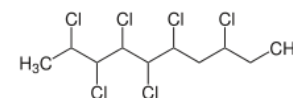
FUNCTIONAL CHEMICALS



Phthalates:
DINP, DINCH
and DBP



SCCP (C₁₀-C₁₃)



Organophosphates:
TEHP, TBEP and
TCPP

Adding functional chemicals contributing to the total amount of chemicals released from the cloths



FUNCTIONAL CHEMICALS

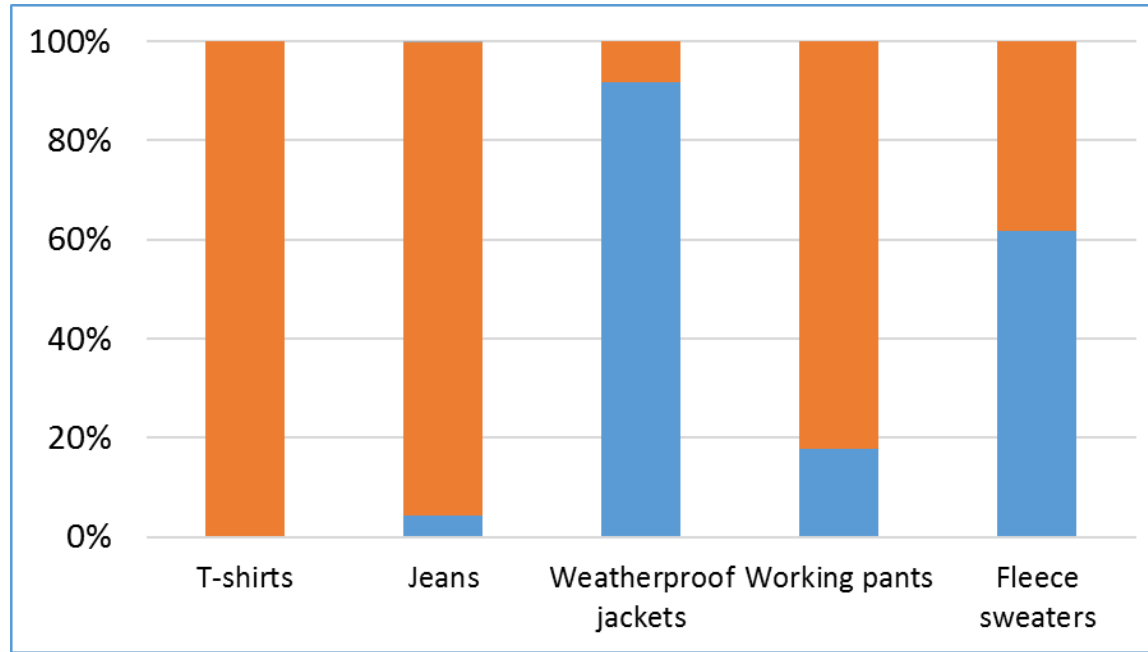
Compound	T-shirts	Jeans	Weatherproof jackets	Working pants	Fleece sweaters
DBP	160	690	120	86	95
DINP	22000	<1500	<1100	1100	<1300
DINCH	16000	<970	<750	2700	<830
SCCP	6.1	2.6	1.0	180	3.3
TEHP	6.2	1500	2.1	n.d.	5.8
TBEP	12	380	21	n.d.	100
TCPP	100	32	97	n.d.	26

µg/kg cloths



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UNWANTED CHEMICALS



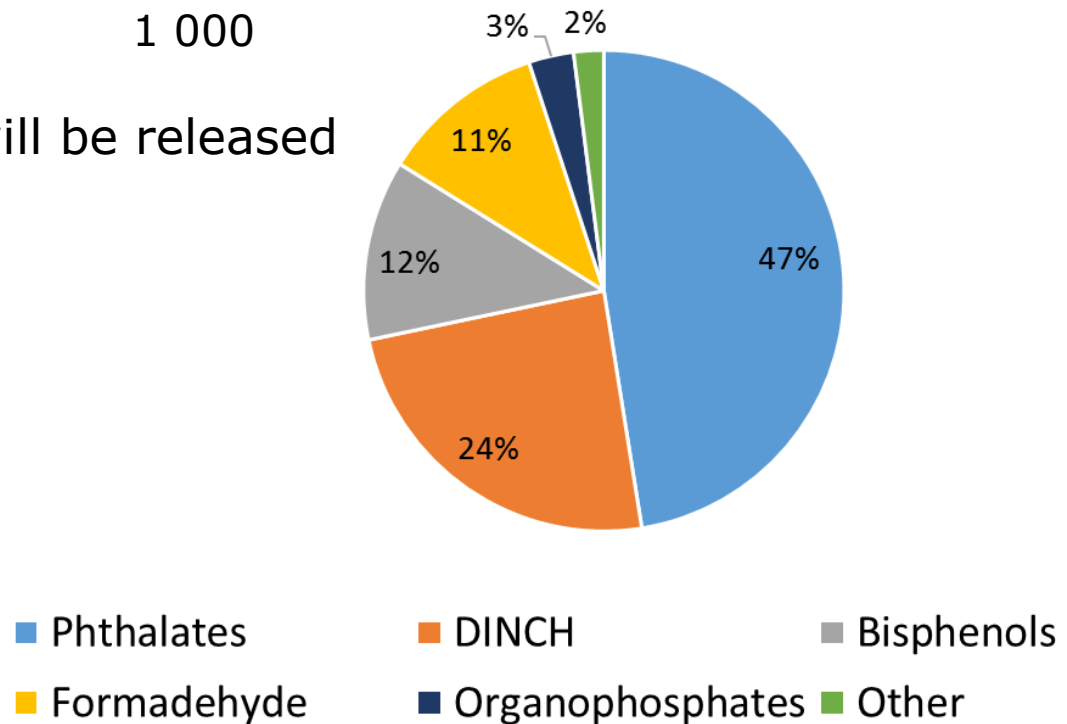
The unwanted chemicals contributed with less than 1% to the total amount of chemicals released from the cloths



Net supply to Sweden in ton/year

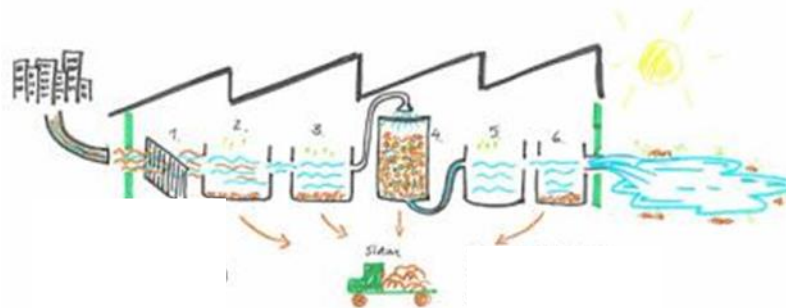
T-shirts:	10 000
Jeans:	6 000
Weathrproof jackets:	3 200
Working pants:	3 600
Fleece sweaters:	1 000

670 kg chemicals will be released



CONTRIBUTION TO EFFLUENTS AND SEWAGE SLUDGE

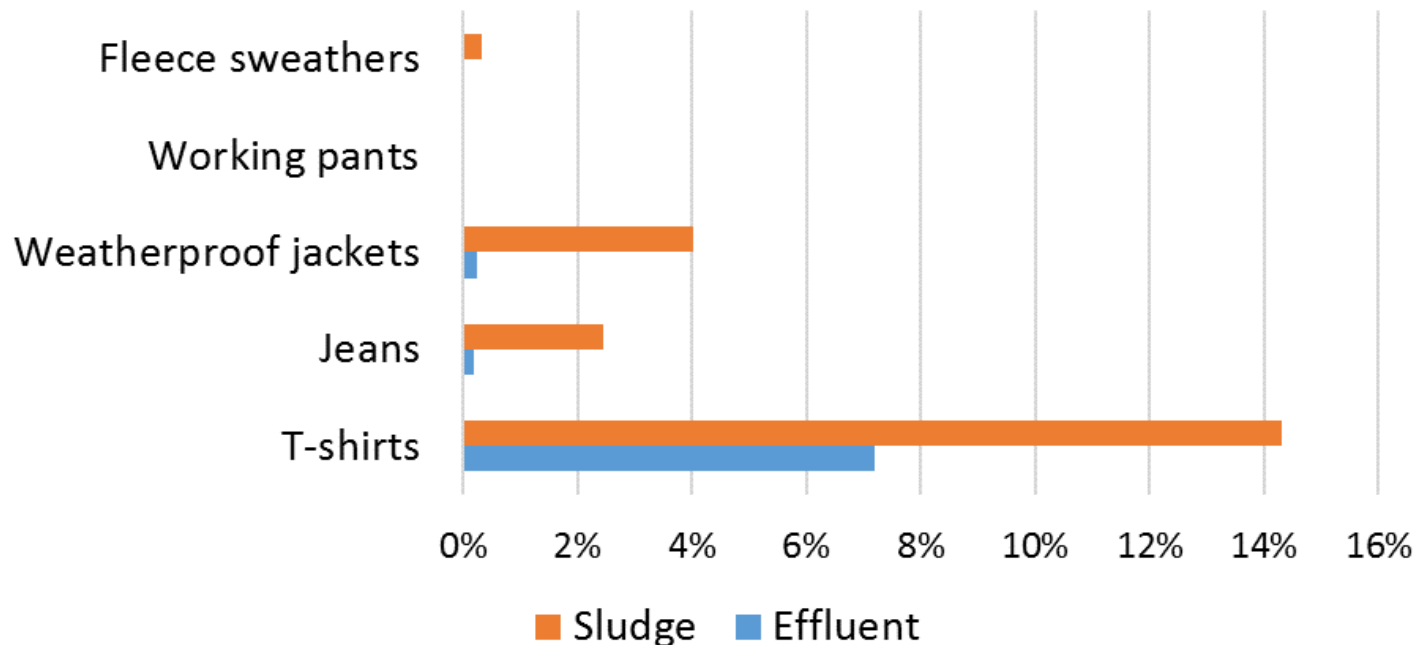
- Data for substances in effluent and sewage sludge
 - Phthalates
 - Organophosphates
- 1.2 billion m³ treated wastewater of which 2% is laundry wastewater
- 240,000 tons of dry matter of sludge



ORGANOPHOSPHATES

Assumptions

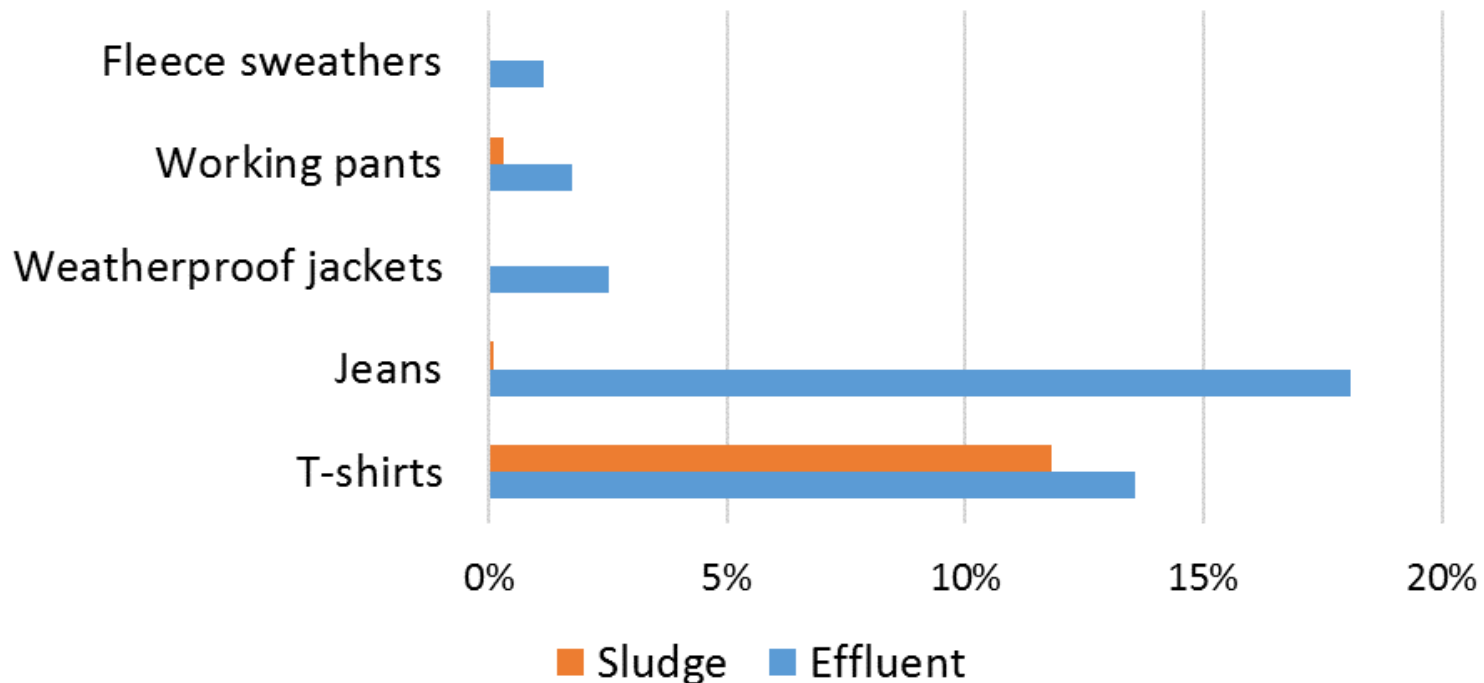
- TCEP, TCPP and TBEP → effluent
- TPP → sludge



PHTHALATES

Assumptions

- DBP and DIBP → effluent
- DEHP, DINP, DIDP → sludge



SUMMARY

- The contribution of phthalates, DINCH and organophosphates from laundry wastewater will be substantial.
- They can potentially end up in the recipient waters or where nutrients are recycled from sewage sludge.



SUMMARY

- Some of the compounds were released in very low concentrations, but these compounds may still pose a threat to the environment if the biological potency is high.
- From a principal point of view we should always aim to have zero tolerance for unwanted chemicals in clothing.



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