Harmful chemicals in waste textiles

- - should we avoid further dispersion?

- Mecki Naschke, World Future Council

Textile waste

- EEA estimated that we caused the emission of 121 million tonnes of CO_2 (270 kg CO_2 equivalent per person) to produce and handle all clothing, footwear and household textiles purchased by EU-27 households with about 27% of CO_2 emissions take place within Europe.

= plastics, cellulose and creatin. Why collect separately?

- Depending on the destination, up to 40% is still not put to any use *[National Geographic 2021]*
- important chunks are: plastics and natural fibres. largest fractions being polyester (in plastics section) and cellulosics (cotton and viscose). Smaller fractions are polyamide (sportswear), (highly elastic fibres can disturb recycling mechanics), wool + silk and acrylic
- Synthetics and blends generally on the rise because cheaper

(=successful out-sourcing of envi. & health-cost).

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What textile recycling?

- Post-consumer?
- Fibre-to-fibre processes almost non-existent as benefits questionable both from economic as well as environmental viewpoint, particularly dubious: chemical recycling.
- Mechanical recycling also not clearly beneficial
- requires clean separation (>sort by fibre-type)
- Colorants “disturb” mechanical recycling (> sort by colour)
- “Food-contact material” –to-fibre “downcycling”
- Pre-consumer production waste should be used (= envi. mgmt)

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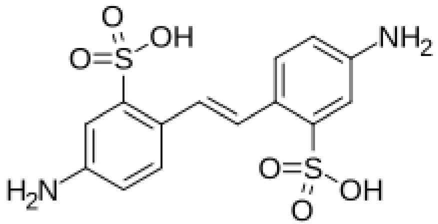
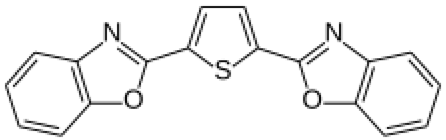
What to expect





All textiles:

- Wide array of disperse dyes and optical brightoners, like stilbenes
- Auxiliaries such as equalizing agent
- Fixing agent
- Maybe fabric softener, usually removed by wash.
- maybe fragrances i.e. musk xylene etc.
- Plastic prints can include plasticisers i.e. phthalates

Home textiles for public buildings, cinemas, theaters etc.: obligation for flame-retarding finish - using what? (GPP issue?)

Outdoor garments, umbrellas, tents: PFCs (which?)

Awareness campaign for "right performance level":

"Will you really be using this raincoat to climb Mt. Everest?"

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What not to expect

- Detergents /surfactants mostly washed out from garments, still present in any textile applications that do not undergo laundry
- Worker’s safety: butadiene and benzole during polymerisation,not in waste but potentially during “chemical recycling”

How about incineration?

- Heavy metals (antimony!, chromium, lead etc.) are emitted!

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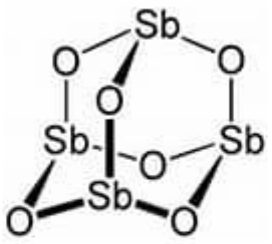
Synthetics

Energy need for chemical recycling is usually exceeding energy & oil need of virgin production.

Polyester:

- circularity: antimony tri-oxide (added in about 3%(weightwise) as catalyst during polymerisation, then again for fibre-extrusion
- For dyeing disperse dyes and carrier



Polyamide:

- circularity: monitor caprolactam
- h&s: Aminohexanoic Acid, Hexamethylendiamine, Cyclopentanon
- climate: during production: emission of nitrous oxide (N_2O)!!!

Polyacrylic:

not recyclable mechanically (decomposes below melting temperature)

monitor Acrylonitril and DMF

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Man-made cellulose fibers

These man-made fibres are made from natural polymers, i.e. wood-chips (or other) which are chemically dissolved, maybe cooked and extruded (imagine very fine spaghetti-ice-cream that hardens after being pressed (extrusion).

Viscose & Modal:

- monitor sulfur-balance
- h&s during xantation: formation of carbon disulfide CS2 (neuro-toxic effects) and potent greenhouse-gas (GHG).

Lyocell

- monitor NMMO during production and eventual recycling

All of these production processes are energy intensive and require large amounts of chemical inputs. There are new technologies for recycling being developed presently, currently options are still rather limited, and do not “close the loop.”

Natural fibres

- Pesticides probably washed out already (except BT cotton*)
- Rugs from wool unless washed: moth-protection i.e. permetrin
- Wool, silk and acrylic could contain acidic dyes which can require (heavy-) metals. (also for leather and digital printing)

<u>Agriculture issue</u> (not relevant for recycling)

- conventional cotton is fragile > extreme amounts of pesticides used, no food = no limits, although the cotton seed oil is used for human consumption (after refining) and for fodder.
- conventional sheep rearing (Merino sheep in Australia+): Uses “sheep-dip”, a little puddle in the ground (no soil-protection) where farmers add pesticides against fleas etc. and then chase the whole flock to swim through it, so that the sheep do not scratch > reduce quality.

***BT cotton**: about 80% of cotton on World Market is genetically modified, oftentimes incorporating a gene from “bacillus thuringensis” which produces a “natural” insecticide effective against the bollworm (main cotton-pest). BT can be sprayed targeted in organic agriculture. With BT-cotton the whole cotton plant produces the BT toxin at cellular level.

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Synthetics versus natural fibres

- Require wayyy more energy to produce polymer and to extrude fibre compared to growing, harvesting, cleaning etc.
- Similar to synthetics, production of man-made cellulosic fibres is energy-intensive.
- Like plastics they break down with remainders, split micro-plastic during wash (>water) and also during use-phase (>air).

All fibre shed micro particles during wash and also during wear. But ecosystems as well as our lungs and bodies are not adapted to digest/degrade micro-plastic. Humans inhale them when wearing synthetic sportswear etc.

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What goal do we need?

Prolongue the useful life!!!

- Incentivise up-cycling and repair, make “buy less” more attractive
- Incentivise sharing, renting (seasonal sports…), swapping-events

Gradually shift to natural fibres

- Do not fall for down-cycling, or breaking of clean circles like food-contact material to fibre (one-way-street)
- Ban misleading marketing claims for synthetics and make labels tell the truth of downcycling or deviating from closed loop.

Challenge:

How to create clean streams locally in globalized industry?

Organize separation by fibre-type, and maybe then colour.

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