Life Cycle Assessment of Artificial Turf: Importance of Microplastics

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Goal of the study

- Comparison of the environmental impacts of natural and artificial turf sports fields (TSF) using Life Cycle Assessment methodology by ZHAW
- Four types of turf under study:
  - Natural turf, no drainage
  - Natural turf, drainage
  - Artificial turf, unfilled, asphalt + EL 25 mm
  - Artificial turf, filled, asphalt + EL 25 mm
- Identification of ecological hotspots as well as recommendations for ecological improvement
- Update in 2022 by Carbotech AG:
  - Additional type: artificial turf, filled with kork, asphalt + EL 25 mm
  - Inclusion of micro plastic emissions for the artificial turf types
  - Impact assessment with MöK21 including micro plastic

Reference units

1. Per turf sports field: Use of a TSF in the city of Zurich for one year (lifetime 30 years)
2. Per usage hour: Use of TSF according to theoretical and effective usage hours

Sources of microplastic emissions in Switzerland

Plastic emissions	in tons per year	Share in %
Tyre wear particles	7’696	47%
Littering	2’700	17%
Streets	1’502	9%
Buildings and construction sites	1’320	8%
Sports fields	1’120	7%
Households	850	5%
Waste disposal	474	3%
Industry	620	4%
Agriculture	3	0%
Total	16’285	100%

Frischknecht et al. (2021)
based on Erny et al. (2020) and Schleiss (2017a)

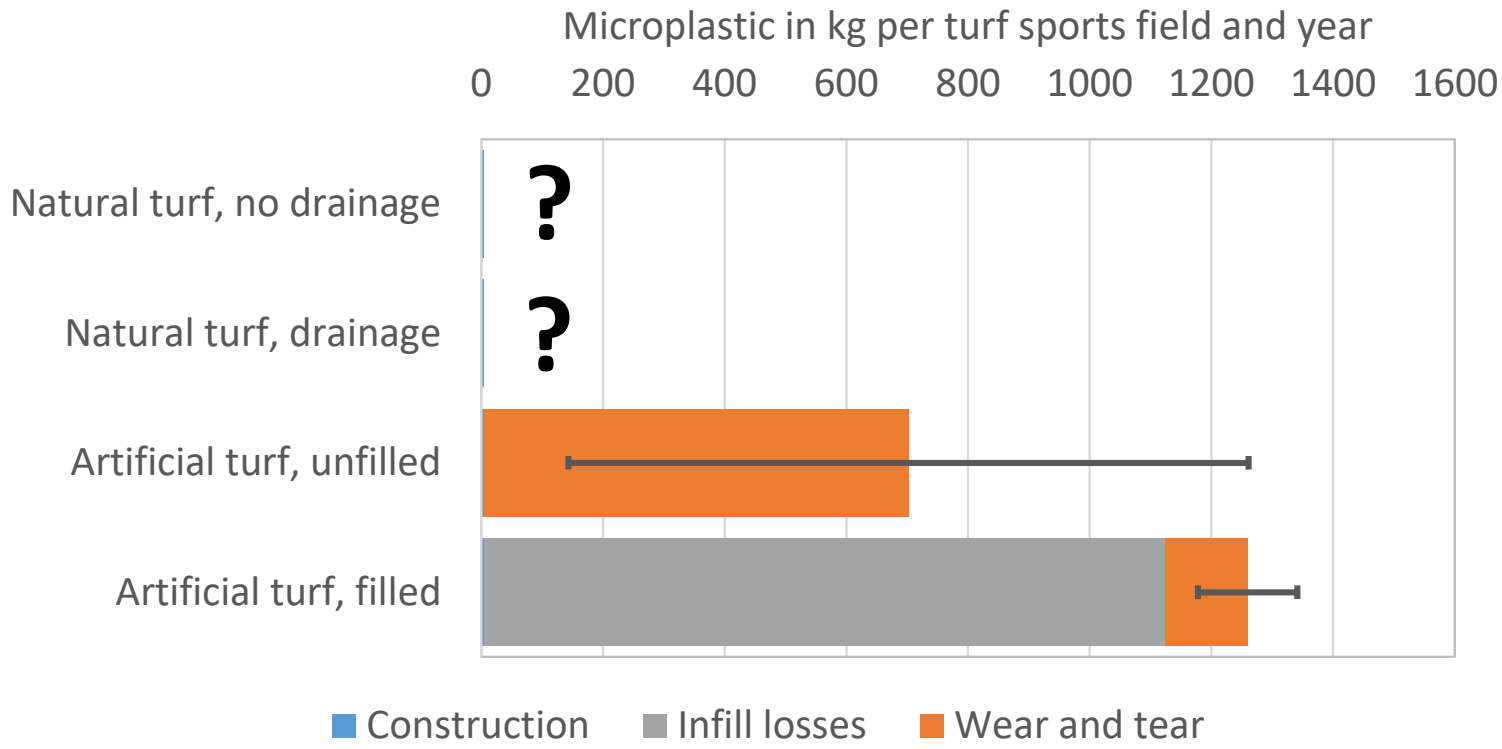
Eco-factors for microplastic emissions according to Ecological Scarcity Method 2021

Eco-factor for plastics in environmental (soil and water)	Edition 2021	Source
Normalisation (t plastic/a)	16’285	Erny et al. (2020)
Current flow (t plastic/a)	474	Schleiss (2017a)
Critical flow (t plastic/a)	687	Calculated from Schleiss (2017b) and ChemRRV Anhang 2.6.2.2.1 2b
Weighting (–)	0.48	
Eco-factor (eco-points/kg plastic)	29’000	

Frischknecht et al. (2021)

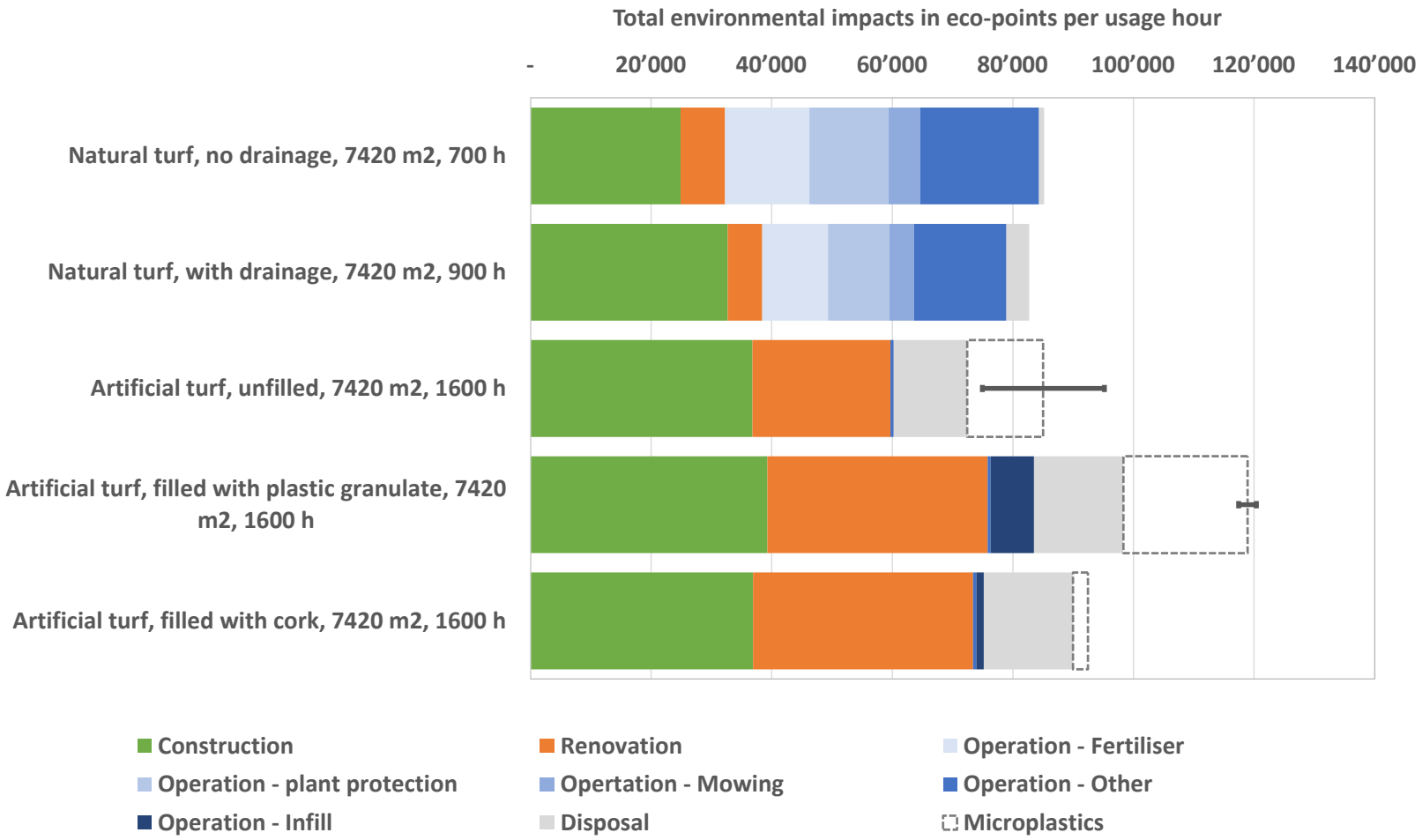
- 29’000 Eco-points per kg of microplastic emissions vs.
- Around 6000 eco-points for the production per kg plastic
- Ecological Scarcity Method 2021 in its current implementation does not distinguish between
  - micro- and macroplastic as well as
  - emission to soil or water

Microplastic emissions



- Infill losses: 50% of the yearly replenished amount
- Wear and tear: estimations based on Bertling et al. (2021), high range and uncertainty, especially for unfilled turf
- Estimated annual emissions from sports fields in Switzerland: 1120 tons per year (Frischknecht et al. 2021, Erny et al. 2020)

Total environmental impacts per theoretical usage hour



Conclusions

- Significant microplastic emissions arise from articifial turf sports fields (TSF)
- Accounting for microplastics can change the results in favour of natural compared artificial TSF
- With regard to filled artificial TSF, cork as filling material leads to lower impacts, as significant amounts of microplastic can be avoided

Life Cycle Assessment @ ZHAW

Zurich University of Applied Sciences
Life Sciences and Facility Management
Institute of Natural Resource Sciences

carbotech
Umweltprojekte und Beratung

Questions and answers

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Comparative Life Cycle Assessment of natural and synthetic turf

Life Sciences und Facility Management

IUNR Institut für Umwelt und Natürliche Ressourcen

Ökobilanzierung von Rasensportfeldern: Natur-, Kunst- und Hybridrasen der Stadt Zürich im Vergleich

für Grün Stadt Zürich

Version 1.0

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The complete study in German is available in the ZHAW Digital Collection:
https://digitalcollection.zhaw.ch/handle/11475/20774

In addition, there is an executive summary of the study in English:
https://digitalcollection.zhaw.ch/handle/11475/21510

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