FINAL REPORT

PART 3: SUMMARY

Investigations on outdoor sports fields with synthetic turf systems to determine wear phenomena due to fibre abrasion related to the intensity of use

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1 Initial situation

The ILOS at the Osnabrück University of Applied Sciences, together with the EMEA Synthetic Turf Council, the joint committee for synthetic turf systems (ESTC), is investigating outdoor sports facilities with synthetic turf systems throughout Europe in order to contribute to the estimation of the discharge quantities of secondary microplastics.
In the study presented here, the aim is to clarify which quantities of microplastic are discharged from synthetic turf systems through abrasion and fibre wear.

2 Method

In this study, 35 synthetic turf systems on large outdoor football pitches were investigated. The 25 pitches investigated in Hamburg are filled with sand. In addition, 10 rubber-filled pitches in Great Britain, the Netherlands and Italy were also investigated. The age of the selected pitches lies between 15 and 2 years.
Taking samples from the pitches, after suctioning off the filler, 20 fibre bundles are cut flush with the base fabric at each of the five test points representing different usage intensity. Sampling point 1 is used as a control area, where very low usage is assumed due to its location in the goal. The difference to sampling point 1 is taken as a measure of the mass lost through abrasion. Sampling point 2 is assigned to intensive use areas and test points 3 to 5 to extensive use areas (the method is described in detail in the report ILOS PART 1: SPORT FIELDS 2023-03).

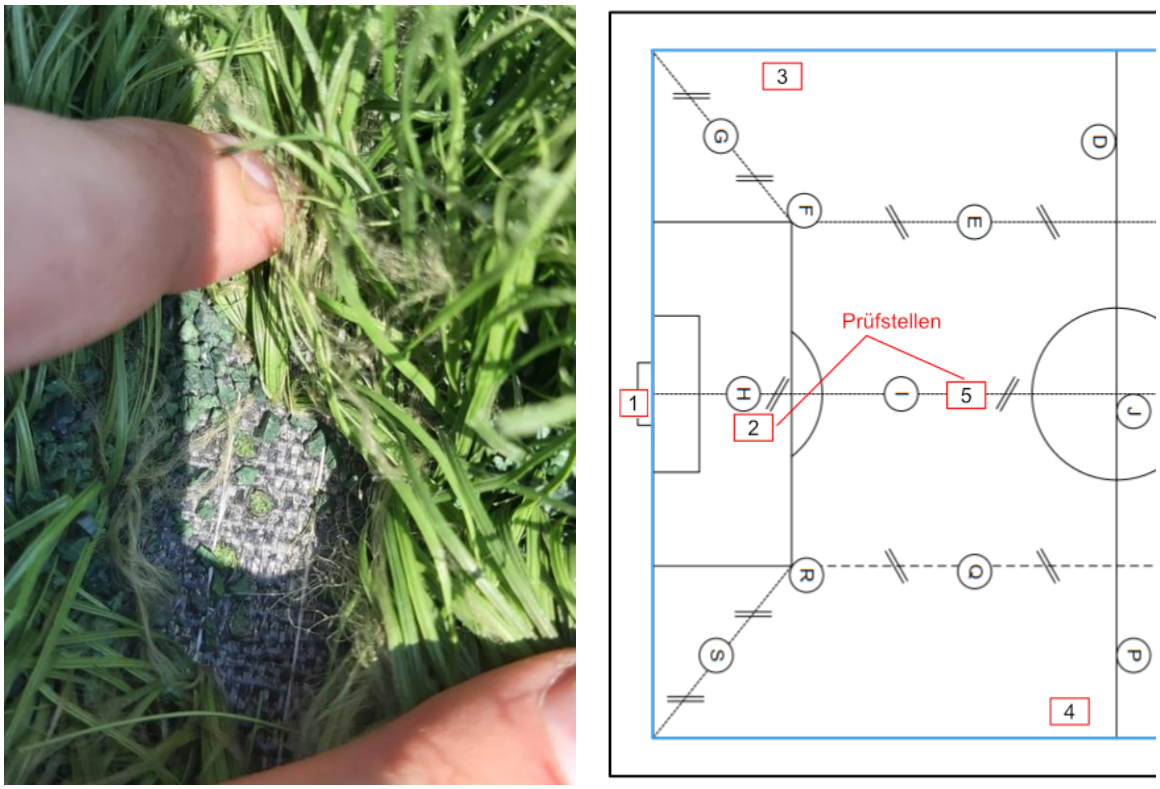

Figure 1: Overview of sampling and measuring points for football pitches (according to FIFA 2022, p. 23, modified).

After cleaning and drying, the fibres are measured and weighed in an analytical laboratory. In the statistical evaluation of the measurement results, in addition to the arithmetic means, the medians, as well as the coefficients of variation are compared with the aid of boxplot representations. The difference in mass between the different sampling sites and the control site can be used to estimate the loss of mass over the age of the pitches. Since the investigated synthetic turf systems have different pile weights, the mass loss is given in relation between 0.0 and 1.0 to allow comparability. For clarification of possible statistical trends, regression degrees are calculated which have the highest agreement with the obtained values.

3 Evaluation of the sports fields

In this summary, only the mass losses in the intensive as well as in the extensive area are presented and compared.

3.1 Fibre wear Hamburg

The following two graphs show the total mass loss from sand-filled pitches in Hamburg for test sites 2 and 4 over time.

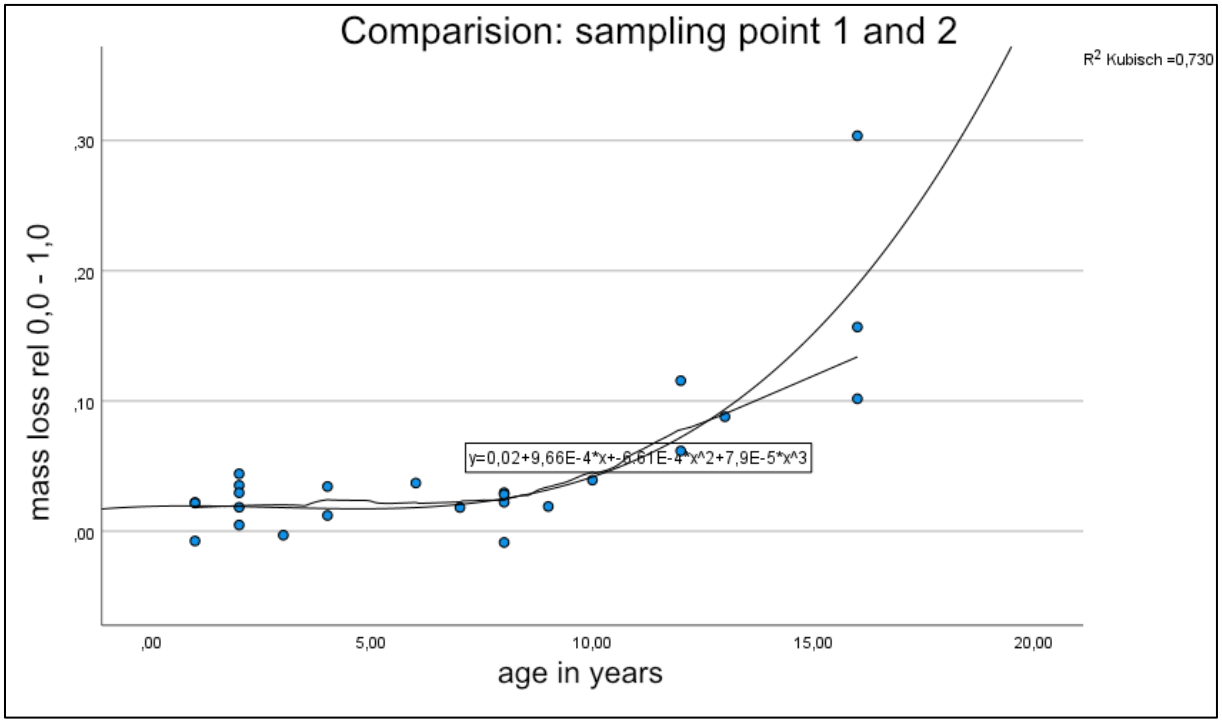

Figure 2: Total fibre wear on pitches in Hamburg at sampling point 2 - intensive.

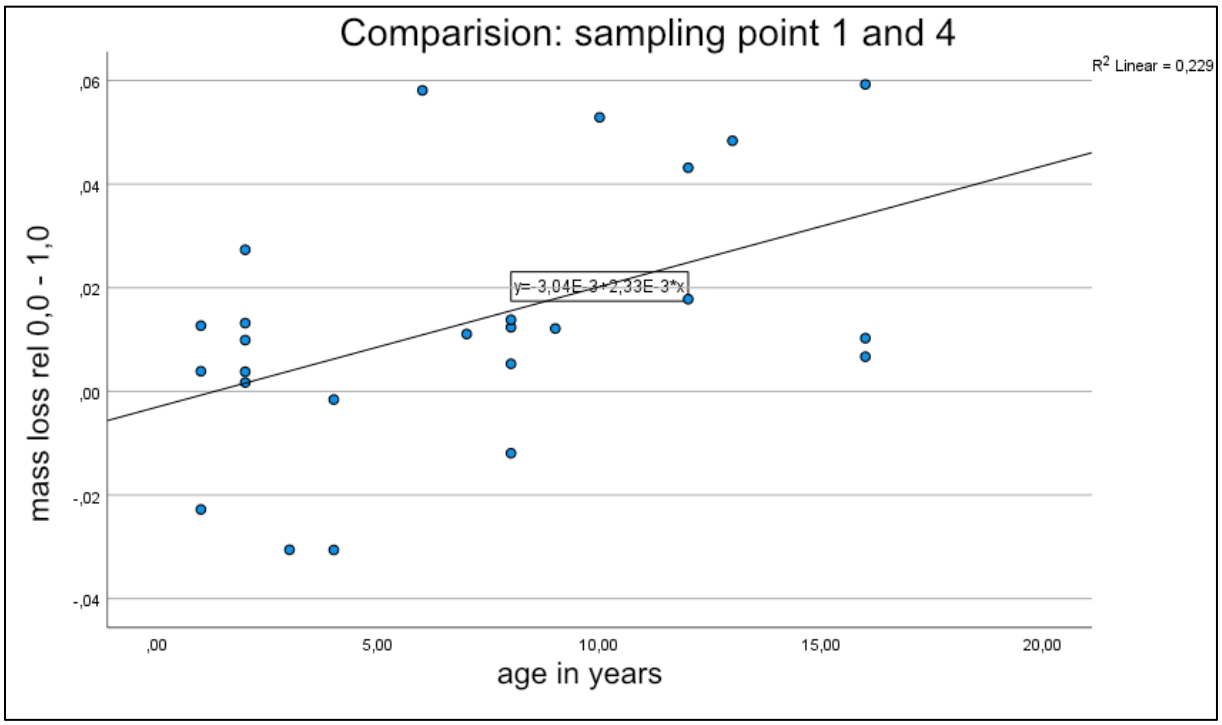

Figure 3: Total fibre wear on pitches in Hamburg at sampling point 4 - extensive.

The excessive mass loss of the new pitches in test site 2 is shown in the following figure by converting the total mass loss to the average mass loss per year.

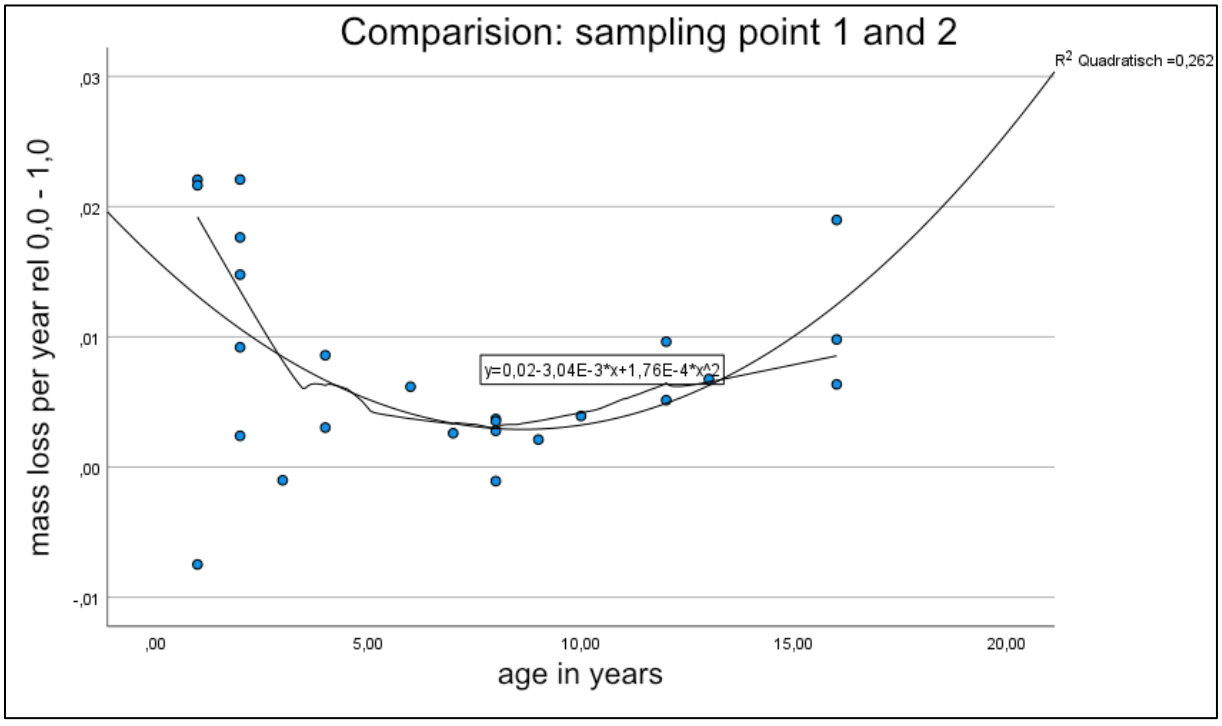

Figure 4:Total fibre wear per year on pitches in Hamburg at sampling point 2 - intensive.

3.2 Fibre wear within the investigated pitches

The mass losses of the rubber-filled pitches in Great Britain, the Netherlands and Italy are presented in identical form.

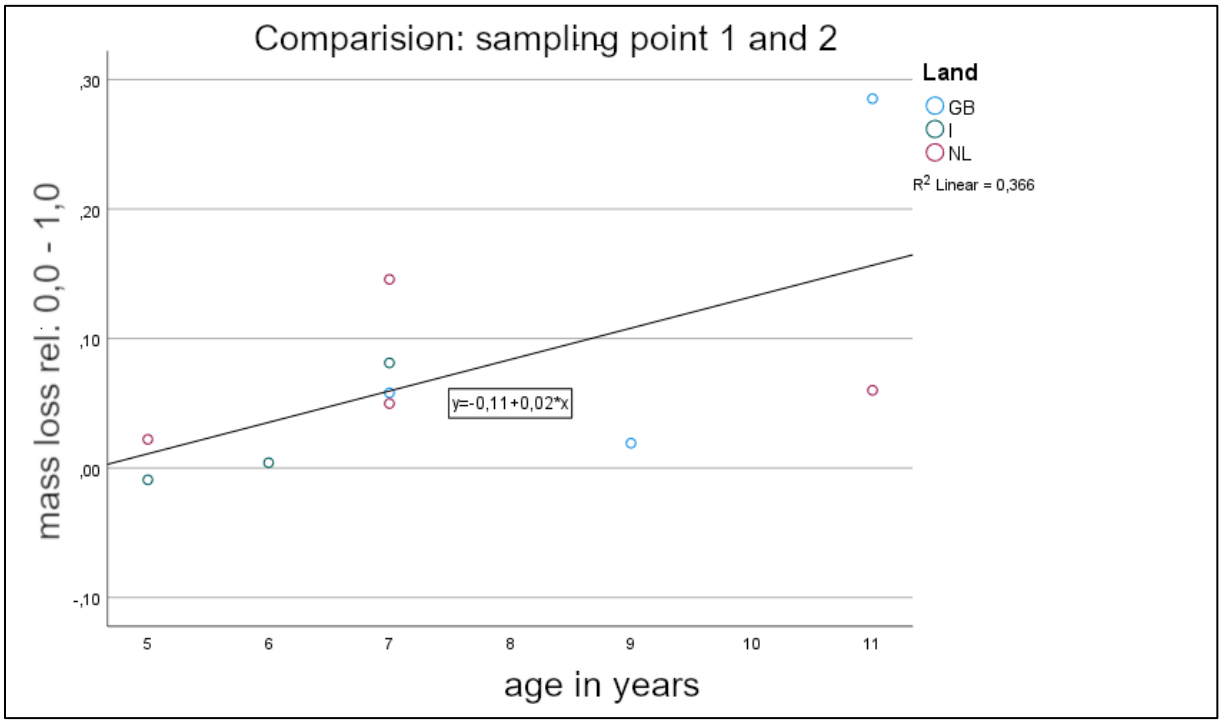

Figure 5: Total fibre wear on pitches in Great Britain, Italy and the Netherlands at sampling point 2 - intensive

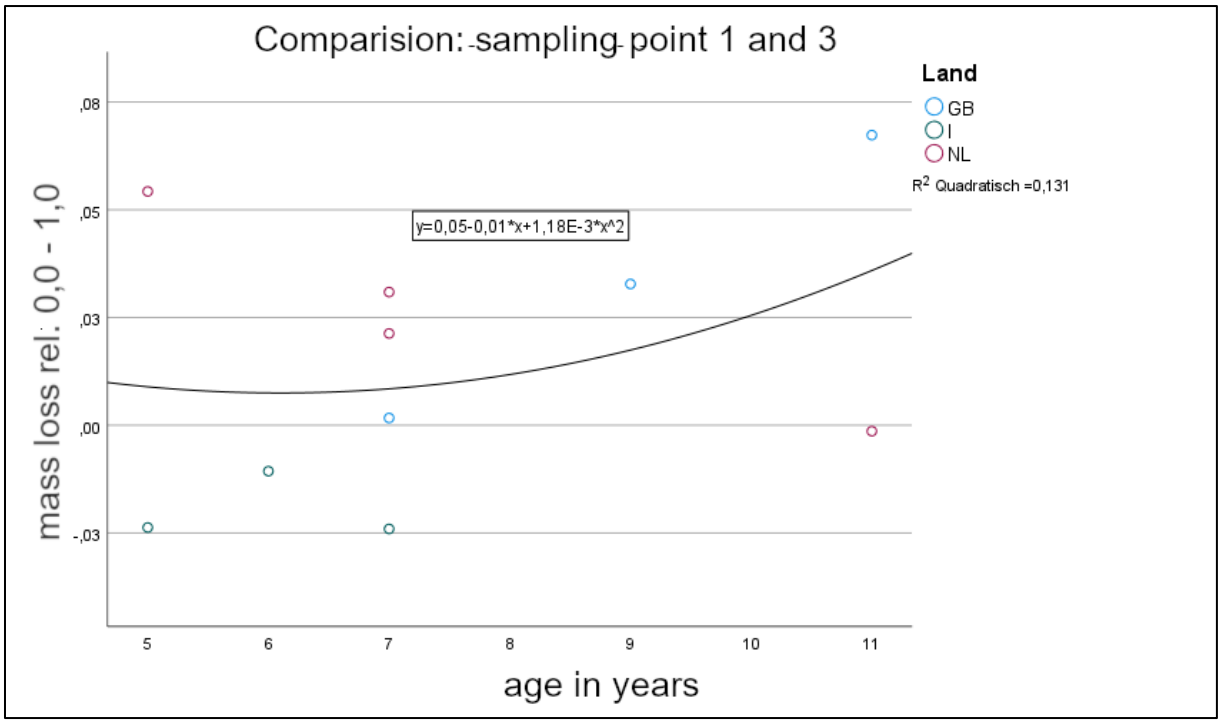

Figure 6: Total fibre wear on pitches in Great Britain, Italy and the Netherlands at sampling point 3 - extensive

3.3 Infill comparison

Following the individual analysis, the different filler types are compared. In order to show a possible significant dependence between filler type and mass loss, the 95 % confidence interval is plotted in addition to the regression degrees.

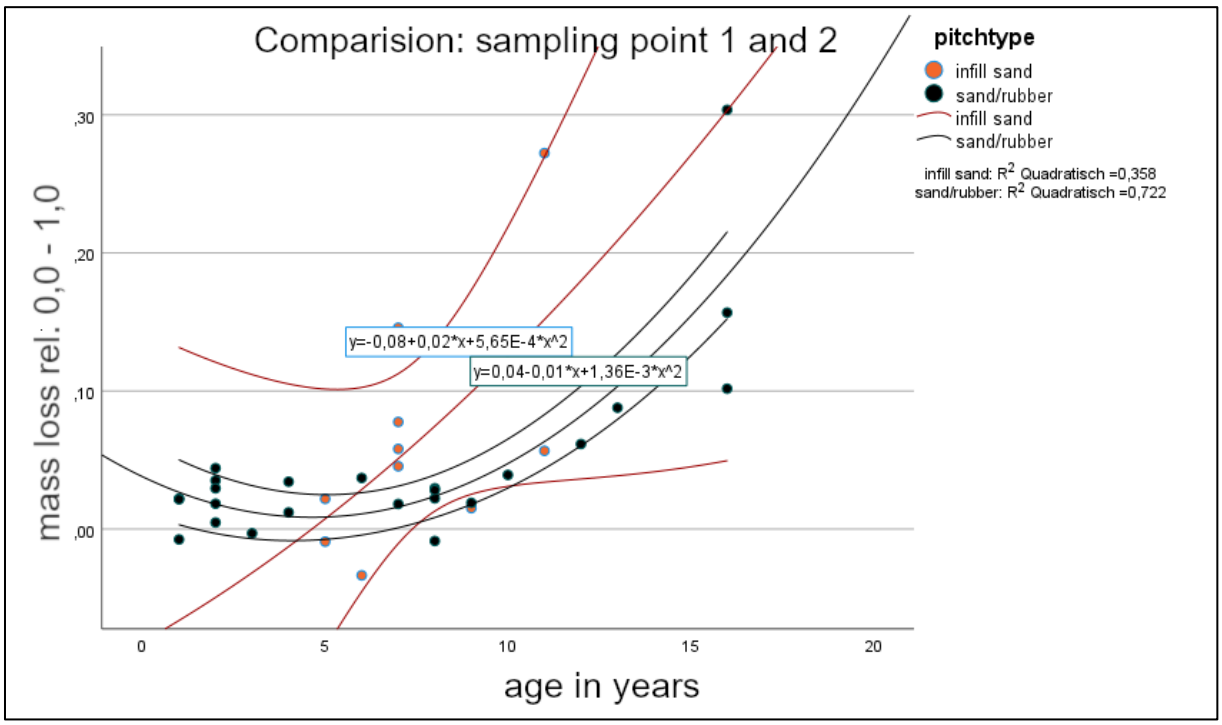

Figure 7: Comparison of fibre wear on pitches with sand-rubber infill and sand infill at sampling point 2 - intensive

4 Discussion of the results

The measurement results show a high scatter. If sampling points 2 to 5 are compared with the control point, a significant loss of mass can be observed. The Comparison between Sampling point 1 and sampling point 2 shows the highest average mass loss. This is not surprising, since this point is located in the intensively used area .

The negative values are caused by the erroneous assumption that there is no mass loss at the control point, sampling point 1. This is amplified by statistical outliers due to the high variances. The excessive mass loss from the pitches in Hamburg, with a low age, is possibly explained by torn out fibres, which are insufficiently glued into the carrier fabric. However, deviating qualities of the polymer would also be a possible explanation. The average percentage of completely missing fibres in Great Britain, the Netherlands and Italy is 1.4 % and thus has a significant share of the total mass loss. The sharp increase in mass loss towards the end of the service life, > 10 years, is probably due to the reduced technical properties of the fibre material, which by then has aged considerably. The effects described are more pronounced in the intensively used areas than in the extensively used areas.

A significant loss of mass can be determined overall. However, since the measurement results show a high variance, no significant relationship between the mass loss and site-specific properties, such as geographic location, filler type or fibre cubature, can be demonstrated. However, statistical trends can be observed. For example, the observed mass loss increases with increasing pitch age and with increasing intensity of use.

The research to date provides a preliminary indication of the amounts of wear on synthetic turf. The methodology appears sound and provides a means to objectively measure fibre loss on playing fields; however, more data are needed to improve the accuracy of the results and to understand the causes of yarn wear.

Further research should include measurements from more fields, applications, and geographic locations to improve confidence in the developed methods and findings. With a larger experimental matrix, other factors influencing abrasion in addition to the age of the pitches, can be determined. This will provide better insight into attrition and is something that is being planned.

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Prof. Martin Thieme-Hack

5 Literature

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