FFG-Praktikumsbericht von Julia Richter, Vorarlberg

Sommer 2020

1. MEIN PRAKTIKUM

Gib einen kurzen Überblick über dein Praktikum und füge ein Foto (z.B.: du an deinem Arbeitsplatz) ein.

The Research Institute for Textile Chemistry and Textile Physics is a local branch of the University of Innsbruck located in Dornbirn. It was my workplace for four weeks during which I used to work on a project about the changes in cotton fabrics after alkali treatments.

For producing sustainable clothes, biofuel or ethanol using cellulose that had been taken from plant sources are a convenient option. When working with cellulose polymers in textiles a problem that often occurs is the difference in reaction between areas due to crystallinity. In the case of cotton an alkali treatment can be done to reduce the crystallinity and increase the similarity of the fibres. The effects of the treatment on the textiles were the subject of my research.

In our experiments on pure and uncoated cotton my supervisor Dr. Manian and I treated the fabrics with three different alkali solutions using different soaking times within the samples. This we did in two sets, once putting tension on the fabrics and once without holding it in shape. For testing the differences between the samples with different solutions, soaking times and tension we did measurements concerning length, wide and weight. To find out, which impacts the treatment would have on the samples' quality we did a red-green test followed by colour measurement for both sets. In this constellation we also took a look at the impact of colouring concerning FTIR measurements.

Additionally, I spent a week at the MINT summerschool in Innsbruck to get an inside look on the University and its' subjects.

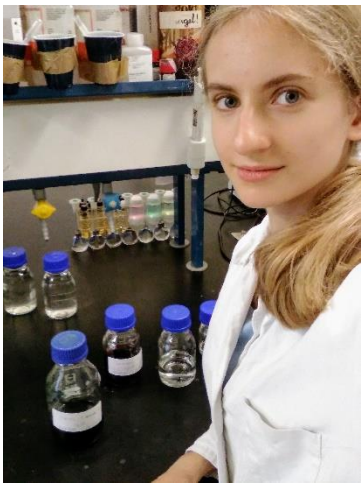

Figure 1: Me in the loboratory

2. ORGANISATION UND BETREUUNG

Kurzbeschreibung der Organisation (Unternehmen oder Forschungseinrichtung), in der du dein Praktikum absolviert hast und wie du in deinem Praktikum betreut wurdest.

The Institute for Textile Chemistry and Textile Physics is a part of the University of Innsbruck but located outside the university campus in Dornbirn in Vorarlberg. That's because Vorarlberg has the highest density of textile industry in Austria.
The research Institute itself is split in two places: one in the same building as the HTL Dornbirn and the other on Rundfunkplatz 4.[1] Out of my own experience I can tell that those places are separated by approximately five minutes of walking.

[1] Universität Innsbruck (Hrsg.): Research Institute of Textile Chemistry and Textile Physics. The history of the Institute. https://www.uibk.ac.at/textilchemie/history/ (Zugriff: 5.8.2020).

Throughout my internship I was being supervised by Dr. Avinash Manian, who conducted me on working on my project excellently. Easily understandable and patiently he explained the project in general and step by step every experiment to me in order to enable me to work on my own. When I was operating he would always be open for questions and he would check up on me occasionally to keep track on my progress and help me if necessary.
Even though the other members of the institute were busy working on their own projects they offered me support and advice in case I needed it. Generally seen I have experienced the internal culture of the institute as open hearted. This showed during worktime as well as in the lunch break when I was welcome to engage in conversations and got to know my colleagues personally.

Figure 2:Dr. Aguiló-Aguayo (bottom right side), Laura – another girl doing an internship – (bottom left side), Dr. Manian (back right side) and I (back left side)

3. PROJEKT UND TÄTIGKEITEN IM PRAKTIKUM

Beschreibe ausführlich das Projekt, an dem du gearbeitet hast, deine Aufgaben und Tätigkeiten sowie die erzielten Ergebnisse und möglichen Schlussfolgerungen. Berichte zusätzlich über deinen typischen Tagesablauf und die Zusatzaktivitäten, an denen du teilnehmen konntest.

My Working Hours and other Projects of the Institute

Usually my working day started at eight in the morning and ended at about quarter past four in the noon because of my eight hour day, which included a half an hour break for lunch. On Tuesday I started at nine twice and then stayed until quarter past five due to the institutes habit of having one of their members holding a lecture about their current research. I was lucky to have two regular Tuesdays before the summer break of lectures, which were about dyeing with indigo and chloride detection sensors used for a project about textile fibres in the production of cement. Additionally I got an insight into the projects of two other internship students. Together with a girl my age I could prepare copper solutions for coating cotton in order to make the fabrics conductive and listen to her supervisor Dr. Aguiló-Aguayo talking about the chemical background of this experiment.
The other student who was doing an internship let me take a look at his different kinds of fabrics and explained how his research on their composability was progressing.

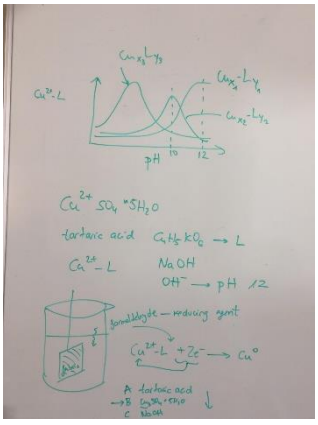

Figure 3: Notes for understanding the experiment of Dr. Aguiló-Aguayo

Alkali Treatment on Cotton

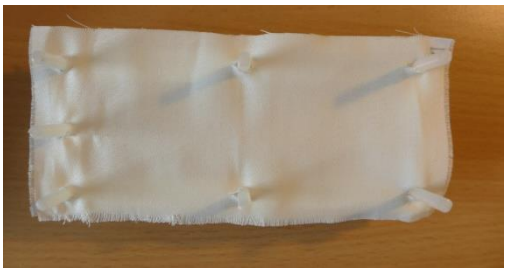

Abb.4: cotton samples fixed on the frame

For the experiment three different alkali solutions and 36 pure uncoated cotton samples were needed. Per alkali solution my supervisor Dr. Manian and I used four different soaking times of which we repeated each twice with sets of two samples.

Those four samples per alkali and soaking time consisted out of three cut by warp and one cut by fill all marked with the solution they would be bathed in, the time we would let them sit in the liquid and a note whether it was a fill or which of the three warps.
Fill and warp are two directions of cutting a fabric. When the longer side of the sample faces the selvedge, which is the part of the fabric that was used to transport the fabric during the production process and is usually marked by pinholes, the way of cutting is called warp. If the longer side stands normal to the selvedge the fabric is called a fill.
Another marking on the fabric were two times two dots with a measured difference of three cm drawn on the middle of the samples. One set of them parallel to the length of the fabric the other one parallel to the wide in order to measure the shrinkage force influencing the cotton during the treatment. Each of the fabrics had a wide of six cm, a length of thirteen cm and seven holes made for fixing the fabrics onto a plastic frame leaving a ten cm long and three cm wide whole to let the liquid flow through in order to wet the fabric completely. It was printed out with the 3D-printer using the plastic acrylonitrile butadiene styrene (ABS), which is resistant against strong alkali.

When preparing the alkali solutions we had to calculate the weight by weight percentages of two litre liquids in total to prepare the three concentrations of 11%, 22% and 30% alkali. The soaking of the samples took place in four time spans: 30s, 60s, 180s and 60min. After bathing the fabrics, they were held into a bucket of hot water that was constantly running to remove the leftovers of the alkali during those five minutes of washing time. Then the samples were pulled off the frame and put into the acid CH_3COOH for an hour to neutralize them. Afterwards they were air dried.

Figure 5: set-up for my experiments

When taking the fabrics off the frame the tension that had increased through the shrinking of the cotton was noticeable. There was a big difference between the feeling when removing the fabrics bathed in 11% alkali and the ones in 22% alkali. In comparison to that there was no noticeable difference in pulling the fabrics taken out of the 22% alkali and the30% alkali off. Another difference was the rolling up of edges, which rarely happened to the cottons soaked in 11% alkali but was visible with nearly every sample out of the 22% and the 30% alkali bath.

The second experiment was held on three pieces of warp per half a minute and per three minutes of inserting them into the same three alkali solutions as in the first experiment. Those pieces were put in the bath without any addition to keep it in place. Afterwards they were also washed for five minutes and left in the acid CH_3COOH for an hour.

Measuring the Shrinkage

After soaking in the eleven percent alkali the distance between the foresaid dots, which were originally placed three cm away from each other, had decreased by one or two mm.

Concerning the samples that sat in 22% alkali the dots had usually lost two or three mm of distance. What all three concentrations have in common is a higher shrinkage force on the length but still there is no definite result to see concerning the question if one side shrinks more, especially because the fill samples ought to represent the opposite behaviour of the ward pieces due to its structure, which is not always the case. In conclusion we can't speak of a general effect.

Also with the 30% solution the length had shrunk more. Except for the two fills there is only one example of higher wide shrinkage. The loss of distance between the dot was around two to three mm, which is very similar to the 22% alkali solution.

When doing the same experiment without putting tension on the samples not only the shrinkage got worse but there was also a clear difference between the shrinkage of the length and the wide stressing what we had noticed within the samples soaked in the other alkali solutions. There is only one piece of warp that had a higher wide shrinkage. Differences seem to be hardly noticeable looking at the fabrics soaked in the 11% solution.

Comparison of the Weight

To compare the weights of the treated and untreated cotton samples Dr. Manian and I took the average mass of the untreated cotton samples as reference. Our first expectation was a slight loss of mass because of the reduction of material in the yarns because of the shrinkage.
The actual result showed a gain of mass in most cases. The most definite result was visible in the measurements of the fabrics treated without putting tension on them.
A likely explanation is an increase of moisture after the treatment.

Titration

To determine the exact concentration of alkali in the solutions I did a titration of the alkali solutions before and after usage with the Mettler Toledo DL 50 Graphix. The idea behind Titration is, that the amount of acid or alkali, which are called analyte, can be measured by diluting it in either acid or alkali depending on what has an opposite pH until the pH of the analyte reaches zero.
For finding out the exact concentration of our titrant HCl we had to standardize it with Na_2CO_3, which was dosed with exactly one mol per litre.

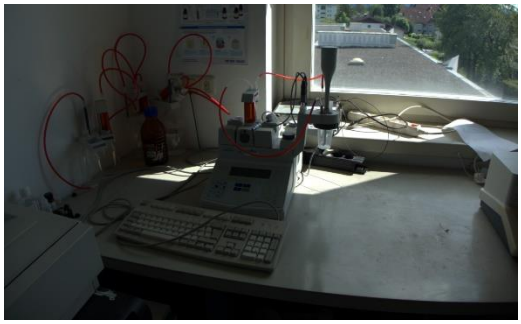

Figure 6: device for titration

The first measurement showed how much HCl was needed to neutralize the Na_2CO_3 and brought us to the result that mol per litre of HCl were incorporated in the titrant solution. Then I titrated the original and the used solutions, which both were represented by two probes diluted in DI water by the rate of ten within the eleven and the twenty two percent solutions and by one hundred within the thirty percent solutions, which was done by mistake. As the results for the thirty percent solutions were not comparable, I multiplied them by ten. The results of the titration measured in mol per litre are pictured in the following table.

While within the eleven and the 22% alkali solutions there are nearly no meanderings the 30% solution shows a difference between the used and the not used probes. This might be due to the inaccuracy of working with the wrong dilution.

Red-Green Test

The idea behind the red-green test is to check the fabrics quality through bathing it in a solution containing red and green colour. Depending on which of the two dyes will soak into the samples more easily one can determine its' properties. Ripe cotton yarns with thick cell walls will turn red and not ripe cotton yarns with thin cell walls will absorb more of the green colour.

For preparing the testing solution I prepared stock solutions for the colours Sirius green and Livercell red as well as for NaCl and Na_2CO_3. In order to find out the amount of dyes and additional components I needed I cut two out of the alkali treated warp samples of both experiments in half and weight them. After creating a table about how much of which substance I required I added those figures to find out how much of the stock solutions I had to generate I could prepare them. During the experiment every sample was soaked in the right proportion of the stock solution and DI water depending on the samples weight.

The process of letting the sample sit in the dye took place over a water bath heated up to 85°C (degrees Celsius) where they were placed for half an hour and stirred by hand every three minutes. After the procedure the liquids' leftovers on the samples were washed off and the fabrics air dried.

Figure 7: dyeing the samples

Colour Measurement

All dyed samples were measured with the spectrometer CM_3810d Konica Minolta to determine the portions of red and green contained in the fabrics. Dr. Manians' expectation was that the samples out of the alkali treatment done without putting tension on the fabric would show a more greenish result than the ones stuck to the frame because latter ones had a more controlled shrinkage and would not allow pores to deform in a way they could absorb the larger molecules of the green dye.

The results showed that the higher the alkali percentage or the longer the soaking time during the treatment was, the redder the colour got. Comparing the samples held on a frame and the ones bathing without tension there was a clearer difference to see between the higher alkali concentrations. In fact, the samples treated without tension were more greenish than the others but still they were mainly red.

FTIR Measurement

The FTIR measurement shows the vibration and arrangement of the functional groups in form of patterns in specific regions of the diagram. Looking at the alkali treated and dyed samples the question to be answered was if either colouring or the alkali treatment had an influence on the measurement results.

MINT - Summerschool

For one week a group of nineteen girls visited diverse lectures about several MINT-subjects offered as Bachelor- or Master-studies at the University of Innsbruck. I was one out of seven students who lived at the Kolpinghaus because our homes are a long way apart from Innsbruck.

Figure 8: the summerschools' students and our tutors

On the first day we were guided through the main building of the university and got an introduction on the subjects offered. As we couldn't visit the library because of its' hygiene concept, which wouldn't allow too many visitors, we were shown pictures of the study rooms and were guided through the book search on the libraries' webpage. In the afternoon we got an insight on the subject pharmacy, followed by mathematics, mechanics, electrics, mechatronics, molecular biology and microbiology, computer science, geology, botany, physics and chemistry the following days. Even though we couldn't visit most laboratories due to the pandemic all lecturers managed to give us a nice insight into their workspace through photos and videos. Spending one week in Innsbruck enabled me to get an overview over the university's subjects and a gaze into its' scientific research. I'm pretty sure that this will help me deciding between the different fields I have been considering for my future education. It was also a great chance to connect with other girls who have the same interests as I have and I'm still having contact to three of them.

4. MEINE PERSÖNLICHEN EINDRÜCKE

Fazit: Was hat dir an deinem Praktikum besonders gut oder überhaupt nicht gefallen? Welche Erfahrungen kannst du für deine Zukunft (Schule, Studiums- oder Berufswahl) mitnehmen?

In conclusion I am convinced that those four weeks shaped my own imagination of my future work. I didn't just gain confidence in my will of studying a chemical subject at university, but what's more, I discovered my capability of working in a laboratory. Preparing and experiments and analysing the results was as much of a pleasure as conducting the experiments and running the institutes' machines gave me a feeling of responsibility.

Before starting my work at the institute I felt unsure about if my knowledge and abilities were sufficient for working on a scientific project. Now that I had worked on this project I have extended my knowledge and got an inside look on what it is like to work in a field where the basics out of my chemistry and physics lessons find an active use. I'm thankful for having received this great opportunity and glad that I decided to take a shot even though I had doubts in myself.

5. FOTOS

Hier kannst du zusätzliche Fotos von deinem Praktikum einfügen.

Figure 9: My workspace

Figure 10: device for FTIR-measurement with cotton sample placed inside

All pictures used in this report I took by myself except for figure 8. The image rights of this photo belong to the public relations office of the University of Innsbruck which gave me the permission to publish it in my report. Their contact and further information about the MINT-summerschool can be found under following link:

https://www.uibk.ac.at/public-relations/