Improving Chemical Management through more Sustainable Practices in Chinese Shoe Factories

Toolkit – Version 1.0

german cooperation
DEUTSCHE ZUSAMMENARBEIT

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

develoPPP.de

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Contents

How you can benefit from this toolkit:

Between 2018 and 2021 the German online fashion retailer Zalando and the German Agency for International Cooperation Deutsche Gesellschaft für Internationale Zusammenarbeit' (GIZ) GmbH implemented a comprehensive project approach to better understand the situation and needs of a chosen set of factories in China. With the aim to improve Chemical Management through more sustainable practices, the project collected detailed information from 12 factories by mapping the local production situation, conducting chemical testing, setting up and monitoring action plans with the factories and training the factories workers to become in house trainers for chemical management.

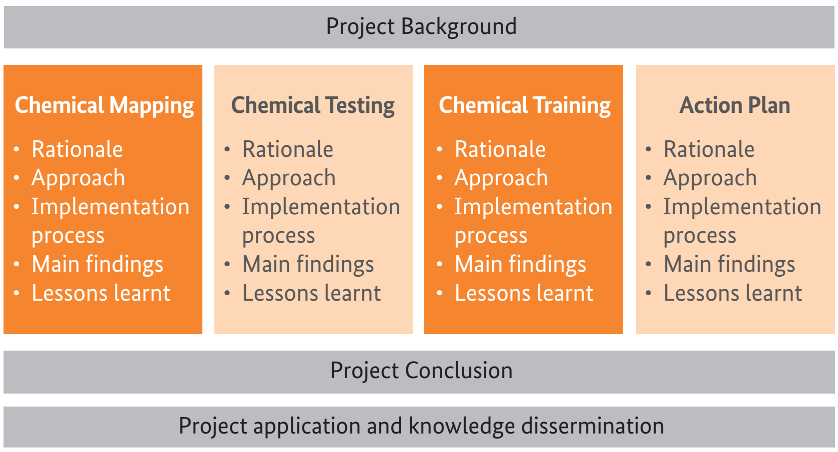
While the sample size may not be huge, the in-depth assessment and cooperation with local factory owners and managers through the course of the project revealed some key findings which can help others set-up, assess, and improve their own chemical management systems.

Since this is a project supported by funds from the German Ministry for Economic Cooperation and Development (BMZ) with the goal to improve chemical management practices in the whole industry, the project will make its findings, methodology and approach as well as the tools used freely available. This toolkit will therefore do two things for two groups:

- Brands & Retailers can use the overall toolkit, including the first more general chapters, to understand and copy the overall project approach in their supply chain. This relates to the elements of the project (esp. mapping, testing, training and action plans), but also to overall project set-up management and lessons. The approach described here includes information on how to set up develoPPP.de programme, however, brands can also implement the approach fully independently or together with other brands and retailers at own cost.

- Suppliers can use the fact sheets on each thematic area, to learn about the parts they are most interested in, as well as the respective tools they can use in the implementation. It is encouraged that suppliers also consider copying the full approach, however, for suppliers that are mainly interested in one topic, the toolkit shall also allow easy access to information on one thematic area only.

DPP GIZ and Zalando: Project Methodology / Toolkit



The structure of the fact sheets for each thematic area will always follow the same logic: First you will learn about the benefit and rationale of engaging on this activity, then you will learn more about the approach we used and how it can be implemented, then, you will find some notes regarding main findings, what costs to expect and some lessons we found relevant to share.

This toolkit is by no means "complete" and of course, the local situation in each factory may be different, but over these three years, we felt there are some common themes which came up again and again and which we think will likely apply, at least to some extent, to many production sites.

Reach out: We will make this toolkit and all other information available on www.asiagarmenthub.net which is a multi-language platform for sustainability resources in the textile and garment industry in Asia. We look forward to receiving your feedback and experiences with our toolkit on one of the online discussions on the Asia Garment Hub or directly via email to us at Tingting.Chen@giz.de.

Abbreviations

BEPI	Business Environmental Performance Initiative
BMZ	German Federal Ministry for Economic Cooperation and Development
CMA	Chemical Management Audit
CMS	Chemical Management System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
HW	Human Resources
OECD	Organization for Economic Cooperation and Development
MRSL	Manufacturer Restricted Substances List
PCP	Pentachlorphenol
PID	Photoionization detection
PDCA	Plan-Do-Check-Act
PPP	Public Private Partnership
PU	Polyurethane
RSL	Restricted Substances List
SDG	Sustainable Development Goals
SDS	Safety Data Sheet
TeCP	Tetrachlorphenol
ToT	Training of Trainers
VOC	Volatile Organic Compound
ZDHC	Zero Discharge of Hazardous Chemicals

1. Project background

1.1 Industry background: Relevance of Chemical Management Systems

The shoe industry plays an important role in the development of China's livelihood economy. As the available income of China's huge population continues to rise, the consumer demand for footwear products grows. However, with the rapid economic growth of the industry, environmental problems and pollution are also increasing. Along with the stringent environmental regulations, the exposure of media and the surveillance of production, more and more brands get down to help their suppliers to eliminate the emission of hazardous chemicals and other restricted substances by assuming responsibility through sustainable production.

Benefits of a Chemical Management System	
Maintain a license to operate	Reduce down time by creating a safer work environment
Access to global market	Stop potential hazards before they become an issue
Maintain a competitive advantage	Helps facilities ensure that RSL compliant materials are being produced; becomes invaluable in tracking down issues if they do arise
Minimise excessive or replicative chemical purchases/ consolidate chemical purchasing	Traceability of chemicals in the supply chain
Reduction in costs by reducing waste/overages	Reduction of chemicals can result in loading reduction in ETP
Enforce chemical managing knowledge by expert or certified trainer	

Excerpt from the original training materials (Basic training, Module 2)

1.2 Focus on Volatile Organic Compounds (VOCs)

One of the objectives for this project was to get a better understanding on problems related to Volatile Organic Compounds (VOCs) that are released in the production of PU leather shoes.

The VOC issues can be attributed to the following aspects: (1) Selection and checking of raw materials and chemicals for presence of VOCs and (2) control of VOCs during the manufacturing processes. Both aspects are related to internal management systems and practices at the manufacturer level. To address these aspects in a sustainable manner, it is essential that factories fully understand their customers´ requirements in Restricted Substances Lists (RSL) and Manufacturer Restricted Substances Lists (MRSL), communicate their customers´ requirements to their own material suppliers, and establish and maintain procurement process for raw materials and chemicals which ensures that only acceptable shoe materials is used in-house, etc.

With regards to the selection and procurement of raw materials for shoe production, the final shoe manufacturer is not the primary chemical user, the shoe manufacturer however plays an important role as intermediary quality assurer between the actual chemical user (e.g. raw material manufacturer, tanner) and the brands as well as retailers. With regards to the process chemicals, the shoe manufacturer has a more direct influence.

1.3 Project Framework: Applying for develoPPP.de

The German online fashion retailer Zalando (https://en.zalando.de) and the German federal enterprise Deutsche Gesellschaft für Internationale Zusammenarbeit' (GIZ) GmbH (www.giz.de/en) implemented the joint project "Improving Chemical Management through more Sustainable Practices in Chinese Shoe Factories" during the period from May 2018 to December 2020 as part of the develoPPP.de programme that GIZ implements on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ).

What is the develoPPP -programme?

- develoPPP is a cooperation format for companies, set up by the German Federal Ministry for Economic Cooperation and Development (BMZ); PPP is short for "public private partnership".
- It applies for companies registered in the EU, a member country of the European Free Trade Association or a country on the OECD DAC list, which includes companies from China.
- BMZ offers financial and technical support for companies that are doing/want to do business in developing and emerging-market countries
- Within the develoPPP -programme, the private sector (one or more companies) and development cooperation agencies (i.e. GIZ more info) join forces to identify solutions to global challenges, especially the challenge of achieving the Sustainable Development Goals (SDGs).
- Target group are companies with project ideas that offer potential development benefits
- The company has to cover at least half of the overall project costs, the other half is paid by the German government

More information on develoPPP.de here. See also develoPPP.de-flyer for cooperation with GIZ.

The objective of this three-year project was to improve the sustainability of chemical management processes in selected Zalando polyurethane (PU) shoe factories in China. In this context, the project focused on improving chemical management processes, i.e. for the handling of hazardous and non-hazardous chemicals, and creating safer working conditions in the selected factories. The project worked with 12 strategic supplier factories of Zalando in China that produce PU shoes. For this project, Zalando handed in the application for a develoPPP.de in late 2017 after collaborating closely with GIZ to develop the project design. The implementation started in May 2018.

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2. Project Management

2.1 Roles of project partners

In the context of Zalando-GIZ DPP project, GIZ was responsible for the overall project management and the implementation of trainings and activities for knowledge dissemination in China. Zalando took the lead in the chemical management related work, which included mapping, monitoring, developing chemical actions and following up on the improvement measures with their suppliers.

Both Zalando and GIZ appointed teams for project steering and for management and implementation. Both included staff from Germany and China (Mainland and Hong Kong). A project manager in GIZ's develoPPP.de team at Headquarters was responsible for steering and coordination from Germany and acted as direct counterpart for the Zalando team in Germany. Thanks to this link to both organizations headquarters, a valuable information flow could be secured: GIZ could feed in their experience of running over 2,000 development partnerships with the private sector in more than 100 countries for the past 20 years as well as more than 30 years of expertise on chemical management, including developing trainings. For Zalando, the project director was able to ensure that the project implementation is in line with and reacts to latest strategy developments of Zalando, esp. on their new sustainability strategy. Also, the fact that Zalando ran the project jointly by their Ethical Trade and Quality Management Team, different strengths and experiences fed into the project.

In China, GIZ supported the project with two internal experts, who locally coordinated the project management and implementation. Zalando appointed a key contact person, for working closely with the GIZ project manager and ensuring that the project activities stayed on track. For the implementation and coordination of activities in the field, Zalando obtained the support of its Ethical Trade and Product Safety teams, with staff being located in Berlin and Hong Kong.

In addition, after a tender competition, the project partners engaged the support of TÜV Rheinland Guangdong as an implementing partner, to support the on-site mapping, conduct the trainings and facilitate the development of action plans, including tutorship for the factories in the implementation.

The project team met regularly to jointly plan activities and discuss project progress based on the project workplan. They also developed regular biannual progress reports for develoPPP.de and use them as a tool to discuss progress, successes and challenges during project implementation.

2.2 Project implementation: The workplan

The projects main goal was to reduce the harmful impact of chemicals on workers and environment and to improve chemical handling processes to ensure safer working conditions. To achieve this, a workplan was set-up which had five main focus areas, that will also serve as the framework for this toolkit:

1. Firstly, in order to understand the current status of chemical management practices and to what extent a chemical management system was in place, a mapping was conducted to assess the current situation in each factory.

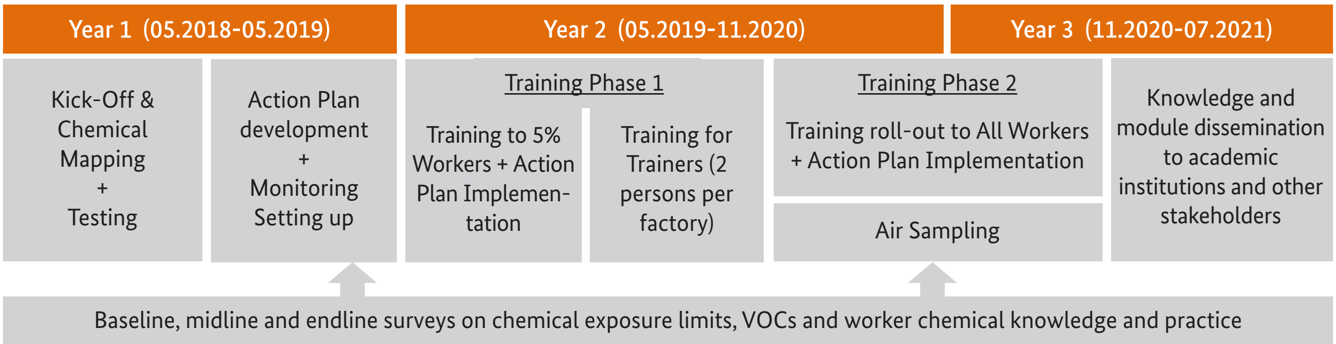
2. Next, chemical testing was conducted to specifically analyse the situation of "Volatile Organic Compounds" (VOCs).

3. Based on these findings, action plans were set up with each factory to agree on concrete improvement measures and trainings were conducted.

4. The trainings happened in different phases. First, a chosen number of workers and managers received training directly from TÜV expert trainers in a two-day basic training and two-day advanced training. Later, at least two participants per factory were chosen to become in house trainers. They received further trainer (including on soft skills) so they could then roll-out the training to more workers over time and act as an important resource person in the factory.

5. Finally, at the end of the project, the knowledge and materials were made available – for example as part of this toolkit in the knowledge dissemination.

DPP GIZ and Zalando: Timeline overview



What factories where chosen for the project?

- In total, 12 factories were part of the program, of which 11 completed all steps
- Factories are located in two different production centers in China, 7 from Wenzhou area (including one in Ningbo) and 5 from Guangzhou area
- In terms of the number of workers, different sizes of factories were chosen. The smallest factory had 37 workers, the largest 580. The average number of workers per factory was 195, though numbers varied during the year, due to regular changes especially before/after Chinese New Year and during peak seasons of production
- In total, more than 2300 workers work in the 12 project factories.

2.3 Monitoring progress: Conducting a baseline, mid-line and end-line survey

In addition to the exams, which we recommend to conduct to assessed the knowledge of staff if you conduct trainings, it is important to understand if the overall awareness in the factories and if it improves due to capacity building measures, such as the trainings (including internal training roll-outs we propose in the training chapter) and the action plan implementation. Thus, at the beginning of any intervention, we recommend conducting a baseline survey.

In our programme, we designed a survey with 20 questions to regular workers and additional 20 question for management staff. The baseline survey was conducted during the chemical mapping, when no training had been conducted yet. The mid-line survey was conducted during the on-site tutorship when our Phase 1 training had been completed. Finally, the end-line survey was conducted after the Phase 2 training programme (including first internal roll-out), when the action plan measures should also have been widely implemented.

The data from our surveys indicate that the programme greatly improved the factory's performance: the score for all participants (managers and workers) increased from 39% to 67% to 70%, the score for regular workers increased from 36% to 66% to 68%, and the score for management staff increased from 52% to 72% to 73%. This shows a significant improvement between baseline survey and mid-line survey, while the improvement from midline to end-line survey was smaller. However, it needs to be considered that the basic training was much more in-depth than the later internal roll-out training and that it can be assumed that the management implemented most changes and had the highest knowledge gain at the start of the project.

What's important to make sure from our view when you implement the trainings is that by the time of the end-line (or any further assessments) the knowledge does not go back towards the original level. Textile, garment and shoe factories have a very high staff turnover. That is why, from our perspective, it is crucial for the long-term success and sustainability of any capacity development programme that in-house trainings are continued regularly. That is why we feel educating in house trainers to enable staff at the factory to continue implementing trainings, is crucial.

This however depends a lot on commitment by the management and pressure from brands towards their suppliers. At the same time, we also need to consider that in times of COVID-19, when factories were a lot under pressure, we can assume that any capacity training programme, including our own, received less attention than in "normal" times. However, it also shows the importance of continuously working on these matters and of doing it in a concerted effort by factories, brands and whenever possible with support by experts, as the framework conditions always change and new situations and problems require updated solutions.

3. Chemical Mapping

3.1 Rationale

During the production of PU leather shoes, so called "Volatile Organic Compounds" (VOCs) are released into the air. Typical occasions where this occurs is at gluing at heating stations. Depending on the type of chemicals which are included in the air and their concentration, this may be harmful to workers health. For this reason, it is important to know how to measure and monitor individual chemical levels at the factory. Chemical mapping is the starting point to understand the situation in the factory. It mainly combines inventory of the process chemicals and the PID screening at different places.

In order to assess how a factory is currently performing regarding chemical management and in order to be able to later monitor improvements, a mapping can serve as a very good basis. Ideally, you start with a baseline mapping to understand the current situation and improvement needs and then repeat the mapping over time to assess (and prove!) the improvements you made. The mapping will allow you to focus your efforts on the main problems as well as to document internally and externally (e.g. to your brands and buyers), that your factory uses a professional (chemical) management system.

3.2 Approach

In order to be able to give detailed guidance to a factory, taking in account the full situation of chemical management in a way mutually understandable and comprehensible to all parties involved, an assessment tool is needed which uses detailed and clear criteria. For this purpose, our project developed a special chemical mapping tool (please see under this link) that you can use. The tool is targeted specifically at analysing the entire chemical management system of a factory with particular focus on shoe production in China. The chemical mapping tool

Basic Management Tool							
Number	Checklist Standard	Rating	Scoring Standards (Please select only one setion with the most Suitable description)	Score	Audit Notes (First Assessment)	Score	Audit Notes (Second Assessment)
1.1	Has the facility established a clear target, policy or announcement or similar high level chemical management document to lead facility's chemical management practice?	0	The facility does not establish any high level document, such as target, policy, or announcement, etc.	NA		1	
		1	The facility prepares a brief description on chemical management policy, or it was briefly mentioned in other management documents like environmental management system, quality management system, health and safety management system.				
		2	The written policy has included necessary legal and regulation compliance requirements, and traceability requirements.				
		3	Besides the above requirements, the written policy has included some clear and detailed compliance requirements on laws, regulation, standards, and some overseas laws and regulations, like CPSIA, REACH, brands RSLs, MRSLs.				

Screenshot from the chemical mapping tool we propose. For each assessment category (here: Basic Management Tool) a number of questions are provided (here question 1.1.) and different answer options are provided. Depending on which option best describes the current situation in the factory, notes are added and the score is chosen (here 1 as an example).

Why did we develop our own assessment tool and what does it build on?

In fact, there are a lot of standards available in the industry. However, unlike ISO 9001 for Quality Management, ISO 14001 for Environmental Management, ISO 50001 for Energy Management or ISO45001 for Health and Safety, there is no globally uniform and accepted CMS (Chemical Management System) standard available.

Chemical management is multi-facetted and relates to aspects of quality, environment, energy, and health & safety. Thus, reference can be made to all aforementioned ISO management systems.

For the development of the chemical mapping tool, we also reviewed a number of guidance resources and handbooks developed by industrial associations or brands, such as the

- Business Environmental Performance Initiative Chemical management Audit (BEPI CMA) checklist;
- Zero Discharge of Hazardous Chemicals (ZDHC) Chemical Management System (CMS) Guidance Manual;
- Higg FEM How to Higg Guide;
- Outdoor Industry Association's Chemicals Management Guide; and
- Inditex's Ready to Manufacture handbook.

All these guidance documents together with the ISO standards formed the knowledge foundation and starting point for the chemical mapping tool.

Prior to the preparation and implementation of the chemical mapping tool, GIZ, Zalando, and TÜV Rheinland decided on the main directions, functions, objectives, and focal areas in course of several planning meetings. It was agreed that the chemical mapping instrument should

(1) be able to assess the factory´s chemical management performance and identify the points of improvement

(2) help the factory identify high VOC risk chemicals, which should be considered to be replaced; and

(3) also help the factory identify the high-risk places within the manufacturing processes.

It was not possible to test all chemicals the factories used and test exposure levels in every single workplace in the scope of this project. For an initial narrowing down of the number of critical workplaces and identifying priority areas, the team used PID (photoionization detection) for conducting a screening of chemicals and workplace. While the use of the PID cannot give very precise individual VOC readings similar to other methods which collect samples on site for analysis in a laboratory, the PID approach can provide total VOC readings, which can be used as pointers to workplaces and chemical which warrant closer investigation. Once a shortlist of such places and chemicals had been compiled, the chemicals and workplaces in question could be investigated in more detail. For more details, see chapter on chemical testing.

combines on-site auditing and on-site screening together. For this purpose, the chemical mapping tool consists of two parts, namely a chemical management assessment checklist and a VOC screening checklist, however the chemical management assessment is most important, while the on-site screening can be considered more advanced level.

When we designed the chemical mapping tool, we also considered the need to make it comparable. Therefore, the chemical management checklist consists of four key elements. In each of them, the factory can receive up to 25 points. In the checklist, you can always see a question and different answer options. Depending on which answer best describes your factory's current situation, you can see how many points you get.

3.3 Implementation

Chemical management assessment checklist (Recommended process)

To apply the checklist, you can either print it out and fill it out manually or do it on the computer right away. Then you need to go through the factory question by question to assess the situation and document the results. Its easiest, if two people do it together. The full assessment would be completed in 1 man-day for small to medium sized factory and the large factories may require two or more man-days.

The chemical management assessment checklist consists of the following four sections:

(1) Basic management structure

In all ISO management systems, the "Plan-Do-Check-Act" (PDCA) cycle as per Deming concept constitutes a core structure. The same underlying logic was adopted to the chemical mapping tool. In this first section, a range of questions about the common elements of the general chemical management system are included, covering management policy, organization chart (e.g. roles and responsibilities in chemical management, procedures for reviewing and updating regulatory requirements, emergency planning, training, performance review, etc. These questions reflect the most basic requirements for any management system, and of course are the basic requirement for chemical management.

(2) Chemical Traceability

One of the most important characteristics of chemical management is the maintenance of chemical transparency, which poses a major challenge in chemical management. For example, while in some instances the quality, environmental or health & safety issues may be obvious and even visible, it is usually impossible to find out without use of further means whether, for example Pentachlorphenol (PCP) or Tetrachlorphenol (TeCP), exceed the permissible limits. This section of the chemical management assessment checklist contains a number of questions which verify if the factory is able to track the raw materials and chemicals they are using, from procurement through the in-house manufacturing processes to the final the product. A good tracking system can help to identify exactly the place where the problem located.

(3) Hazardous Chemical Identification

This section is the most technical one of the whole checklist. It is designed to check to which extent the factory can identify the hazardous chemicals. In particular, the questions in this section are meant to verify: the data integrity of the factory's chemical inventory, as well as whether the factory has the basic ability to (i) screen hazardous substance by using the CAS number, (iii) identify hazardous chemical, (iii) the skills in identifying the hazardous chemical by law, the factory's testing result, and if any chemicals have been substituted in the part, after a hazardous substance has been detected.

(4) Basic Environmental Health and Safety (EHS)

The last section of the checklist includes eight questions covering machine maintenance, management of waste air, management of hazardous (chemical) waste, risk assessment, personal protection equipment (PPE), provisions for emergency management (e.g. firefighting) etc. All eight questions relate to minimum requirements in national legal compliance. This section is important to assess to improve the environmental health safety conditions and performance of the factory.

The 30 questions in this section represent the most basic requirements in chemical manage practice. The maximum score is 100 points. Your score will show you, how much more work you need to conduct, in which area and what you can do to improve.

VOC screening checklist (Advanced level)

In order to conduct the VOC screening, you will need a PID-screening device (photoionization detection, please see photo).

In our case, we bought two hand-held direct read-out PIDs to adapt different scenario's needs. One PID's detection range was 0- 5000 ppm, which can be used for chemical screening, the other had a PID's detection range of 0-50 ppm, which should be used to do the workplace and material screening. PIDs can be bought from instruction seller or manufacturer online or in shops and their cost is around 30,000 to 50,000

CNY for China-made brands, and 50,000-80,000 CNY for western brands. If you do not want to buy your own device, you can also borrow them from a third-party institute such as TUV Rheinland or BV, for example. Alternatively, you might also consider buying one with several factories together.

To conduct the VOC screening, you should consider different areas where VOCs may appear in your factory: VOCs in chemicals you use in the chemicals used in production (to know which substances can be harmful so you can consider using alternatives in the future) and VOCs in workplaces (so you better understand at which location in your factory, the risks are highest and can consider relevant control measures, such as installing ventilation systems or providing PPEs to protect your workers).

(1) VOC Screening in chemicals
The chemicals used in the shoe factories are usually adhesives, or the auxiliaries for adhesives or printing chemicals. Many of these are known or considered sources of VOCs. For purpose of the VOC screening, you can use a number of sampling bottles (e.g. with a volume of 50 ml) to draw samples from each of the chemicals used on site. The handheld portable read-out PID instruments need to be placed on top of the sampling bottleneck for less or more than 1 minute till a stable reading keeps. The PID then automatically records the readings at set intervals every second of the total VOCs released. The data then needs to be sent to a computer, to determine the average total VOC value (TVOC) as the result. During the screening, all factory chemicals should be screened, and data collected. Ideally, based on the data collected, a limited number of chemicals (those, with very high TVOCs) should be selected for further detailed analysis for VOCs in a laboratory.

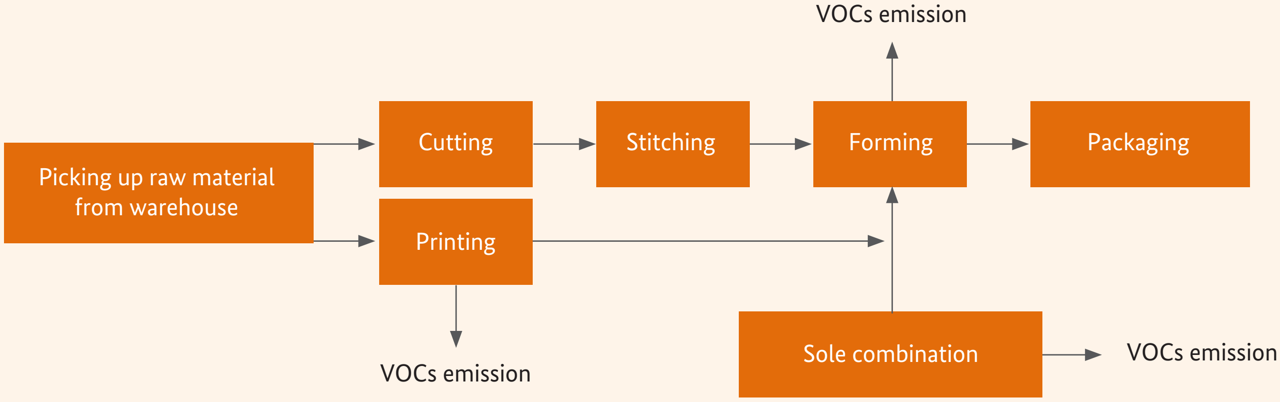
(2) VOC screening in working place
In a typical shoe factory, there are many different workplaces where chemicals are being handled. These usually include the raw material warehouse, chemical warehouse, product warehouse, sampling workshop, cutting section, printing section, sewing/stitching section and glue preparation room. The short range PID (0-50 ppm) can be used to investigate and screen the various workplaces for presence of VOCs in the indoor ambient workplace air. For this purpose, the assessors should position themselves in the workplaces where chemical are handled. Then, the total VOC concentration should be monitored for one minute. Again, the PID instrument records the readings automatically at the set intervals (normally set by the instrument's manufacturer). The data needs to be transferred to a computer and the average TVOC levels to be determined. During the screening, all relevant factory workplaces should be assessed. Based on the data accumulated, it can be determined, which workplaces indicate higher than average readings. These shortlisted workplaces are recommended for further and more detailed indoor air sampling and analysis using industrial standardized hygiene methods. Also, doing PID screening gives you a priority list for all chemical they used, and provide the priority list for next step of chemical lab testing. Below shows normal process of shoes-making with VOCs emission in main three parts.

3.4 Findings

In this chapter, we would like to share some findings we made, mainly for your orientation when you apply the mapping and/or VOC screening yourself, but also, because the findings might help you target your own assessments.

Chemical management checklist findings

For your reference and orientation: The mapping checklist scores of the factories in our programme was between 14.32 for the lowest and 51.08 for the highest in total in the baseline mapping (average 34.63). At the end of our project, the average could be improved to 58.23. From our perspective, if your total score is



below 80 in total, you should become active. Also, in each of the four categories, your score should not be lower than 20. Generally, since this mapping is only looking at the real basics, you should aim to get as close as possible to the maximum score to make sure your chemical management system is set up and operating properly. The internal analysis also shows that the performance regarding the chemical management structure and hazardous identification showed the strongest needs, followed by EHS. The good thing is: The management can be improved with improvement measures as part of action plans and the knowledge and understanding needed.

VOC screening findings

In our findings, we also summarized the top 3 chemicals with VOC reading (highest TVOC levels) by PID in each of the 12 factories. We found that chemicals used in different factories differ greatly, which means there are no real common chemicals used in most of the factories. Factories' performance differs greatly in top 2 chemicals, it means the control of the top 2 chemicals is more important than others.

As the one of important outputs of the VOC screening work, the highly concerned chemicals via PID screening need to be tested in the lab later, and the highly concerned workplaces need to be identified via specific workplace sampling test. This also paves the way for chemical and workplace sampling testing work.

Link to other areas described later:

- If you also plan to set up action plans to improve your processes (and future mapping scores), the mapping results help you know exactly, what you need to do more or differently in the future, as you can read the exact measures you would have needed, to receive a higher score. Generally, for each of the checking point in the chemical management checklist, if the factory's score is "0" and "1", an action plan items should be prepared.

- Likewise, if you also plan to do trainings, it makes sense to list the detailed requirements you need to improve based on the mapping results, so you can make sure to focus on these areas in the training.

3.5 Lessons learnt

- The chemical mapping checklist and screening work

Factory	Workplace Screened	Top 3 Concerned Workplace					
		Workplace	PID reading (ppm)	Workplace	PID reading (ppm)	Workplace	PID reading (ppm)
Factory 1	18	Later Phase Gluing	39.10	Later Phase heat setting	20.54	Front bonding	11.91
Factory 2	13	Adhesion	93.51	Heat Setting	48.18	Spot Cleaning	20.59
Factory 3	17	Heat Setting	94.60	Adhesion	71.33	Phase I Oven	44.51
Factory 4	12	Heat Setting	28.55	Chemical Warehouse	23.68	Quality Inspention section	19.49
Factory 5	17	Packing section	12.47	Quality Inspection section	11.93	Adhesion	7.24
Factory 6	19	Hazardous Waste storage	14.48	Vulcanization	11.54	Packing section	11.00
Factory 7	16	Sewing section	18.96	Chemical Warehouse	8.34	Quality Inspention section	2.95
Factory 8	11	Gluing 3	66.26	Brushing treatment agent	60.58	Adhesion Section	57.36
Factory 9	19	Middle of modling	12.09	Adhesion Section	10.30	Glue Preparation Section	8.65
Factory 10	26	Sampling workshop 2	87.49	Adhesion Section	85.72	Packing section	60.67
Factory 11	36	Adhesion Section	94.71	Quality Inspection section	47.35	Packing section	41.34
Factory 12	25	Heat Setting Section	94.70	Adhesion Section	94.70	Upper bonding	90.01

Workplaces with highest VOC readings

The above table summarizes the workplaces with the highest total VOC readings using the PID instruments in the factories. Important: In most of the factories the highest total VOC levels were detected in gluing and formatting processes, which should be the most concerned areas where strict VOC control should be implemented. In the meanwhile, these tentative results also provide pointers towards compiling a priority list of the sampling points for in-depth industrial standardized hygiene measurements, using air sample collection and lab analysis for each of factory.

Why are VOCs present in the chemicals?

There are different root causes for VOCs and mostly, this information is not available at the time of selecting and buying chemicals. Reasons include among others:

- limited quality control by chemical manufacturers
- poor awareness of chemicals suppliers about the shift of market demands
- inadequate communication about the chemical composition by chemical suppliers either as part of the safety data sheet or technical data sheets.
- If the information is provided, the shoe manufacturer might not be aware of the implications and the link between chemical procurement and worker health and safety as well as the environmental impact and the fact that the final product may not be accepted

High VOC measurements and thus, product return rates increasingly lead to more attention by brands and buyers on the topic.

works well to assess the factory's performance, identifying the concerned chemicals with higher VOC risk, and identifying the concerned working place with higher VOC risk.

- PID screening is a comparatively cheap method to determine the total VOC value, which is the sum of all VOC's in the air. It can indicate problematic chemicals (those with high VOC readings) as well as identify workplaces with higher VOC levels in the air and thus more risks for workers health and safety.
- PID is a sensitive tool, it is easily affected by changes in the surrounding environment. So, when doing the PID reading, the framework conditions need to be well controlled. If, when you take measurements and the data goes up and down sharply, your framework conditions are not stable.
- We recommend the development of a PID user guidance, which should specify the detailed procedure of using PID, such as how to do PID's warm-up and matters the user needs to pay attention to when doing the chemical screening and working place screening. This would allow more factories to independently conduct VOC screening and have better control of the risks.

4. Chemical Testing

4.1 Rationale

PID screening determines the total VOC value (TVOC), which is the sum of all VOC's in the air, but it doesn't give any specific values on the actual concentration of individual substances Thus, additional chemical testing at factory level is required to really understand the level of VOC in workers' air. This will help factory management achieve two important goals:

- make sure your factory is in line with governmental exposure limits
- make sure you workers stay healthy, which may in turn increase worker satisfaction and reduce staff turnover.

Also, by conducting chemical testing, or to be precise: air sampling, you will be able to gain additional insights into the root-causes (substances) which are responsible for high TVOC levels which have been measured in the previous PID measurements and it will help you verify your PID-measurements.

So, in a nutshell: The aim of chemical testing is the identification and the quantification of individual chemicals, which are part of the chemical mixtures which are assessed for total VOCs with the PID.

4.2 Approach

Monitoring VOCs is actually not very difficult and there are different ways how you can do it.

For chemical testing, you should analyse those concerned chemicals, which had high total VOC emissions (over 1500 ppm while measured above the open chemical). This means, ideally you conduct the PID screening first and then do the air sampling.

If you are not sure about the specific composition of the chemicals that might be part of the mix and could be responsible for the high PID value, you could select one chemical from each category with high TVOC levels: glues, finisher, machine oils, cleaners etc.

Air sampling and lab analysis is the most accurate method to determine the compliance with the Chinese work safety standard GB 2.1-2007 (link to buyable versions on Chinesestandard.net), as it enables to identify and to quantify specific VOCs, which are located at the working air. The drawback of this method is, that it's quite expensive, with one potential testing point of RMB 3000-5000.

Disclaimer:
In the following, we will describe a case study on the chemical testing we conducted, as well as the findings we made. However, the testing you implement should of course depend on the findings in your own factory (i.e. Where did you have high PID measurements? Which risks for chemical that may hit exposure limits do you see?). Thus, our findings described in the following shall rather give you ideas on what considerations you may have when choosing if and how to conduct air sampling, how to implement it and to consider some of the findings we made from the scenarios we assessed, which may also be relevant for your own production. For us, these assessments were relevant to explore new and innovative research methods for the analysis of the impact of VOCs and to verify some of the measurements we made with the PID device before.

How and why we conducted our chemical testing (air sampling)

In view of the high costs of the air sampling and lab analysis for VOCs, we choose three factories for further chemical testing.

For our chemical testing we selected one factory because we were interested in comparing test results for the usage of standard glues with water-based glues, and factory, because we wanted to gain a better understanding on the impact of engineering control measures (hood and vent) and one factory, because we wanted to test a method of developing a factor that should allow us to calculate how likely it is that a factory may exceed government limits on certain substances, based on a "Calculated Risk Factor" (CRF) we developed (more scientific exercise).

To determine the Calculated Risk Factor, we considered the following three aspects:

1. Value from the PID screening
2. Concentration of the chemical in the mixture based on the individual test results from the process chemicals (chemical test results)
3. Limit values and restriction from Chinese work safety standard GB2.1-2007

Based on these three aspects, we developed a formula which should indicate, how high the values from the restricted chemicals in the process mixture could rise in the worst case. The worst case has been simulated through the selection of the highest TVOC value measured in the factory. The calculated concentration of the restricted substances then was put into relation with GB2.1-2007. The outcome of the calculation was the Calculated Risk Factor 1 (CRF1):

$$\frac{\left[\frac{C\ substance\ in\ the\ mixture}{C\ TVOC\ in\ the\ mixture} \cdot MAX\ TVOC_{air}\right]}{C\ substance\ \mathrm{GB2.1-2007}} \cdot 100\% = CRF1$$

The higher the risk factor, the closer the substance concentration may be to its limit value. A CRF1 under 100% means, that the value should be below the legal limit – however, the closer it gets to 100%, the less security we have. So, for the air sampling selection, the CRF1 have been reviewed, but also technically measured which have been applied by the factories so far.

Please note this method is a scientific case study which has not been independently verified and is only outlined here for your reference.

4.3 Implementation

To implement chemical testing, you will likely need to work together with an external lab that can analyse your samples. Usually, you can either ask them to come to your factory to take samples, or you submit your samples directly to their lab. You will later receive a report on the findings.

In our case, in order to select the right factories for the air sampling trial, different aspects have been reviewed which we wanted to investigate in terms of ensuring legal compliance, generating knowledge for the industry and proof improvements caused by the project. Finally, three out of 12 factories were selected to cover the following three different scenarios:

Scenario 1: Chemical Substitution (both solvent-based; factory A)

1) This test is conducted at the workplace where the chemical has been replaced with a chemical with less VOC level à Ensure, that less risky substances which you consider to use in the future as safer replacement, are used for 1 hour. Start with the measurement and measure through the standard process with the duration of 1 hour.

2) Make sure that all workers are wearing PPE before continuing with the next step

3) At the same place, use the chemical mixture, which has previously been classified as risky. Let the standard process run for 1 hour, making sure that those are the conditions, which illustrate the situation, before the chemical has been replaced. (PID can be used for this purpose). After the conditions are comparable, start with the air sampling.

Scenario 2: Substitution of solvent-based with water-based product, i.e. glue (Factory B)

1) Select a working step in the solvent-based product line with the highest PID-reading. Make sure the standard process runs at least 1 hour before starting with air sampling.

2) Select a working step in the water-based product line. The process step should be quite similar to the process step which has been measured in the solvent-based product line. Make sure the standard process runs at least 1 hour before starting with the air sampling.

Scenario 3: Check on engineering control measures (Factory C)

1) Measurement during the standard situation: both, air collection hood and vent are running

2) Make sure the workers are wearing PPE before continuing with the next steps

3) Switch off the vent for at least an hour. Check with PID how the values are increasing. If the value remains more or less the same for 5 minutes, continue with the air sampling.

4) Switch off the air collection hood for at least an hour. Check with PID how the values are increasing. If the value remains more or less the same for 5 min, continue with the air sampling.

5) Switch both the vent and the hood off, for at least an hour. Check with PID how the values are increasing. If the value remains more or less the same for 5 min, continue with the air sampling.

Onsite sampling scenario description

Factory A

Date:	January 2, 2020
Sampling time:	10:00- 10:30 Group 1 (Zalando nominated glue) 16:30- 17:00 Group 2 (Non-Zalando nominated glue)
Location:	Gluing Process

Factory B

Date:	January 6, 2020
Sampling time:	10:00- 10:30 Group 1 (water-based glue) 15:40- 16:10 Group 2 (solvent based glue)
Location:	Gluing Process

Factory C

Date:	January 7, 2020
Sampling time:	9:30- 10:00 11:00- 11:30 13:30- 14:00 15:00- 15:30
Location:	Gluing Process
Sampling Scenario	9:30- 10:00 Group 1 Both vent and hood 11:00- 11:30 Group 2 Hood Only 13:30- 14:00 Group 3 Neither vend nor hood 15:00- 15:30 Group 4 Vent Only

4.4 Findings

When you send off samples to the lab, you can usually expect to receive the results after 2 weeks.

Scenario 1: Substitution solvent-based through solvent-based (Factory A)

	Group 1 Zalando nominated glue	Group 2 Non- Zalando nominated glue
PID Reading in average(ppm)	14.59	38.22
Lab Data (μg/m^3)	9268.3	15703.5

The date we got from our Scenario 1 showed us that the hypothesis, that the Zalando recommend glue has better performance in terms of lower VOC release compared to the chemical bought by the factory is in fact true. The lab result showed Zalando recommend glue resulted in a 41% reduction of VOCs in the air in the workplace. Zalando has a list of recommended chemicals it provides to its suppliers to make the choice of chemicals with lower VOC levels easier.

Scenario 2: Substitution solvent-based through water-based (Factory B)

	Group 1 water-based glue	Group 2 solvent-based glue
PID Reading in average (ppm)	33.145	149.81
Lab Data (μg/m^3)	3115.8	4487.5

The data of Scenario 2 at Factory B also clearly indicated that water-based glue has better performance in VOC-release than solvent based chemicals. The lab result shows that the water-based glue in our case gave a 31% reduction in the VOC concentration of the air in working place. Not surprising, since water-based glues are considered a common good practice in VOC management.

Scenario 3: Check on engineering control measures (Factory C)

	Group 1 Both vent and hood	Group 2 Hood Only	Group 3 Neither vent nor hood	Group 4 Vent Only
PID Reading in average (ppm)	158.98 (lowest)	352.63 (second highest)	269.567 (second lowest)	462.954 (highest)
Lab Data (μg/m^3)	3217.1 (lowest)	5330.9 (highest)	3761.4 (second lowest)	3776.6 (second highest)

Factory C's data from Scenario 3, was a little more complicated: First of all, the PID data did not match the lab data well. We assume that the reason is because PID is a very sensitive device, whose reading can be greatly influenced by tiny changes of the environment. However, the lab data is based on a consistent 30 minutes' sampling time, and the analysis process has been strictly controlled by testing standards. Therefore, the lab data would be more reliable, showing that to be on the safe side, air sampling is always the best choice.

Both PID data and lab data indicate that, in Group 1 (both hood and vent running), the VOC's data is the lowest. It indicates if the hood and vent are used together, it will give be best effectiveness to remove VOCs. Comparing with the data in Group 2 and Group 4, the lab data indicates that the vent used in our assessment had a better effectiveness than the hood. It was supposed the highest VOC data would be in group 3 where neither hood nor vent were running. However, the lab's highest data was found in Group 2 (Hood only). The reason might be that on the sampling date, in order to protect people's health, the factory did not allow us to close hood and vent for two hours, and we only closed both vent and hood for half hour, so the sampler cannot capture the full changes.

4.5 Lessons learnt

- First of all, a main learning for us was that while governmental limits are provided for different chemicals and their concentration, due to the fact that the test method for the assessment is not given in the regulation, it is not clear how compliance can or should be assessed. This situation was found for China, but it is actually the case in many other countries, including in Europe also, and leaves factories rather alone if they want to ensure legal compliance.

- In order to improve the VOC issues in shoe factories, chemical substitution is always an effective way to contribute to the improvement of the indoor air quality.

- For effectiveness of the engineering control, in our test case the vent was more effective than the hood. However, our study only had one sample in an experimental group and one sample control group and as mentioned, the impact of environmental factors is considerable. So, the result cannot be considered representative. Also, we only ran our test with one specific type of hood and one specific type of vent, so the results may look very different with different devices.

- What is relevant to consider though is that when we compared with the hood's airflow we found that the vent's air flow was much higher than the hood, leading to greater effect. Also, in many cased we observed the location of the hood's installation, the air flow, the maintenance etc. did not really enable the hood to show its maximum function. So we can learn that simply buying a hood or vent and installing it is not very effective. The hood and vent need to be well-chosen, based on the specific environment. They need to be installed and maintained for full effectiveness. This also means: if you already have a hood and/or vent: check or let an expert check, if they are used effectively. You may be able to make a huge difference for your workers health, by using what you already have in a more effective way.

5. Chemical Management Trainings

5.1 Rationale

A central element if you want to improve your chemical management system is to improve the knowledge and awareness of the factory management and workers. A good way of doing that is by implementing trainings. The main objective of the training is to increase the awareness on the risks associated with the use of chemicals in shoe manufacturing to both management and workers and equip the factories with the knowledge and tools to build a robust chemical management system.

If you only change the management system, but do not educate the management for the reasons behind, the solutions may be less effective. So, if you only tell your workers they need to wear masks and gloves, they may not always follow the recommendation. However, if they aware of the risks if they do not wear masks, they may be much more supportive of this action. Likewise, if they understand that different types of gloves protect them from different risks, they may pay more attention and then pick the right type of gloves for the work they do in the future. Thus, training can also lead to changes in behaviour and therefore, to greater legal compliance and more worker protection.

5.2 Approach

There are a lot of different training materials available in the industry and we will also outline all the materials we used as basis to develop our own materials in the following section. Depending on which goal you want to achieve (e.g. only improve knowledge on a specific thematic area where you may know you have a problem or generally upgrade your staff's knowledge on chemical management), you should choose the materials accordingly. Also, you need to consider if you only want to train your factory management, especially those, who are working with chemicals, or the whole workforce, incl. workers.

Since chemical management is a cross cutting topic, we felt there are many different units who are working with chemicals or whose decisions have an impact on the chemical management practices in the factories. Thus, we decided to train all of them. Also, since our projects objective was to reduce the negative impact of chemicals, especially VOCs on workers' health and safety and to reduce the negative impact on the environment, we decided to train workers as well. This of course has implications on the training approach, as workers usually have a lower educational background than the management staff. Still, we felt including them in the training is extremely valuable, because ultimately, how they do their work has a major impact on how the factory performs overall on chemical management.

Who (which staff) should join a chemical management training?

We recommend training especially the following staff:

- High management: Factory Board Chairman, Managing Director, General Manager
- Department Manager in Quality, EHS, R&D, Manufacturing, Purchasing, IT, HR, Sales, and Admin; Chemical Manager (if the factory has one)
- All staff in quality department, lab, and EHS department (i.e. health and safety committee)
- Shift leaders in each manufacturing line, in chemical warehouse

In order to reach as many workers as possible, we recommend using a 'Train-the-Trainer' methodology. In our case, that meant that instead of sending expert trainings to conduct factory trainings who then leave again after training completion (and very often, with them, the expertise leaves the factory), we trained normal factory workers to become chemical management trainers in their own factory. And we received astonishing results with this approach. The advantage is that these workers stay with their factory and can continue rolling out the training later among other staff.

Training material development

By 2019, the "Detox" campaign had already been appealing to the world for almost 10 years and in response, many brands, industry associations, NGOs, service providers, educational institutes and development organizations have developed and accumulated a number of training programmes and training materials, which formed the basis for developing our training materials. However, similar as with the chemical mapping tool, we found that there are not so many mature and systematic chemical management training materials that are specifically targeted at the shoe industry and China, especially in local language, which is why we developed our own training materials.

In the following, we will introduce our training materials to you and how you can apply them in your own factory. You can do that fully independently, by using the PowerPoint slides and session plans we provide. If you do not have the expertise in house to run the training by yourself, you can also commission a service provider.

Which materials to refer for chemical management?

REMC Toolkit and further GIZ training material

- GIZ published a collection of training materials arranged in form of training units along the seven steps of "Resource Efficient Management of Chemicals" (REMC) cycle of change. These materials are available online including all presentations and session plans and follow the recommended structure and content of the Zero Discharge of Hazardous Chemicals (ZDHC) Chemical Management System Guidelines. (under Downloads).
- In addition to the training materials, the website also offers a handbook to provide practical guidance to personnel of factories in the textile and leather sector who are involved in the implementation or upgradation of resource efficient management of chemicals in their respective factories. The handbook contains worksheets, handouts, presentations as well as reading materials to provide a ready reference for the different steps of implementing chemical management systems elements and good chemical management practices.
- From 2017, GIZ together with REWE and Tchibo implemented a Strategic Alliance (STA) as part of the develoPPP programme which focused on chemical capacity building in wet process units, focusing on dyeing and printing process. The training materials for this programme include 24 sets of slides, covering very comprehensive topics around chemical management. The materials are available in English and Chinese and can be downloaded here (see Chemical and Environmental Management – files Basic Training and Advanced training)

ZDHC's training material

- TÜV Rheinland joined the ZDHC Foundation as a contributor from 2016 and became ZDHC approved training service provider in 2017. So far, ZDHC has developed 4 training programmes, including 1) introduction to ZDHC, 2) Top 10 issues in chemical management, 3) Wastewater treatment technology, and 4) Leather chemical management training.

Higg training material

- TÜV Rheinland is a member of SAC and is approved training and verification service provider for environmental aspect of FEM3.0. SAC developed a set of training material based on "How to Higg", which performed as the handbook of the Higg tools.

Chemical Mapping's result

- Findings from the chemical mapping as part of this project were also an important reference for the training material development. The results of a mapping provide valuable insights into people's awareness and their knowledge about chemical management.

List of service providers and individual experts you can commission in China

- TUV Rheinland, contact person Ray Niu
- SGS
- Bureau Veritas (BV)
- Kit Lee (Independent Consultant)
- CITA (Clothing Industry Training Authority)

5.3 Implementation

5.3.1 General Structure of the training programme

Our overall training programme has two phases and three sets of training materials:

The main training materials include two levels of training courses: a basic level training and an advanced level training. Each of them can be conducted as a 2-day onsite training on two consecutive days of about 8 hours each, including an exam/final assessment at the end of the course. The exam is important to do at the end to assess the training impact on workers´ knowledge and it is important to announce in advance, as it will let participants pay more attention. In our case, the basic and advanced trainings were held by expert trainers of TÜV Rheinland to factory managers and workers. We left a few weeks between basic and advanced training and started the advance training with a repetition of the basic training knowledge.

The internal roll-out training materials include a reduced set of training materials, chosen from both basic and advanced training, which we used in our second project phase, the factory's internal training given by factory trainers. After the basic and advanced training, in our project about 5% of the factory workers (usually 2-3 per factory) were chosen by the TUV expert trainer based on their exam results and overall performance on the training to undergo further 2-day trainer training by TUV Rheinland and become an in-house factory trainer. Their education background, communication skills, and their willingness was also be considered in the selection. These “factory trainers” then attended another 2 -day training in China, which focused on the reduced set of materials that the newly trained trainers should later roll-out themselves. The idea was that they cannot be expected to run a full training of everything they just learned once before but that the basic and advance training provide them with enough background knowledge so that they can easily implement the internal roll-out themselves. In our ToT, they had the chance to familiarize themselves with the materials they should deliver themselves and to learn some soft skills, plus practice being a trainer. In the Training of trainer (ToT) training, the first day is a review of the key knowledge of the Phase 1 training materials, while the morning of day two is a soft skill training on how to become a good trainer. The afternoon of the Day 2 was arranged to be a trail training section for all factory trainers. Afterwards, they were awarded a trainer certificate.

In our project, the newly trained factory trainers were then asked to give regular chemical management training to other workers in the factory based on the Phase 2 training materials. The first internal roll-out was conducted jointly with the TUV expert trainer, to give them more security and allow them to ask questions afterwards, as well as receive feedback.

If you implement this training in your factory, you basically have four options:

1) You implement the full (main) training approach, in which you train your workers in depth with the basic and advanced training materials. If you also plan to train in-house trainings, then among the trained participants, you can select some to become in-house trainers and train them also in a trainer-training and have your own trainer pool.

2) You only implement the basic training from our phase 1 materials to cover the basics in depths over two days. This way, you will have a solid foundation of knowledge among the trained staff.

3) You only implement the reduced set of training materials, which we set up for the internal roll-out. It takes between 0,5 and 1 day to implement, depending on how many exercises you include, and focuses on the most important contents from the basic and advanced training.

4) You pick individual topics (modules) from the basic and advanced training materials, which cover the topics that you think (or know from the mapping) that they are most needed in your factory.

When we conducted the basic and advanced trainings, usually, 15-20 participants, including managers and workers joined each training. That's also the group size we recommend, to establish a peer-learning atmosphere, but to have a small enough group to allow for interaction.

Training Process

Step 1	• 2-Day Basic Training • Selected workers	EXAM
Step 2	• 2-Day Advanced Training • Selected workers	EXAM
Step 3	• 2-Day Trainer Training • 2 Chosen workers	AWARD
Step 4	• 2 Worker Trainers roll-out (reduced) training to the rest of the factory • Up-scaling!	

Training Materials

Basic level	• Module 0: Programme overview and training arrangement • Module 1: Knowledge prepanration, basic chemistry review • Module 2: Chemical management system • Module 3: Hazard identification and risk control • Module 4: Regulation, standards and RSL
Advanced level	• Module 5: Detox, ZDHC and MRSL • Module 6: VOCs and air emission control • Module 7: Chemicals in shoe materials • Module 8: Chemicals in adhesives
Factory internal training material	Day 1 • Chemicals in our lives and work • Chemical management system • Hazard identification and risk control • Law, regulation and standards • VOCs and air emission control Day 2 • Soft skills, presentation & communication • Training rehearsal

From our experience, the advanced level training materials are a little more relevant for managers and they require completion of the basic training before. For general workers, the internal roll-out materials may be best suited.

5.3.2 The training material's topics, content, and purpose

The following table summarize the detailed objective and expected outcomes of each of the training modules of the basic and advanced training. The basic logic for the content arrangement is:

1) Using half day to review necessary chemistry knowledge, which is the base for the following topics;

2) Chemical training material will help the participants to understand the overall structure about the chemical input control, process control, and output control;

3) Risk identification and risk control will help people to know the chemical's hazards, how to get the information, how to understand the Safety Data Sheet (SDS), and how to choose the right risk control measures, such as personal protective equipment (PPEs);

4) Laws and regulations are the basis for legal compliance, which is the minimum requirement the factory should achieve;

5) The Detox and ZDHC section will give the trainee a picture of the framework most first line brands and retailers committed to, to reduce the use and impact of hazardous chemicals from the industry, and give detailed introduction of the hazardous chemicals;

6) The VOC section helps the people to know what VOCs are, where they are coming from, what the associated risks are and what the technology is to treat VOC pollutants;

7) Module 7 section introduces the hazardous substance's risk in the major shoe materials, such as leather, synthetic leather and textiles;

8) Module 8 introduces the basic structure of adhesives, and the hazardous chemicals risk in the glue.

When we designed this knowledge structure, wanted the training to cover all necessary topics about chemical management, and it should be integrated, interesting, and knowledgeable. When people complete the learning, they should be able to have a general idea about the chemical management work's scope, concerns, and have a logic structure in mind about how to start and how to improve.

Module	Topic	Contents and objectives (Which topics were covered)	Learning objectives for participants (At the end of the training, the participant will be able to...)
Basic Training contents: Modules 0 - 4			
0	Programme Overview and Training Arrangement	1. Introduce the whole programme; 2. Introduce the arrangement of the training and tutorship; 3. To understand the trainee's expectations. 4. Why is chemical management an important topic?	1. Relate to the whole chemical management programme from chemical mapping, testing, training, and knowledge sharing and how it links together; 2. Relate to the arrangement of the training sections; 3. Explain the importance of working on the topic of chemical management.
1	Knowledge Preparation, Basic Chemistry Review	1. To raise trainees' interest in chemistry; 2. To help workers without chemistry knowledge have a basic understanding about chemicals; 3. To help workers with chemistry knowledge recall their knowledge; 4. To pave the way to the in-depth topics on following topics;	1. Distinguish between commonly used elements symbols; 2. Locate relevant information in the SDS; 3. Classify chemicals; 4. Relate to some chemical phenomena with chemistry principles.
2	Chemical Management System	1. Overview of a chemical management framework; 2. Benefit of a chemical management system in the factory; 3. Importance of policies and how to develop a chemical management policy; 4. How to establish a chemical management team and each staffs' responsibility; 5. Key components in chemical management system; 6. How to develop SOPs in different sections in Chemical management system; 7. Good practice of chemical management.	1. Explain the benefits of have a chemical management system in the factory; 2. Develop a chemical management policy; 3. Set up a chemical management team and define each team's responsibility; 4. Design and implement a full chemical management system in the factory; 5. Develop SOPs in different sections in Chemical management system; 6. Describe good practices of chemical management.
3	Hazardous Identification and Risk Control	1. Hazards, risks and exposures of chemicals; 2. How to do conduct a risk assessment; 3. Basic about GHS; 4. SDS and its information items; 5. How to choose the right PPEs; 6. Chemical risk control hierarchy and measures.	1. Set up and maintain factory`s own chemical inventory (in line with sample template); 2. Verify the quality of the safety datasheet (e.g. up-to-date, complete, GHS conform); 3. Locate relevant information in the SDS; 4. Identify hazard types and levels/bands for each chemical; 5. Prepare and use procedure for conducting risk assessment for different positions where chemicals are handled; 6. Distinguish between different risk control methods; 7. Select appropriate/ recommended methods to prevent and control risks (in line with risk assessment and recommendations in SDS); 8. Identify and select the recommended/ required PPEs against hazard categories and types of exposure; 9. Prepare and respond to emergencies.
4	Law, Regulation, Standards, and RSL	1. Relevant chemical regulations in China and in Europe; 2. RSL requested by Zalando;	1. Name the mandatory regulations regarding chemical management; 2. Identify the requirements of Zalando regarding chemical management; 3. Prepare and maintain an inventory of legal and other requirements (source, area of applicability); 4. Describe major problems with regards to the RSL test; 5. Conduct a root cause analysis with regards to the RSL test; 6. Select and purchase chemicals and raw material considering these regulations.

Advanced Training contents – Module 5 - 8			
5	Detox, ZDHC, and MRSL	1. Green Peace's DETOX campaign; 2. ZDHC and ZDHC's tools; 3. Hazardous chemicals listed on ZDHC's MRSL; 4. Zalando's MRSL.	1. Relate to the relevance of Detox campaign and ZDHC to the chemical management requirements; 2. Explain the difference between MRSL and RSL; 3. Identify the root source of substances listed on MRSL.
6	VOCs and Air Emission Control	1. How to definition of VOCs substance; 2. Typical VOCs substance in footwear industry; 3. Regulations on VOCs; 4. VOCs control technology and its treatment mechanism; 5. Procedures to do chemical substitution.	1. Identify typical VOC substance and list typical processes with VOCs; 2. Find root cause if VOCs were detected; 3. Select and implement long-term and short-term control measures (in line with requirements of SDS and regulations); 4. Identify and prioritise chemicals in the factory´s chemical inventory for substitution.
7	Chemicals in Shoes Materials	1. To have a comprehensive understanding of the major shoe materials; 2. Chemicals are used in the shoe material manufacturing process; 3. Hazardous chemical's sources from shoes material aspects; 4. Advancements of the water-based PU technology.	1. Describe the general manufacturing processes of the natural leather, synthetic leather, and textile; 2. Describe chemicals used in shoe's material manufacturing process; 3. Identify processes and sources of hazardous chemicals and waste ; 4. Relate to development of water-based PU materials in the context of VOC control.
8	Chemicals in Adhesives	1. To review typical shoe manufacturing processes; 2. Different types of adhesive and its chemical components; 3. Different solvents used in different adhesive system; 4. How to speed up the VOC's evaporation in factory side; 5. Advancement of water-based adhesives.	1. Explain how adhesives work and how to choose appropriate adhesives; 2. Describe potentially hazardous substances/ compounds present in adhesives; 3. Select and purchase glues according to Chinese regulation; 4. Outline the advantages and disadvantages in water-based adhesive.

5.3.3 Examination

In order to encourage trainees' learning attitude, and in order to have a comparable result of the training effect, and in order to provide evidence for factory trainer selection, we designed two exam papers for basic training and advanced training. The exam paper for the fundamental training only covers the first 4 training modules, while the advanced training is covering all the 8 modules.

There are single choice question, multiple choice questions, True or False questions, term explanation, short answer question, Case study questions, and essay question. The standard exam duration is 1.5 hours.

5.4 Findings

During the on-site trainings, most of the factories were very cooperative. One of the strong feelings about the on-site training is that in most of the factories people are very interested in the topics we prepared. From our experience, it's important that trainers have a good interaction with the trainees, and most of the trainees were highly involved in the lecture, discussion, games, and teamwork. However, there are still one or two factories, where the trainees were forced to attend the training by their superiors. We also felt the exam played a crucial role in the training, and many trainees cared a lot about their score.

The exam is an important method to check the people's learning result. When we designed the exam, we intentionally designed a number of challenging questions, rather than all entry level questions. In this way, it's easier to single out better trainees, which is especially important if you also plan to train inhouse trainers.

We set a score of 60 out of 100 as the exam passing level. In our trainings, the average score across all factories was 48 in the basic training and 41 in the advanced training. On average in each factory, 28% passed the exam, though the variation from factory to factory was very high. In our view, this shows that the choice of the right participants is crucial. Factories with low pass rates may have sent workers who were easier to bear from production that day, which may indicate they have less background knowledge and thus, more difficulty following the course. For the advanced training, the training participants were focused on the most important staff to continue learning, which may be the reason why despite the exam being harder, still 23% passed on average.

Generally, even within a factory, the scores varied a lot, which may be attributed to the fact that we taught managers and workers together. While not all workers may be able to pass the exam, we still felt it can make sense to train them with the managers, because this way they understand the overall importance of the topic and the links between management decisions and practices during production better and it can contribute to their team spirit and the awareness of the importance of chemical management.

Also, we found the factories performance differs greatly, as the best performing factory's average score was 62 in the basic exam and 65 in the advanced exam, while the lowest performing factory only got 24 in the basic exam and 26 in the advanced exam. From our impression, the factory's performance is highly related with the factory's high management's engagement and support. Factories where management was very engaged in organizing the trainings, choosing the (right) participants and taking the training seriously themselves, their staff tended to have higher scores. It was also found in above table that people's performance differs greatly in each of the factories. The best performing person in basic training got 87 score, while the best performed person in advanced training got 74 score. It was noticed there are a number of extremely low score, like 4, 8, 9 etc. We found these extremely lower scores usually come from staff, who were in high age or less educated. This again indicates the importance of choosing the right staff from the exam.

Link to other areas described later:

Training is ideally linked to action plans, to make sure the knowledge is also leading to actions.

5.5 Lessons Learnt

- For trainings to be successful, involvement and support of the factory management is crucial.
- We realized that before the trainings, many of the factories did not have a clear idea about why to manage chemicals, what the benefits are, how to start, etc. Some of the factories even did not have any appointed staff looking after chemical related issues, so chemical management for them was a very new and strange topic. Thus, we feel that there is a greater need for implementing trainings in the industry.
- Even though our materials already use a number of interactive formats, videos, quizzes and concrete examples, from the feedbacks we collected, in the future it will be important to reduce the contents of the 8 modules even more and include yet more case studies or story telling teaching styles, as well as videos and pictures. Also, some participants would prefer to take more time to learn. In our case, since the main training (basic and advanced) was done by external expert trainers who had to travel to the factories, we focused on quite condensed training days. Especially for workers, who are not used to taking part in seminars and trainings, its better to hold more shorter trainings, to allow for more repetitions to let the knowledge sink.
- Finally, in addition to the presentation inputs, the session outlines should plan for more time of exploring solutions in real life settings in the factory and at the workplace, to be able to show concrete examples – of tools to use or examples of factory documents or do exercises on site. This applies for workers and managers alike.
- Especially if you also train workers, it's important to consider their level of education and to plan well, who to send to the trainings. In our case, some factories had also sent workers to the first basic training, who could not read or write much. For them, it was very hard to understand the trainings. Still – and maybe even more so – these workers need the relevant knowledge to apply chemical management practices. For them, the use of images and videos for communication is crucial. We partly addressed this by using pictures and by working on a booklet of the main symbols which are important to understand, i.e. those of hazardous chemicals. However, especially for the group of workers with no background knowledge and

very low educational background, more explanations and sensitization will be needed in the future. For this group, also specialized and even more simple trainings should be developed with step by step, sallow to deep components with technical and management should be developed. Here, also gamified training approaches on mobile devices, as offered by Quizzr, Sustify or MicroBenefits could be explored more in the future.

- In fact, when you do trainings, we recommend focusing particularly on the session plans which the trainers use to structure the training. They should list the interactions explicitly.

- Important to have the learning objectives clear and to not consider them under the logic: what knowledge should my factory staff have, but what awareness and understanding should they develop, in order to change their behavior in the future. Thus, when testing the effectiveness of your approach, an exam can always only be one part of the assessment – observing behaviours of trained staff gives much deeper insights (practical, instead of theoretical tests).

- Repetitions are crucial to strengthen the understanding. Thus, no matter if you conduct only one training or several, always repeat the main points at the end of each training unit and start a new training course or training day by repeating the contents which were learned before, especially, if the new knowledge builds on it.

- Factories should consider incentives for their workers who complete the training, as those workers likely lead to a reduced risk for the factory and may even help the factory rank higher in assessments like the Higg FEM (Factory Environment Module) which many brands request.

- Also, brands should consider incentives for factories that take part in or conduct their own trainings, as sending workers (incl. management) to a training costs the factory money, as the workers still need to be paid for the trainings and are missing from the production during that time. The price and time pressure on factories is extremely high.

- While our materials were set up in both Chinese and English for two reasons (a) many of the trainers preferred to also see the English text, as their previous trainings had been in English and b) to allow initial quality control of the slides, for future implementations we recommend to use only the Chinese text on the slides and cut the English text, to reduce the information on the slide and avoid participants from feeling overwhelmed by the materials.

- Printing of training material in advance is very important (staff could take notes).

- Consider the best timeline for conducting trainings in factories: our phase 2 training was arranged after Chinese New Year holidays, which is usually the low season, when factories can engage more staff to attend the training.

6. Action Plans

6.1 Rationale

The purpose of the whole program is to drive positive changes in chemical management in the footwear factories, thus preparing an achievable and challenging action plan and implementing it on the ground is a key step for the program. The action plan preparation and implementation play an important role in bridging the classroom knowledge to reality improvement, meanwhile bridging the pure knowledge to factory's routine working procedures, even self-conscious working habits.

6.2 Approach

6.2.1 Step by step approach

In order to give factories clear instruction about their improvement journey, we developed a step-by-step approach for the factory to follow, setting two-level improvement targets for the factory to achieve:

1) The fundamental requirements are the minimum requirements for the factory; it was expected that all factories would at least achieve the fundamental level in half a year;

2) To reach the second level requirements the factory was given additional 6 months to go beyond the most basic requirement, and encourage factories to pursue continuous improvements.

6.2.2 Training in classroom and tutorship on site

Considering most of the factories have very limited understanding of chemical management and some do not know how to start, we recommend an action plan preparation + training + on-site tutorship model:

1) Once the requirements for the fundamental and second level were determined, TUV discussed with the factories and worked out their individual action plan with detailed action description, timeline, responsible personnel. For this, the results from the mapping in the factory were a crucial basis as they show how far a factory is away from achieving both levels.

2) The purpose of conducting tutorship is to give the factory direct onsite teaching on their chemical management and to help the factory implement their knowledge learnt from the classroom into their working practice. For this, we prepared an Action Plan tracking table, which was used to monitor each factory's improvements over time.

6.3 Implementation

Before the action plan development, the responsible trainers thoroughly reviewed the chemical mapping result with the factory representatives and communicated the basic and second level requirements of the program and the key points in preparing an action plan. Based on the trainer's instruction, each factory prepared their own action plan, which should be achievable but challenging.

Timeline: In our case, the action plan preparation was arranged before the first on-site training, so that the factory management could pay specific attention on the topics related to their action items. However, we feel it is also possible to first conduct the trainings and then develop the action plans with more background knowledge on part of the factory. Both approaches have advantages and disadvantages.

During the on-site tutorship, the trainers provided a range of advice on overall chemical management policies, procurement procedures, chemical inventory list preparation and updates, chemical safety storage, chemical emergency plan and drill practice, etc. The trainer not only gave general advice on what the factories need to do, they were also working closely with the factories to explore how to make things happen.
Timeline: The on-site tutorship was after the basic training and advanced training each.

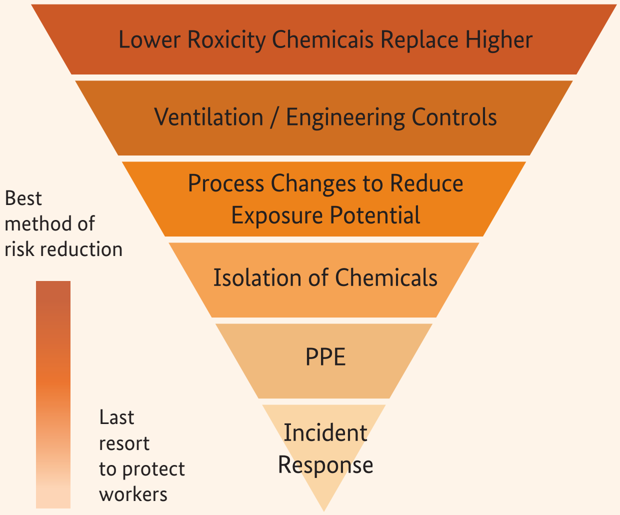
After the training and tutorship program, most of the factories were able to first of all establish a very early stage chemical management system such as chemical management regime, chemical management org.-chart, chemical assessment and procurement policy, chemical manager nomination letter, laws regulation standards collection table, chemical management training plan, etc.

6.4 Findings

All factories from our program had great improvements in their action plan completion. The average completion rate for the 11 factories that finished the program is 88%, the best two factories achieved 97%, the last factory achieved 77%.

We found that the completion ratio differs in the 4 chemical mapping dimensions, where the “Basic Management Structure”: received the highest completion ratio (98%), the “Basic EHS” received 85% completion ratio, “Hazardous chemicals identification” 81%, and the lowest in completion ratio was on “Chemical’s Traceability” 78%. The statistical data reflects that most factories have established a brief chemical management structure, however implementing it on the ground was more challenging.

Chemical Risk Control Hierarch



Excerpt from training materials Basic training module 3 Hazards Identification and Risk Control

	factory 1	factory2	factory 3	factory 4	factory 5	factory 7	factory 8	factory 9	factory 10	factory 11
Overall Action Plan Completion Ratio	80%	84%	92%	97%	77%	97%	94%	86%	83%	95%
Basic Managements Structure	92%	100%	95%	100%	91%	100%	96%	100%	100%	100%
Chemical Traceability	83%	50%	92%	100%	100%	100%	100%	63%	0%	93%
Hazardous Chemicals Identification	76%	78%	86%	100%	65%	100%	75%	83%	66%	72%
Basic EHS	92%	78%	92%	88%	63%	90%	93%	78%	93%	9%

Thematically, when looking at improvement measures, there is one topic which is also covered in the basic training, which is important to keep in mind, namely the “hierarchy of controls”: If you want to choose the measure that best reduces the risks, you need to replace chemicals with higher toxicity by chemicals with lower toxicity (Chemical substitution). This is the single most effective measure you can take. Engineering controls should be the second option after substitution. If this is not possible, you can work on the process which relates to the chemical exposure. As per ILO Code of Practices on Safety in the use of chemicals at work, a good work practices and systems include (1) reduction of the number of workers exposed and limiting non-essential access to such areas, (2) reduction in the period of exposure of workers (either by providing for additional breaks or rotating workers between processes with and without chemical exposure) . If you go further down the options, which is already less effective in worker protection, you can only still hand out PPEs (i.e. masks or gloves) to protect the worker when he/she is working with the chemical, otherwise, you can only still witness the incident (worker contamination) and react to it, which should not be an option.

6.5 Lessons learnt

Although all participant factories experienced an overall improvement in their chemical management, however there are still a number of learnings:

- The trainer/tutor was required to spend a lot of time explaining the necessary components of the chemical management system and necessary documents during the training and tutorship. Many of the documents need further optimization, such as the 1) chemical emergency plan, 2) chemical inventory list, 3) chemical management internal training plan, 4) equipment maintenance plan and record table, 5) work place risk assessment table, 6) factory’s internal audit plan and assessment table etc. Updating these documents is an on-going process, rather than a once-off thing. The factory is always in a dynamic environment given changing customer’s requirements and legal requirements. So, these documents are usually “living documents”.

- Since many factories established their own chemical management system for the first time, many of the procedures were still new and not immediately working well. It takes a long time for factories to embed the chemical management system into their daily management

- Some of the issues, like chemical transparency, could not be solved easily by the footwear factories themselves, such as the traceability issues. It depends on government's law enforcement and upstream manufacturers' self-discipline. Thus, for the action plan it's important to consider measures which are mostly under control by the factory itself.

- Due to the impact of the COVID-19 Pandemic, the planned 6-month task had to be extended to 13-months to complete, which disturbed the rhythm of the implementation. It would be much better to implement the whole action planning, training, and on-site tutorship faster and in a more compact setting, however, we understand the pandemic had an exceptional impact on the entire industry.

7. Knowledge Dissemination

A lot of knowledge and practical lessons have been generated during the project. One key result is the training materials that have been adapted and compiled. These materials are mainly based on existing training materials by GIZ. These in particular include the GIZ REMC (Resource-efficient management of chemicals) toolkit, training materials developed under the ongoing develoPPP.de Strategic Alliance (STA) “Sustainable chemicals and environmental management in the textile sector”, which GIZ has jointly implemented with the German retailers Tchibo and REWE and Partnership for Sustainable Textiles, as well as additional materials provided by TUV Rheinland. While these materials, have a strong focus on textiles, the same were adapted to the specific situation in the shoe industry, with a particular focus on polyurethane (PU) shoes and the production conditions in China, as part of this project. Amongst others, an objective of this project, which is supported with funds from the German Federal Ministry for Economic Cooperation and Development, was to make the newly developed training materials available to the industry and integrating it into the training curricula at an educational institution in China. While this task is not a classical task to copy, we do feel that considering how to make knowledge and materials available more broadly in the industry is also worth copying for others.

7.1 Rationale

In this context of the project, one of the key objectives is to generate better and more up to date information on the needs of Chinese PU leather shoe factories and how they can be addressed. Thus, it is important for us to share the knowledge, tools and experiences we obtained with various stakeholders, with the purpose of upskilling more industry stakeholders as well as increasing the number and competence of local chemical management experts to allow them to support Chinese factories and foster change in the industry. The specific target groups of the efforts include staff and students of technical and vocational training institutions, industry experts as well as brand representatives.

7.2 Approach

To achieve the goal of knowledge dissemination with a wider range of recognition and application, three main approaches/ tracks have been identified:

Track 1: Disseminate and anchor training contents

The first track focuses on making knowledge on chemical management, especially focusing on chemical management in Chinese shoe factories, available to a wider audience. The corresponding activities target especially vocational/technical education institutions that might be interested in incorporating the chemical management training modules into their training curricula. On the other hand, a number of large international initiatives, e.g. Sustainable Apparel Coalition (SAC) play a key role in the industry. These players, who often have numerous brand members, shall be involved as partners as well.

Activities/Contents
Share training materials with University/vocational education/ Polytechnics, i.e. as weekend-seminar or summer school
Share training materials with industrial associations at national and provincial level
Share training materials with other stakeholders, especially multipliers; focus on initiatives such as SAC where many brands are members

Track 2: Share project results and lessons learned

During the set-up and implementation of the project, a lot of practical knowledge has been gained and lessons learned. These have been drawn up and made available in the form of this toolkit, to allow other interested stakeholders, especially brands and suppliers, to consider it in their own approaches.

Activities/Contents
Consolidate the Methodology/Lessons Learned on the milestones of the project (especially project set-up, mapping, testing, action plans and internal training roll-out) in form of a toolkit and make them available to other industry stakeholders, especially brands, retailers and suppliers in China
Present Project Idea and Lessons Learned to industry associations on national and provincial level and connect them to the project. They are of particular relevance because they could potentially roll-out chemical management trainings to their members
Organize an internal project closing event

Track 3: Create awareness about initiative and its results

In order to increase the awareness about the project among industry-wide stakeholders and create interest for involvement of other industry players and brands, outreach activities can be arranged. These include the organization of a conference on chemical management in Guangzhou (close with Chinas Textile/shoe production Clusters and one of the two focus areas of our project) , mainly targeting at Chinese and/or international producers, suppliers in the textile and shoes sector, decision-makers, brands etc., through which the products developed in under tracks 1 and 2 shall be presented, awareness shall be raised on the topic as such and knowledge exchange between brands and suppliers shall be fostered.

Activities/Contents
Prepare marketing tools, especially a flyer/fact sheet and PPT
Organize at least one conference to present overall project to wider industry and draw attention to the outputs of part 1 and 2
Participate at least in one external event to present the project idea and outputs

7.3 Implementation

Track 1:

The Guangdong University of Technology has been identified as suitable partner to provide a platform for our training materials and toolkits' dissemination at a Chinese university. To better understand our training materials and related toolkit, as well as to assess the feasibility and compatibility with the current curriculum, the following steps were taken jointly:

- Review the GIZ-Zalando basic level training materials
- Define the chemical management topics of the curriculum outline development
- Develop the curriculum content and readjust GIZ-Zalando training materials
- Set up 6 pilot courses at University in the spring term of 2021

In total, 7 chapters of the curriculum outline and contents have been developed as a new course:

1) Safety basis of hazardous chemicals
2) Safety management of hazardous chemical enterprises
3) Leakage and control of hazardous chemicals
4) Hazardous chemical accident management and contingency plan
5) Environmental management of hazardous chemicals
6) Occupational health management of hazardous chemicals
7) Impact of hazardous chemicals management on international trade

The first 4 chapters were coordinated by Prof. Xu Wenbin, Director of the Environmental Safety Team, Department of Environmental Sciences, Department of Safety Engineering. Chapters 5, 6, and 7 were coordinated and held by Mr. Ray Niu, the Senior Technical Manager of TÜV Rheinland. The lectures were successfully delivered on April 7th, 14th, and 21st. In total 43 university students attended the class. The students are the junior students majoring in Safety Engineering.

Track 1+2:

The training materials and toolkit, including lessons learned, are shared with the China National Textile and Apparel Council (CNTAC) and the Sustainable Apparel Coalition (SAC) as well as the ILO SCORE Program in China, after uploading in the Asia Garment Hub (see: www.asiagarmenthub.net/CM-toolkit)

Track 3:

The outputs of the project as well as project approach have been presented at various events to the wider public:

- The develoPPP project team organized a major conference on Chemical Management in Guangzhou on May 27, 2021. All conference materials including agenda and speaker brochure as well as knowledge product on the main tools and methods regarding chemical management as well as links to further information can be found on the Asia Garment Hub. Overall 311 participants from across Asia joined the event onsite and online and learned about latest chemical management developments and trends in inputs by the Chinese Ministry of Environment and Ecology (MEE), Peking University and China National Textile and Apparel Council (CNTAC). The project materials and approach were presented as part of the main thematic session on Chemical Management Systems held by TUV Rheinland, the brands perspective input by Zalando and a good practice example from a factory owner of this project. Finally, four parallel workshops were held on the topics VOC assessment and control, Wastewater management (testing) and hazardous chemical substitution, risk management and chemical procurement and inventory.

- The project approach and training approach were presented and discussed in a joint event by GIZ and ILO SCORE in October 28, 2020 which brought together about 40 sustainability trainers from different organizations as well as representatives from MNEs

- The project approach and training approach were presented at the Environmental Health and Safety Summit by the Safety Engineering Committee of Guangdong Province in December 2020

- The project approach was presented at a training by TUV on Chemical Management in June 2021.

7.4 Findings

At the end of the last class of the three university classes (6 seminars in three double sessions), student's feedback was collected by means of a questionnaire. The feedback was quite positive: 91.89 % of the student agreed or strongly agreed that they have obtained the necessary knowledge on the given lecture topics. 89.19 % of the student agreed or strongly agreed the knowledge obtained from the classroom will help them to solve the problems in their future career. 91.89 % of the student agreed or strongly agreed that the class helps them broaden their horizons on relevant domestic and foreign knowledge resources. 89.19 % of the students agreed or strongly agreed that the case study, the exercises, and the homework could help them on problem solving skills. Thus, the integration of our training materials and the engagement of the TUV expert trainer can be considered a positive contribution to bringing academia and business practices closer together.

The interest in the industry in all events we joined was very high. Even before completing the training materials and toolkit for public release, there was a strong demand and email registration to be notified about their availability. This shows, that there is a continued and strong interest in learning more about how to set up and improve Chemical Management Systems in China.

7.5 Lessons learnt

It is a meaningful and valuable trial to share the project experience with industry peers by different channels such as industry association meeting, university classroom, or publications. Meanwhile, we received a number of suggestions from the meeting audiences, the university professors, and students. Their comments and suggestions are summarized as below:

- Some meeting audiences suggested to prepare a more specific and detailed guidance on how to establish a chemical management system for a small or medium sized businesses;

- Some meeting audiences commented that the biggest issue of the chemical management is the hazardous chemicals, and the biggest risk of the hazardous chemical is their potential to cause fire disasters and explosions. Thus, they suggested that the content of materials and training courses could focus more on how to prevent the serious safety accidents. From our point of view, it would also make sense to consider special sensitization sessions on this topic, such as a one-hour class in all factories on fire safety and emergency response.

- Some factory representatives commented that the RSL/MRSL for different industry associations, brands, retailers etc. are almost same but still slightly different, and continuously change. It makes it very hard for factories to catch up with them. Here we see a need for more harmonization.

- Moreover, it was suggested to provide a public information pool, which can give one stop searching service for legal and business's requirements on restricted substances.

- Some university professors believed that the course is very welcomed by students, because there are many real case studies in the course content. In addition, the students are very interested to know what the real issues in the factories is and how to understand and solve the issues, and suggest organizing the scientific principles and the right-thinking model behind the case study;

- After looking for potential partner universities who would be interested in incorporating our training materials in their curricula, we learned that the highest chances for this are in the area of safety engineering, which is a little less obvious than chemical departments or textile departments. We are very glad to have found a very suitable and engaged partner with the Technical University of Guangdong. Our research and the conversations with different industry stakeholders, including from other Multinational Enterprises showed that the main problem in China is the fear of working in the area of environmental health and safety, due to the high number of accidents and the common response that the EHS Manager is held accountable and sent to prison. As a result, MNEs find it incredibly hard to fill vacancies on EHS and to find qualified personnel. Likewise, many universities told us that students avoid registering for EHS or safety engineering classes, which are also mostly voluntary, because they do not want to work in the area for fear of the consequences. As a result, the respective university classes often rank low in popularity. Thus, in turn leads to the fact that they receive even less support and have difficulty attracting sponsorship or external funds – a vicious circle. Not surprising thus, that some university students suggested showing more case studies on factory's reality and introducing more management methods of hazardous chemicals in emergency response situation for accidents. For this important area to be taken more seriously to educate more students, qualify more staff and improve chemical management and EHS practices (which are often closely related) and thus, make a major contribution to avoiding further accidents, more attention and support is needed. Means to achieve this could be making respective classes compulsory and making them more practically relevant, introducing dual models in which universities collaborate with enterprises, changing the practice of holding the EHS manager generally accountable and raising awareness on the importance of the topic as well as all the good practices and materials that exist.

8. Overall Lessons

- First of all, from our experience, we can say that its best to do the whole project approach including mapping (esp. checklist), training and action plans. Implementing additional chemical testing can help gain additional insights into sources of VOCs, but in order to set up a Chemical Management System, the other three elements are certainly key.

- From our experience, main gains can actually win from the basics, which also means: you can achieve a lot of improvement by focusing on the core elements. In the mapping for example, we found a major problem is that many factories did not assign the role of "chemical manager" to anyone. Also, they did not have the right processes and structures in place. These often refer to documentation and procedures. That is of course still an effort to do right, but it is also something, the factory has full control of.

- To improve the chemical management practices, the factory is in the driver seat: only the factory can make improvements in their internal management and performance covering the whole range from chemical pre-assessment, procurement processes, manufacturing processes to final product assurance. Thus, management involvement is critical.

- Involving external support makes sense, especially at the beginning, to make sure, you address the real problems and pick the right solutions. Here, the support from service providers to come to your factory outside of an audit but at a time, when your factory is not in peak season may add a lot of value.

- If you, as a factory, are concerned about the costs, do not hesitate to approach your buyers – many brands and retailers have support programmes for their factories. Also, you can refer to the materials included in this toolkit, so while you may still want a third party to help you do the mapping for example, you can ask them to copy our approach.

- Implementing trainings and action plans based on the actual needs of a factory is most effective and allows working in and with the factories and by using concrete examples.

- The choice of the factories and the close contact with them through the course of the programme is crucial for brands running this programme. Regarding the commitment, we could not find any evidence that smaller or larger factories are more engaged, however, in terms of project management, it is important to consider a few points:

    - It's important to consider the project timeline well: During peak times of production, it is extremely hard for factories to let their workers and managers participate in trainings, especially if they take a full day or more; so its important to avoid peak season. At the same time, parts of the mapping and testing are sensitive to temperature. Thus, in order not to falsify data, it is important not to conduct these assessments at a season which is particularly hot or cold.

    - The higher the brands order rate with a factory, the more willing the factory is to engage in a project. This needs to be seen in context: If a factory produces for four or more major buyers and all of them ask the factory to take part in – party very different – training projects, the factories face a resource problem in an already very competitive market with high time and price pressure. Thus, in the future, it might be good for more brands to run the project together, especially with shared suppliers

- Continuous and on-site support is crucial for factories, because many questions come up only during daily operations and after changes have been introduced.

- Action plans and trainings need to be conducted hand in hand and we would always recommend others to also combine these two. With trainings only, there may be greater capacity at the factory, but there is no clear push to change behaviour.

At the same time, an action plan alone is hard to implement, if you do not invest in capacity development at the factory. Conducting both processes in parallel helps target the training to the specific actions required from the factory.

- Internal training roll outs are key to scale-up the project impact – but it's hard to secure beyond the project period. Thus, we recommend involving the Human Resource (HR) department in the process and to discuss options to a) include chemical management trainings as part of the new staff onboarding trainings, b) consider shorter, focused training sessions, i.e. over lunch break, to highlight key topics and c) encourage and incentivise further internal roll outs.

- Knowledge can also lead to fear: Once workers understand the dangers related to chemical handling, there is a risk that they are afraid of the risks from their work. Thus, they may request a pay-rise or even quit. Therefore, it is important to keep close communication to clarify, that the fact that the factory is addressing these risks together with their workers show, that this is a responsible factory, committed to reducing risks and that workers who pay attention to the training have a high chance not to contract any risks.

- Of all methods introduced, the hierarchy of controls is key to keep in mind, please review 6.4 Findings.

- Linkages with industry standards and codes is key: Due to the globalization of supply chains, factories have to find their way in a jungle of requirements placed upon them, from legal requirements in the country where they are based to legal requirements that apply for the buyers they sell to (often relating to foreign legislation) to specific codes or programs their buyers commit to (such as Higg FEM by SAC) to brands own codes (such as the Zalando MRSL). With this large set of frameworks and requirements, it becomes clear that factories will be most interested in joining a program that helps them fulfil requirements of one or more of these. Thus, in our project, we included elements of Higg FEM, since many factories need to do the Higg assessment and working on chemical management systems helps them advance not just on the explicit section on chemical management, but also on other parts, i.e. health and safety or emergency response. Also, by being part of further programs and initiatives, producers may have access to further support materials or exchange fora.

- In the beginning, a lot of steps relating to Chemical Management Systems relate to paperwork. Thus, especially in the beginning its important management is involved closely with the project and the factory appoints at least one person as chemical manager. For more information on the Higg and how it links to the action plans and trainings we describe in this toolkit, please see the following box.

zalando

What is the Higg FEM?

- The Higg Facility Environmental Module (Higg FEM) is a sustainability assessment tool that standardizes how facilities measure and evaluate their environmental performance, year over year
- The Higg FEM informs manufacturers, brands, and retailers about the environmental performance of their individual facilities, empowering them to scale sustainability improvements.
- The Higg FEM provides facilities a clear picture of their environmental impacts. It helps them identify and prioritize opportunities for performance improvements.
- The Higg FEM is part of the Higg Facility Tools, which offer standardized social and environmental assessments that facilitate conversations among value chain partners to socially and environmentally improve every tier in the global value chain.

The Higg FEM assesses:

1. Environmental Management Systems
2. Energy Use and Greenhouse Gas Emissions
3. Water Use
4. Wastewater
5. Emissions to Air (If Applicable)
6. Waste Management
7. Chemical Management

Higg builds on self-assessments, verification and later publication. It has three levels: Level 1 is the basic awareness and performance tracking, Level two is the baseline and target setting for improvement and Level three is industrial best practice. Questions for all three levels of include questions on chemical management.

While this toolkit approach was not designed to prepare factories for Higg FEM certification, improving chemical management practices has direct effect on the Chemical Management Assessment and also covers many aspects of the other assessments. In fact, there is an overlap of questions in our Action Plan measures which are also part of the Higg FEM assessment.

Level 1

1. Does your facility maintain chemical inventory records used and a list of suppliers for each chemical?

7. Does your facility select and purchase chemicals based on their hazard and MRSL/RSL requirements?

Level 2

14. Does your facility have an Action Plan to improve your chemical management system?

Level 3

18. Has your facility conducted chemical analysis against human and environmental hazard criteria (e.g., persistence, bioaccumulation, and toxicity) for the replacement process?

More information on see https://apparelcoalition.org/higg-facility-tools/
Download the Higg FEM How to Higg Guide

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