

Training of Trainers on Water: Water supply, In-house, End of Pipe

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Program on Promoting Sustainability in the Textile and Garment Industry in Asia (FABRIC)

Guideline for Trainers and Facilitators

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Purpose This document has been prepared to guide trainers using the GIZ training package of Training of Trainers on Water: Water supply, In-house, End of Pipe.	

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List of abbreviations used

CRP	Caustic Recovery Plant
FABRIC	GIZ Project on Promoting Sustainability in the Textile and Garment Industry in Asia
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
IWRM	Integrated Water Resource Management
MVR	Mechanical Vapor Reompression
RFT	Right First Time
SDG	Sustainable Development Goals
ZLD	Zero Liquid Discharge

1 About this guideline

The objective of this document is to provide guidance to trainers, learning facilitators, or service providers who conduct training of Trainers on Water: Water supply, In-house, and End of Pipe. The GIZ Water training course was prepared under the project *Promoting Sustainability in the Textile and Garment Industry in Asia* (FABRIC).

The materials are primarily intended to help the trainer to support the service providers and university faculty members to know about the opportunities and techniques of water saving in the textile wet-processing industry. That is why GIZ-FABRIC has considered this training as one of the training and advisory services covering the water supply, in-house processing, and end-of-pipe part.

The materials under the Water training course are based on the training needs of service providers, university faculties and textile and garment factories in Bangladesh.

The master materials are managed by the GIZ, who will manage further the review and updating of learning materials.

1.1 Overview of Training Materials

The training course comprises 21 *topic-specific presentations* and one *on-site plant visit/practical session*.

Section 3 of this trainer guideline provides an overview of the *available modules and learning units*. Each module consists of 4 components, including (1) 3 - 5 *power presentations* with illustrations (2) *group discussion formats*, and (3) *hand-outs/reading materials*. It also contains formats of site visit questionnaires and evaluation criteria.

Interactive sessions would be the key for the training program to be involved and interesting.

Practical exercises are intended to guide learners towards the next step in practically translating the newly acquired knowledge from the module/learning unit into the context of water saving. To achieve this, the trainers may use short quiz questions after one set of slides is over, on average, some 3-4 quiz sessions within the presentations.

1.2 Target groups of this training course

The primary target group of the training course is selected Environmental Technology Companies and Environmental Centres that meet the following criteria:

- Having a business model (in the areas of Cleaner Production and Resource Efficiency in enterprises)
- Having resource personnel (numbers and experiences over the years for services provided)
- Having dedicated resource personnel (if there is any Water Efficiency/Water Saving expert with experience)
- Having WE services (already provided or planned in the next 1 to 3 years)

Another target group is the faculty members from the wet-processing department of textile universities who have at least three years of active teaching experience.

In short, the target group of this training program comprises multipliers who include service providers, associations, factory managers, and faculty members from textile universities.

1.3 Learning objectives

After attending this training, the participants of this course shall be able to

- Learn about water Security and Integrated Water Resource Management (IWRM)
- Understand the basic concept of Water Efficiency in Textile Wet Processing and RFT
- Learn the process of water Metering and Raw Water Treatment
- Understand the process optimisation of different wet processing of textiles, such as Knit Fabric Dyeing, Woven Fabric Dyeing, Denim Dyeing, Yarn Dyeing, Garment Dyeing and Washing, Printing
- Learn about Advanced and Tertiary Treatment of Textile Effluent, Zero Liquid Discharge System.

1.4 How to use this guideline

Section 2 of this guideline explains various options regarding how you as a trainer, learning facilitator, or service provider, can employ or integrate the water training materials into your training or advisory services.

Section 3 of this guideline provides a more detailed description of all the available Training modules. Apart from stating the purpose of the respective module, you will also find (i) an overview of the content of the modules and learning units, (ii) available materials (e.g. presentations, handouts, quizzes, assignments), (iii) references to additional training and reference material (iv) the average estimated time required for completing the module or each of its learning units, and (v) notes for trainers to understand the session plan.

This guideline will allow you to decide which modules/learning units to include in your course and how to plan your training program in one stretch or as multiple modules. Furthermore, the information in this section will also help you plan the time required for your course and schedule the same accordingly.

2 How to use the Training materials to plan a training program

The learning materials are mainly structured for class lectures. However, for integrating this course with other academic activities such as seminars on specific topics or include it in curriculum in a training course by a University etc. several variants/options are possible and two of them are discussed here.

2.1 Option 1- Using materials in a standalone short term training

The service providers trained for this dissemination and provided with the course material may organise commercial training programs for the ETP operating staff in batches. The material provided under this course can be freely used by them with proper acknowledgement. The service providers may add, modify and cut off some of the material and create their own package.

Still, it must be stated here that the course material provided is all-inclusive for a six day training package without any modification or addition in itself, if so desired by the service provider.

The training materials are primarily structured to directly integrate the presentations into virtual or face-to-face classroom lectures with the learners. In this setting, your role would be to directly reflect on the content of the entire module or learning unit presentations (or parts of them) together with your workshop participants. For this option, however, please keep in mind that all participants are required to follow the same learning pace, i.e., not allowing them to tailor the learning settings to their individual preferences (e.g., when and how to complete which learning unit).

However, it must be noted that all the modules do not need to be delivered on consecutive days, and the training can be divided into multiple phases. It may be possible that if the ultimate group of trainees are already employed in the factory, it may be difficult for them to stay away from their workplace for a long time. In such a case, the six days can be spread into six weeks with one day in a week (ideally the weekly holiday) as the training day. This, however, may need greater commitment and interest from the participants.

The material is organized in modules, each one focussing on specific, exclusive but connected topics and the trainers may define number of phases according to the availability of trainees and their convenience.

2.2 Option 2 - Supplementing academic learning programs

Quality materials with up-to-date information on Water: Water supply, In-house, End of Pipe training are very scarce.

The training package is expected to fill this gap, and now the institutions may find it much easier to design the curricula and conduct such short-term programs.

It is also possible that the training material provided herein would be used by the faculty to supplement their teachings in the regular environmental engineering/science courses too. As this is a course with enough structured presentations, this package will be an invaluable asset to them.

3 Content and structure of the water module: Water supply, In-house, End of Pipe training materials

Presentation 1.1: Water Security		
Description	Contents	Learning materials
<p>This presentation will help the learners to relate to water security challenges in the textile business supply chain, assess the risks to water security of business, identify water security risk mitigation actions, refer to possible responses of businesses and governments at local and global level.</p>	<ul style="list-style-type: none"> • Water in the Headlines • Water stress • Water scarcity • Water Supply and Demand • Water stress and scarcity • Managing water security • Responding Globally • Success Stories 	<p>Presentation 1.1 with 35 slides</p> <p>Time required: 50 min</p>
Presentation 1.2: Introduction to IWRM		
Description	Contents	Learning materials
<p>By this presentation, the learner will be able to understand the concept and need of IWRM and distinguish among various elements of IWRM, relate IWRM in a global context and its linkage with Sustainable Development Goals, Future Trends, and Requirements.</p> <p>The Learner will also acquire improved comprehension of IWRM in the context of the manufacturing of Textiles and Garments as explained through case studies enabling the learner to apply IWRM concepts in the textile and garment sector.</p>	<ul style="list-style-type: none"> • Water Resources and Their Consumers • Historical Development of Managing Water Resources • Elements of IWRS • Alliance for Water Stewardship 	<p>Presentation 1.2 with 33 slides</p> <p>Time required: 50 min</p>
Presentation 1.3 and 1.4: Basic Concepts of Water efficiency in Textile Processing		
Description	Contents	Learning materials
<p>This presentation will enable the learners to understand the basic concepts of Water efficiency in Textile Processing which encircle the textile supply chain flowchart, water requirements in different part of supply chain, water</p>	<ul style="list-style-type: none"> • Textile supply chain flowchart • Water requirements in different part of supply chain • Water KPIs in Textile factory • Water quality requirements for processing • RFT - Lab to bulk and bulk to bulk RFT 	<p>Presentation 1.3 and 1.4 with 28 slides</p> <p>Time required: 45 min</p>

KPIs in Textile factory, water quality requirements for processing, Lab to bulk and bulk to bulk RFT and process flow mapping.	<ul style="list-style-type: none"> • Process flow mapping 	
Presentation 1.5: Water metering		
Description	Contents	Learning materials
This presentation will lead the learners to gain knowledge about water meter basics, its types and its use in textile industry.	<ul style="list-style-type: none"> • Water meter Basics <ul style="list-style-type: none"> • velocity • Installation • Water Meter types • Water Meter in Textile Industry • Water Meter Reading issue 	Presentation 1.5 with 41 slides Time required: 60 min
Presentation 1.6: Raw water treatment		
Description	Contents	Learning materials
This presentation will help the learners to grasp a basic understanding of raw water treatment and relevant ideas.	<ul style="list-style-type: none"> • Raw water • Distinguish between technical options for treatment <ul style="list-style-type: none"> • Pumping • Pre-treatment (softening, pre-process filtration) • Raw water quality control • Select suitable or relevant input water treatment options 	Presentation 1.6 with 17 slides Time required: 30 min
Presentation 2.1: Checking of Parameters – Step towards RFT		
Description	Contents	Learning materials
This presentation will give an idea about the Right First Time of lab to bulk and bulk to bulk. Also there are slides about some processing parameters and sensors' performances to be checked for better RFT.	<ul style="list-style-type: none"> • More details on RFT <ul style="list-style-type: none"> • Lab to Bulk and Bulk to bulk • Processing parameters <ul style="list-style-type: none"> • Common parameters • Batch vs semi-continuous/continuous • Sensors' performances 	Presentation 2.1 with 28 slides Time required: 45 min

Presentation 2.2: Process Optimisation - Cotton Knit Fabric dyeing		
Description	Contents	Learning materials
This presentation is about the process optimisation in cotton knit fabric dyeing and the water saving possibilities.	<ul style="list-style-type: none"> • Knit dyeing – Exhaust process • Pretreatment (scouring, bleaching, singeing, bi-polishing) • Dyeing (reactive, direct, Vat etc.) • Finishing (Compacting, stenter, drying etc.) • Understanding technology of dyeing machine for low water requirements • Process Modification • Advance Dye Chemistry 	Presentation 2.2 with 69 slides Time required: 1 hr 45 min
Presentation 2.3: Water Conservation - Low hanging fruit_Final		
Description	Contents	Learning materials
After the completion of this presentation, the learners will be able to distinguish between different basic approaches in water conservation, apply general good housekeeping principles and other basic/small measures, implement up to medium cost and implementable measures with the help of consultants	<ul style="list-style-type: none"> • Water conservation - Benefits • Training and Awareness – sample sheet • Internal audit/assessment and water balance data analysis <ul style="list-style-type: none"> • Water conservation • Common good practices • General good housekeeping basic/small measures 	Presentation 2.3 with 30 slides Time required: 45 min
Presentation 4.1: Process Optimisation - Cotton Woven Fabric dyeing		
Description	Contents	Learning materials
This presentation deals with process optimization opportunities of different processes of woven dyeing.	<ul style="list-style-type: none"> • Woven dyeing – Padding dyeing • Continuous/Semi continuous • Cold pad batch • Finishing • Process parameters • Advance Dye Chemistry 	Presentation 4.1 with 63 slides Time required: 2 hr 30 min

Presentation 4.2: Process Optimisation - Denim dyeing		
Description	Contents	Learning materials
This presentation deals with the process optimization opportunities in denim dyeing to save water.	<ul style="list-style-type: none"> Denim dyeing <ul style="list-style-type: none"> Rope dyeing Slasher dyeing Water saving opportunities 	Presentation 4.2 with 72 slides Time required: 2 hr 30 min
Presentation 4.3: Process Optimisation - Printing		
Description	Contents	Learning materials
This presentation deals with the basics of printing and its process optimization for water saving opportunities.	<ul style="list-style-type: none"> Printing Basics Screen Printing vs Digital Printing Screen Printing Processes Digital Printing processes Water minimization in printing Process Modification Modern Technology 	Presentation 4.3 with 53 slides Time required: 1 hr 15 min
Presentation 5.1: Process optimisation - Yarn Dyeing		
Description	Contents	Learning materials
This presentation deals with the basics of yarn dyeing and yarn dyeing machines. It mainly focuses on the process optimization opportunities in yarn dyeing for water saving.	<ul style="list-style-type: none"> Basic concepts of yarn dyeing Yarn dyeing machine <ul style="list-style-type: none"> Package dyeing Hank dyeing Lace/elastic/tape dyeing Process Optimisation New development 	Presentation 5.1 with 60 slides Time required: 1 hr 20 min
Presentation 5.2 Garment Washing and Dyeing		
Description	Contents	Learning materials
This presentation deals with the concept of Garment Washing and Dyeing, their types, techniques and procedure, various machines used and the new developments to create water opportunities.	<ul style="list-style-type: none"> Garment Washing and Garment Dyeing <ul style="list-style-type: none"> Wet process vs dry process The technique and procedure Garment washing/dyeing machine New development 	Presentation 5.2 with 50 slides Time required: 1 hr 15 min

Presentation 5.3: Recent Developments in water conservation in textile processing		
Description	Contents	Learning materials
This presentation deals with the recent developments in water conservation in textile processing. The recent developments include Supercritical CO2 dyeing, Cationic Cotton dyeing/nanodyeing, Spray dyeing and Plasma treatment or ozone treatment.	<ul style="list-style-type: none"> • Supercritical CO2 dyeing • Cationic Cotton dyeing/nanodyeing • Spray dyeing • Plasma treatment or ozone treatment 	Presentation 5.3 with 15 slides Time required: 25 min
Presentation 5.4: Water conservation - Utility		
Description	Contents	Contents
This presentation will help the learners to understand some concepts of water conservation which include Steam Distribution System, Condensate recovery, Cooling Tower Management and Rainwater Harvesting Systems.	<ul style="list-style-type: none"> • Steam Distribution System • Condensate recovery • Cooling Tower Management • Rainwater Harvesting Systems 	Presentation 5.4 with 17 slides Time required: 30 min
Presentation 5.5: Some other Best Practices		
Description	Contents	Learning materials
This presentation deals with the other best practices for reuse of water that were not discussed in the previous presentations. Here the learners will get to know the use of green chemistry, reuse of water from CRP	<ul style="list-style-type: none"> • Use Green Chemistry • Reuse of water/alkaline water from Caustic Recovery plant (CRP) • Reuse of Vapor Condensate of Caustic Recovery Plant • Moisture management in weaving 	Presentation 5.5 with 23 slides Time required: 30 min
Presentation 6.1: Textile effluent treatment		
Description	Contents	Learning materials
This presentation will enable the learners to know about various pollutants in textile effluent, their ill effects. They will also learn typical effluent steps, they will get idea about the management of sludge and the quality of treated waste water.	<ul style="list-style-type: none"> • Pollutants in textile effluent • Ill effects of pollutants • Typical effluent treatment steps • Management of sludge • Treated wastewater quality 	Presentation 6.1 with 37 slides Time required: 50 min

Presentation 6.2: Tertiary Treatment		
Description	Contents	Learning materials
<p>This presentation will help the learners to know about the tertiary treatment and its details. This presentation deals with the objectives of advanced treatment, the basics of Membrane bio-reactor, Filters for polishing treated effluent and Chemical oxidation for organic removal from treated effluent.</p>	<ul style="list-style-type: none"> • Objectives of advanced treatment • Membrane bio-reactor • Filters for polishing treated effluent • Chemical oxidation for organic removal from treated effluent 	<p>Presentation 6.2 with 47 slides</p> <p>Time required: 1 hr</p>
Presentation 6.3: Effluent recycling options		
Description	Contents	Learning materials
<p>This presentation deals with the inception of the idea of effluent recovery. This also gives idea about different recycling options like Nano filtration for salt recovery, caustic soda recovery and partial recovery of effluent.</p>	<ul style="list-style-type: none"> • Genesis of effluent recovery idea • What are membranes in ETP? • Nano filtration for salt recovery • Caustic soda recovery • Partial recovery of effluent 	<p>Presentation 6.3 with 38 slides</p> <p>Time required: 50 min</p>
Presentation 6.4: Zero Liquid discharge systems		
Description	Contents	Learning materials
<p>This presentation discusses Zero Liquid Discharge (ZLD), a comparatively new idea that is being popular and gaining ground for implementation around the world. Firstly, the learners will be able to learn the Concept and origin of ZLD & international experience. Then they will dive deep and learn different processes used for ZLD, requirements, benefits, draawbacks and the cost of ZLD.</p>	<ul style="list-style-type: none"> • Concept of zero liquid discharge, origin & international experience. • Pre-treatment for membranes: need, common methods. • Basic principles of reverse osmosis • Reject management: options, pros & cons of options. • Emerging technologies: membrane distillation, MVR, forward osmosis. • Requirement of ZLD: space, power, chemicals & monitoring • Benefits and draw backs of ZLD. • Cost of ZLD: Capex & Opex. 	<p>Presentation 6.4 with 40 slides</p> <p>Time required: 60 min</p>

4 Conclusion

The training package provided by GIZ is a unique source of knowledge and only one of its kind. It is difficult to find an up-to-date and quality training course on Water: Water supply, In-house, End of Pipe elsewhere. The magnitude of the package will be evident when one considers over 1000 pages of slides in about 21 power point presentations.

Handout materials are generally simple, short and specific.

If site visit to the factory is not feasible, one day of the training program may be deleted and during the remaining day relevant video clips may be used.