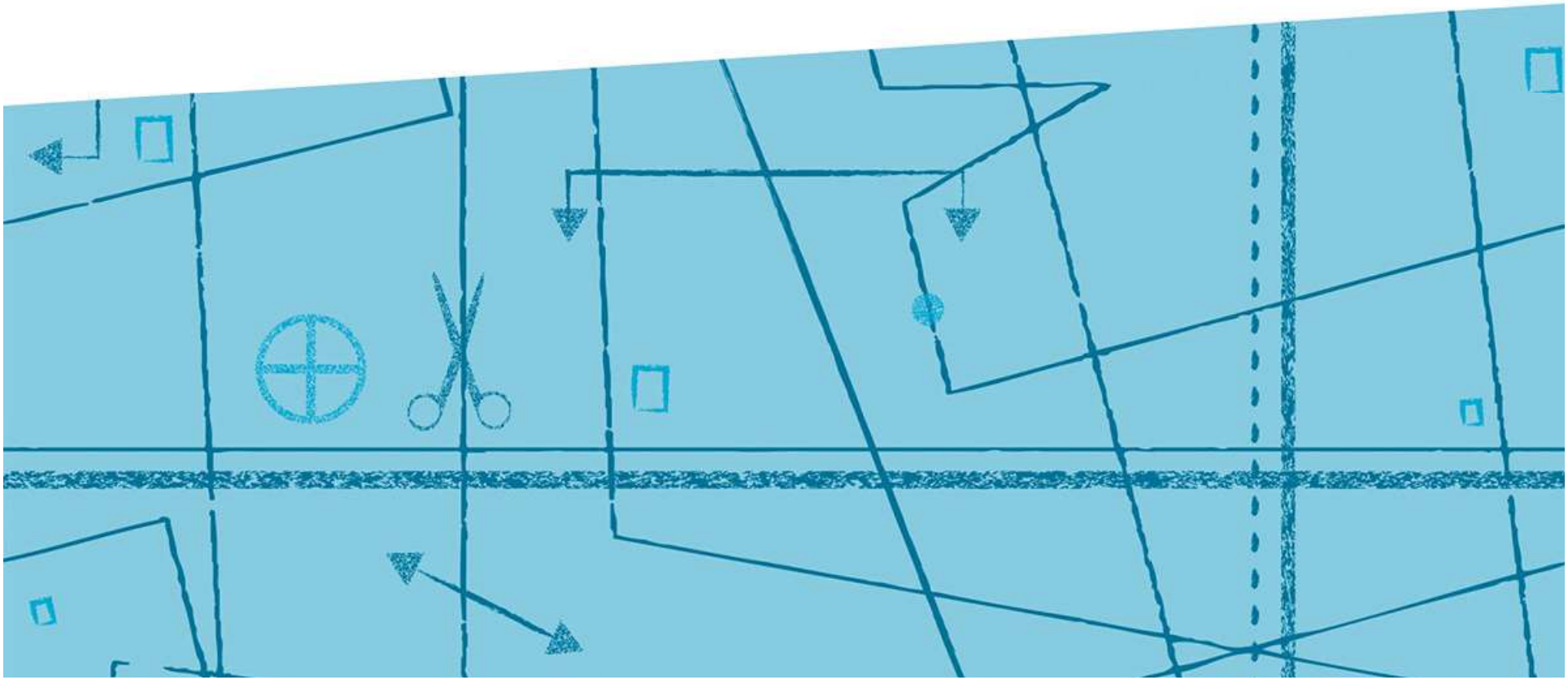
Partnership for Sustainable Textiles

Module 4

Wastewater and Sludge Treatment



Partnership for Sustainable Textiles

Overview and Content

Module 1: Chemicals in Textiles

Module 2: Chemical Management

Module 3: Good Housekeeping

Module 4: Wastewater and Sludge Treatment

- Target of the Module
- Treat Your Wastewater
- Wastewater Sludge Treatment
- Recovery and Reuse of Chemicals
- Reuse of the Treated Wastewater
- International Compliance
- Possible Useful Corrective Actions
- Example and Exercise

Module 5: Health Protection and Occupational Safety

Module 6: Risk Analysis and Action Planning

Module 7: Evaluation and Possible Next Steps

Partnership for Sustainable Textiles

Target of the Module „Wastewater- and Sludge Treatment“

- The textile industry uses vast quantities of water and discharges significant volumes of wastewater. This water consumption and discharge increase the problems of water scarcity and pollution of the waterbodies in the producing countries.
- The actual challenges in the in-house water management of the producing textile factories cannot be solved by end-of-pipe solutions alone.
- Production integrated solutions of the entire water management in the textile wet processes are in demand to reduce the water consumption as well as the emission load of the effluent.

Partnership for Sustainable Textiles

Treat Your Wastewater

- The textile manufacturing processes require large amounts of water. Not all of the chemicals added to the float end up in the final product, but get discharged with the used process water.
- Depending on the type and concentration of the chemicals in the waste water, these chemicals, if not treated, contaminate surface and ground water, affect the aquatic life, and pose health hazards to those who use the water from such water bodies.

Video Wastewater Treatment (CITA):
http://chemicals.cita.org.hk/mod/mediagallery/cita_video_item.php?g=2 & video_id=10048

Partnership for Sustainable Textiles

Treat Your Wastewater

Take a quick look

- ✓ Does your company have an in-house effluent treatment plant (ETP) or is connected to an external one e.g. common effluent treatment plant (CETP)?
- ✓ Does your company have a valid environmental license to operate?
- ✓ Does the ETP/CETP comply consistently with wastewater discharge permits at all times?
- ✓ Is you ETP operated by qualified personnel?
- ✓ Is your ETP operating continuously?

Partnership for Sustainable Textiles

Treat Your Wastewater

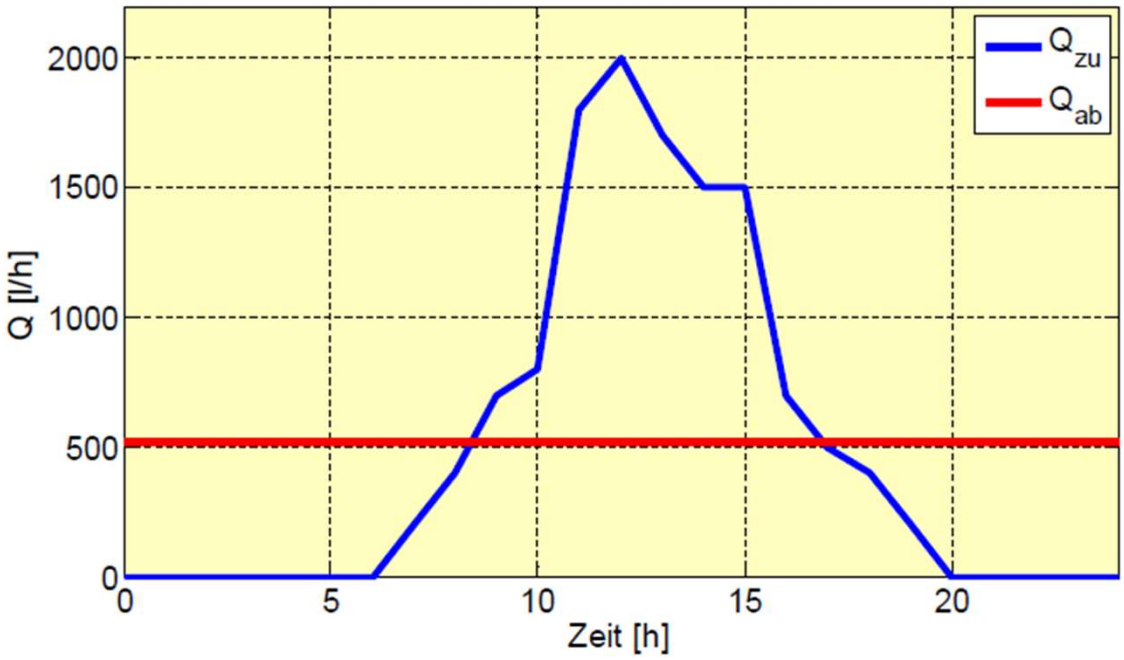
Wastewater Quantity Benchmarks	l/kg
Wool scouring	2 - 6
Yarn finishing (wool)	35 - 45
Yarn finishing (cotton)	100 - 120
Yarn finishing (synthetic fibres)	65 - 85
Finishing of knitted fabrics (wool)	60 - 70
Finishing of knitted fabrics (cotton)	60 - 136
Finishing of knitted fabrics (synthetic fibres)	35 - 80
Finishing of woven fabric (wool)	70 - 140
Finishing of woven fabric (cotton)	50 - 70
Finishing of woven fabric (synthetic fibres)	100 – 180
Bovine leather (from raw to finished)	12 -30
Pig skin leather (from raw to finished)	32 - 69
Sheep/goat skin leather (from raw to finished)	110 – 265 per skin

Partnership for Sustainable Textiles

Wastewater Treatment Techniques

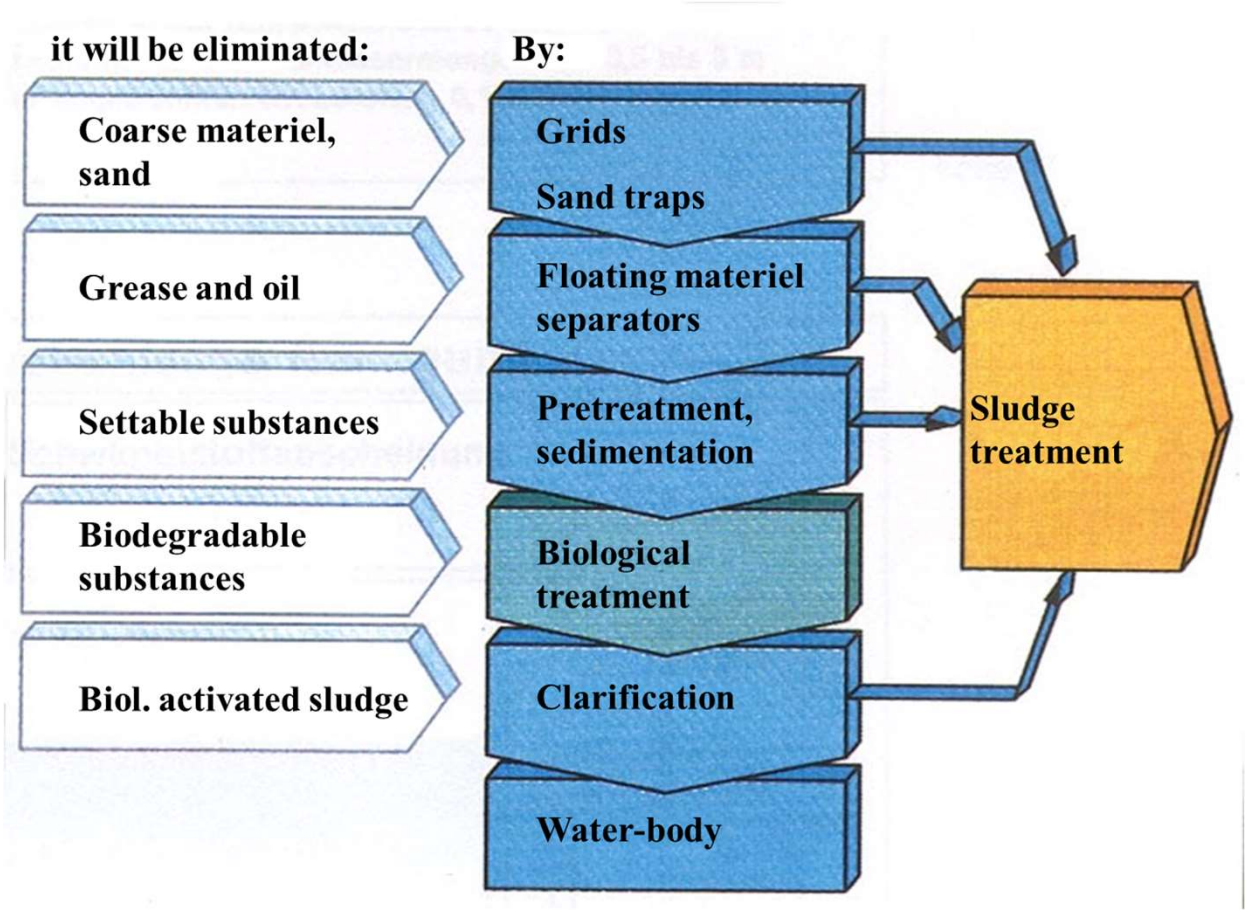
Typical daily flow rate of waste water and equalized outflow of an equalization tank

It is advisable to equalize the wastewater flow in terms of flowrates and as well in terms of concentrations of ingredients (residual dyes).



Partnership for Sustainable Textiles

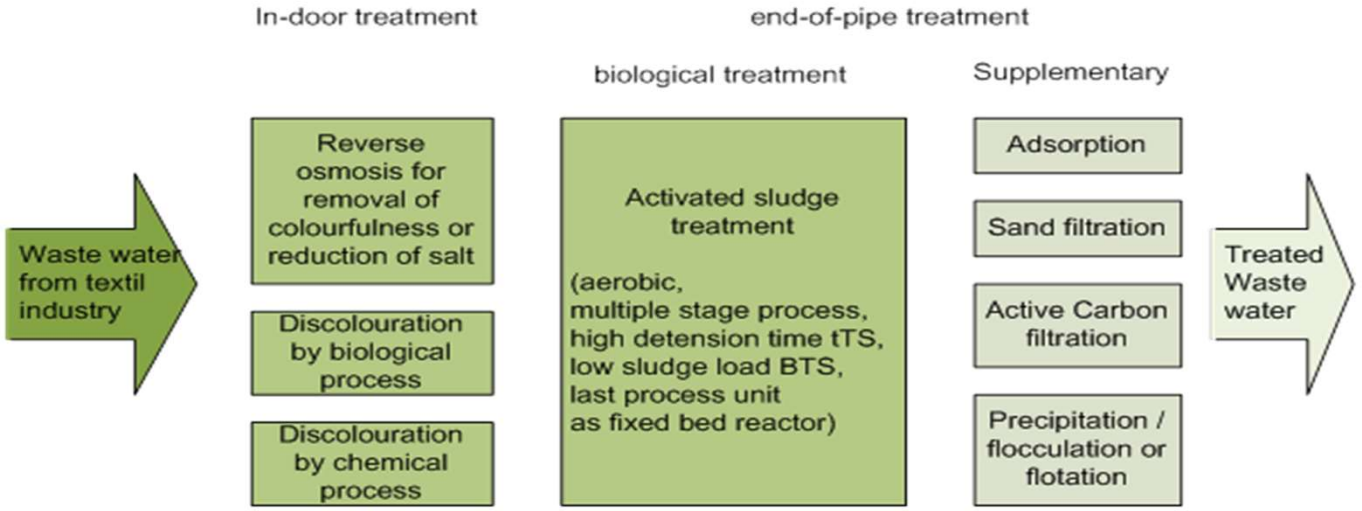
Wastewater Treatment Techniques



Partnership for Sustainable Textiles

Wastewater Treatment Techniques

Scheme of the common treatment of wastewater from textile industries



Mixed wastewater from textile industries are generally characterized by organic carbon-containing substances, which concentrations are slightly higher concentrated than in municipal waste water, but are more difficultly to degrade.

Partnership for Sustainable Textiles

Wastewater Treatment Techniques

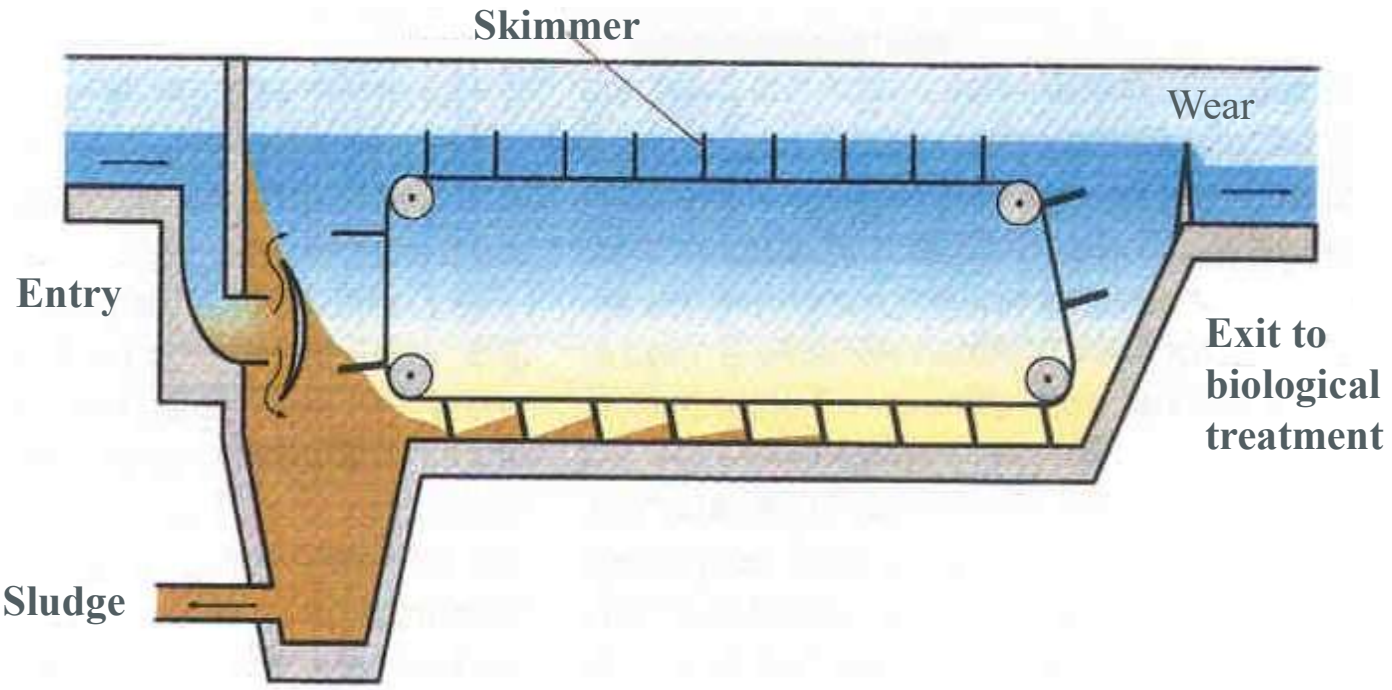
Recommended wastewater treatment process for in-door applications

Main process	Wastewater treatment process
Pre-treatment	Equalization of flow streams + concentration neutralization
Separation of solids Mechanical or physical	Grids, sizes Sedimentation Flotation filtration
Separation of solids Chemical or and physical	Adsorption Precipitation and Flocculation Ion exchange
Degradation of substances (oxygen demanding) Biological	Aerobic Anaerobic
Degradation (reduction) of substances Chemical	Oxidation Reduction

Partnership for Sustainable Textiles

Wastewater Treatment Techniques

Mechanical Treatment: Presettling tank / clarifier



Dimensioning: Presettling: 1 - 6 m^3 wastewater / m^2 surface and hour

Clarifier: 0,4 - 2 m^3 / m^2 surface and hour

Module 4: Wastewater and Sludge Treatment

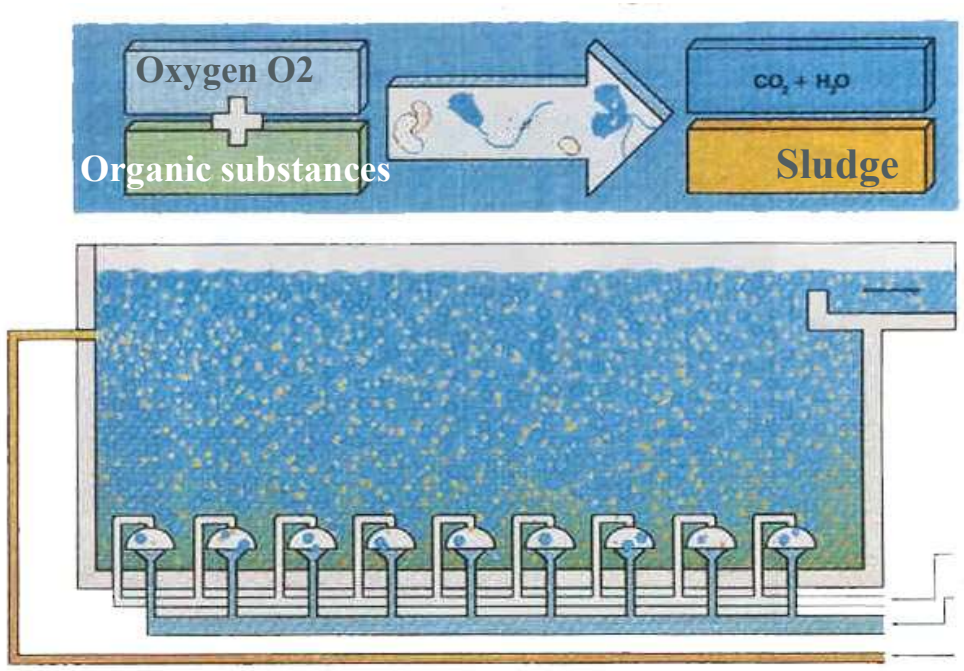
Partnership for Sustainable Textiles

Wastewater Treatment Techniques

Partnership for Sustainable Textiles

Wastewater Treatment Techniques

Biological Treatment: Activated Sludge Treatment



Outlet (water and sludge)

Air entry from mechanical treatment Activated sludge

Dimensioning: communal waste water - 2 m^3 waste water / m^3 basin and day

Partnership for Sustainable Textiles

Wastewater Treatment Techniques

Partnership for Sustainable Textiles

Wastewater Treatment Techniques

Enabling a secure and consistent treatment at the CETP

Many wastewater treatment processes, especially biological methods, require a steady flow of wastewater with stable characteristics in order to function well. Concentration peaks in particular are a danger to biological processes and can completely disrupt their treatment capabilities. Because of this reason, it is common for operators of CETPs to set quantity and quality limits to the wastewater entering their plant, according to their treatment capacity. Therefore, an open communication between the CETP operator and the companies in the industrial park is essential.

Partnership for Sustainable Textiles

Wastewater Sludge Treatment

- Your company is expected to follow generally-accepted process engineering best practices with respect to wastewater treatment and overall facility water efficiency management.
- In addition to the treatment of all wastewater and discharge as per established discharge limits/standards, special attention needs to be paid to the management of the treatment sludge.
- Textile waste water treatment generates up to 1.5 kg sludge per m^3 of waste water.

Partnership for Sustainable Textiles

Wastewater Sludge Treatment

Depending on the concentration of certain chemicals in the sludge the same be considered as hazardous waste.

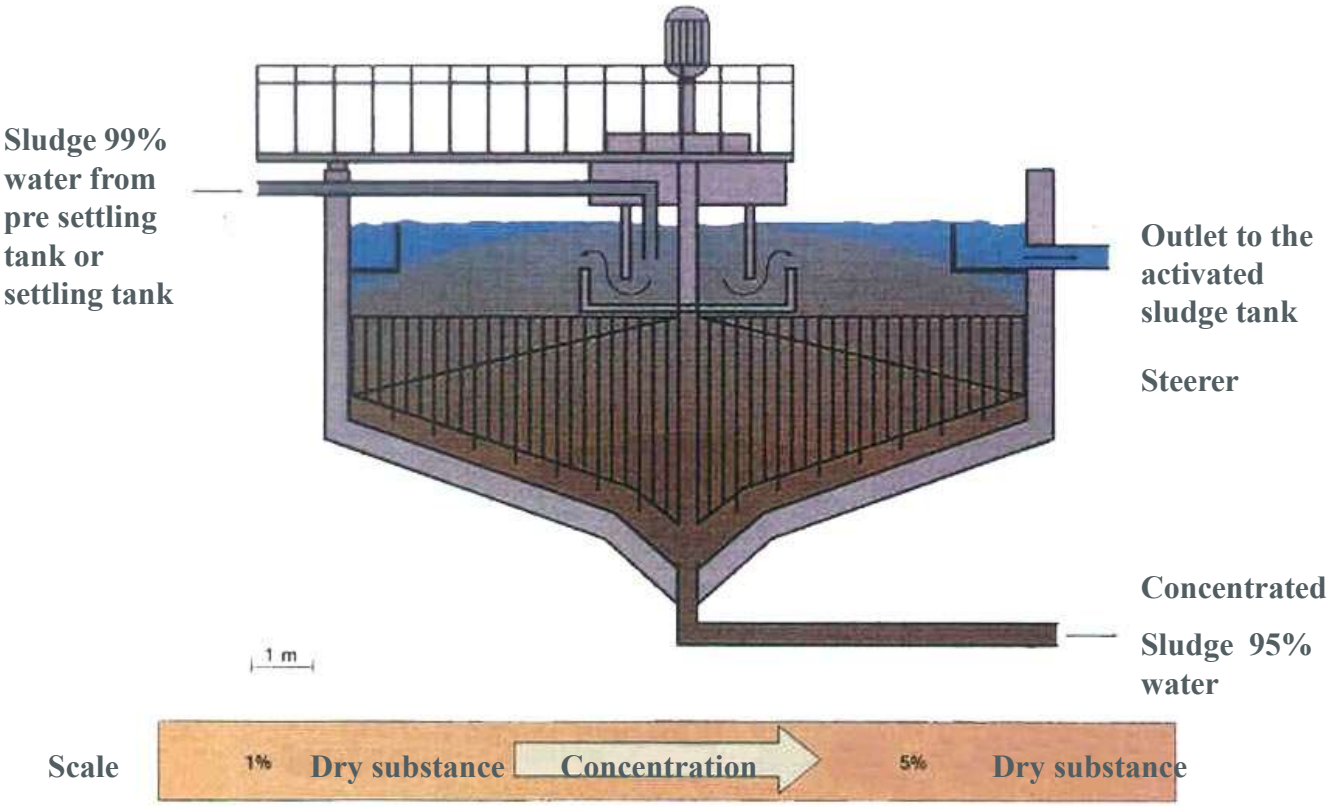
This requires the further removal and disposal of the sludge by licensed/permitted and qualified third parties that have appropriate facilities to properly dispose of the sludge wastes. Only this ensures that sludge and leachates from the sludge do not adversely impact the environment.

Substitution of hazardous chemicals and application of Best Available Techniques (BAT) will help to reduced the hazard levels of treatment sludge and waste, reducing the cost for their treatment and disposal.

Partnership for Sustainable Textiles

Wastewater Sludge Treatment

Sludge Treatment: Concentrator



Wastewater Sludge Treatment

1 – 5 kg treatment sludge per m^3 treated wastewater

Challenges:

- Sludge dewatering (climate, technical)
- Sludge discharge (regulations, infrastructure)

Partnership for Sustainable Textiles

Recover and Reuse Chemicals

A segregation of wastewater streams allows various direct recycling and recovering technologies for certain process chemicals. The application of such technologies will reduce your cost of chemicals while lowering the capital investment and operating costs for the effluent treatment.

Recycling and recovering technologies

- Recovery of alkalis from mercerizing
- Printing paste recovery from the supply system
- Recovery of sizing agents by Ultrafiltration

For further information on sector specific recycling and recovery technologies, refer to the European BREF/BATs http://eippcb.jrc.ec.europa.eu/reference/

Partnership for Sustainable Textiles

Recover and Reuse Chemicals

Recovery of Chemicals

Many chemicals can be recovered from effluents, if the respective streams are separated before mixing with other wastewater streams.

- This leads to a lower loaded wastewater and cost savings due to the recovered chemicals.

Examples for this practice are:

- Caustic soda recovery through distillation
- Acetic acid recovery through extraction
- Precious metal recovery through electrolysis

Partnership for Sustainable Textiles

Reuse of the Treated Wastewater

- As the groundwater table is falling in many industrial areas of the producing countries, pumping the water to the surface and its pre-treatment becomes more expensive.
- Companies have begun on-site wastewater treatment with the goal of reusing the majority of their effluent as raw water for their processes.
- Treating and reusing some low-loaded wastewater streams can already lead to a significant reduction in water consumption and wastewater production.

Partnership for Sustainable Textiles

Reuse of the Treated Wastewater

Processes for reuse of the treated wastewater

ANAEROBIC TREATMENT OF DESIZING WASTEWATER

1. Desizing
2. Bleaching/ Scouring
3. Mercerization Dyeing Printing Finishing
4. Drain towards Effluent Treatment Plant

Over 50% of the total organic load is released in the wastewater system from the desizing process. However, the wastewater volume from desizing only represents about 5 % of the total wastewater volume. The combined treatment of this stream with the other wastewater streams from the textile finishing (mixed wastewater) is associated with considerable energy demand for aerobic biodegradation and high amounts of biomass produced

Partnership for Sustainable Textiles

Reuse of the Treated Wastewater

Energy production from highly loaded streams

- In many industrial processes, for example in paper, sugar or woven textile production, effluent streams with very high organic load (up to 30,000 mgCOD/l) are present.
- These effluent streams are often suitable for anaerobic pretreatment, which greatly reduces the COD load on downstream effluent treatment systems (i.e. CETP) while producing energy rich biogas.

Partnership for Sustainable Textiles

International Compliance

Due to increasing public pressure, more and more brands are demanding their producers to comply with environmental standards such as wastewater standards: e.g. ZDHC, Oeko-Tex or GOTS. Only a fruitful collaboration between CETP operators and the producers can ensure that the effluents are complying with the standards

Partnership for Sustainable Textiles

International Compliance

Move towards zero-liquid discharge (ZLD)

- The application of alternative process technologies (low-float, water-less/free) can significantly reduce the water footprint.
- Dwindling water resources, drop in ground water tables and emerging conflicts about use of remaining water sources requires the need to explore further steps
  - Partially or fully closed cycle water systems
- In several countries, textile and leather industry is already required to install zero-liquid discharge systems. A full recovery of waste water entails a full treatment and/or recovery of chemicals in the effluent. Such ZLD systems usually consist of multi-stage filtration and evaporation components.

Partnership for Sustainable Textiles

Summary of reasons for In-house Pre-Treatment

Reason 1: Recovery of chemicals

Reason 2: Reuse of treated Wastewater

Reason 3: Energy production from highly loaded streams

Reason 4: Enabling a secure and consistent Treatment at the CETP

Reason 5: International Compliance

Partnership for Sustainable Textiles

Possible Useful Corrective Actions 1

1. Management Techniques

- Water monitoring of individual machines or processes and systematic use of the results to reduce water consumption
- Advanced monitoring of all relevant processes in order to establish a water balance of the whole wet processing unit
- Measurements of water consumption of individual finishing processes such as from roller washers or exhaust dyeing

2. Improvement of Installations

- Optimized reverse osmosis plants for the preparation of boiler feed water
- Optimization of water consumption for the continuous pre-treatment of cotton and blended cotton woven fabrics
- Substitution of roller washers by continuous counter-current washing
- Optimization of heat recovery from wastewater of individual machines or a group of machines
- Use of washing water from scouring and/or bleaching for the steam water lock in continuous pretreatment lines

Partnership for Sustainable Textiles

Possible Useful Corrective Actions 2

3. Recycling of specific water streams

- Recycling of cooling water from singeing
- Recycling of cooling water from caustic soda recovery
- Recycling of steam condensate from caustic soda recovery
- Recycling of last rinsing water from mercerization
- Use of RO reject for scrubbing waste gas from coal combustion
- Recycling of cooling water from cylinder dryers

4. Improvement of recipes or usage of chemicals with better environmental properties

- Systematic listing of all chemical products used with all available environmental data and identification of the need of alternatives
- Substitution of liquid ammonia for pigment printing pastes

Partnership for Sustainable Textiles

Possible Useful Corrective Actions 3

5. Pre-treatment of segregated wastewater streams and end-of-pipe wastewater

- Anaerobic pre-treatment of desizing liquors from the pre-treatment of cotton or blended cotton woven fabrics
- Adjustment of optimum conditions for biological wastewater treatment such as maximum temperature of 37°C, food-to-microorganism ratio of less than 0.15 kg BOD5/kg MLSS x d and C:N:P ratio of 100:5:1, and plough flow reactors

Partnership for Sustainable Textiles

Literature, Sources and Further Reading

- ZDHC Wastewater Guideline: *https://www.roadmaptozero.com/fileadmin/pdf/Files_2016/ZDHC_Wastewater_Guidelines_Print.pdf*
- ZDHC Wastewater Treatment Technologies: *https://www.roadmaptozero.com/fileadmin/pdf/Files_2018/Wastewater_Treatment_Technologies_for_the_Textile_Industry-FINAL.pdf*
- -GIZ: Guideline/Handout Wastewater Treatment for the Textile Industries in Pakistan: *http://spc.org.pk/library-2/*

- For further information on sector specific recycling and recovery technologies, European BREF/BATs *http://eippcb.jrc.ec.europa.eu/reference/*

Partnership for Sustainable Textiles

Exercise and Example

Exercise:

“Calculate water consumption and COD”

Example:

“SLUDGE MANAGEMENT PLAN”

(Applicable for all Textile industries with ETP that generates any amount of sludge)

Partnership for Sustainable Textiles

Questions?