

The background of the top half of the slide is a close-up photograph of blue fabric, showing various textures and folds. A dark teal horizontal bar is overlaid on the left side of this image, containing the main title.

Pollution Load in Textile wastewater

Promotion for Sustainability in the Textile and Garment Industry in Asia-FABRIC

Pollution Load in textile wastewater

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- Overview of textile waste water treatment techniques.
- Concentration of different pollutants including heavy metals, content Vs discharge standards.
- Treatment techniques for heavy metals.
- Chemical precipitation technique and chemicals used.
- Need to generate & removal of excess sludge from biological treatment.
- Sludge characteristics from different type of ETPs.

Sources of hazardous materials the general effluent, hazardous pollutants in textile waste water

The use of harmful chemicals in the textile sector has consequences for the environment

- Water pollution
- Pollution of soil and farmland
- Hazardous waste generation
- Pesticides used for cotton



Pollution of soil and farmland

- Hazardous chemicals in wastewater can pollute soil and farmland along rivers
- Sewage sludge containing hazardous chemicals is being applied to land as a soil supplement
- Contaminated soil can lead to contaminated food that is grown on these fields; therefore chemicals can enter the food chain



Water pollution

- Effluents from textile production pollute freshwater resources
- Used hazardous chemicals can even build up in the food chain



Possible impacts of untreated effluent

- **Water = Very valuable resource** AND **Wastewater = wasted water**
- Effluent from textile processing containing various types of contaminants such as organic, inorganic and toxic.
- Discharge of untreated effluent has adverse impacts on receiving environment
- Organic matters are the most common pollutant
 - major contaminant in most industrial effluents such as from distilleries, paper mills, textile factories, tanneries, breweries, fertilizer plants



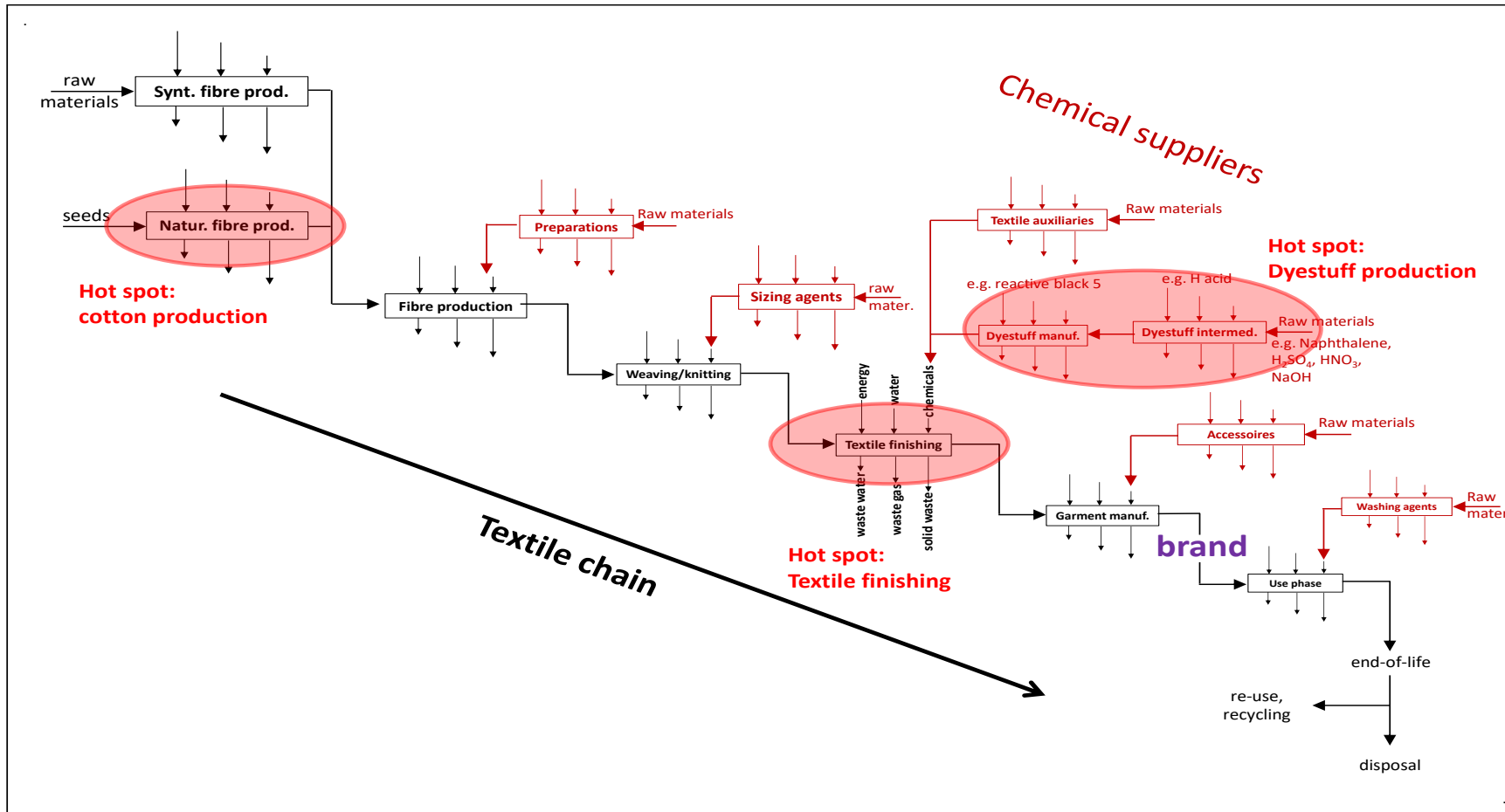
Possible impacts of untreated effluent

- **Damage to aquatic life**, threatening availability of food for people and affecting livelihood of farmers
- **Spoilt groundwater** becoming unfit for domestic usage from effluent discharged to land and percolating down
- **Adverse effects on fertility** and **yield** of crops and vegetation from effluent discharged on to land for irrigation
- **Contamination of fresh surface water** from discharge to water bodies, making unfit for further use

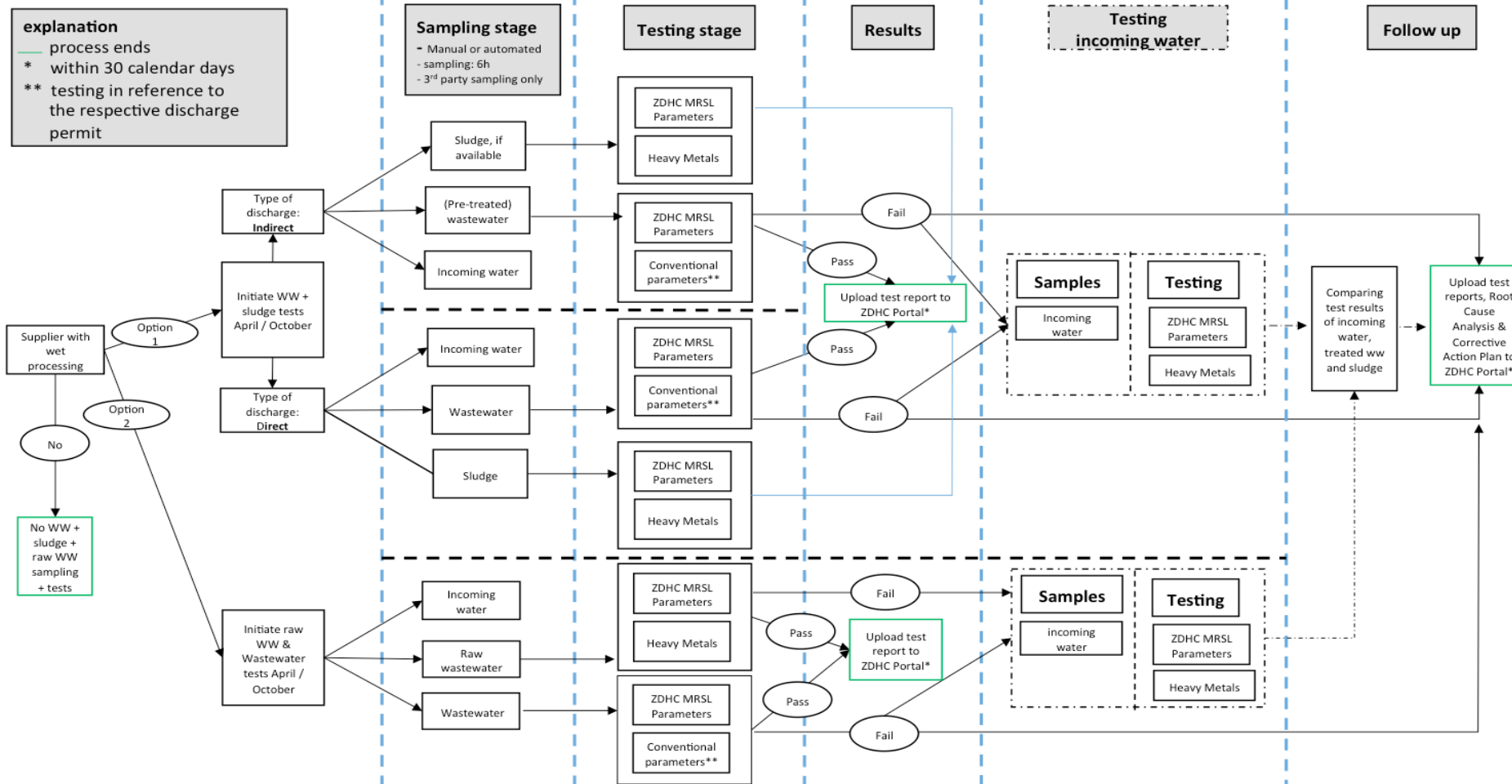
Wastewater Quantity Benchmarks

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

Ecological hot spots in the Textile chain



Process Flowchart for Testing, Appendix C, ZDHC wastewater Guidelines



THE PROBLEM

- **What problems can occur if you do not follow wastewater testing requirements?**



Brainstorm as a group and make notes

Group work

10 min Group
Work

Discuss your experience with wastewater testing.

What were your challenges?

What solutions have you found to positive test results?

Concentration of different pollutants including heavy metals, content Vs discharge standards

DOE Standards for Waste for Discharge into an Inland Surface Water

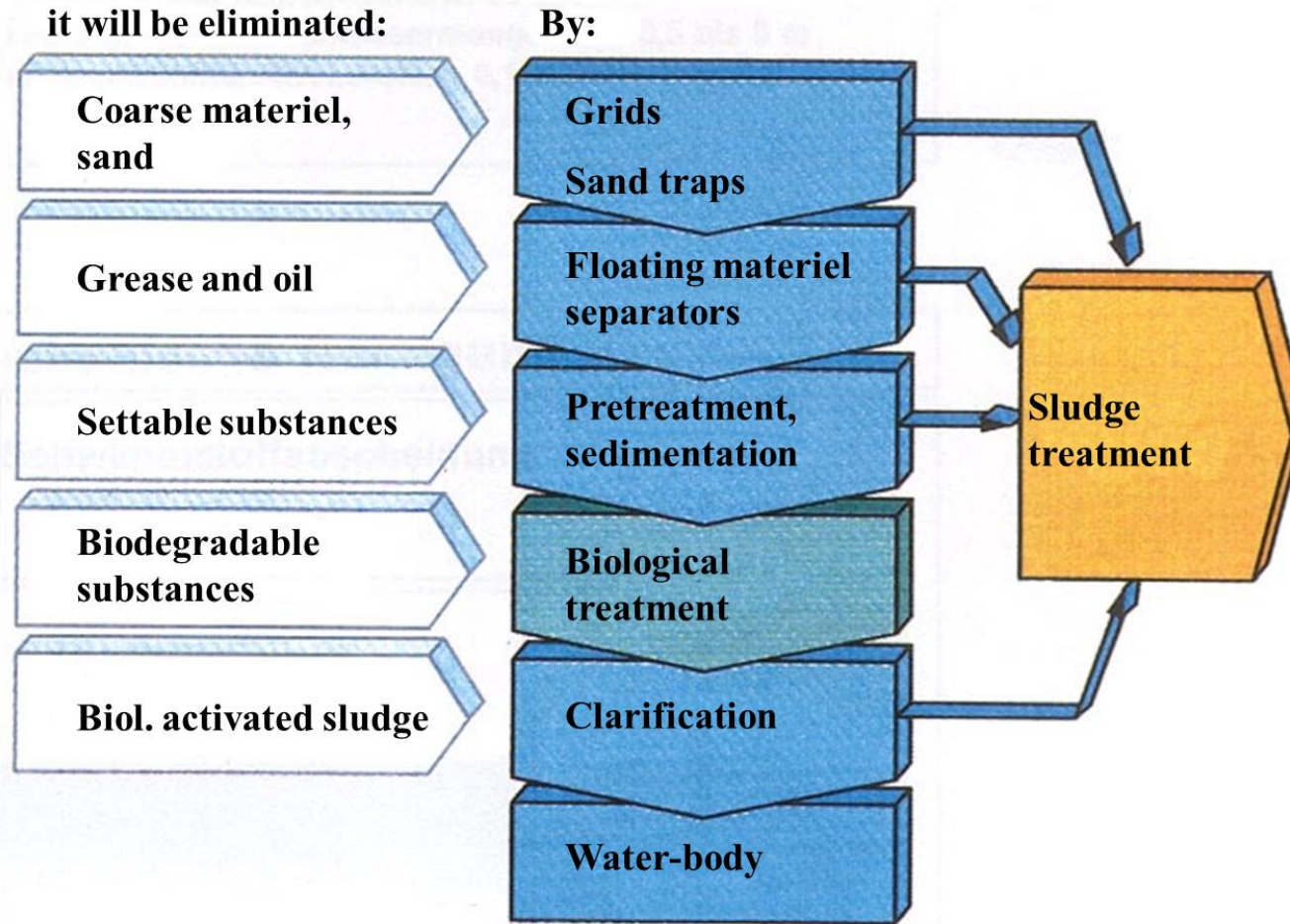
Parameters	Units	Typical Values	DOE Standards For Waste from Industrial Water Discharge
pH		8-10	6-9
Heavy Metals	mg/l	10 – 15	Varies depending on type of metal
Suspended Solids (SS)	mg/l	200 – 300	150
Total Dissolved Solids (TDS)	mg/l	5000 – 6000	2100
Chemical Oxygen Demand (COD)	mg/l	1500 – 175	200
Bio-chemical Oxygen Demand (BOD)	mg/l	500 – 600	50
Oil & Grease	mg/l	40 – 60	10
Surfactants	mg/l	10 – 40	
Sulfide as S	mg/l	50 – 60	1

DOE Standards for Waste for Discharge into an Inland Surface Water

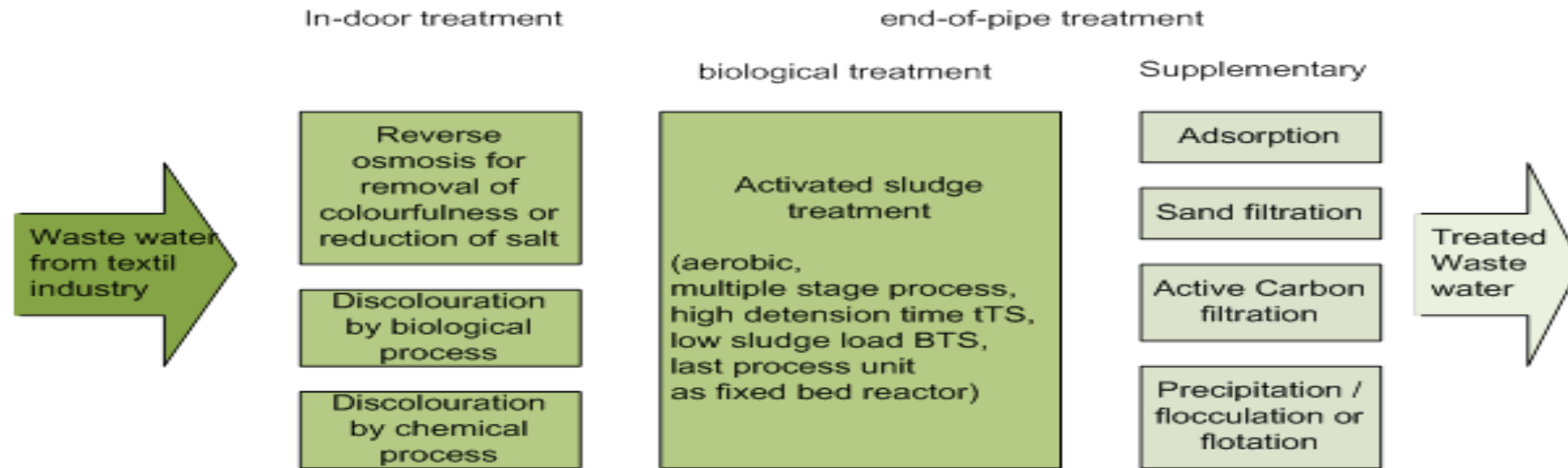
Parameter	Effluent Discharged Water Standards/Limit (mg/l) ¹	Standard for Wet Processing ((mg/l)) ²	Avg. Discharge quality of Bangladeshi ETP's (Biological Based) (mg/l) ³
Total Suspended Solid (TSS)	100	1	15-50
BOD5 20°C	150*	50	30-50
COD	200	200	100-150
DO	4.5-8	Not Permitted	4-5
Oil & Grease	10	1	1-3
Total Dissolved Solid	2100	200	1500-2100
pH	6.5-9	7-8	7-8

Overview of textile waste water treatment techniques

Classical Waste Water Treatment Techniques



Scheme of the common treatment of waste water from textile industries



Mixed waste water 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. The concentrations of nitrogen and phosphorous containing substances are lower than in municipal waste water.

Overview of effluent treatment – organic and inorganics

- **Inorganic contaminants – Heavy metals**
 - Vast variety of inorganic pollutants e.g. salts and heavy metals. most relevant in textile production
 - Common treatment of **metals through precipitation**
 - Possible for most heavy metals as their insoluble salts (such as hydroxides)
 - Precipitated by addition of lime and alum/ ferrous salts aided by polyelectrolytes.
 - Disadvantage: Metals transferred from liquid effluent to sludge and posing sludge disposal problem



SLUDGE

- A residual semi-solid material formed as a **by-product from industrial and municipal wastewater treatment.**
- A residue of effluent treatment plants (ETP) independent of applied treatment:
 - Physio-chemical.
 - Biological.
 - Chemical.



SLUDGE HANDLING

- **Sludge / solid waste** from the effluent stream could potentially **contain high levels of chemicals**, and requires proper handling and disposal:
- Disposal must meet all local requirements.
- Safety protocol need to be followed when handling sludge.
- Sludge must be disposed of through a qualified disposal company.

Disposal

- Landfill.
- Incineration.
- Upcycling.



Removal of Moisture

- Thickening.
- Dewatering.

Chemical precipitation technique and chemicals used

Organic pollution removal

- **Chemical precipitation**
 - Targeting suspended and colloidal organics
 - Involving coagulation, flocculation and solids separation for removal but not destruction of organics.
 - Commonly used coagulating agents: Metallic salts
 - Newer coagulation methods include electro coagulation.



Organic pollution removal

- **Chemical precipitation**

- Basic concept

- Coagulated colloidal particles very small.
- Combination of particles through flocculation to bigger flocs amenable to settling/flotation.
- Solids separation through sedimentation as well as dissolved air flotation & filtrations



Recover and Reuse treated waste water and chemicals

Recover and Reuse Chemicals

A segregation of waste water 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/>

Recover and Reuse 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

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.

ANAEROBIC TREATMENT OF DESIZING WASTEWATER

1. Desizing
2. Bleaching/ Scouring
3. Mercerization Dyeing Printing Finishing
4. Drain towards Effluent Treatment Plant
5. 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

Processes for reuse of the treated wastewater

- 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.

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.

International compliance

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

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
- 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.

Summary of reasons for In-house Pre-Treatment

Reason 1: Recovery of chemicals

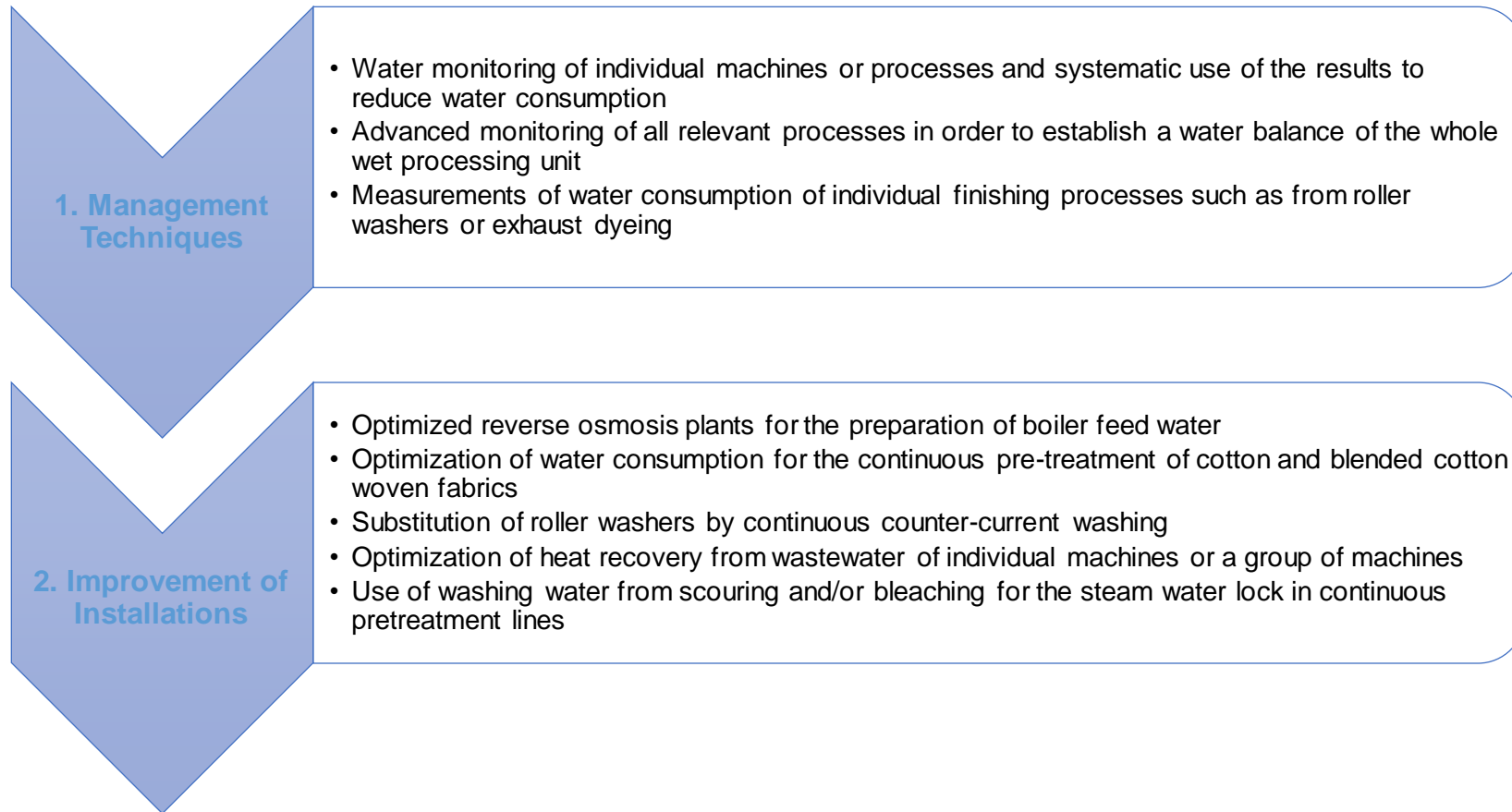
Reason 2: Reuse of treated Wastewater

Reason 3: Energy production from highly loaded streams

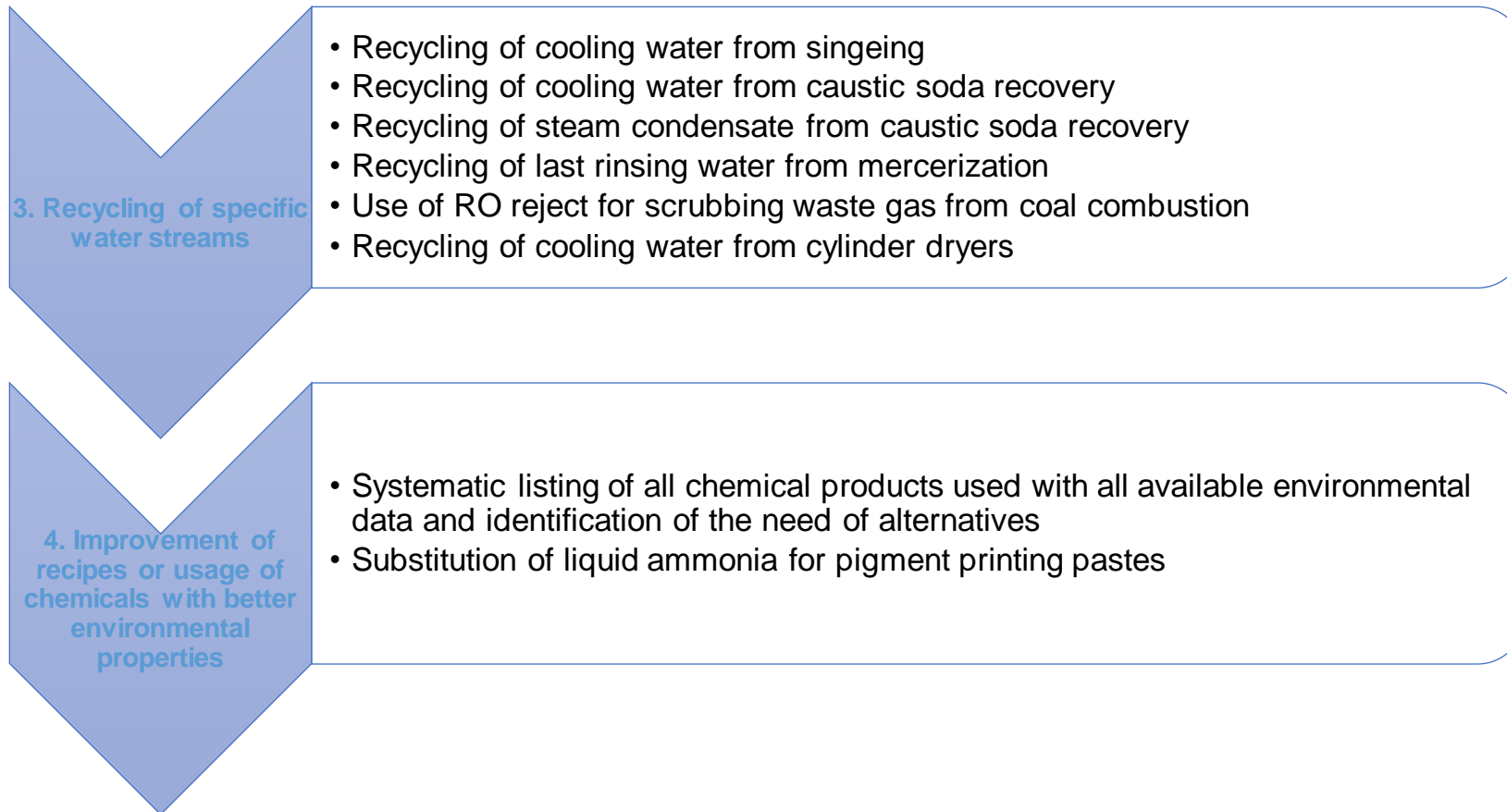
Reason 4: Enabling a secure and consistent Treatment at the CETP

Reason 5: International Compliance

Possible Useful Corrective Actions 1



Possible Useful Corrective Actions 2



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

Literature, Sources and Further Reading

- ZDHC, 2016, Wastewater Guideline
- ZDHC, July 2018, Wastewater Treatment Technologies
- Dr.-Ing. Friedrich-Willhelm Bolle, FIW Aachen, July 2016: GIZ-WETI Guideline, Wastewater Treatment for the Textile Industries in Pakistan
- BREF/BATs <http://eippcb.jrc.ec.europa.eu/reference/>

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