Pollution Load in Textile wastewater

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

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

FABRIC Asia

Pollution Load in textile wastewater

Helmut Krist
GIZ Consultant

on behalf of GIZ FABRICS and adelphi consult GmbH Berlin

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

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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

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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

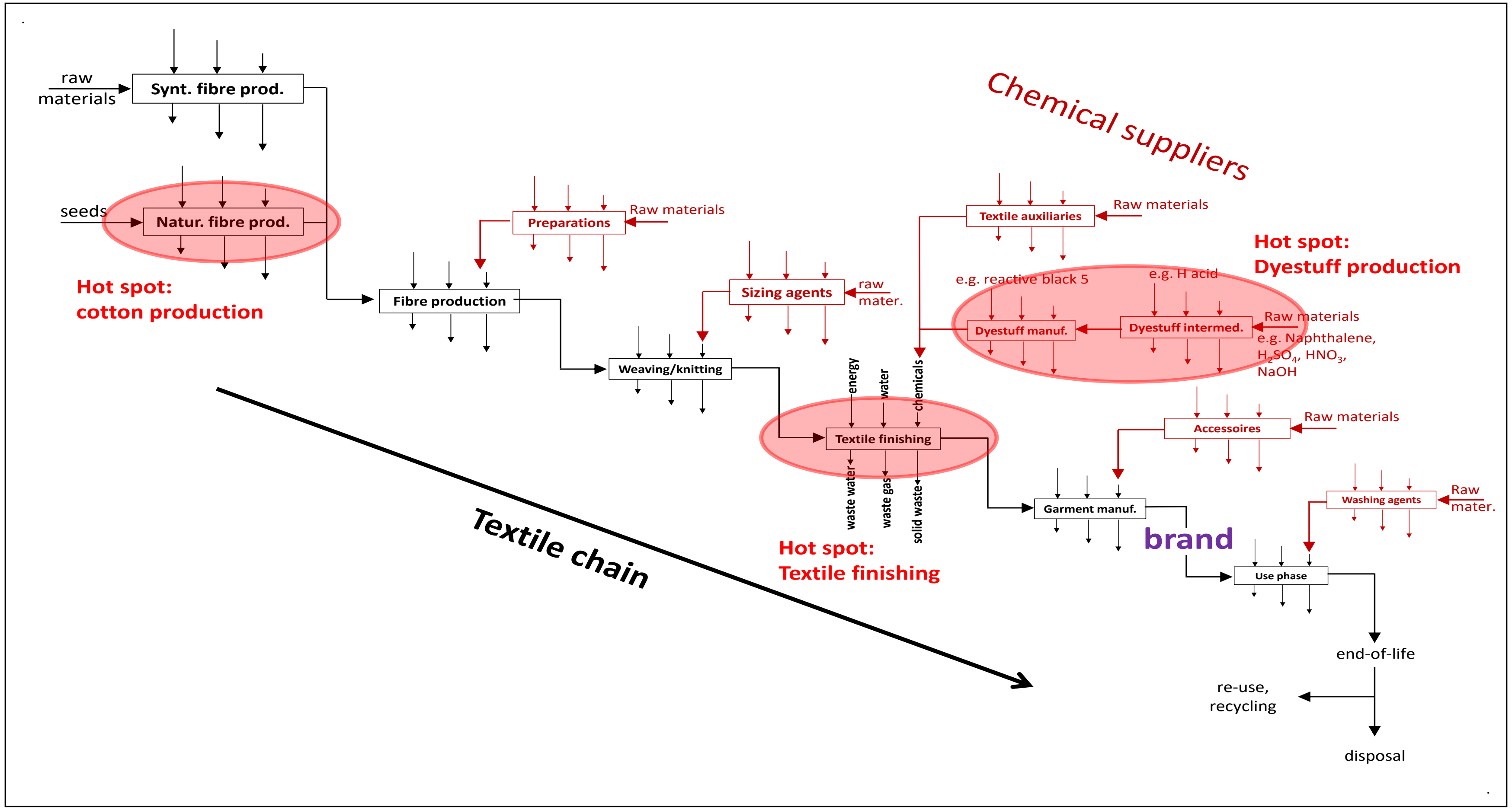
Possible impacts of untreated effluent

- **Damage to aquatic life,** threatening availability of food for people and affecting livelyhood 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	**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

Ecological hot spots in the Textile chain



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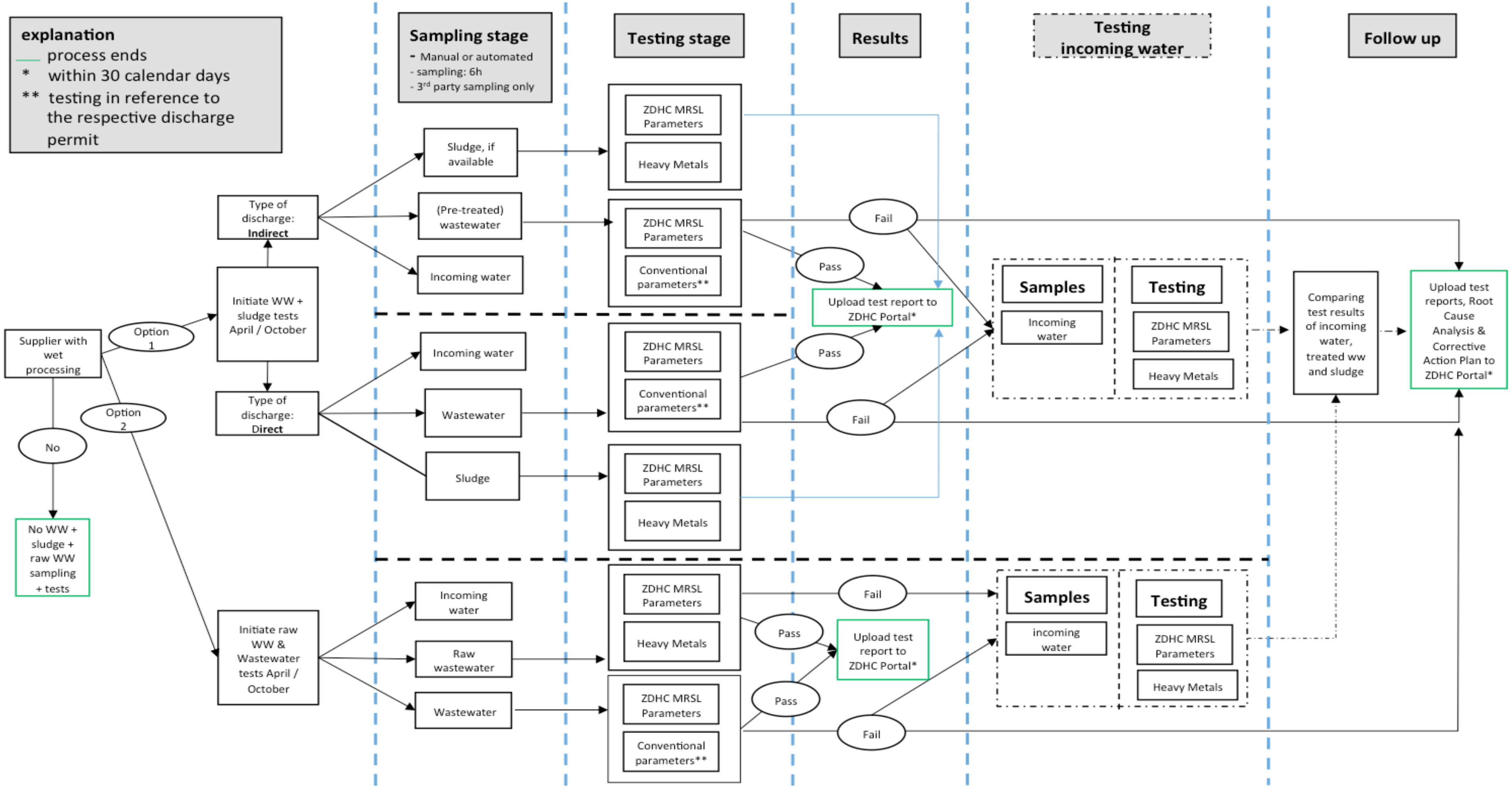
Process Flowchart for Testing, Appendix C, ZDHC wastewater Guidelines



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THE PROBLEM

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

Brainstorm as a group and make notes

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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 Disolved 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

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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

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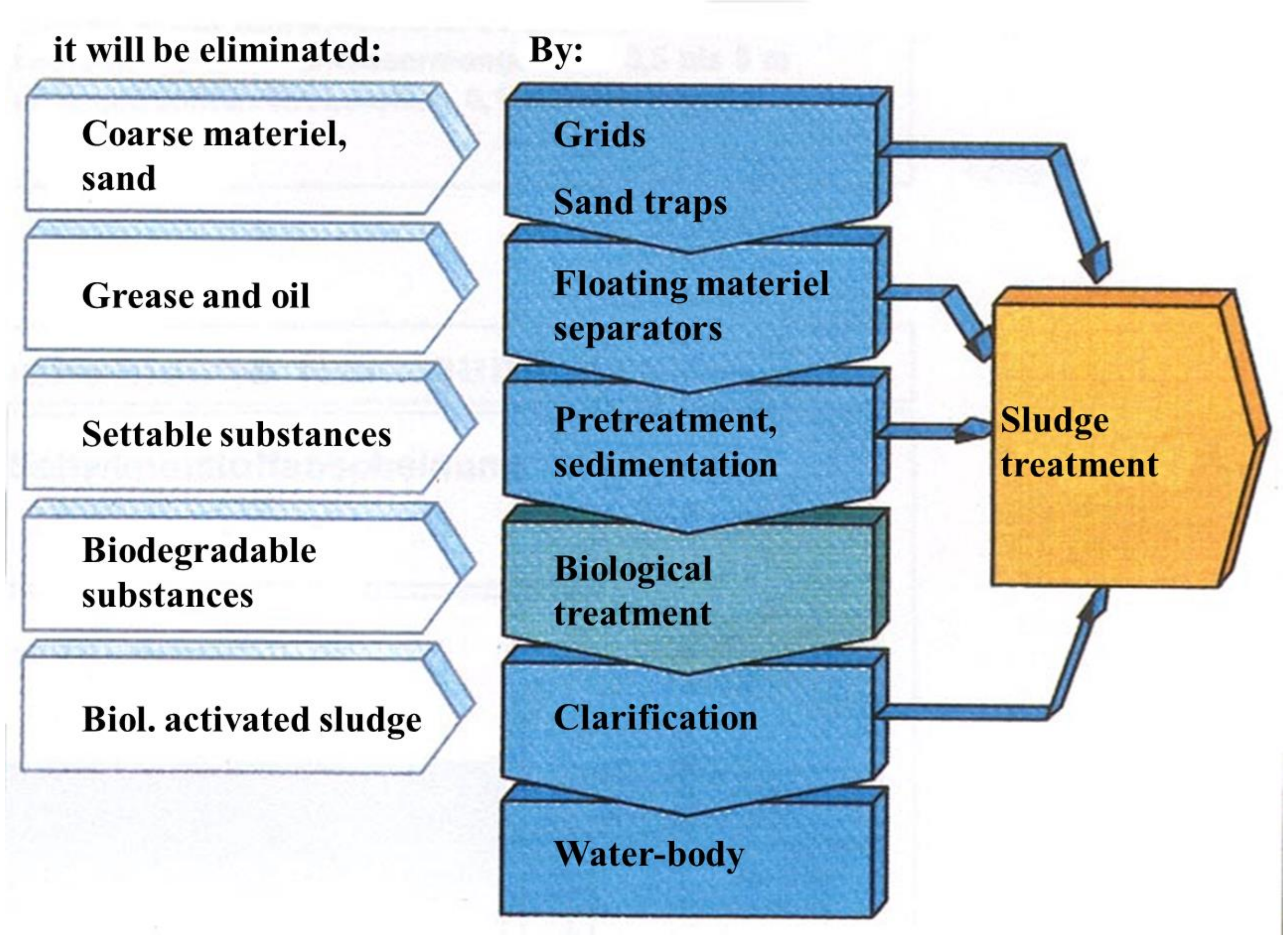
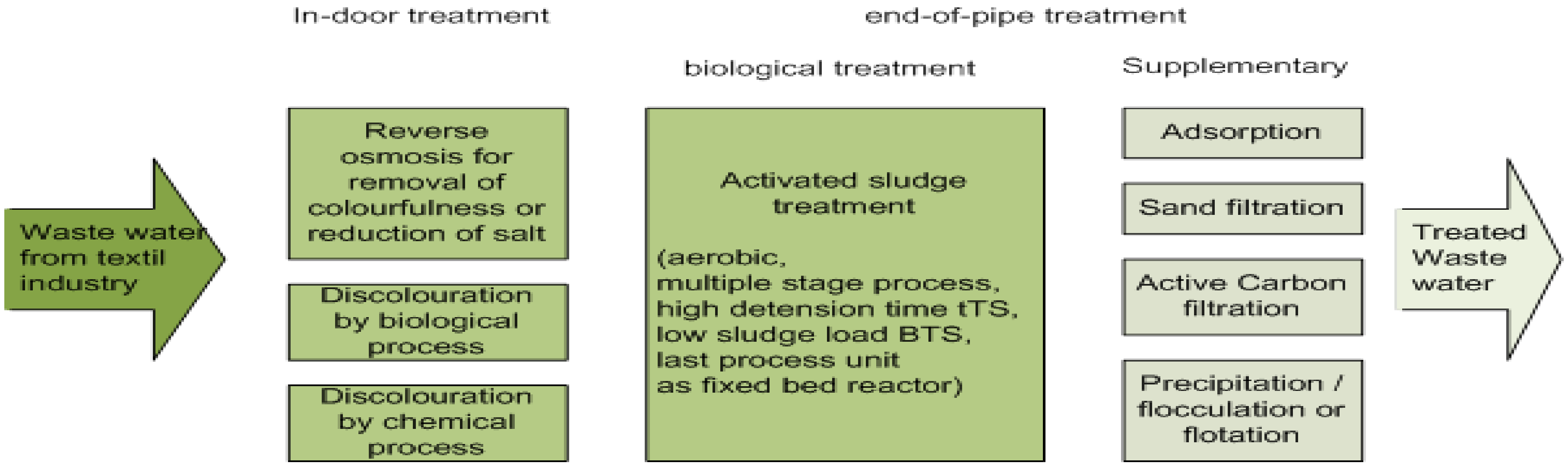
Overview of textile waste water treatment techniques

Classical Waste Water Treatment Techniques



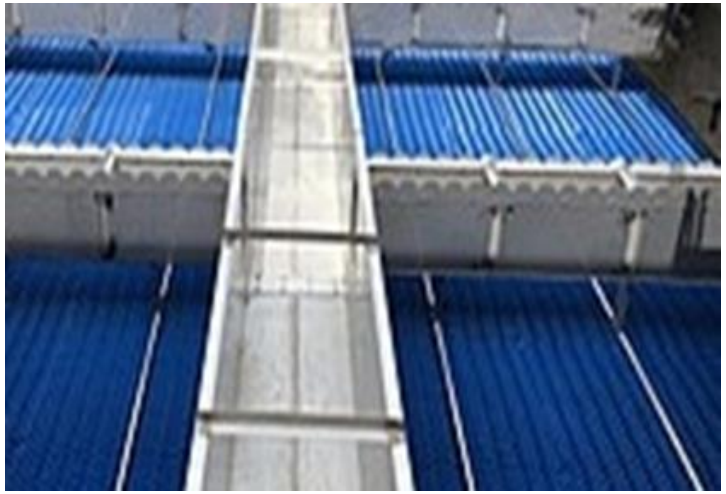
Scheme of the common treatment of waste water from textile industries



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/

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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.

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
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

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

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

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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Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

Registered offices
Bonn and Eschborn

Friedrich-Ebert-Allee 32 + 36
53113 Bonn, Germany
T +49 228 44 60 - 0
F +49 228 44 60 - 17 66

Dag-Hammarskjöld-Weg 1 - 5
65760 Eschborn, Germany
T +49 61 96 79 - 0
F +49 61 96 79 - 11 15

E info@giz.de
I www.giz.de

Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH