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# INTRODUCTION TO TREATMENT OF TEXTILE EFFLUENTS

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## A PROFESSIONAL HANDBOOK

**BY INNOVATIVE INTEGRATED SOLUTIONS**

Federal Ministry for Economic Cooperation and Development

german cooperation
DEUTSCHE ZUSAMMENARBEIT

FRUIT OF SUSTAINABILITY

German Importers
immer auf den PUNKT.

sequa

## FOR GREEN PAKISTAN PROJECT

# A PROFESSIONAL HANDBOOK FOR GARMENT & SPORTS GOODS INDUSTRY

**(Pakistan – EPA Punjab & Sindh Compliance)**

## 1. FOREWORD

Pakistan's garment and sports goods sectors—centered in Lahore, Faisalabad, Sialkot, and Karachi—are major export engines. However, these industries are also among the highest consumers of water and generators of complex wastewater.

With tightening regulations from EPA Punjab and EPA Sindh, and increasing pressure from global brands (ZDHC, HIGG, ESG), wastewater treatment is no longer optional—it is a **core business requirement.**

This handbook provides a concise, practical, and compliance-focused guide to textile wastewater treatment, tailored for Pakistan's industrial reality and global expectations.

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# 2. PAKISTAN WATER CRISIS – INDUSTRY CONTEXT

Pakistan is rapidly becoming a water-scarce country, with groundwater being depleted faster than it is replenished.

## KEY FACTS & FIGURES:

- Per capita water availability has dropped from **5,600 m³ (1947)** to **<1,000 m³** today (water scarcity threshold)
- Pakistan is ranked among the **top 10 most water-stressed countries globally**
- **90%+ industrial water** depends on groundwater
- Groundwater levels in Lahore are declining by **~0.5 to 1 meter annually**
- Karachi faces a water deficit of **30–50% daily demand**

## PUNJAB (LAHORE, FAISALABAD, SIALKOT)

**Declining groundwater levels due to over-extraction**


**Increasing pumping depth and energy costs**

**Deteriorating water quality (TDS, contamination)**

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# KARACHI (SINDH)

Severe supply-demand gap

Heavy reliance on tanker water

Unreliable industrial water supply

# HOUSEHOLD LINK

Only ~36% population has access to safe drinking water

Dependence on bore water and filtration systems

Increasing social and regulatory pressure

**Conclusion:** Industry is directly competing with society for water resources.

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# 3. WHY WATER CONSERVATION & RECYCLING ARE CRITICAL

## KEY DRIVERS:

- Rising cost of groundwater extraction
- Regulatory enforcement (EPA Punjab & Sindh)
- Global brand requirements (ZDHC, ESG, CBAM)
- Export competitiveness

## STRATEGIC SHIFT:

- Old Model: Use → Treat → Discharge
- New Model: Use → Treat → Recycle → Reuse

# 4. INDUSTRY SPECIFIC WASTEWATER CHARACTERISTICS

## SOURCES:

- Dyeing & washing (garments)
- Printing (sportswear, football panels)
- Finishing & softening
- Enzyme/stone washing

## TYPICAL PARAMETERS:

| Parameter | Range |
|---|---|
| COD | 800–2500 mg/L |
| BOD | 200–700 mg/L |
| TSS | 150–600 mg/L |
| TDS | 1500–6000 mg/L |
| Color | High |
| Oil & Grease | Moderate |
| pH | 6–11 |

## CRITICAL ISSUES:

- Color removal
- High salt load (TDS)
- Surfactants & chemicals
- Microfibers


# 5. EPA PUNJAB & SINDH DISCHARGE STANDARDS

| Parameter | Limit |
|---|---|
| pH | 6–10 |
| BOD | ≤ 80 mg/L |
| COD | ≤ 150 mg/L |
| TSS | ≤ 150 mg/L |
| Oil & Grease | ≤ 10 mg/L |
| Temperature | ≤ 40°C |

Increasing focus on color and toxicity compliance for export industries.

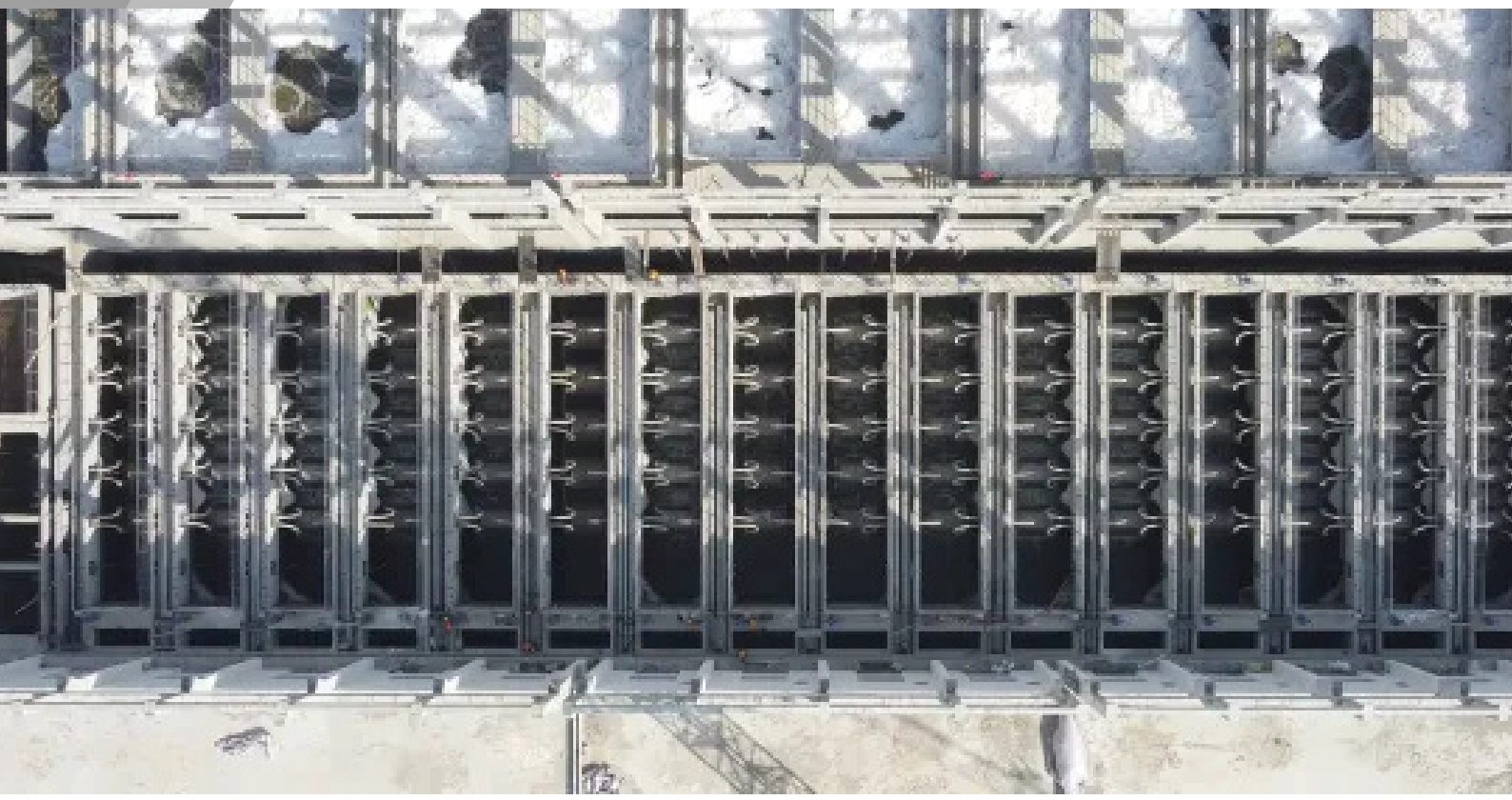
# 6. CLEANER PRODUCTION (FIRST STEP)

## MEASURES:

- Low liquor ratio dyeing
- Enzymatic processes
- Counter-current washing
- Salt optimization
- Chemical dosing control

## BENEFITS:

- 30–40% pollution reduction
- Reduced ETP size
- Lower operating cost



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# 7. OVERALL TREATMENT PROCESS

SCREENING → EQUALIZATION

EQUALIZATION → NEUTRALIZATION

NEUTRALIZATION → COAGULATION/ FLOCCULATION

COAGULATION/ FLOCCULATION → DAF

DAF → BIOLOGICAL (MBBR/ASP/MBR)

BIOLOGICAL (MBBR/ASP/MBR) → SECONDARY CLARIFIER

SECONDARY CLARIFIER → FILTRATION

FILTRATION → (RO FOR REUSE)

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# 8. PRELIMINARY & PRIMARY TREATMENT

## • SCREENING

- Screw type
- Rotatory drum screen
- Brush type rotatory

Removes lint, fibers, and solids.

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## • EQUALIZATION

- 8–12 hours retention
- Prevents shock loads

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## • NEUTRALIZATION


Maintain pH between 6.5–7.5.

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## • COAGULATION & FLOCCULATION

- PAC, decoloring agent, PAM
- Critical for color removal

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# 9. DAF (KEY UNIT FOR TEXTILE INDUSTRY)

## ADVANTAGES:

- High color removal efficiency
- Removes fine solids & oils
- Enhances biological treatment performance

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# 10. BIOLOGICAL TREATMENT

## MBBR (RECOMMENDED)

- Compact
- Stable
- Low sludge production

## ACTIVATED SLUDGE (ASP)

- Lower CAPEX
- Larger footprint

## MEMBRANE BIOREACTOR (MBR)

MBR integrates biological treatment with membrane filtration.

## UF → RO

- 60–80% water recovery
- Reduced freshwater demand
- Export compliance

## ADVANTAGES:

- Superior effluent quality
- Compact design
- Ideal for reuse systems.

## LIMITATIONS:

- Higher CAPEX/OPEX
- Membrane fouling risk

## OPERATING RANGE:

| Parameter | Value |
|---|---|
| MLSS | 6000–10000 mg/L |
| Flux | 10–25 LMH |
| DO | 2–3 mg/L |
| SRT | 20–40 days |

# 11. SECONDARY & TERTIARY TREATMENT

- **SECONDARY CLARIFIER**

  Settles biological sludge.

- **TERTIARY TREATMENT**
  - Sand Filter (PSF)
  - Carbon Filter (ACF)
- **ADVANCED OPTIONS**
  - Ozonation / AOP
  - Ultrafiltration (UF)

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# 13. ZERO LIQUID DISCHARGE (ZLD)

## CONFIGURATION:

**RO → MEE → ATFD / MVR**

## OUTPUT:

- 85–95% water recovery
- Salt recovery
- Minimal discharge

# MVR TECHNOLOGY (ADVANCED SOLUTION)

MVR (Mechanical Vapor Recompression) is an energy-efficient evaporation technology.

## ADVANTAGES:

- 30–50% lower energy than MEE
- Reduced steam consumption
- Lower operating cost long-term

## APPLICATION:

- High-capacity plants
- ESG-focused industries
- ZLD systems

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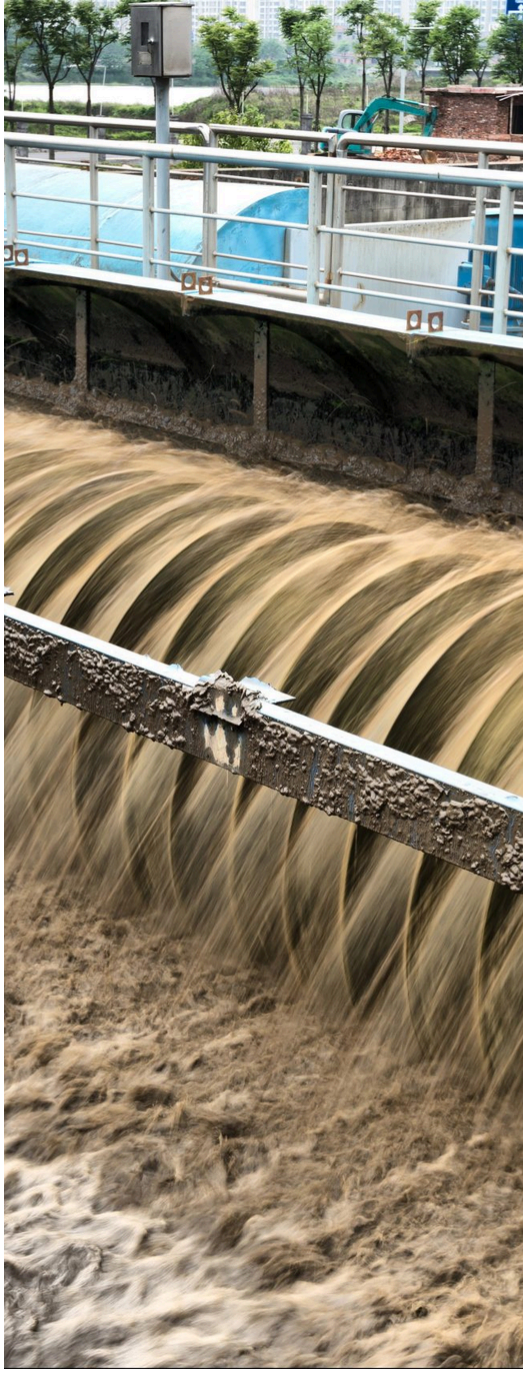
# 14. SLUDGE MANAGEMENT



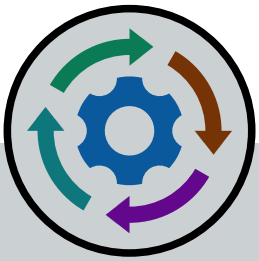
## BELT PRESS:

- Removes water using pressure belts
- Continuous operation

## SLUDGE DEWATERING:

- Reduces water and volume
- Produces dry sludge

## PROCESS:



- Thickening
- Filter press

## DISPOSAL:

- Hazardous landfill
- Cement co-processing

# 15. OPERATION & MONITORING


## DAILY MONITORING:

COD → DO

↓

MLSS → FLOW

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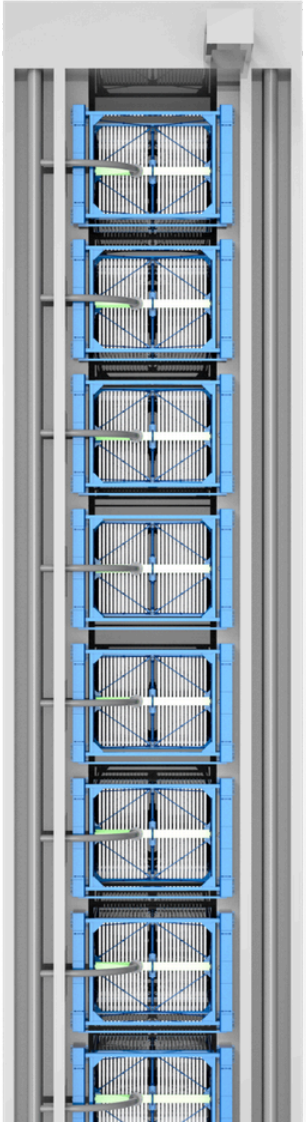
# 16. VILEP AND PROFLON MEMBRANE



## VILEP:

ViLEP's vibrating PTFE membrane uses hydrophilic PTFE and mechanical motion to reduce energy use and fouling while extending lifespan

## PROFLON:

PTFE technology has powered POREFLON membranes, applied by Suke Environmental across multiple water treatment sectors.

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# 17. PACKAGED WASTEWATER TREATMENT PLANT (WWTP) 1–25 m³/h

- Treats 1–25 m³/hour wastewater
- Compact, pre-engineered packaged unit
- Includes aeration, settling, and filtration
- Easy and quick installation
- Requires less space
- Simple and automated operation
- Meets discharge standards
- Low cost and maintenance


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# 18. ESG & GLOBAL COMPLIANCE

## REQUIREMENTS:

- Water footprint reduction
- ZDHC compliance
- HIGG Index reporting
- Sustainable production

Non-compliance = loss of export markets

# 19. STRATEGIC SOLUTION FRAMEWORK

- Source Reduction
- Advanced ETP (DAF + MBBR)
- Water Recycling (UF + RO)
- ZLD / MVR (if required)

# 20. FINAL CONCLUSION

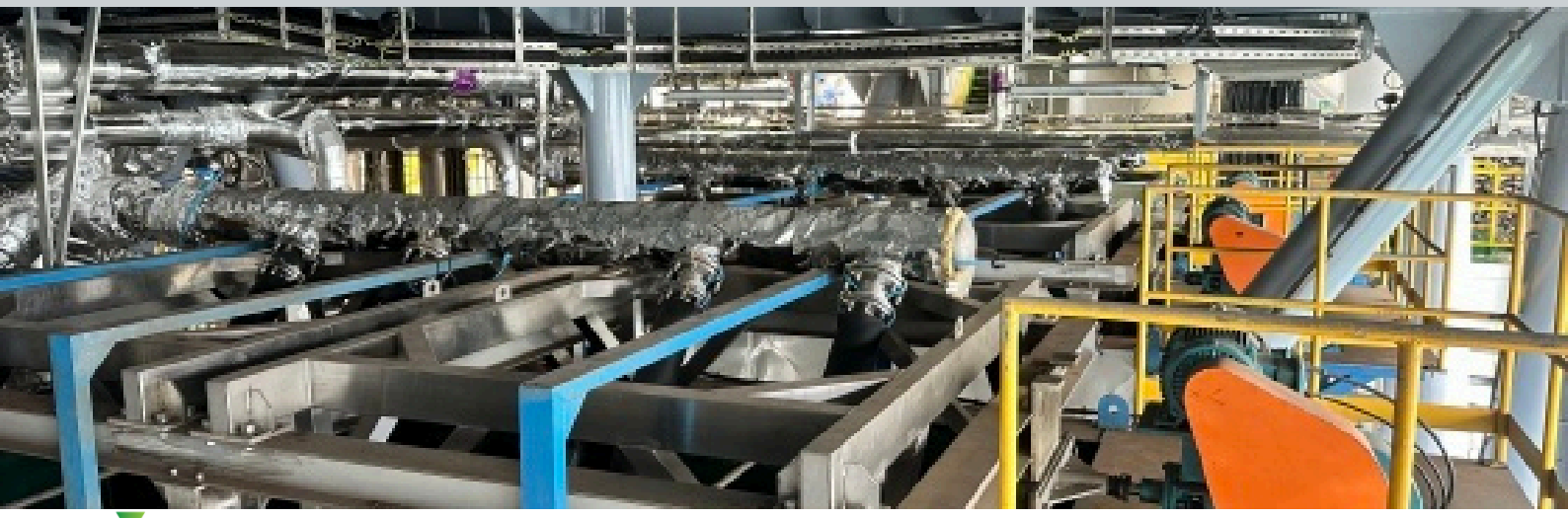
Water is no longer a utility—it is a strategic resource.

## Industries that adopt:

- WATER CONSERVATION
- RECYCLING SYSTEMS
- SUSTAINABLE PRACTICES

## KEY ADVANTAGES:

- Maximum water recovery (near ZLD performance)
- Reduced load on conventional evaporators (MEE)
- Lower energy consumption vs traditional thermal systems
- Reduced membrane fouling & maintenance
- Strong compliance with EPA + ESG + global brands
- Future-ready sustainable solution



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WETS

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ADVANCED FILTRATION AND SEPARATION SOLUTIONS FOR WATER TREATMENT AND INDUSTRIAL APPLICATIONS.


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