



Pilot Study:

Recycled Polyester Guidelines V1.0

***Enhancing Sustainable Chemical
Management Practices in Polyester Recycling***

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Executive Summary

The ZDHC Foundation conducted a pilot study to evaluate the practical implementation of its Recycled Polyester Guidelines V1.0, which aims to advance sustainable chemical management across the recycled polyester (rPET) value chain. Five facilities from China and India—covering chemical and mechanical recycling processes—participated in the study. The assessment focused on feedstock traceability, input chemical management, chemical recovery and monitoring of wastewater and air emissions.

The pilot revealed encouraging conformance levels among participating facilities, particularly in input chemical management and chemical recovery processes, which form the foundation for safer practices. However, critical areas for improvement were identified. These include the need for a more standardised and structured approach to maintaining Material and Chemical Inventory Lists, which is essential for traceability and robust chemical management. Additionally, wastewater testing and sludge management practices require greater consistency to meet the guidelines' expectations. Air emissions monitoring, especially VOC tracking for chemical recyclers and GHG reporting for both chemical and mechanical recyclers, was found to be a key area for environmental performance improvement.

Based on these insights, the study recommends enhancing documentation systems, strengthening emissions tracking, and adopting regular wastewater testing using ZDHC Approved laboratories. The pilot has validated the applicability of the guidelines and offers a clear pathway for broader industry adoption, contributing to a more circular and responsible polyester recycling ecosystem.

Background

Recycled polyester (rPET) plays a critical role in advancing the transition to more sustainable textiles, offering a circular alternative to virgin polyester. However, the recycling and reprocessing of polyester are chemically intensive stages that require focused chemical management to protect the environment and ensure worker safety.

Recognising the need to address chemical impacts beyond traditional textile wet processing, ZDHC expanded its Roadmap to Zero Programme to include fibre manufacturing, focusing on recycled polyester. The development of the ZDHC Recycled Polyester Guidelines V1.0 marks a significant milestone in establishing sustainable chemical management practices within synthetic fibre recycling.

Building on principles such as feedstock traceability, input chemical management, safe handling and storage of chemicals, chemical recovery and pollution prevention, the guidelines offer a harmonised framework for improving chemical management across the recycled polyester production chain—from pre- and post-consumer waste collection, sorting and recycling, to the final fibre output.

As part of this initiative, ZDHC conducted a pilot project involving selected rPET facilities to evaluate current practices, identify gaps and refine the implementation of the guidelines for broader industry adoption. This effort aims to drive the adoption of safer, more sustainable chemical practices and contribute to a circular, responsible textile industry.

Objectives

The primary objective of the pilot was to assess the level of alignment of participating rPET facilities with the **ZDHC Recycled Polyester Guidelines V1.0** and to identify actionable opportunities for improvement for them. Specifically, the pilot sought to:

- **Assess Conformance:** Determine the conformance level with the ZDHC Recycled Polyester Guidelines V1.0 across the participating rPET facilities.
- **Identify Gaps:** Identify any gaps and challenges in the facilities' current chemical management practices compared to the requirements outlined in the guidelines. Once implementation begins, this can be used as guidance for improvements that will be required at the facility level.
- **Gather Insights:** Capture insights into each facility's existing practices, highlight areas for enhancement and provide recommendations to support facilities in preparing for and demonstrating performance during full-scale implementation.

These findings will support broader industry adoption of the ZDHC Recycled Polyester Guidelines by ensuring relevance, practicality and scalability within the recycled polyester segment.

Methodology

The methodology for conducting the pilot study involved the following steps:

- 1. Questionnaire Design:** A comprehensive questionnaire was developed based on the specific requirements of the ZDHC Recycled Polyester Guidelines V1.0. It was designed to assess various aspects of sustainable chemical management, including input feedstock and chemical management, chemical recovery, chemical storage, handling and environmental impacts in terms of wastewater and air emissions.
- 2. Facility Selection:** Five facilities confirmed their participation in the pilot study, as detailed in the 'requirements for participation'. These facilities represented a range of recycling processes and feedstocks.
- 3. Data Collection:** The questionnaire was shared with the facilities. Each facility was asked to complete the questionnaire and provide relevant documentation to support its responses. The documentation included, among other items, a Material Inventory List (MIL), feedstock sourcing documents, Chemical Inventory List (CIL), SOPs, legal permits, internal chemical process flow diagrams, chemical recovery records, ETP diagrams and internal or external wastewater and air emission reports.
- 4. Data Analysis:** The responses and supporting documents were reviewed and analysed internally to assess each facility's conformance with the ZDHC Recycled Polyester Guidelines V1.0. The analysis focused on identifying areas where facilities met or exceeded the guidelines and areas where improvements were needed.

Purpose

The purpose of this pilot study is to:

- **Benchmark Conformance:** The pilot establishes a benchmark for conformance with the ZDHC Recycled Polyester Guidelines V1.0 within the polyester recycling industry, using the participating facilities as a representative sample. This includes checking whether the guidelines are stringent yet realistic, with the aim of continuously driving the sector towards improved impacts.
- **Support Industry Adoption and Implementation:** The pilot provides valuable insights and feedback to the participating facilities and the broader recycled polyester value chain, facilitating the adoption and implementation of sustainable chemical management practices. The aim is to help polyester recycling facilities plan the implementation of the guidelines and prepare themselves to meet the requirements effectively.
- **Promote Environmental Sustainability:** The pilot contributes to the effort of promoting sustainability in the polyester recycling industry by encouraging facilities to adopt best practices in chemical management and reduce their environmental impact.

Pilot Participation Requirements

Eligibility Criteria:

- Conformance with local legal regulations (self-declared).
- Active participation in the ZDHC Roadmap to Zero Programme.
- Willingness to provide detailed records and documentation.

Expectations:

- Thorough and accurate completion of the questionnaire.
- Provision of relevant documentation to support responses (e.g., MIL, feedstock procurement records, CIL, chemical recovery records, chemical handling and storage records, internal or external wastewater and air emission test reports).
- Availability for follow-up questions or clarification during the data analysis phase.

Sustainable Chemical Management Requirements

Recycled polyester facilities should implement a system to meet the following requirements.

INPUT MANAGEMENT	
Input Feedstock Management	Facilities should meet the following requirements for input feedstock: <ul style="list-style-type: none"> A. Record input materials in a Material Inventory List (MIL). B. Assess input feedstock for hazardous substance risks.
Input Chemical Management	Facilities should: <ul style="list-style-type: none"> A. Record all purchased chemicals in the ZDHC Chemical Inventory List (CIL). B. Maintain Safety Data Sheets (SDS) ,Technical Data Sheets (TDS) and record the information in the CIL. C. Become familiar with the ZDHC MRSL and encourage chemical suppliers to register their products on the ZDHC Gateway.
PROCESS MANAGEMENT	
Chemical Recovery	Facilities should implement chemical recovery processes and initiate the following actions under process management: <ul style="list-style-type: none"> A. Solvent recovery (applicable only to the chemical recycling facilities) <ul style="list-style-type: none"> • Glycolysis process: Ethylene glycol recovery • Glycolysis followed by transesterification: Ethylene glycol and methanol recovery • Methanolysis process: Methanol recovery B. Voluntary requirements <ul style="list-style-type: none"> • Safe chemical storage • Chemical handling and worker safety • Training plan for chemical management

OUTPUT MANAGEMENT	
Wastewater	<p>A. Conformance with local regulations Facilities are expected to meet local wastewater regulations mandated by local legal authorities to ensure that their discharged wastewater does not compromise the quality of the receiving environment.</p> <p>B. Wastewater testing and reporting Test wastewater according to the parameters and limit values in the guidelines through ZDHC Approved Wastewater Laboratories. (ISO 17025 accredited third-party labs were utilised for the pilot.)</p> <p>C. Sludge management</p> <ul style="list-style-type: none"> • Meet the local regulations for sludge testing (if any) and disposal. • Report the major sludge disposal pathways they used per the pathways detailed in the ZDHC Recycled Polyester Guidelines V1.0.
Air emissions	<p>A. Conformance with local regulations</p> <ul style="list-style-type: none"> • Have a valid licence to operate. • Quantify, track and report emissions of all parameters, consistent with applicable local regulations (not verified). <p>B. Air emission testing and reporting</p> <ul style="list-style-type: none"> • Mechanical, thermomechanical, hydrothermal and chemical recycling: quantify, track and report GHG (Scope 1 and Scope 2) emissions. • Chemical Recycling: Quantify, track, and report VOC (methanol, ethylene glycol, acetaldehyde, and non-methane total hydrocarbons) emissions.

Details of Participating Facilities

The following are details of the participating facilities in the pilot.

Sr No.	Facility Name	Country	Feedstock Used	Recycling Process
1.	Zhejiang Jiaren New Materials Co.,Ltd.	China	Pre - and post-consumer textile waste	Glycolysis
2.	Facility X	China	Post-consumer PET bottles Ocean-bound plastic waste	Mechanical, Thermomechanical, Hydrothermal

				Process
3.	Hangzhou Benma Chemfibre and Spinning Co., Ltd.	China	Pre-consumer textile waste Post-consumer textile waste Post-consumer PET bottles Ocean-bound plastic waste	Glycolysis
4.	revalyu Recycling (India) Limited	India	Post-consumer PET bottles Ocean-bound plastic waste	Glycolysis
5.	Sulochana Cotton Spinning Mills (P) Ltd.	India	Post-consumer PET bottles Ocean-bound plastic waste	Mechanical

Performance Metrics

Facility	PERFORMANCE METRICS					
	INPUT		PROCESS		OUTPUT	
	Input Feedstock Management	Chemical management	Solvent recovery	Chemical storage, handling and training	Wastewater	Air emissions
Jiaren						
Facility X			NA			
Benma						
Revalyu						
Sulochana*			NA			

*Note: For a mechanical, thermomechanical and hydrothermal recycling facility, the solvent recovery metric does not apply

High Performance	Meets or exceeds 80% of the requirements
Moderate Performance	Meets more than 50% but less than 80% of the requirements.
Low Performance	Meets up to 50% of the requirements.
NA	Performance metrics are not applicable

Key Findings

The participating facilities showed encouraging conformance with sustainable chemical management requirements outlined in the guidelines. As participants, they were

instrumental in identifying areas for improvement to align more closely with the ZDHC Recycled Polyester Guidelines V1.0.

- **Opportunities for Advancement:**

- Material and chemical management: Facilities should adopt a standardised and structured approach for maintaining Chemical and Material Inventory Lists to strengthen traceability and chemical management systems.
- Chemical storage, handling and training: Facilities have made positive progress in implementing chemical storage, handling practices and training programmes, but are encouraged to maintain clear, comprehensive documentation to demonstrate implementation during assessment.
- Wastewater Management: Consistent improvement in wastewater testing and conformance with guideline requirements remains a key opportunity.
- Air Emissions: Testing and monitoring VOC emissions by chemical recyclers, and GHG emissions reporting by both mechanical and chemical recyclers, presents a clear opportunity for minimising environmental impacts.

- **Positive Steps in Chemical Recovery:**

- Implementing chemical recovery processes across chemical recycling facilities is a strong foundation for sustainable practices. Strengthening systematic record-keeping on recovery percentages will enable better tracking, reporting and continuous improvement.

Recommendations

- Recycled polyester facilities are recommended to adopt a standardised and more structured approach for record-keeping of chemicals and materials under Chemical Inventory list (CIL) and Material Inventory list (MIL).
- Facilities are advised to enhance their current practices for tracking chemical procurement, usage and recovery where applicable. This will contribute to more robust assessment outcomes and stronger conformance with the guidelines which reflect the sustainability expectations of the market.
- Conduct regular wastewater testing through ZDHC Approved Laboratories to ensure facilities meet foundational requirements and continuously improve.
- Chemical recycling facilities are recommended to strengthen VOC emissions testing/monitoring and adopt advanced control technologies to minimise air emissions.
- Establish structured systems for monitoring GHG emissions (Scope 1 and Scope 2) at both mechanical and chemical recycling facilities.

Conclusion

The pilot study provided valuable insights into the current practices of participating recycled polyester facilities, highlighting both strong areas of conformance and critical opportunities for improvement. Particularly around inventory management, tracking of chemicals and materials, as well as wastewater and air emissions monitoring.

The findings reaffirm the potential of the ZDHC Recycled Polyester Guidelines V1.0 to drive positive change toward sustainable chemical management in the recycled polyester sector. Addressing identified gaps will enable facilities to align more closely with the guidelines and further enhance their environmental performance.

Overall, the pilot has delivered actionable recommendations that will support broader industry adoption and contribute to a more circular, sustainable polyester recycling value chain. It will also support facilities, enhancing their overall environmental performance.

Acknowledgements

We extend our sincere appreciation to all participating facilities for their cooperation, openness and commitment throughout the pilot. Their valuable contributions have been instrumental in shaping the practical implementation of the ZDHC Recycled Polyester Guidelines V1.0 and advancing the industry's journey toward safer and more sustainable chemical management practices.