ANPE Conference 2026

Can AYRA

R&D Team Leader – Polyester

Kimpur

Introduction

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Can Ayra, M.Sc.

Polymer Chemist | R&D Team Leader

- Transitioned from academia to industry in 2020, right before the COVID-19 pandemic.
- Combines doctoral-level research background with hands-on industrial R&D experience.
- Actively involved in R&D projects on thermoset polyurethane systems and polyester polyols.
- Also contributes to technical development, portfolio management and product management activities.
- Focused on recycled materials, particularly rPET, since master's studies
- Board member of the Turkish Chemical Society

Academic Background
Doctoral-level research experience

Industrial R&D
Polyurethane systems & polyester polyols

Current Role
R&D Team Leader at Kimpur

TÜRKİYE KİMYA DERNEĞİ
TURKISH CHEMICAL SOCIETY
Kuruluşu: 1919

Presentation Overview

- About Kimpur
- KIMpol Polyester Polyols at a Glance
- Strategic Evolution of Kimpur's Polyester Polyols Portfolio
- From Waste Pressure to Technical Opportunity
- Upcycling vs. Downcycling: Unlocking the True Value of PET
- Why PET Matters: From Waste Stream to High-Value Raw Material
- State of the Art Developments
- From Glycolysis to Tailored Polyester Polyol Design
- Lab Scale Studies at Kimpur
- Industrial Scale Studies at Kimpur
- Industrial Scale Performance Comparison
- Differentiated & Competitive Approach
- Specialty Materials and Ongoing Project

About Kimpur

THE LEADING MANUFACTURER OF POLYURETHANE SYSTEMS AND POLYESTER POLYOLS **WITH THE LARGEST PRODUCTION CAPACITY AND SALES VOLUME IN THE REGION**

+40 Years Experience	**144 kT** Sales Volume	**600+** Polyurethane Systems and Polyester Polyols	**319** Employees
5 Continents **60+** Export Countries	**%37** of total activities are exports	Türkiye's **181th** Largest Company	Türkiye's **Export Leader** Polyurethane System House
Since **2017** R&D Center Certificate	**BIST** Sustainability Index (Since 2023)	GOLD | Top 5% ecovadis Sustainability Rating NOV 2025	ISCC International Sustainability & Carbon Certification

Kimpur, became a public company in April 2022 with the aim of rapid growth in global markets, a stronger corporate structure and financing new investments.

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KIMpol Polyester Polyols at a Glance

The largest polyester polyols producers in the region with

80,000 tons

annual production capacity

High Performance Solutions

For demanding polyurethane applications with strong focus on rigid foam insulation and recycled raw materials

Broad Portfolio

Aliphatic, Aromatic and Hybrid Polyester Polyols

Broad Portfolio

Flexible raw material strategy including recycled content

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Strategic Evolution of Kimpur's Polyester Polyols Portfolio

Early Stage
Polyester polyol production initiated to support internal needs, with a primary focus on in-house consumption.

Initial Portfolio Structure
Portfolio mainly built around polyester polyols developed for internal polyurethane raw material production.

Current Transformation
Portfolio evolving in response to increasing market demand and shifting strategic priorities.

Strategic Direction
Focus on building a structured technical portfolio supported by strong product management capabilities.

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From Waste Pressure to Technical Opportunity

Waste streams, upcycling potential, and high-value polyester polyol applications

1. Waste Pressure
EU plastic packaging waste is increasing
35.3 kg/person generated
14.8 kg/person recycled

2. Recycling Pathways
Downcycling limits material value
Upcycling creates higher-value chemical routes

3. Technical Opportunity
PET as an aromatic polyester source
Conversion into polyester polyols for rigid PU/PIR insulation

Transforms PET waste into valuable raw material

Enables design of high-performance polyols

Supports energy- efficient insulation solutions

"

PET is not just waste.

It is a high-value aromatic polyester resource.

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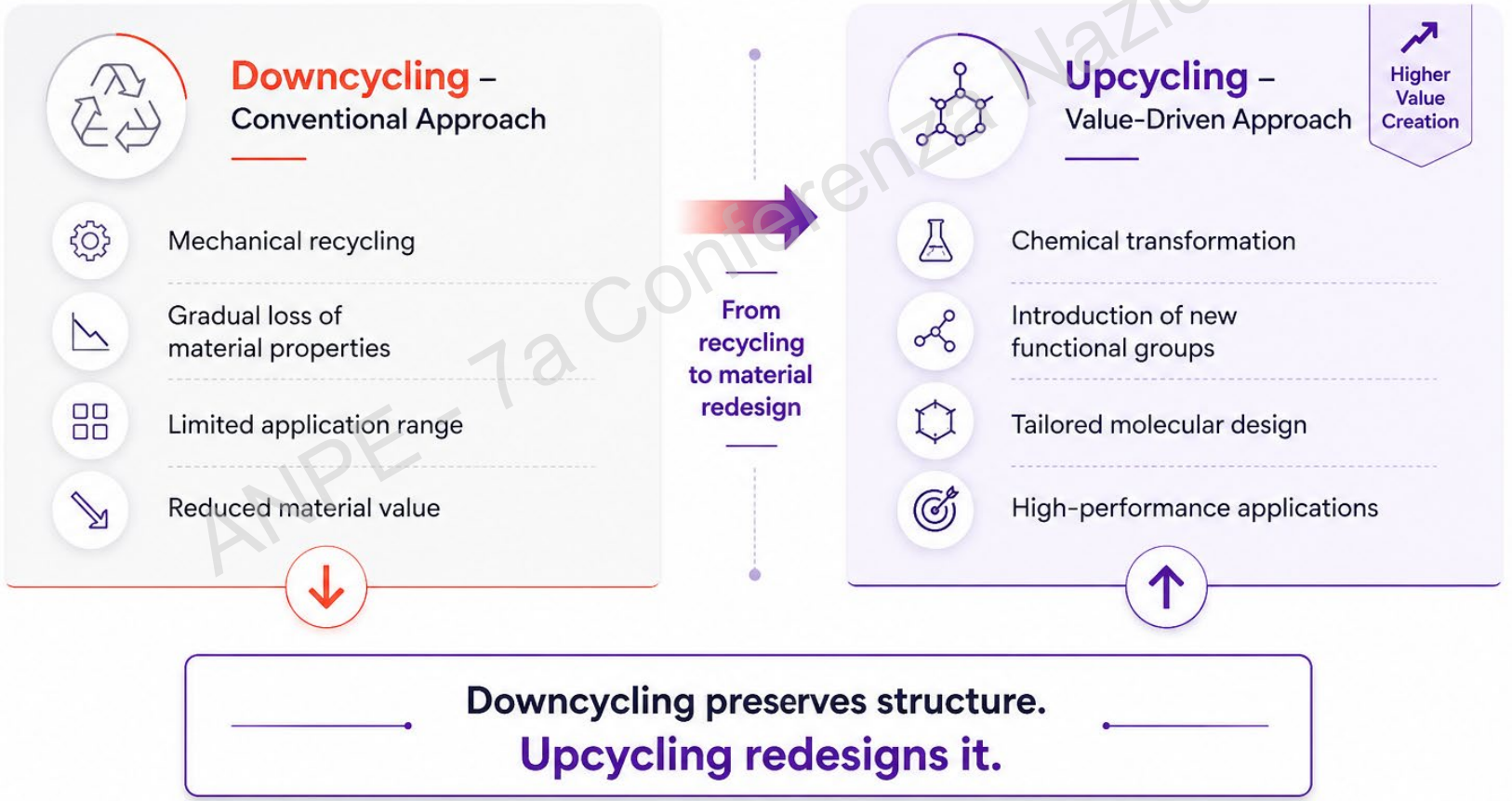
Upcycling vs. Downcycling: Unlocking the True Value of PET



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Why PET Matters: From Waste Stream to High-Value Raw Material

PET is not just a waste stream, it is an aromatic polyester with a well-defined chemical structure.
Its rigid backbone and ester linkages make it an ideal candidate for chemical transformation.

Through controlled processing, PET can be converted into polyester polyols,
making it a highly efficient starting material for rigid polyurethane foam applications.

Today, rPET can be used as a reliable feedstock for the development of tailored polyester polyols,
specifically designed for high-performance rigid PU foam systems.

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FROM PET WASTE TO HIGH-PERFORMANCE SOLUTIONS

Transforming discarded PET materials into high-performance polyurethane foam through innovative chemistry and responsible choices.

1 PET WASTE

Used PET bottles and other PET materials are collected.

2 CHEMICAL DEPOLYMERIZATION

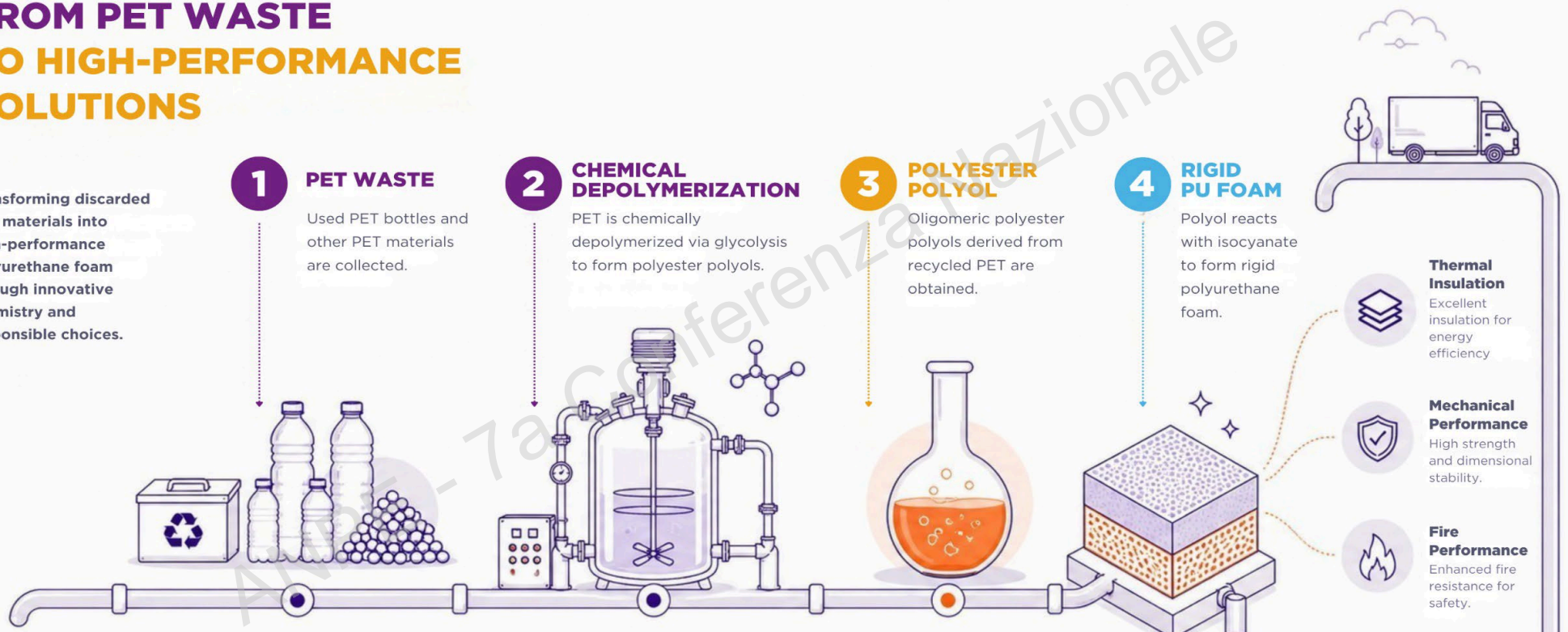
PET is chemically depolymerized via glycolysis to form polyester polyols.

3 POLYESTER POLYOL

Oligomeric polyester polyols derived from recycled PET are obtained.

4 RIGID PU FOAM

Polyol reacts with isocyanate to form rigid polyurethane foam.



Thermal Insulation
Excellent insulation for energy efficiency

Mechanical Performance
High strength and dimensional stability.

Fire Performance
Enhanced fire resistance for safety.

COLLECTED FROM:

- **Bottles** (clear PET)
- **Sheets/Trays** (thermoformed)
- **Fibers** (textile PET)
- **Industrial Scrap** (post-industrial)

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State of the Art Developments

The most effective recycling route is not simply the one that depolymerizes PET, but the one that delivers the right intermediates for polyurethane chemistry. This allows us to avoid going back through the full synthesis pathway.

Route	Main chemistry	Main output	Strength	Main limitation	PU polyol relevance
Glycolysis	Transesterification with glycols	OH-functional aromatic oligomers	Direct polyol precursor	Product distribution control	Direct / High
Hydrolysis	Water/acid/base cleavage	TPA + EG	Monomer recovery	Salt/acid/base load, extra esterification	Indirect
Methanolysis	Methanol transesterification	DMT + EG	PET-to-PET circularity	Pressure, methanol recovery, Explosion-proof process requirements	Indirect
Aminolysis	Amine cleavage	Amide derivatives	Specialty materials	Reactivity control, not standard polyol	Limited
Solvent purification	Dissolution-precipitation	Purified PET	Contaminant removal	Solvent cost/EHS; no OH product	Not applicable (no OH functionality)
Enzymatic	Enzyme-catalyzed cleavage	TPA/MHET/BHET	Mild/selective	Slow, pretreatment, scale-up?	Emerging / indirect
Acetolysis	Acetic acid cleavage	TPA-related intermediates	TPA-chain compatibility	Emerging, not polyol-direct	Indirect

Selecting the right route is key to delivering the optimal intermediates for **high-performance polyurethane chemistry.**

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From Glycolysis to Tailored Polyester Polyol Design

Recycled PET-Based Polyols for High-Performance Polyurethane Applications

- Glycolysis of recycled PET enables the formation of an **oligomeric aromatic structure**, serving as a versatile intermediate for polyester polyol production.
- At this stage, the process becomes **design-driven rather than pathway-dependent**, allowing the material to be directed toward **different application targets**.
- **Rigid polyurethane foam applications** represent a key focus area; however, each application requires **specific performance criteria**, making **tailored polyol design essential** rather than a one-size-fits-all approach.
- Through precise control of **molecular structure and composition**, the resulting polyester polyols can **match or exceed virgin material performance**, particularly in terms of:
  - Fire behavior
  - Dimensional stability
- This approach is primarily driven by the need to **reduce virgin raw material consumption**, while ensuring alignment with **evolving regulatory and sustainability frameworks**, such as CAM.

CAM

Criteri Ambientali Minimi

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Lab Scale Studies at Kimpur

Role of Lab-Scale Validation

- Lab-scale studies are critical to understand process variability prior to scale-up.
- All new concepts and early-stage developments are validated at laboratory level before industrial implementation.

Method & Process Evaluation

- Continuous assessment of:
  - State-of-the-art methods
  - Compatibility with existing process conditions

Collaborative Development

- Active collaboration with universities and customers
- Support for advanced research areas, including enzymatic PET recycling approaches.

Exploratory R&D Focus

- Ongoing evaluation of aminolysis-based products
- Potential applications in other business segments such as CASE, where they may act as reactive crosslinkers.

Synergy with Polyurethane Recycling

- Strong synergy with our polyurethane recycling initiatives, driving active development of know-how in this area.

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We obtain ISCC PLUS Certification for our facilities

- ISCC PLUS certification obtained for Gebze and Düzce production facilities
- Integration of ISCC Plus cerfified **bio-circular and circular (recycled) raw materials** via **mass balance** approach.
- Maintains existing production processes and product performance.
- Supports traceability across the value chain
- Ability to offer ISCC PLUS certified polyurethane systems and polyester polyols

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Industrial Scale Studies at Kimpur

Industrial Production Framework

At industrial scale, focus is on:

- Efficiency
- Process reliability
- Sustainable production

Production Infrastructure

- Two production facilities in Türkiye
- Both certified with ISCC+

Process & Quality Control

- Dedicated reactor systems for rPET-based polyester polyol production
- Ensuring:
  - Consistent product quality
  - Process control

Sustainability Integration

- Use of renewable energy sources:
  - Solar-powered electricity
- Integrated into production processes

Raw Material Strategy

- Multiple PET feedstock sources evaluated
- Post-consumer PET bottles selected as primary raw material
- PET sheet recycling remains under active development

Commercial Reality

- Industrial-scale production achieved
- rPET-based polyester polyols in active commercial use
- Consistent specifications & supply capability

Application Platform Approach

Tailored Polyester Polyols for:

- Rigid PU insulation (PUR/PIR)
- Sandwich panels
- Spray foam systems

Product Design Approach

- Tuned OH value and functionality
- Controlled viscosity & processability
- Balanced aromatic content for performance
- Adapted to customer processing conditions

Flexibility & Collaboration

- Continuous development for new requirements
- Open to joint development projects
- **We consider our customers as partners**
- Custom formulations based on application needs

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Certified Sustainability ISCC ISCC PLUS

We do not offer a single recycled polyol — we offer a platform.

Platform-based approach enables scalable, and application-specific polyol solutions.

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Industrial Scale Performance Indicative Comparison

PET-Based PUR System vs. Original PUR System

System	Cream Time (sec)	Gel Time (sec)	Rise Time (sec)	Density (g/cm^3)	Lambda (W/mK)
rPET-based PUR system	16	48	93	41.7	0.02251
Original PUR system	16	48	95	41.5	0.02211

- The results shown were obtained under laboratory conditions via hand mixing at 3000 rpm.
- Dimensional stability changes were found to remain below 1% at both -40°C and +70°C
- Compression strength exceeded 100 kPa for foams with a density of 37–38 kg/m³, depending on panel thickness.
- Tensile strength values also remained above 90 kPa, showing performance comparable to the reference system.
- rPET-based PUR system shows a similar reaction profile and density range, with thermal conductivity remaining close to the original PUR system.

Special thanks to the Kimpur R&D Rigid Polyurethane Foam Department for their support and contributions.

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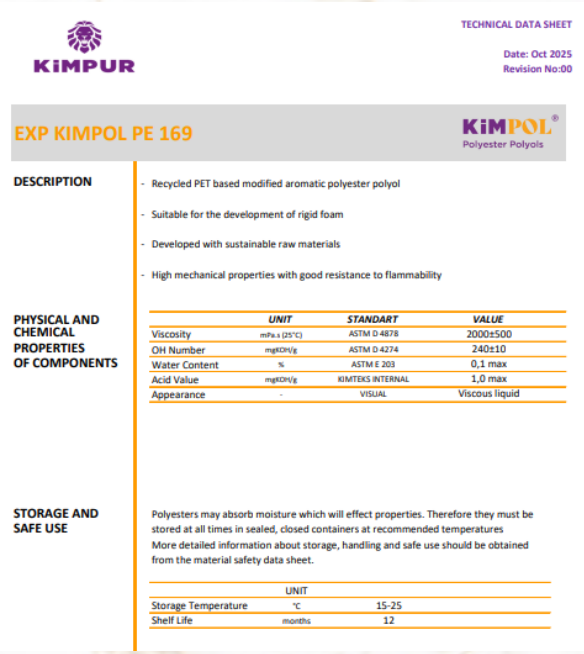
A Differentiated & Competitive Approach

- Multi-stage production process
- Modified reactor technology
- Multi-step filtration & in-process QC
- Various polyester formulations
- Tailored to customer performance targets
- Consistent and reliable quality
- High-efficiency filtration prevents clogging and production downtime
- Strong performance in end-use applications
- Clear differentiation vs. standard recycling solutions
- High-quality post-consumer **rPET**



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TECHNICAL DATA SHEET

Date: Oct 2025
Revision No:00

EXP KIMPOL PE 169

KiMPOL® Polyester Polyols

DESCRIPTION

- Recycled PET based modified aromatic polyester polyol
- Suitable for the development of rigid foam
- Developed with sustainable raw materials
- High mechanical properties with good resistance to flammability

PHYSICAL AND CHEMICAL PROPERTIES OF COMPONENTS

	UNIT	STANDART	VALUE
Viscosity	mPa.s (25°C)	ASTM D 4878	2000±500
OH Number	mgKOH/g	ASTM D 4274	240±10
Water Content	%	ASTM E 203	0,1 max
Acid Value	mgKOH/g	KIMTEKS INTERNAL	1,0 max
Appearance	-	VISUAL	Viscous liquid

STORAGE AND SAFE USE

Polyesters may absorb moisture which will effect properties. Therefore they must be stored at all times in sealed, closed containers at recommended temperatures
More detailed information about storage, handling and safe use should be obtained from the material safety data sheet.

	UNIT	
Storage Temperature	°C	15-25
Shelf Life	months	12

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30%
rPET content

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TECHNICAL DATA SHEET

Date: June 2025
Revison No:00

EXP KIMPOL PE 145-RPT

KiMPOL® Polyester Polyols

DESCRIPTION

- Recycled PET based modified aromatic polyester polyol
- Suitable for the development of PUR / PIR rigid foam
- Developed with sustainable raw materials
- High mechanical properties with good resistance to flammability

PHYSICAL AND CHEMICAL PROPERTIES OF COMPONENTS

	UNIT	STANDART	VALUE
Viscosity	mPa.s (25°C)	ASTM D 4878	3500±1500
OH Number	mgKOH/g	ASTM D 4274	190±10
Water Content	%	ASTM E 203	0,1 max
Acid Value	mgKOH/g	KIMTEKS INTERNAL	2,0 max
Appearance	-	VISUAL	Viscous liquid

30%
rPET content

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TECHNICAL DATA SHEET

Date: June 2025
Revison No:00

EXP KIMPOL PE 168 -RPT

KiMPOL® Polyester Polyols

DESCRIPTION

- Recyled PET based aromatic polyester polyol with high quality
- Suitable for the development of PUR / PIR rigid foam
- Developed with sustainable raw materials

PHYSICAL AND CHEMICAL PROPERTIES OF COMPONENTS

	UNIT	STANDART	VALUE
Viscosity	mPa.s (25°C)	ASTM D 4878	3000 - 5000
OH Number	mgKOH/g	ASTM D 4274	180 - 200
Water Content	%	ASTM E 203	< 0,1 max
Acid Value	mgKOH/g	KIMTEKS INTERNAL	< 1 max
Appearance	-	VISUAL	Clear liquid

40%
rPET content

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TECHNICAL DATA SHEET

Date: Oct 2025
Revision No:00

EXP KIMPOL PE 160 -RPT

KiMPOL® Polyester Polyols

DESCRIPTION

- Aromatic polyester polyol with high quality
- Suitable for the development of PUR / PIR rigid foam
- Developed with pure raw materials leading consistent performance
- High mechanical properties with good resistance to flammability

PHYSICAL AND CHEMICAL PROPERTIES OF COMPONENTS

	UNIT	STANDART	VALUE
Density	gr/cm3 (20°C)	ASTM D 891	1,17
Viscosity	mPa.s (25°C)	ASTM D 4878	3300 - 4200
OH Number	mgKOH/g	ASTM D 4274	250 - 270
Water Content	%	ASTM E 203	0,10 max
Acid Value	mgKOH/g	KIMTEKS INTERNAL	1,0 max
Appearance	-	VISUAL	Viscous liquid

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Feedstock Selection & Supply Strategy

- ✓ Post-consumer PET bottle waste was identified as the primary raw material based on formulation studies.
- ✓ The main supplier is RecyClass-certified and operates at industrial scale.

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Specialty Materials and Ongoing Projects

- ✓ rPET-based polyester polyols tailored for rigid PU foam applications
- ✓ Standard product grades with **>30% rPET content**
- ✓ Polyester polyols with enhanced **flame-retardant (FR) performance**
- ✓ Novel bio-based polyester polyols, developed as standalone backbones or functional modifiers
- ✓ Polyester polyols designed to achieve **lower thermal conductivity (λ) values**
- ✓ Ongoing focus on rPET recycling from diverse sources and thermoset polyurethane recycling

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