

rPET in Turkey: Will Bottle-to-Bottle Recycling Take Off?

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Contents

- Legislation on Packaging Recovery
- CEVKO and Extended Producer Responsibility (EPR) Model on Packaging Recovery
- Collection and Sorting
- PET Recycling
- Food Grade Bottle-to-Bottle Recycling
- Conclusion and Final Remarks

Legislation on Packaging Recovery

Origin of Waste Plastics

- Waste plastics are originated from many applications:
 - Packaging
 - Construction/demolition
 - Electrical and electronic equipment
 - End of life vehicles
 - Agricultural film
 - Etc.

Packaging Life Cycle



Sales Points



Consumers



Waste Collection



Sorting/ Recycling



Fillers, Packers



Packaging Producers

EU Packaging and Packaging Waste Directive

Directive 94/62/EC revised as 2004/12/EC :

Recovery Min.: **60 %**

Recycling Min.: **55 %**
Max.: **80 %**

Recycling specific Materials

Glass	Min.: 60 %
Paper	Min.: 60 %
Metal	Min.: 50 %
Plastic	Min.: 22,5 %
Wood	Min.: 15 %

Extended Producer Responsibility (EPR)

An environmental policy approach, in which a producer's **responsibility** for a product is **extended to the post-consumer stage** of a product's life cycle.

An EPR policy is characterised by:

- (1) shifting of responsibility (physically and/or economically; fully or partially) upstream toward the producer.
- (2) the provision of incentives to producers to take into account environmental considerations when designing their products.

Implementation of the EU Packaging Directive

Fund Scheme

run by Industry
Iceland

EPR

but close to market
UK (PRN System)

Taxes

No compliance scheme
Denmark

Tax + Compliance Scheme

The Netherlands

Croatia

Fund versus EPR

27 with Producer Responsibility

*Austria, Belgium, France, Spain, Germany, Ireland,
Luxembourg, Portugal, Sweden, Greece, Latvia,
Lithuania, Poland, Czech Republic, Slovak
Republic, Hungary, Slovenia, Cyprus, Malta,
Estonia, Romania, Bulgaria, Turkey, Norway,
Finland, Italy, Serbia*

Some Data on Turkish Waste Legislation

- Environment Law (1983)
- Solid Waste Regulation (1991)
- Harmonisation with the EU (since 2004):
 - Changes in Environment Law
 - Waste Framework Directive
 - **Packaging Waste Control Regulation**
 - Regulation on Batteries
 - Regulation on Mineral Oil, etc.

Turkish Packaging Waste Control Regulation

- Roles and Responsibilities:
 - Ministry of Environment and Urbanization
 - Municipalities
 - Licenced Collectors, Sorters and Recyclers
 - Producers (Extended Producer Responsibility)
 - Authorised Recovery Organisations
 - Sales Points
 - Consumers

Recovery Targets in Turkey

RECOVERY TARGETS PER MATERIAL (%)					
Years	Glass	Plastics	Metals	Paper/Board	Wood
2005	32	32	30	20	-
2006	33	35	33	30	-
2007	35	35	35	35	-
2008	35	35	35	35	-
2009	36	36	36	36	-
2010	37	37	37	37	-
2011	38	38	38	38	-
2012	40	40	40	40	-
2013	42	42	42	42	5
2014	44	44	44	44	5
2015	48	48	48	48	5
2016	52	52	52	52	7
2017	54	54	54	54	9
2018	56	56	56	56	11
2019	58	58	58	58	13
2020	60	60	60	60	15

ÇEVKO and Extended Producer Responsibility (EPR) Model on Packaging Recovery

Authorised Recovery Organisation

ÇEVKO, set up and run by the Industry (founded in 1991, authorised in 2005)

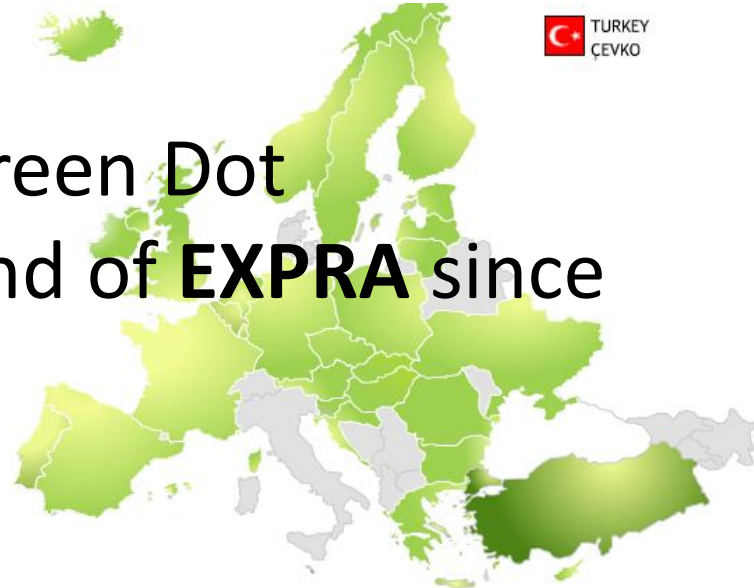


ÇEVKO

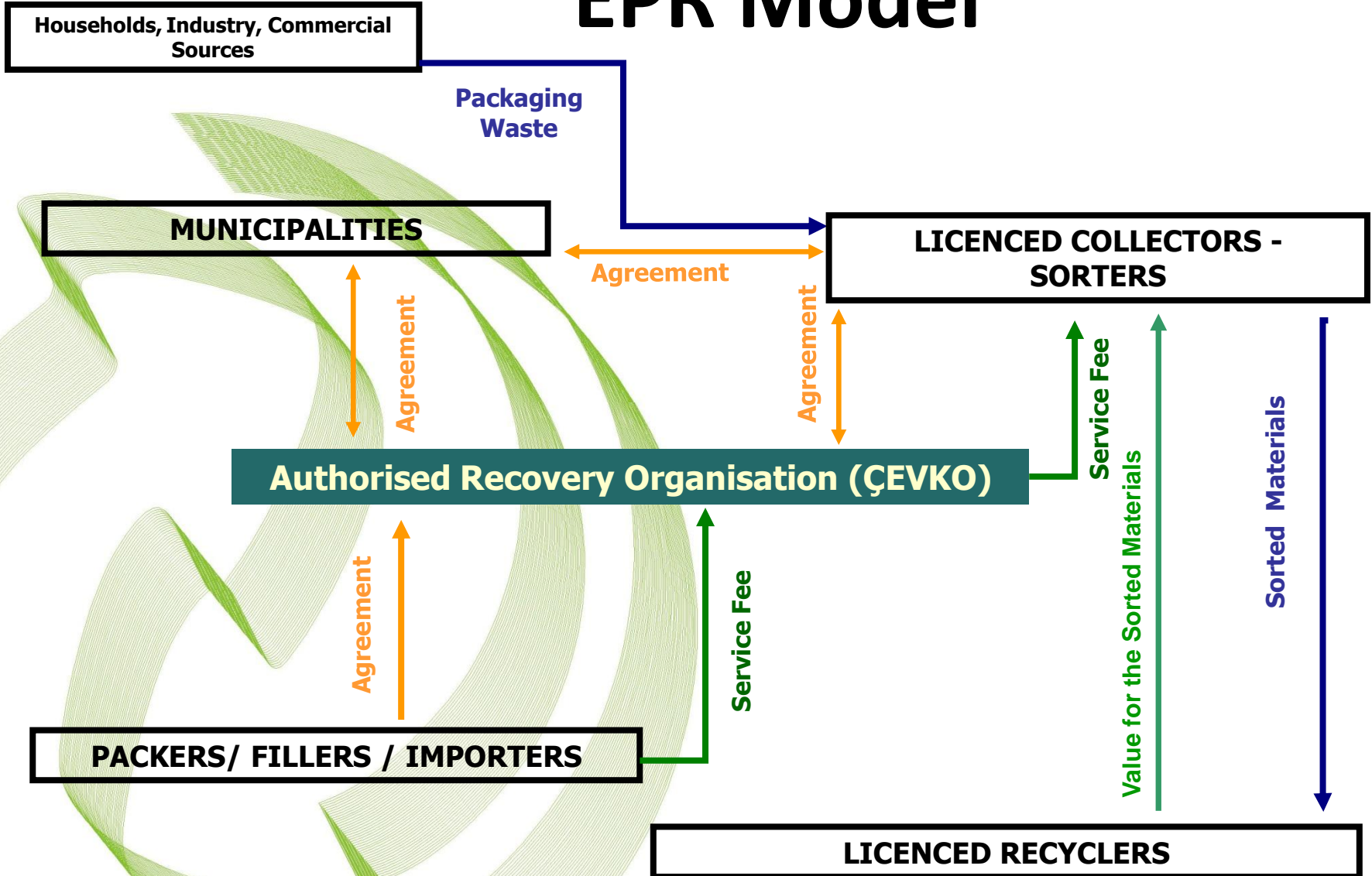
- **Vision:**

A **sustainable** recovery system, led by the **Industry**, contributing to the **environmental** protection, **economic** and **social** development in Turkey

- Member of **PRO-EUROPE** (Green Dot Organisations) since 2002 and of **EXPRA** since 2013.



EPR Model



Collection and Sorting

Collection in Turkey

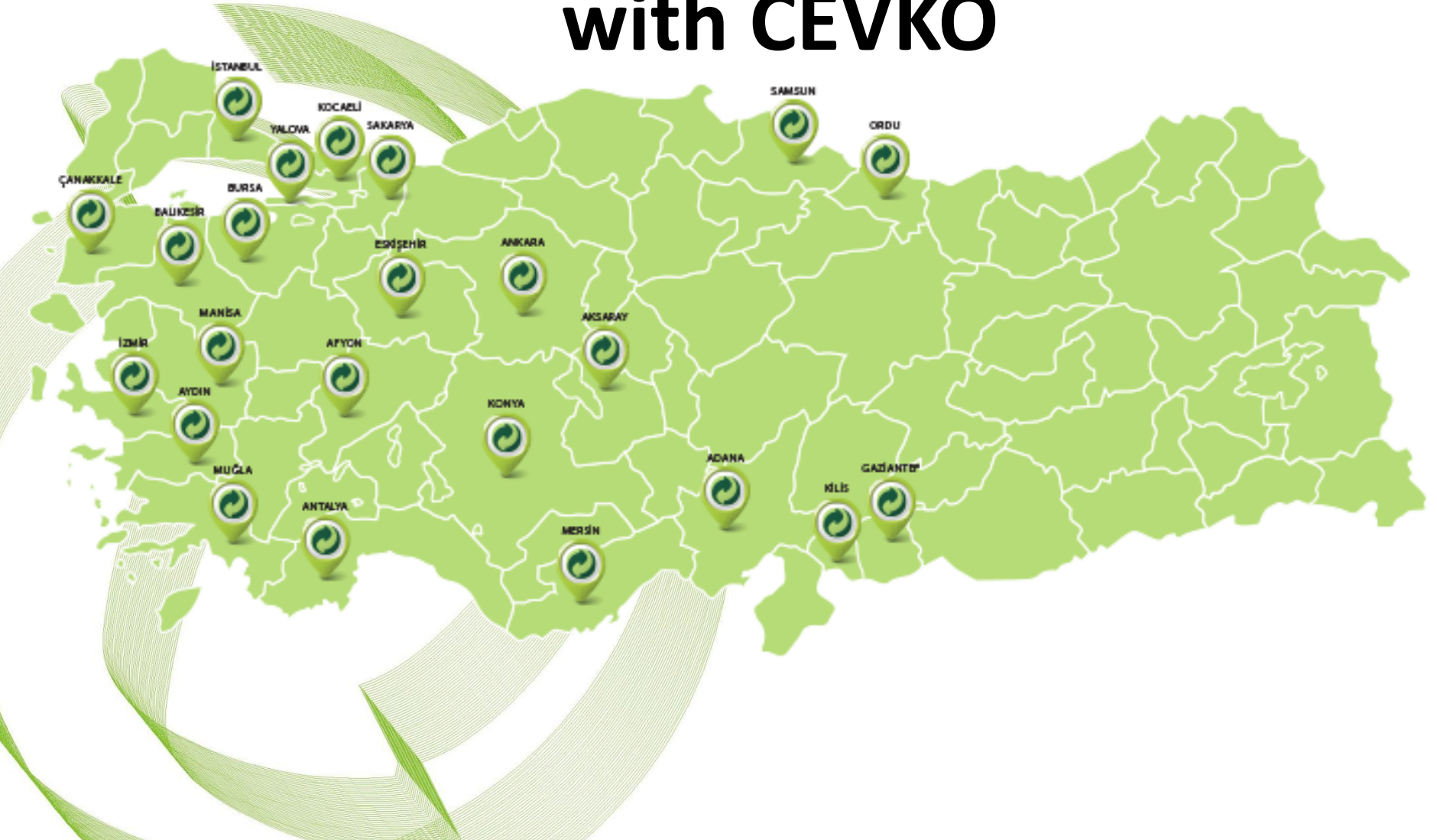
Official Collection:

- Packaging waste separated from organic waste at source by households, trade and industry
- Collected as commingled by municipalities or by licenced collectors-sorters on their behalf by:
 - Kerbside collection
 - Packaging waste containers
 - Bring centres



ÇEVKO
ÇEVRE KORUMA VE AMBALAJ ATIKLARI
DEĞERLENDİRME VAKFI

Municipalities Cooperating with CEVKO



Separate Collection Methods



Separate Collection Methods

By Packaging Waste Containers

From

- Housing complexes
- Schools
- Shopping areas
- Industrial complexes
- Offices



Separate Collection Methods

By Kerbside Collection:

From

- Houses
- Restaurants
- Hotels
- Cafes
- Small businesses



Consumer Awareness Activities



Challenges for Official Collection

- Low level of consumer awareness
- Low level of enforcement by the authorities
- Informal collection via street collectors



Sorting

- Packaging waste is collected as commingled and sorted at packaging waste sorting plants licenced by the Ministry of Environment.
- There are currently 403 licenced sorting plants in Turkey.
- Sorting of plastics are per polymer type (PET, PE, PP, PVS, PS).
- Manual sorting is the most common way.

Packaging Waste Sorting Facilities



Recycled Quantities

	Total Recycled Plastics (ton) *	Recycled Plastics by ÇEVKO (ton)	Recycled PET by ÇEVKO (ton)
2011	307.540	108.587	42.219
2012	—	128.191	43.278
2013	—	140.619	53.063

* Data from the Packaging Bulletin, published by the Ministry of Environment and Urbanization, 28/2/2014

PET Recycling

PET Recycling in Turkey

Background Information

- Obligation for the collection and recycling of PET packaging (bottles) in 1992 through Solid Waste Control Regulation.
- Through its agreement with its obligated customers SASA (manufacturer of PET resin and PET bottles) organised post consumer PET bottle collection.
- In 1994, SASA constructed first PET recycling plant with 12,000 t/yr capacity using Govoni dry process.

PET Recycling in Turkey

- Collected post consumer PET bottles came from dumpsites and were very dirty, causing at least 40% process loss.
- However, SASA built a glycolysis unit and used recycled PET flakes in fiber production.
- Turkey concluded Customs Union agreement with EU in 1996 and thereafter certain PET converters started operation.

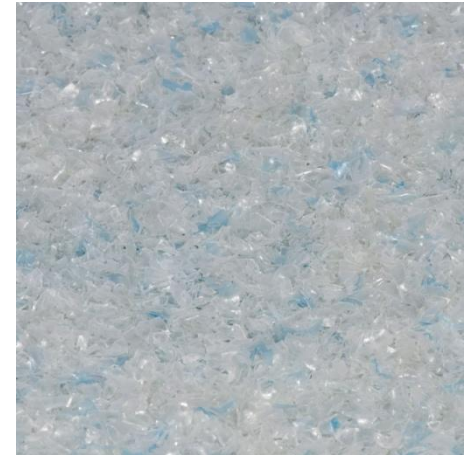


PET Recycling in Turkey

- Demand for fairly sorted and dry PET from the Far East stimulated some waste contractors for exports.
- Such waste contractors constructed their first PET recycling units (manual sorting, local design).
- Later in the early 2000's some other modern recycling plants were built targeting textile industry and other applications (i.e. water insulation sheets)

PET Recycling in Turkey

- After 2005, certain waste contractors modernised their PET recycling plants by installing automated sorting systems for bottles and flakes for higher quality product.
- Also owing to extension of separate collection schemes, input material quality gradually became better.



Standard PET Bottle Recycling Process

- **Bale feeding, breaking and metal separation:** Bales of PET bottles are fed to the bale opener and breaker, metals are separated.
- **Pre-washing:** Loose bottles are optionally prewashed to improve the separation of PVC bottles and to remove labels.
- **Automatic and manual sorting:** Depending on bale composition, a series of sorting systems are installed.
- **Grinding:** Bottles and caps are ground to flakes.

Standard PET Bottle Recycling Process

- **Washing:** PET flakes are separated from other thermoplastics in the sink/float tank before hot washing and rinsing. Caustic soda is applied to dissolve the glue from the labels.
- **Flake sorting:** After drying, the flakes go through a series of sorters to improve final flake quality.
- **Sampling and storage:** Before extrusion the flakes are checked for quality and stored for uninterrupted production.

End markets for rPET

- Fiber (40%)
- Sheet (27%)
- Blowmoulding (22%)
- Strapping (7%)
- Other (4%)

Source: PCI for Petcore



Synthetic Fibers

- Synthetic fibers, being the the most popular fibers in the world, account for about 65% of world production vs. 35% for natural fibers.
- Most synthetic fibers (approximately 70%) are made from polyester, and the polyester most often used in textiles is PET. Used in a fabric, it's most often referred to as "polyester" or "poly".
- The reasons for recycled polyester (rPET) are considered as a green option in textiles today:
 - Energy needed to make the rPET is less than what was needed to make the virgin polyester.
 - Bottles and other plastics are kept out of the landfills.

Multinational Textile Firms

H&M's view on recycled plastic:

“ We get our recycled plastic from things like PET plastic bottles, plastic bags and shampoo bottles. We use this to make everything from our shopping bags through to some of our most popular accessories.

Why we love recycled plastic

- It's the same high quality as standard plastic
- Recycling our plastic means we get less oil out of the ground, and keep waste products out of landfill
- It takes less energy to recycle plastic than it does to make new plastic.



”

Fiber Recycling in Turkey

- Positive developments for polyester demand in textile industry and increasing use of recycled material in PET sheets triggered new investments for PET recycling.
- Certain recyclers constructed polyester fiber facilities as downstream investments.
- It is estimated that total capacity of fiber plants processing rPET amounts to 80,000 tons/yr, corresponding to 19 % of local polyester fiber market (420,000 tons as of 2011).

Food Grade Bottle-to-Bottle Recycling

EU Legislation

Commission regulation 282/2008/EC of 27 March 2008

- regulates the use of recycled plastic materials and articles intended to come into contact with foods
- efficiency of process to remove contaminants to the level not posing a risk to human health to be monitored
- purification steps to remove chemical pollution to be checked through challenge tests and migration tests
- requires safety assessment / quality assurance system (QAS)

EU Legislation

- European Food Safety Authority (EFSA) evaluates the safety of mechanical recycling and of manufacturing methods.
- Only recycled plastics obtained from processes assessed for safety by EFSA to be used for food contact.

Turkish Legislation

Regulation on Changing the Turkish Food Codex Food Contact Regulation (No. 29090, 16 Aug. 2014)

- does not allow the use of recycled plastics in production of food contact materials EXCEPT for the following cases:
 - Production scraps within the facility, if reprocessed according to good manufacturing practices
 - Monomers/ oligomers obtained by the chemical depolymerisation of PET

Technology

- Chemical recycling (which is recently allowed by the Turkish Regulation)
- Mechanical recycling (which is not allowed in Turkey, yet)

Chemical Recycling

- Process
 - Hydrolysis depolymerisation of post consumer PET can be achieved using water, acids or bases.
 - **Methanolysis** uses methanol to initiate depolymerisation of PET.
 - **Glycolysis** involves depolymerisation of PET using ethylene glycol to obtain short-chain PET polymers (oligomers).
 - These polymers are purified for subsequent repolymerisation to produce PET for food contact applications.

Chemical Recycling

- In Turkey facilities utilising chemical recycling process exist (e.g. Indorama, Meltem Kimya).
- According to E. Chiellini-2008: “Chemical recycling is energy intensive and costly and often making resultant PET material more expensive than the virgin material. In order to make PET bottle recycling more economically viable, mechanical recycling processes are considered to be less costly and economically feasible.”

Mechanical Recycling

- Washed flakes obtained by PET recycling can be fed into further mechanical recycling processes to obtain bottle-to-bottle food grade PET
- For the mechanical recycling of PET:
 - Homogeneous stream of sorted PET
 - Limited amount of contaminants
 - Critical mass and consistent supply
 - Reliable market for flakes/granulates are essentially required.

Mechanical Recycling

- Some proprietary state-of-the-art technologies are:
 - Starlinger
 - Buehler
 - Erema
 - URRC
- From washed flakes, food grade flakes, pellets or products (preforms) are produced.



Mechanical Recycling

- For example, in a Starlinger mechanical recycling process producing food grade pellets:
 - Washed PET flakes are fed into hot air drying unit through a scew conveyor.
 - Next step is extrusion including a degassing extruder.
 - After a melt filter, there is a pelletiser and a crystalliser.

Mechanical Recycling

- Material is, then, fed into a preheating unit by vacuum transport.
- Then there is a Solid State Polycondensation (SSP) reactor, a cooling unit, an energy recovery kit and, finally, a storage silo.
- Decontamination takes place in predrying unit, degassing extruder, preheating vessel and SSP reactor.

Great Expectations!

Various stakeholders have different expectations:

- Authorities have to make sure that laws for food-safety are observed.
- Recyclers need efficient and flexible recycling equipment and process stability for the production of food contact safe pellets to compete in a volatile environment.
- Preform producers demand resin-like quality in terms of intrinsic viscosity (iV), flow characteristics and processability.
- Bottlers and brand-owners require high rPET content without risking quality of the final product in terms of visual appearance.
- Finally, all stakeholders including the consumers need to be absolutely certain that the packaging is safe for direct food-contact.

In the World

- rPET is generally mixed with virgin PET to a concentration of 10 to 50% rPET although it is technically possible to make a bottle of %100 rPET.
- From economic point of view, all over the world, a comparison of rPET vs. virgin PET prices:
 - 40-50% of the cases rPET is more expensive.
 - 15% of the cases rPET is less expensive.
 - 30% of the cases rPET is at parity with virgin PET.

In Turkey

Challenges for food grade bottle-to-bottle recycling:

- Consistent availability of sorted PET flakes
- rPET price would probably be higher than of virgin PET due to:
 - Feedstock cost
 - Exports to Far East (China)
 - Investment cost for chemical recycling or state-of-the-art mechanical recycling (if allowed in the future)
- Quality assurance for a sustainable bottle-to-bottle recycling process.
- Consumer perception

Conclusion and Final Remarks

Conclusion and Final Remarks

Key drivers for rPET

- Legislation
- Availability (Volume) of Sorted Material
- Process Technology for Quality
- Market Conditions and Price
- Consumer Perception



Conclusion and Final Remarks

In Turkey,

- Harmonisation process with the EU helps upgrading legislation on recycling and rPET:
 - Packaging waste regulation including extended producer responsibility, selective collection at source, licenced sorting and recycling facilities
 - Food contact regulation (only for chemical recycling, yet)
- Consumer awareness and recycling market grows gradually in spite of challenges.

Think of the future: Start recycling now.

Thank you!

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