



DR. THIELE

POLYESTER TECHNOLOGY

Polyester Recycling in Eastern Europe

A Challenge to Governments and Private Entrepreneurs

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Polyester-Technology



The Consulting Firm Polyester Technology

Background

- The consulting firm Dr. Thiele Polyester Technology was founded in 1999
- Founder was active in nearly all fields of the polyester industry for more than 30 years like PET production, recycling, PET R&D, engineering, application
- Inventor or co-inventor of more than 50 patents
- Variety of publications, polyester related books, public presentations and information activities
- Main fields of activity are
 - # Melt phase and SSP process development, plant revamp and optimization
 - # New catalysts
 - # New polyester like PTT, PBT, PEN, PCT and co-polyester
 - # PET-recipes for bottle PET and FDA approvals
 - # High speed spinning technology
 - # Film PET technology
 - # Masterbatch development
 - # Polyester recycling technologies

Activities of Polyester Technology

Seminars – Polyester Further Education - Personal Training – Coaching

→ New employees are entering your company every year and it is important to empower them as quickly as possible to understand and further create the technical and chemical processes.

→ With the steadily growing output of the polyester industry margins are under pressure. To keep the business profitable costs saving programs are more important today than during the past.

→ Experiences, background information and know how of the education, personal training and coaching service

→ Training issues are selected by the customers need

more information regarding possible topics, background and references see also

www.polyester-technology.com



Activities of Polyester Technology

Research and Development Support in Polyester Chemistry and Technology

Current active developments in the fields of PET-masterbatch and new PET catalysts, textile PET and PET-spinning additives → four customer contracts, companies like for instance SABIC, SUKANO, M&G, INVENTA, FREUDENBERG, NESTLE

Single project with polyester producer companies like ZHUHAI Polyester, TWD or PIC

Consulting

Consulting of the top management and the technical staff

→ customer like BARMAG, RIETER, LIST, M&G



Activities of Polyester Technology

Support in Polyester Chemistry, Machinery Development and Sales Support

Together with selected engineering companies in Germany

Latest products:

Polyester Book:

The book of PETplanet print Vol. 5:

Polyester Bottle Resins

Production, Processing, Properties and Recycling

by Dr. Ulrich K. Thiele

Chemical Engineering – Polyester Information Platform

www.ce-pip.com

A new information and advertisement tool for the polyester industry

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1. Polyester recycling word wide – development and outlook

When we examine the development of the polyester recycling cross the World, we can find some interesting correlations, impacts and similarities.

As frontier of many industrial developments the USA started the first substantial PET-recycling during the late 70th. Low raw material cost – at that time used PET bottles where rubbish – and environmental activities of a highly developed society have been the major driving forces to develop within a relatively short time an US polyester recycling industry.

The saturation of this development came during the late 90th and the first years of the new century. The achieved collecting level of 20 – 25% became stagnant for several reasons. Mainly driven by the sharply rising prices of baled bottles and the general down trend of the US-textile-industry the interest in PET-recycling shrunk. Driving force behind was the exploding textile industry in China connected to a tremendous price increase of collected/baled PET-bottles.



Polyester recycling world wide – development and outlook

As point of remembering: During the years 1995 – 2000 the price of one ton baled bottles was between 20 and 50 €. Today one must pay approximately ten times of this price!

Today mainly the brand owners in USA like Coca Cola keeping the PET recycling running on an dissatisfactory level by forcing the bottle producer to apply a fix amount of 10 – 30% of recycled polymer in each new bottle.

Quite different the development in Europe. After a slow start in Europe during 90th other mechanisms came in force which where the very strict plastic waste regulation of Germany like the green dot and the “Verpackungsverordnung” as well as similar EU regulations. Together with a “green – environmental” driven politics and similar movements in public relations Europe was overhauling the USA in collection rate and the total amount of collected PET bottles.

Polyester recycling word wide – development and outlook

To understand the recycling market better it might be interesting how the source of the collected waste bottles, the PET bottle resin is developing. Table 1 is providing a summary. After this North Americas will lead the resin production till 2010. But looking at table 2 which is showing the estimated PET bottle recycling market development one can see, that the collection rate of the USA will be further stagnant (2006 15% and 2010 16%) Europe in the opposite will increase the collecting rate from 22,7% in 2006 to 28% in 2010.

Completely different the situation in Middle East, Asia, Africa and South America, let us say the low developed or fast developing countries like China or India. Here we see a rapid increase of the collection rates from about 4% in 2006 to 33% in 2010.

Chinese (unofficial) sources are claiming a collection rate of more than 90%! In China because of a large number of very poor migrant workers PET bottles are picked up everywhere they are dropped.

The tables 1 and 2 are providing a complete summary about PET resin production and bottle PET recycling cross the World.



The triumphal procession of the PET bottle started during the 90th of the last century and we have not yet reached the stage of saturation. Table 1 is showing the expected market development of the bottle resin between 2004 and 2010.

Table 1: Bottle PET resin production 2004 - 2010

PET Resin Capacity [kt/a]	2004	2005	2006	2007	2008	2009	2010
North America	3.685	3.745	3.923	4.595	4.595	4.595	5.000
South America	513	500	500	725	950	950	1.200
Europe	2.411	2.894	3.515	3.766	4.005	4.005	4.205
Africa, Middle East	308	338	499	604	843	843	843
Asia (ex China)	4.107	4.411	4.636	4.636	4.636	4.636	4.636
China	1.469	2.490	3.217	3.255	3.255	3.255	3.255
Total WORLD	12.493	14.378	16.290	17.581	18.284	18.284	19.139

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The huge potential of PET bottle recycling is becoming obvious by comparing data of resin and flake production in Table 1 and 2. Provided the estimated production amount of 5 Mio t in 2010 is realistic the rate of recycling achieved world wide is a little more than 25% only

Table 2: Bottle PET recycling market development estimation

R-PET Capacity all in [kt/a]	1999	2002	2003	2004	2006	2010
North America	470	480	500	550	600	800
Europe	211	350	430	680	944	>1200
ME, Asia, South America, Others	218	370	470	680	1 700	3 000
World R-PET Bottle Flakes	899	1200	1400	1 900	3 100	5 000 ↑ ??
World PET-resin	7 100	9 900	11 800	12 500	16 300	19 200
Recycling potential	6 201	8 700	10 400	10 600	13 200	14 200

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Polyester recycling world wide – development and outlook

Off course the data concerning the emergence of collected bottles within several areas of the World are to handle with care, but the trends are becoming obvious and comparable:

- As higher the standard of living as more difficult the voluntary collection**
- As higher the standard of living as more governmental, political and public pressure are required**
- As higher the price of collected bottles as lower is the incentive to step in polyester recycling processing activities – bottle or flake selling is more easy**
- As higher the price of collected bottles as more trading volume will occur**
- As higher the price of collected bottles as more interesting are final products of high value like for instance A-PET film, strapping, food grade bottle resin or “GREEN” products like staple fiber made of 100 recycle.**
- As higher the flake prices as more attractive are vertical integration from collection to intermediate products like fiber, film, strapping and resin**
- As lower the standard of living (in developing countries) as higher the voluntary collection rate**

2. Plastic recycling in Eastern Europe – polyester still a small segment

When talking about bottle collection, collection rates and bottle recycling there is at first interesting the source which is the polyester resin production. Within the last 5 years we have seen in this respect a tremendous increase of production capacities especially within the area of CIS states and Poland.

Main resin producer in this area are today Neopet (Lt) 320 kt/a, Orionpet (Lt) 200 kt/a and, SK Eurochem (PL) 150 → 280 kt/a, Elana (PL) 175 kt/a; the other PET producer like Sibur (Ru), Vladimir (Ru), Kurskchimvolkno (Ru) and Cherenigov (UA) together about 200 kt/a. Itera/Belpak (By) is producing 120 kt/a resin. This means CIS states and Poland are producing about 1300 kt/a PET resin today. From this amount 800 kt/a are consumed by Russia alone.

The planning is that Russia shall produce in 2010 1000 kt/a PET resin which would be the base for a complete self-sufficiency.

Based on this figures one can say that the sources for the PET recycling are even presently more than enough available.

3. How to enter polyester recycling – collecting or trading?

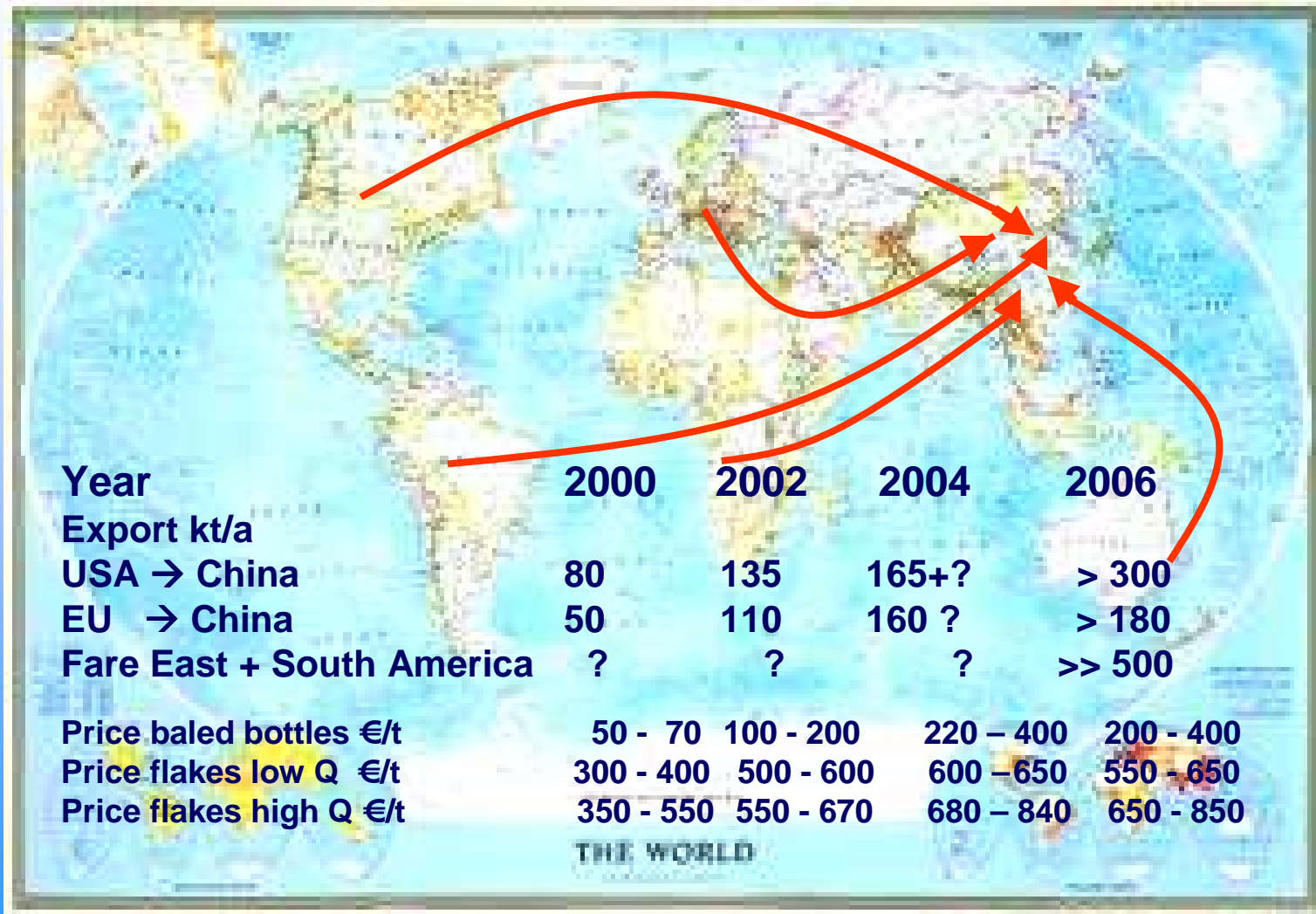
Answering this question it is again very interesting to watch and compare the development of PET bottle recycling in China. I am visiting this country frequently and I observed about 5 years ago the first substantial boost of bottle recycling activities.

The Chinese fiber makers learned to handle and process bottle flakes. Together with a significant shortage of PTA and PET production in general during 2003 - 2005 time the Chinese started at large scale to import the flakes from all over the World. Unofficial data are counting the conversion amount of PET bottle flakes in China 2006 to about 2 000 kt/a

Figure 1 is giving an idea about the flow of PET waste bottles and bottle flakes to China.

The sales approach is charming as soon as one has made long term contracts which assuring investments in cleaning and processing units.

Figure 1: Polyester flakes are going to China - and prices went up





How to enter polyester recycling – collecting or trading?

Compared to China, Russian companies involved in recycling might have a better point of departure to step into the trade of waste bottles and bottle flakes especially with companies located within states of middle Europe:

- There are a less distances of transport
- Truck direct transport is useful
- Direct pick-up services of waste bottles organized by Russian traders are possible
- Russians are familiar with culture in EU and trade ties are well developed

Especially during the last year we observed increased trading activities of Russian polyester processing companies (for example Wostokchimvolokno a producer of staple fiber)

CONCLUSION: In a transitional period the promotion of increased sales activities between Russia and the EU countries might be able to alleviate the effect of shortage of collected bottles in Russia and surrounded countries.



4. Governmental impacts

Unfortunately the impact of governmental ruling, environmental policy and public attention about environmental problems and so also to the collection of PET waste bottles and to the success of PET recycling are enormous.

Research of the situation of Russia and the other CIS states resulted in general answers like:

YES there are provisions of national and municipal laws

BUT the practical effectiveness, the state control and the public support are within the process of development and the awareness of broad population strata is also within a premature status of development.

Result is for the time being are low collection rates and with this lack of material to develop a substantial polyester recycling industry.

Still running recycling plants like for instance the biggest recycler in Belarus, the company Replas-M with a capacity to process about 8000 t/a bottle flakes are running far below their name plate capacity due to the lack of collected bottles.

This situation might change as soon as highly efficient waste sorting plants – as they are under planning and development – are coming on stream in Russia

Governmental impacts

Currently we are observing a very negative example of terribly failed waste management in the center of Europe, in Italy, Naples where mismanagement and corruption are anticipating even a basic service which is removing the waste from the streets – 80% of this waste comes from packaging. Not to speak about waste separation in plastic/metal, paper and garbage or the recovery of useful PET bottles

This negative example demonstrates drastically the role of public, city and state government to all areas of recycling industry.



5. Private and public activities

Off course it is at first the call for the municipal and governmental activities to improve bottle collection and plastic / waste separation. But also private initiatives might have a big chance.

As a special example in Europe I would like provide some facts are the collection activities in Switzerland where different to Germany no refundable deposits on PET bottles are mandatory. The collection is based on a variety of different measures like each bottle include in its price 0,04 SFr to cover the disposal costs. But the high rate of collection is reached be a huge number of collecting places which has meanwhile reached the number of 26 000. The result is a collecting rate of 76% in 2006. (>90% from home consume and > 50% from consume outside, see also <http://www.petrecycling.ch>). The EU collection average was at about 35% in 2006.

One has to mention that there exists meanwhile a law in Switzerland which is forcing the bottle collection in a way that – in case the collection rate will shrink to < 75% - the government has the right to ask for a mandatory deposit.

Private and public activities

There are different tools to collect the bottles like bottle collection IGLUS, or automatically working vending machines, collection boxes and collection bags which are broadly distributed cross the country.

I am talking about the example Switzerland because quite different to Germany where a dense network of sometimes contra-productive regulations is in force and PET bottle collection is not separately organized in Switzerland PET collection is organized by the non-profit-organization association PRS PET-Recycling Switzerland (founded in 1990).

This organization is heading and managing all activities from providing collection containers, via bottle handling and transport until a broad range of public promotion initiatives.

This mix of state support and private initiatives might be a good example for the successful development of polyester recycling industry in Russia.

The model government is ruling a disposal charge to each PET bottle produced, this money is going to a private non profit organization which is caring for all necessary bottle collection activities might be an auspicious approach.

Private and public activities

PET bottle collecting box in front of winter sporting places in Switzerland

There are companies active which are organizing and supporting professionally the development of efficient polyester recycling systems (see for instance www.redilo.ch)



6. A wide range of technology for polyester recycling available

Contents of the today's conference contributions are dealing with latest currently available technology and machinery to produce and process PET bottle flakes. Starting from automatically bottle and flake sorting via efficient flake production till highly developed processes to produce PET-film, food approved bottle resin, pellet preparation, staple fiber production and melt treatments a newcomer is spoiled for choice.

Besides the commonly known bottle to bottle process or the direct conversion of bottle flakes to A-PET film currently a new development is of interest.

7. Better profit margins by eco-labeling

An increasing amount of large furniture and apparel producers in Europe and the UAS are converting increasing amounts of polyester staple fiber made of 100% recycling. This is ostensible NOT for price reasons but for the positive environmental contribution of such products and the connected publicity promotion (Walmart US, Mark+Spencer UK)

Textiles are regarding their ecology of high direct impact to the consumer. This trend is rapid increasing in Europe and USA today.

This movement is summarized in the new trend to produce textile products which are approved by an ECO-LABLE.

Green or eco labeling

What is the target of green or eco labels?

To demonstrate the environmentally friendly status of the product including all its productions processes

What are the advantages of eco labeling?

- **The producer has an official ecological approval for his product**
- **The approval procedure is assuring and increasing the product quality**
- **The consistency of eco-quality is granted**
- **The consumer trust in the eco product will be increased**
- **The label is an excellent marketing tool**
- **The selling of the product is supported**
- **The product awareness level is increased**
- **The pricing or competitiveness are of advantage compared to non label products**

Examples of eco label institutions and organizations

Meanwhile a number of organizations and institutions are present which are providing the approval for different eco-labels. The labels are not limited to the textile industry.

Interesting for fiber producer are the material composition labels which are approving the textile source as ecologically proven.

Some examples of labeling organizations:



www.oecotex.com - Switzerland

Provides eco-tex-standards
100, 1000. 1000 plus

Ecotex approved meanwhile more than 1000 companies in different areas of textile production.



The European environmental label
www.europa.eu.int/ecolabel



The Terratex label
www.terratex.com
specialized in PET recycling fiber products



The green Council label Hong Kong
<http://www.greencouncil.org/eng/greenlabel/res.asp>



8. Summary

- ~ **The polyester recycling industry is developing world wide with double digit growth figures**
- ~ **In 2010 not much less 10% of the total polyester production of the world is expected to be recycled material – mainly from collected bottles**
- ~ **Substantial growth rates needs besides governmental rules and laws private initiatives to enlarge collection rates – especially in Eastern Europe**
- ~ **Intensifying flake and waste bottle and bottle flake trading during the initial phase of polyester recycling industry development in Russia and Eastern Europe might fill the gap between demand and internal recycling production**
- ~ **A wide range of processing technologies and processing experience to produce polyester intermediates from bottle flakes are available meanwhile**
- ~ **Exploiting the ecological advantage of PET recycling and organizing eco labeling approvals improves competitiveness and profit margins**

THANK YOU FOR YOUR ATTENTION!